Management Plan for the **Conservation of Bonneville Cutthroat Trout in Idaho**

2022

Prepared by **IDAHO DEPARTMENT OF FISH AND GAME**

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Executive Summary

It's no wonder that Cutthroat Trout *Oncorhynchus clarkii* were given the lofty distinction of being Idaho's state fish. Widespread, brilliantly colored, uniquely spotted, and emblematic of Idaho's wild rivers and mountainous landscapes, Cutthroat Trout hold a special place in the hearts of anglers fortunate enough to fish Idaho. Broadly described as a single species, comprised of 14 North American subspecies, Idaho is home to three subspecies of native Cutthroat Trout, including Westslope Cutthroat Trout *O. c. lewisi,* Yellowstone Cutthroat Trout *O. c. bouvieri*, and the focus of this document, the Bonneville Cutthroat Trout *O. c. utah*. Of Idaho's three native Cutthroat Trout subspecies, Bonneville Cutthroat Trout are the most geographically restricted and least numerous. This plan describes both historical and recent information regarding Bonneville Cutthroat Trout throughout its range in Idaho, organized into six management units, and provides management and conservation direction for this native trout subspecies.

Bonneville Cutthroat Trout are native to portions of Idaho, Nevada, Wyoming, and Utah. The vast majority of the Bonneville Cutthroat Trout historical range occurs within Utah, with only about 14% (1,447 km) of the range occurring in Idaho. Here, Bonneville Cutthroat Trout may be found within the Bear River drainage and Malad River subbasin, all of which occur within Idaho Department of Fish and Game's (IDFG) Southeast Region. During the last range-wide status assessment in 2015 (BCTCT 2019), 202 conservation populations of Bonneville Cutthroat Trout occupied 4,254 km of stream and 1 large lake (Bear Lake). This "conservation population" designation includes both "conservation populations" considered to be of (>90% genetic purity) and "core conservation populations" (>99% genetic purity) (May and Albeke 2005). Approximately 55% of populations were classified as "core populations" (i.e. 99% genetically pure). As of 2015, Bonneville Cutthroat Trout were estimated to occupy about 39% of their historical range. We estimate that Bonneville Cutthroat Trout occupy approximately 1,049 km (or 54%) of their historical distribution within Idaho, 42% is unknown, and 3.6% is extirpated. Implementation of conservation measures have led to a gradual, yet meaningful, improvement in the status over the last four decades.

Fisheries management direction for IDFG is formalized (through public input and IDFG Commission approval) in a document titled, *Fisheries Management Plan 2019-2024: A Comprehensive Guide to Managing Idaho's Fisheries Resources* (IDFG 2019). *The Management Plan for the Conservation of Bonneville Cutthroat Trout in Idaho* is a complimentary but more detailed management plan and this version updates the previous plan prepared in 2007.

The goals of this plan are to:

1. Ensure the long-term persistence of Bonneville Cutthroat Trout within the current range in Idaho.
2. Increase the abundance of Bonneville Cutthroat Trout populations and manage Bonneville Cutthroat Trout populations at levels that provide desirable angling opportunities.
3. Increase the number of Bonneville Cutthroat Trout populations by reestablishing populations in currently unoccupied portions of historical range where feasible.
4. Increase the security of Bonneville Cutthroat Trout populations and reduce fragmentation by reconnecting existing populations.

A variety of factors may affect Bonneville Cutthroat Trout populations and cause range constrictions or population declines. Some of the most common threats include competition or hybridization with non-native fish species, habitat alteration, stream flow alteration, migration blockages and associated habitat fragmentation, and water quality or quantity issues. Since the last plan, IDFG staff and partners have implemented many conservation measures and management actions to increase population abundance and expand the range of Bonneville Cutthroat Trout. Actions included removing non-native fish species, re-introducing Bonneville Cutthroat Trout into historically occupied habitats, improving habitat, and modifying passage barriers.

Since the 2007 Idaho plan, Bonneville Cutthroat Trout occupancy has increased an estimated 146 km, and Bonneville Cutthroat Trout are known to occupy 1,049 km of historically-available habitat. Using higher resolution stream mapping, we estimate that Bonneville Cutthroat Trout occupy 54% of their historical range, compared to 63% in the 2007 plan. Recent genetic testing and assessment indicate hybridization and introgression remain low across Idaho, though the threat of hybridization remains in several areas. Of the 18 Bonneville Cutthroat Trout populations identified, 14 contain sections deemed “core conservation” or “conservation” populations, which we estimate is approximately 49% of the current Bonneville Cutthroat Trout distribution.

This plan described necessary steps to further improve the status of Bonneville Cutthroat Trout by delineating and prioritizing conservation measures and management actions. Actions include:

1. Increase abundance of existing Bonneville Cutthroat Trout populations by improving riparian, aquatic habitats, and increasing streamflow.
2. Reestablish Bonneville Cutthroat Trout in portions of their range where extirpated.
3. Reduce negative effects of non-native fishes on Bonneville Cutthroat Trout populations.
4. Identify migratory barriers and improve passage to reduce population fragmentation.
5. Improve knowledge of the status of Bonneville Cutthroat Trout and other sympatric fishes by surveying streams where occupancy is unknown using rigorous sampling designs.
6. Continue monitoring long-term trends in Bonneville Cutthroat Trout distribution, abundance, occupancy, and limiting factors.
7. Monitor and assess genetic composition of Bonneville Cutthroat Trout populations.
8. Ensure fish community, habitat, and genetic information is cataloged into statewide databases.
9. Regularly update the range-wide assessment database managed by Utah Division of Wildlife Resources with current Idaho data and coordinate on related status assessments.
10. Determine whether fish diseases or pathogens are affecting of Bonneville Cutthroat Trout populations.
11. Educate and inform the public about Bonneville Cutthroat Trout conservation and fishing opportunities.
12. Conduct research necessary to conserve and manage Bonneville Cutthroat Trout.
13. Ensure adequate regulation, enforcement, or management of factors causing declines of Bonneville Cutthroat Trout populations.

Acknowledgments

We would like to acknowledge the following Idaho Department of Fish and Game employees for their contributions to the development of this management plan and for their efforts conserving and managing Bonneville Cutthroat Trout in Idaho: Matt Campbell, Ryan Hillyard, Arnie Brimmer, Carson Watkins, Bryan Grant, Wayne Fowler, Kevin Meyer, Evan Brown, Bekki Wakkovich, Martin Koenig, and Joe Kozfkay. We are grateful to Dan Isaak and his staff for providing the climate change analysis, and for Dona Horan for building the associated climate refuge maps. Dan Garren and Andy Dux (both of IDFG) provided helpful reviews that improved this document. Additionally, Trout Unlimited staffers Dan Dauwalter, Jim DeRito and Warren Colyer provided numerous helpful comments on the draft plan. Ryan Beatty (Bureau of Land Management) and Randy Oplinger (UT Department of Natural Resources) also provided additional feedback that improved this plan.

A handsome Bonneville Cutthroat Trout from a small stream. CCBY Tyler Coleman

Introduction

Idaho's anglers are fortunate to be able to pursue the state fish, Cutthroat Trout *Onchorhynchus clarkii*, within their native habitat throughout a large portion of the state from the Canadian border, throughout central Idaho, to the southern border with Utah. Three subspecies are found throughout Idaho, including Westslope Cutthroat Trout *O. c. lewisi*, Yellowstone Cutthroat Trout *O. c. bouvieri*; and, the focus of this document, Bonneville Cutthroat Trout *O. c. Utah*.

The native range of Bonneville Cutthroat Trout is located entirely within the Bonneville Basin, spanning portions of four states: Idaho, Nevada, Utah, and Wyoming. The vast majority of Bonneville Cutthroat Trout historical range occurs within Utah. Only about 14% of the range occurs in Idaho, specifically in the Bear River drainage and Malad River subbasin, and all within the Idaho Department of Fish and Game's (IDFG) Southeast Region. Range constriction and population declines have been caused by a variety of factors, but are primarily due to competition or hybridization with non-native fish species and extensive habitat modifications. The most recent range-wide information described the existence of 202 Bonneville Cutthroat Trout populations occupying about 39% of their historical range or 4,390 km of lotic habitat and 1 large lake (Bonneville Cutthroat Trout 2019).

Bonneville Cutthroat Trout have received much attention from management agencies and conservation entities especially related to Endangered Species Act (ESA) protections or other types of protective classifications. Bonneville Cutthroat Trout were petitioned for listing as threatened under the ESA in 1998. Petitions cited lack of abundance and distribution information and real or perceived threats to the long-term viability of the subspecies. Based on information provided from a range-wide status assessment, ESA-listing was determined to be not warranted in 2001. Subsequent lawsuits attempted to reverse this decision; however, another not warranted determination was made in 2008. Idaho administratively classifies Bonneville Cutthroat Trout as a game fish and manages them with restrictive angling regulations. NatureServe is a non-profit organization that uses a broadly accepted standardized method to assess conservation status of many animals. Species are ranked on a 1-5 scale, with "1" being "critically imperiled" and "5" being "secure or common". As of the 2013 review, the NatureServe global status for Cutthroat Trout is "G5", while the subspecies Bonneville Cutthroat Trout is ranked "T4", indicating they are uncommon but not rare, and have some cause for long-term concern due to declines or other factors. Idaho's State Wildlife Action Plan (SWAP) is a statewide comprehensive plan for conserving and managing Idaho's diverse fish, wildlife and their habitats. Idaho's SWAP is currently being revised, and Bonneville Cutthroat Trout have been proposed as a Species of Greatest Conservation Need (SGCN) within that plan. Primary threats include anthropogenic changes to habitat, competition and hybridization from non-native species, and climate change. The USDA Forest Service classifies Bonneville Cutthroat Trout as a "Sensitive Species", and a "Type-2 Sensitive Species" according to the Idaho Bureau of Land Management's Special Status Animal Species list (BLM 2022).

Per Idaho statute, the Idaho Department of Fish and Game (IDFG) is the state fish and wildlife management agency with the statutory authority to preserve, protect, perpetuate, and manage the fisheries resources of the state for the citizens of Idaho to provide fishable populations for current and future generations. Considering this mandate along with public input, the direction for staff and fisheries management actions are formalized in an Idaho Fish and Game Commission-approved document titled Fisheries Management Plan 2019-2024: *A Comprehensive Guide to Managing Idaho's Fisheries Resources*. Within, general guidance for conserving Bonneville Cutthroat Trout is provided. However, for this subspecies, more detailed and comprehensive planning efforts are needed. In accordance, we developed this document, *Management Plan for the Conservation of Bonneville Cutthroat Trout in Idaho*, to guide conservation and management efforts for this native trout. The current plan is an update to the initial, Idaho-specific Bonneville Cutthroat Trout management plan completed during 2007 (Teuscher and Capurso 2007) and updates status, notes major milestones and accomplishments, and re-directs efforts, as needed, to ensure effective conservation of this native trout. Furthermore, IDFG, along with other states, federal land management agencies, Native American Tribes, and Trout Unlimited, is a signatory to the recently updated, multi-entity Bonneville Cutthroat Trout Range-Wide Conservation Agreement and Strategy (BCTCT 2019); therefore, it is important that the current Idaho-specific plan is congruent with this larger multi-state agreement and strategy.

Migratory forms of Bonneville Cutthroat Trout can reach large sizes. CCBY Tyler Coleman

Goals and Objectives

Fluvial Bonneville Cutthroat Trout during spawning migration. CCBY IDAHO FISH AND GAME

Goals

1. Ensure the long-term persistence of Bonneville Cutthroat Trout within the current range in Idaho,
2. Increase the abundance of Bonneville Cutthroat Trout populations and manage Bonneville Cutthroat Trout populations at levels that provide desirable angling opportunities, and
3. Increase the number of Bonneville Cutthroat Trout populations by reestablishing populations in currently unoccupied portions of historical range where feasible.
4. Increase the security of Bonneville Cutthroat Trout populations and reduce fragmentation by reconnecting existing populations.

Objectives

1. Identify and conserve core populations of Bonneville Cutthroat Trout:
   a. Survey 50% of streams with currently "unknown" status within 10 years (2032) to describe the population and genetic status of Bonneville Cutthroat Trout, and identify potential additional core populations.
   b. Conserve existing core populations so there is no net loss of core populations in any Management Unit (MU) during the next 15 years (2037).
   c. Reestablish core populations in at least five currently unoccupied streams by 2037.
2. Improve habitats and restore stream flows:
   a. Implement at least five instream habitat restoration projects on priority streams by 2037.
   b. Restore stream flows on at least three priority streams by 2037.
   c. Restore fish passage at five migration barriers by 2037.
3. Minimize genetic and competition impacts from non-native fish species:
   a. Remove all non-native trout populations from five climate-resilient streams and reestablish Bonneville Cutthroat by 2037.
4. Prioritize management and conservation actions by basin.

Natural History and Biology

Distribution/Biogeography

Historical Distribution

The historical native range of Bonneville Cutthroat Trout is located entirely within the Bonneville Basin, which covers approximately 132,649 km^2 within the Great Basin and spans portions of four states: Idaho, Nevada, Utah, and Wyoming (Figure 1). Bonneville Cutthroat Trout originally evolved within Pleistocene Lake Bonneville and its tributaries, one of the largest of the ancient pluvial lakes. Pleistocene Lake Bonneville was estimated to have existed between 13,000 – 30,000 years ago. At its maximum size, Lake Bonneville extended over 51,838 km^2 and had a maximum depth exceeding 300 m, comparable to the size of Lake Michigan (United States Fish and Wildlife Service 2001). The lake included the Bonneville Basin and covered much of Utah, as well as portions of Idaho, Nevada, Utah, and Wyoming. The vast majority of the Bonneville Cutthroat Trout range occurs within Utah, with only about 14% (1,447 km) of the range occurring in Idaho. Here, Bonneville Cutthroat Trout may be found within the Bear River basin and Malad River subbasin, all of which occur within Idaho Department of Fish and Game's (IDFG) Southeast Region.

Taxonomy

Behnke (1992) originally proposed that all Cutthroat Trout inhabiting the Bonneville basin originated from an ancestral Yellowstone Cutthroat Trout from the Snake River basin. This hypothesis was based on evidence that the Bear River was historically a tributary to the Snake River, and was originally thought to have been diverted around 50,000 years ago to the Bonneville basin, a result of basalt flows during the late-Pleistocene. Desiccation of pluvial Lake Bonneville was believed to have then fragmented Bonneville Cutthroat Trout into three geographic areas that make up the subspecies' current range, including the Bear River basin, the Snake Valley region on the Utah-Nevada border, and the main Bonneville basin (Loudenslager and Gall 1980; Martin et al. 1985; Behnke 1992). These native trout exhibit multiple life history strategies to persist in the often harsh and fluctuating environment found throughout the Bear River and Bonneville basins (Sigler and Zaroban 2018).

While questions regarding the evolutionary history of Bonneville Cutthroat Trout have not been fully resolved, more recent studies have improved our understanding. Loxterman and Keeley (2012) as well as Trotter et al. (2018) provide comprehensive theories and with supporting genetic evidence for the evolution of Idaho's several subspecies of Cutthroat Trout, which we summarize here. Several studies point to a complicated mixing of evolutionary lineages in the Bonneville and Yellowstone Cutthroat Trout evolution. This mixing is largely a result of ancient hydrological connections influenced by glaciation, volcanism and pluvial lakes throughout the geological history of the upper Snake River and Bonneville watershed. Recent genetic evidence suggests that Cutthroat Trout of the upper Snake River and Bonneville watersheds diverged into two major lineages: the Bonneville-Yellowstone lineage and those in the main Bonneville Basin (Loxterman and Keeley 2012; Campbell et al. 2018). The Bonneville-Yellowstone lineage included two subclades, one of which is distributed in the entire Bear River as well as the Snake River in Wyoming and Idaho. The other subclade is primarily found in the Yellowstone River, but also in lower frequency downstream in the Snake River.

The second main lineage which Loxterman and Keeley (2012) referred to as the "Great Basin" lineage. This lineage (or subclade) is absent from the Bear River and predominantly contained within the main Bonneville basin, but does include the Malad River subbasin. This more divergent Great Basin lineage is thought to be more closely related to the Colorado River, Green-back, and Rio Grande clades of Cutthroat Trout, possibly from an ancient connection between the Colorado and Bonneville basins.

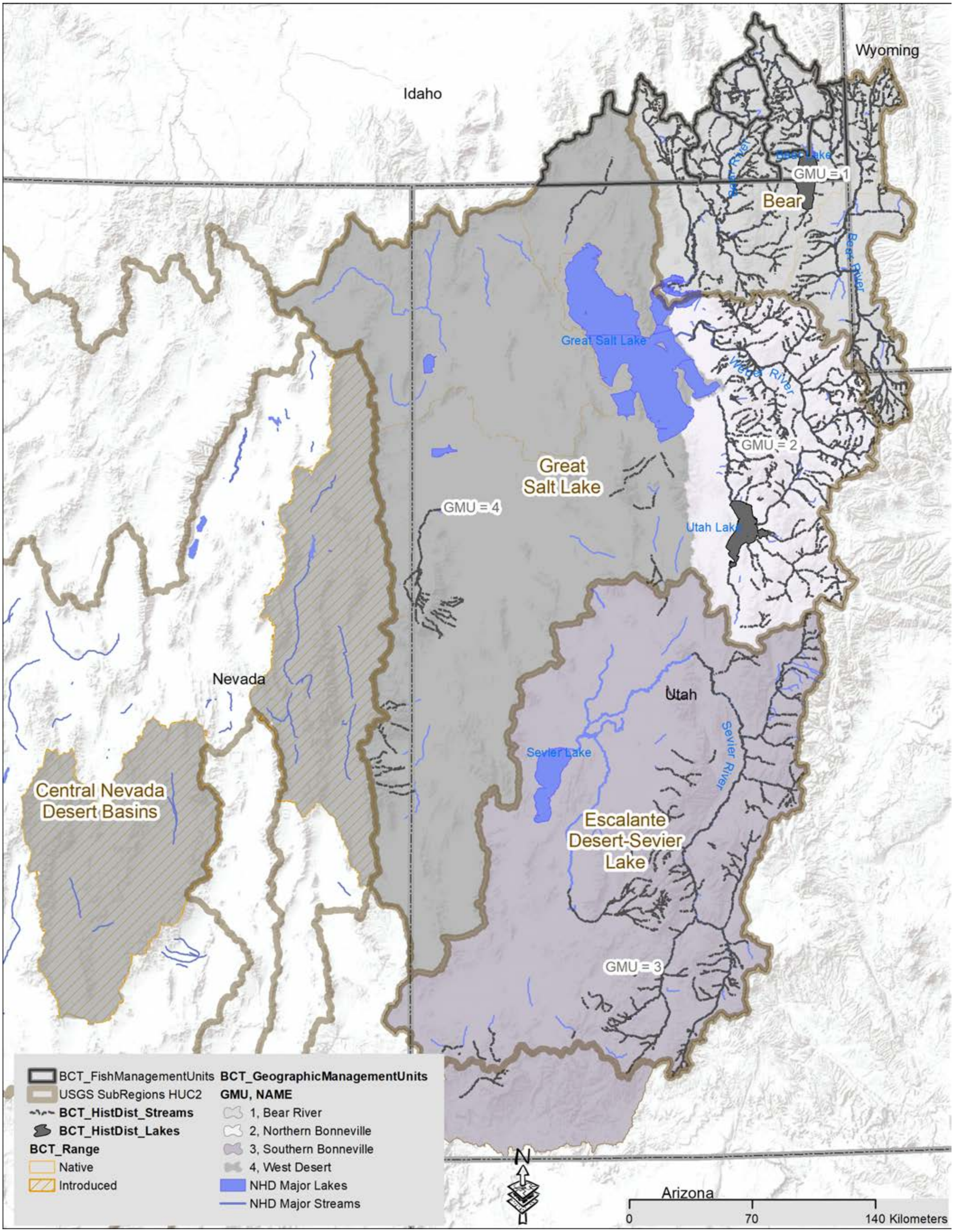

Figure 1. Historical distribution of Bonneville Cutthroat Trout throughout the Great Basin.

Bear River Bonneville Cutthroat Trout Populations

Although Cutthroat Trout inhabiting the Bear River drainage are currently taxonomically designated as Bonneville Cutthroat Trout, it must be recognized that they exhibit an evolutionary history that has largely been independent from Bonneville Cutthroat Trout outside the Bear River drainage, including the Malad River. Instead, populations within the Bear River drainage share a closer phylogenetic relationship with Yellowstone Cutthroat Trout, reflecting the historical connection between the Bear River and Snake River drainages (Martin et al. 1985; Smith et al. 2002) and long periods of isolation of the Bear River from the Bonneville basin (Bouchard 1998). For additional information about the hydrogeological events that led to the diversification of the major genetic lineages of Cutthroat Trout in the Yellowstone and Bonneville Basins, please see: Trotter et al (2018), Loxterman and Keeley (2012), and Campbell et al. (2011).

Despite the fact that Cutthroat Trout inhabiting the Bear River drainage are currently taxonomically designated as Bonneville Cutthroat Trout, it must be recognized that they share a more recent ancestry with Yellowstone Cutthroat Trout. The Bear River is currently a tributary to the Bonneville Basin, and there has not been a formal agreement on changing their taxonomic status. Thus, for the purposes of this management plan, the Cutthroat Trout throughout the Bear River drainage are considered and managed as Bonneville Cutthroat Trout.

Current Distribution

Undoubtedly, the range and total abundance of Bonneville Cutthroat Trout have decreased compared to pre-European settlement. Range constriction and population declines have been caused by a variety of factors, but are primarily due to competition or hybridization with non-native fish species, stream flow alteration and extensive habitat modifications. As recently as the late 1970s, incomplete knowledge of the range-wide status of Bonneville Cutthroat Trout led some to conclude that Bonneville Cutthroat Trout had been extirpated (Hickman 1978). However, this conclusion was based on incomplete information; and subsequent investigations identified 14 Bonneville Cutthroat Trout populations inhabiting 70 km of stream. By the late 1980s, continued investigations identified additional populations increasing the total to 41, including 39 populations inhabiting 302 km of lotic habitat as well as two lentic populations (Duff 1988). By the early 2000s, the known number of populations had increased further to 153, occupying 3,316 km of lotic habitat (Lentsch et al. 2000; May & Albeke 2004). Since the early 2000s, additional survey efforts have improved our understanding of occupancy and distribution, increasing the known number of extant populations. In addition, the increasing impetus for reintroducing Bonneville Cutthroat Trout into formerly occupied habitats has continued to increase the number of populations and extent of range.

According to the 2019 Bonneville Cutthroat Trout Range-Wide Conservation Agreement and Strategy (BCTCT 2019), there are an estimated 202 Bonneville Cutthroat Trout populations occupying about 39% of their historical range, or 4,390 km of lotic habitat and 1 large lake. This strategy document groups Bonneville Cutthroat Trout populations into four major Geographic Management Units across the species range (GMUs; Figure 1). Data from Bonneville Cutthroat Trout Range-Wide Conservation Agreement and Strategy indicated the Bear River GMU – including the Bear River, Malad River (and portions including Utah) – might be the most secure GMU in the Bonneville Cutthroat Trout range, and included 44 total populations and more occupied kilometers of stream than other GMUs (BCTCT 2019). Of those 44 total populations in the Bear River GMU, there are 18 populations that reside within Idaho. Of those 18 populations, 14 are considered “core conservation populations”, indicating >99% genetic purity. One additional population is a “conservation population” with >90% genetic purity. Additionally, there are two “sportfish populations” (<90% purity), and six other sportfish populations occupying segments of streams containing core/conservation populations. However, only 75% of the currently-occupied stream km have been assigned into


Bear River BCT. CCBY IDAHO FISH AND GAME

these population types. Therefore (most likely from limited scope of sampling), the population status of the other 25% of remaining km of occupied habitat is currently unknown and is unclassified at this time (Table 1). Table 1 provides a summary of these 18 populations, while more detailed distribution and occupancy data are presented in the Management Unit sections below (see Tables 8, 10, 12, 14, 16, 18).

We estimate that Bonneville Cutthroat Trout currently occupy 1,049 km (or 54%) of their historical Idaho distribution (1,935 km; Figure 2). Bonneville Cutthroat Trout are extirpated from at least 70 km (3.6%), and occupancy in approximately 42% of the historical distribution remains unknown at this time. Bonneville Cutthroat Trout have been re-established to approximately 61 km (3.1% of historical) of stream habitat where previously extirpated. We estimate that approximately 26% of the historical Idaho distribution is currently occupied by core/conservation populations. These conservation populations account for 49% of the total estimated current Bonneville Cutthroat Trout distribution. However, the significant amount of stream length classified as "unknown" occupancy illustrates the need for more extensive sampling efforts in the coming years (see Population Trends and Extinction Risk for discussion of sampling). Approximately 75% of the currently occupied habitat occurs on private land, highlighting the importance of conservation partnerships with private land owners.

The occupied range has increased since 2007 as a result of newly re-established populations, conservations actions, and more detailed survey data. However, the extent of historical range has also increased, as a result of more detailed stream mapping information used in our latest assessment. Because of these conflicting metrics, the total percentage of historical range currently occupied decreased between 2007 and now, even though Bonneville Cutthroat Trout have expanded their range in Idaho during that time. When the first Idaho Bonneville Cutthroat Trout management plan was published, Teuscher and Capurso (2007) estimated that Bonneville Cutthroat Trout occupied 909 km (or 63%) of their previously estimated 1,443 km of historical range. While the total length of occupied habitat has increased since our last assessment (from 909 to 1,049 km), the percent occupancy of the historical range has decreased (from 63% to 54%). Newer, more detailed stream maps allowed finer-scale estimates of the historical range, which in turn has added many smaller streams not accounted for in previous assessments. The updated mapping used in this assessment will improve the resolution of Bonneville Cutthroat Trout status and make our assessment directly compatible with the range-wide assessments coordinated with other states. Detailed historical and current distribution summaries are presented in a series of tables by each management unit (MU) in the Proposed Conservation Actions by Management Unit sections below (starting with Table 9). Streams and tributaries which are contained within conservation populations identified in Table 1 are shown in bold font, but are not necessarily additional populations.

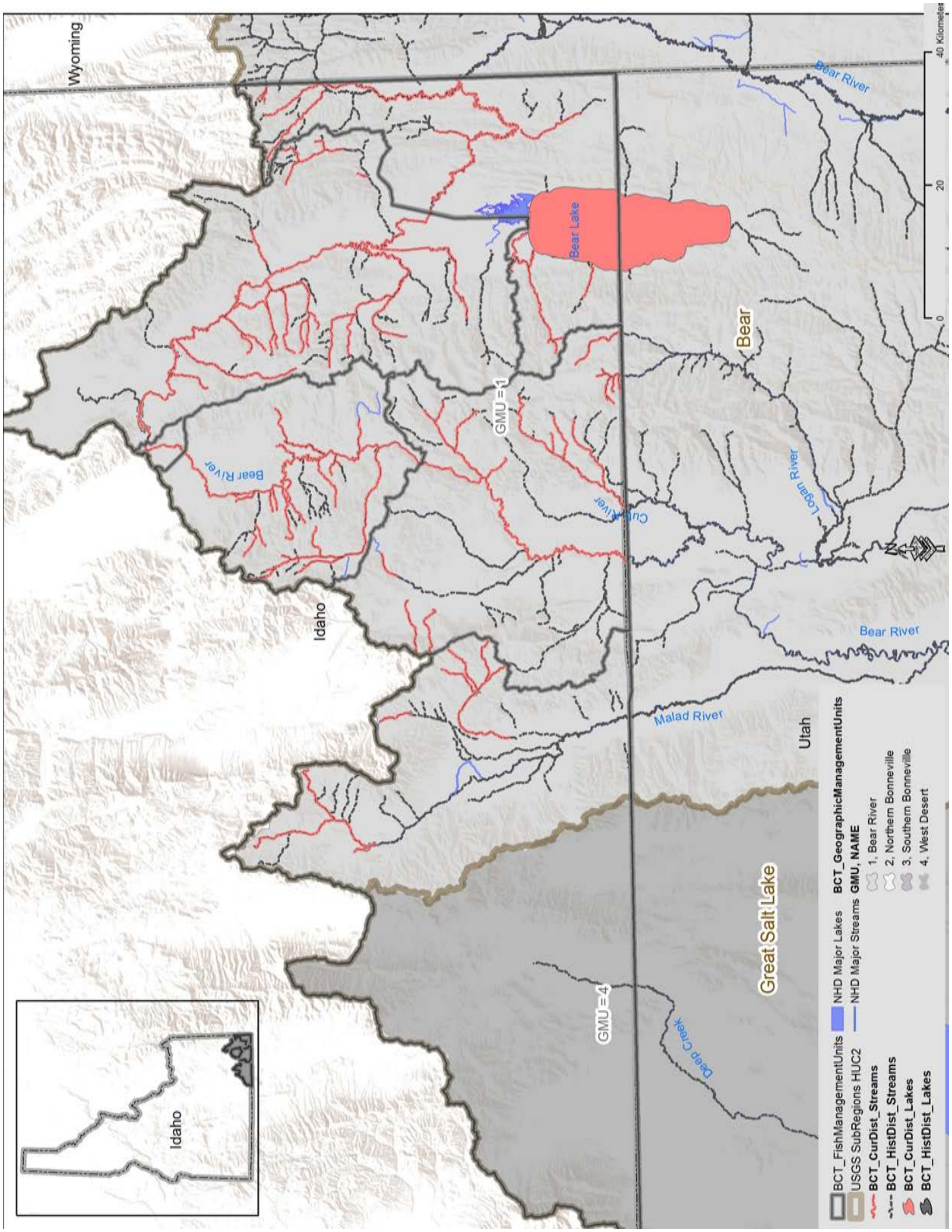

Figure 2. Current Bonneville Cutthroat Trout distribution within Idaho. Segmented black lines indicate historical distribution, while red lines indicate currently occupied distribution. Within Idaho, Bonneville Cutthroat Trout currently occupy 1,049 km of stream habitat, which is an estimated 54% of their historical range within the state.

Table 1. Summary of Bonneville Cutthroat Trout status and distribution across Idaho. "Core conservation", "conservation" and "sportfish" populations with identification number (CPID) within the range-wide assessment database (see BCTCT 2019). "Occupied unassigned" includes stream km where BCT are present but not assigned a population type.

Bear River Basin - Idaho populations CPID = conservation ID num from rangewide assessment DB									
				Currently occupied stream habitat (km)				Historical stream habitat by MU (km)	
GMU	IDFG MU	Cons population name	CPID	Core conservation pops (99% pure)	Conservation pops (90%)	Sportfish populations	Occupied unassigned		
Bear River	Malad	Upper Deep Cr. Lower Third Cr.	16010204cp002	18.1		7.8		Malad	347
		Upper Third Cr.	16010204cp001	4.9					
		Unassigned	-				61.6		
	Nounan	Eightmile Creek Bear River	16010201cp004	192				Nounan	537
		Upper Eightmile Cr.	16010201cp008	12.7					
		North Cr.	16010201cp001	38.6					
		Lower Montpelier Cr.	16010201cp003			1.9			
		Upper Montpelier Cr.	16010201cp002	2.8		17.6			
		Paris Cr.	16010201cp005			20.1			
		South Skinner Cr.	16010201cp009	2.5					
		Unassigned	-				39.8		
	Pegram	Thomas Fork Bear River	16010102cp003	78.2		62.8		Pegram	311
		Saint Charles Cr.	16010201cp006		24.2	18.4			
		Dry Creek Thomas Fork	16010102cp005	7.3					
		Preuss Cr.	16010102cp004	16.3					
		Unassigned	-				6.7		
	Riverdale	Bear River Mink Cr.	16010202cp001	7.9		75.0		Riverdale	450
		Upper Beaver Cr.	16010203cp008	6.1					
		Logan River Lower Beaver Cr.	16010203cp006	12.0		4.3			
		Cub River	16010202cp002	27.8	21.3				
		Unassigned	-				37.3		
	Thatcher	Cottonwood Creek Bear River	16010202cp003		36.9	64.0		Thatcher	282
		Unassigned	-				113.7		
	Dam complex	Unassigned	-				8.2	Dam complex	8.2
			Total stream km	427.1	82.3	272.0	267.3	**Total historical**	**1,935**
			Percent of total occupied	**41%**	**8%**	**26%**	**25%**	**Total current**	**1,049**

To describe the current status of Bonneville Cutthroat Trout in Idaho we quantified the amount of *potential* habitat, termed "historical habitat" as an indication of the potential maximum range. This was determined using the historical distribution available within the Bonneville Cutthroat Trout Range-Wide Assessment database based on the 1:24K National Hydrography Dataset (NHD) using the methods described in May and Albeke (2005). The authors (and team of biologists involved) began delineating the historical distribution using all streams within any fourth-level Hydrologic Unit Code (HUC) within the historical range described by Behnke (1992) as a starting point. Use of this widely accepted technique to determine historical distribution ensures this Bonneville Cutthroat Trout assessment is comprehensive and comparable with that of other states within the subspecies' range.

Using that historical distribution as a starting point, we refined the distribution to reflect the best available data. A team of IDFG fisheries professionals excluded streams from the broad distribution based on geological barriers, tectonic/climatic conditions, habitats not able to be recolonized, and habitat judged to be unsuitable based on gradient, flow, or temperature (May and Albeke 2005). Streams that are intermittent during the irrigation season due to anthropogenic causes were included as potential habitat, assuming they would provide suitable habitat in a natural state.

Next, we estimated the currently occupied distribution of Bonneville Cutthroat Trout updated using the best available data. We included all relevant data within the underlying 2019 Bonneville Cutthroat Trout Range-Wide Conservation Agreement database, as well as additional data from state and federal agencies and academic programs. Major contributors included the U.S. Forest Service (USFS), Idaho Department of Environmental Quality (DEQ), U.S. Bureau of Land Management (BLM), and IDFG. A large percentage (86.3%) of the available survey data was collected during the past fifteen years. However, an effort was made to locate all pertinent survey information in order to cover as large a geographic area as possible. To begin assessing Idaho status, information was pooled into a common database with metrics comparable to the database underlying the Range-Wide Conservation Agreement and Strategy. This will make future updates more efficient and comparable between and among Idaho, Utah, Wyoming, and Nevada. Data were compiled in the Bonneville Cutthroat Trout Fisheries Management Plan geodatabase (Bonneville Cutthroat Trout_FMP.gdb) using Arc GIS version 10.6. The Bonneville Cutthroat Trout_RWA Current Distribution feature class was used as the starting point in updating the Idaho Bonneville Cutthroat Trout distribution. We added or removed stream segments, whole streams, or lakes depending upon the most current data. The updated current distribution was linked back to our copy of the Bonneville Cutthroat Trout range-wide assessment database (Bonneville Cutthroat Trout_RWA) and the associated data was updated.

All potential streams were classified into one of five categories; present, absent, extirpated, re-established, or unknown. Streams were classified as "present" based on records that indicated the subspecies was observed during sampling surveys. We made an effort to minimize determinations based on "professional judgement", and instead relied primarily on sampling data. Streams classified as "absent" were those with suitable habitat, and survey data that indicated Bonneville Cutthroat Trout were not present. Streams were only classified as "extirpated" when Bonneville Cutthroat Trout were known to be present at one time, yet recent sampling data from multiple years showed no Bonneville Cutthroat Trout present. Streams with "re-established" populations are those that were previously classified as absent or extirpated, but now have Bonneville Cutthroat Trout present as result of translocations or conservation aquaculture stocking. Streams with uncertain Bonneville Cutthroat Trout presence where no survey data was available were classified as "unknown".

We adjusted the length (stream km) of currently occupied stream habitat using fish survey

Tracking BCT movements with telemetry on the Bear River. CCBY IDAHO FISH AND GAME

data. We also adjusted occupancy to reflect changes in fish passage (i.e., barriers removed). We scrutinized old observations of Bonneville Cutthroat Trout and verified whether that habitat was still present using aerial photos. When survey data were available, we estimated the upper extent of distribution as the midpoint between the last survey location where Bonneville Cutthroat Trout were present and the next survey showing they were absent. We summarized the percent occupancy as the total km currently occupied divided by the total historical km available.

We described the relative abundance of Bonneville Cutthroat Trout in each occupied stream using available survey data. The majority of data was collected using backpack electrofishing using standard techniques. Linear fish density (fish/km) was estimated at each sampling site, then we calculated a stream-wide mean density by averaging results from all sites. We characterized the variation in fish density within streams using the coefficient of variation (CV) among sample sites. Fish density was further categorized using relative abundance indices. We assigned a relative abundance index to rate Bonneville Cutthroat Trout streams using the criteria outlined by May and Albeke (2005). Relative abundance of Bonneville Cutthroat Trout was rated as low density (0 – 31 fish/km), moderate density (32 – 93 fish/km) or high density (>93 fish/km). In the absence of detailed sampling, single pass electrofishing data and professional judgments were used to rate Bonneville Cutthroat Trout densities in each system. Therefore, the intent of this assessment is to provide a relative index for population condition and should not be interpreted as rigorous statistical findings. In addition to the abundance index, many of the Bonneville Cutthroat Trout populations sampled were found to occupy some but not all sections of a given stream. We described spatial variation within a stream using the coefficient of variation (CV) around mean density. This was provided to serve as an index of spatial uniformity, with higher values corresponding to more patchy distributions.

Management Units

This plan divides the Idaho Bonneville Cutthroat Trout range into six management units (MU) shown in Figure 3. Within each management unit, Bonneville Cutthroat Trout show unique genetic characteristics, probably due to many years of natural and anthropogenic segregation and separation. However, the purpose of the MU concept in this plan is to define the geography at a scale at which conservation may be meaningfully implemented. The MUs are not delineations based on genetic characteristics nor differences. The MU framework has been adopted to allow fishery managers to communicate about spatially-relevant conservation issues and to define the limits of immigration and emigration among populations. While similar in function to the geographic management units identified in the Bonneville Cutthroat Trout Range-wide Conservation Agreement and Strategy (BCTCT 2019), the MUs in this document are not the same and apply only at the Idaho-state level scale for this plan.

The management units reflect major delineations in the river corridor based on upstream movement barriers. Because of the Bear River dams, the management units define population segments with limited or no upstream population exchange. Only downstream drift of individuals is thought to provide connection among MUs. Using those criteria, the Bear River system was split into five MUs beginning at the Wyoming Border and following the Bear River downstream to the Utah Border. The Bear River MUs include Pegram, Nounan, Dam Complex, Thatcher, and Riverdale units. The Riverdale management unit includes the Cub and Logan rivers, which enter the Bear River in Utah. The Malad River drainage was defined as an additional sixth management unit and also enters the Bear River in Utah (Figure 3).

Life History and Population Dynamics

Bonneville Cutthroat Trout exhibit three life history patterns including resident, fluvial, and adfluvial. The resident life history pattern is the least migratory. Resident Bonneville Cutthroat Trout complete their entire life cycle in a relatively short stream reach including spawning, rearing, and over-wintering. Stream reaches need to be of adequate distance (>8 km) to ensure that isolated populations may persist over the long term (Hilderbrand and Kershner 2000); however, it may be possible for some populations to persist in shorter reaches (< 1 km; See Population Viability Section). The fluvial life history pattern is more migratory, but continues to complete its life cycle entirely in flowing water. Fluvial Bonneville Cutthroat Trout complete seasonal migrations to smaller tributary streams for spawning, and generally move downstream into larger flowing waters for rearing and over-wintering (Colyer et al. 2005; Budy et al. 2020). Seasonal migrations of up to 86 km have been documented. Adfluvial Bonneville Cutthroat Trout spend most of their lives in lakes or reservoirs, feeding and growing until maturity, and then making spawning migrations into tributary streams or rivers. Adfluvial Bonneville Cutthroat Trout populations are exceedingly rare. Bear Lake, ID/UT contains one of the few remaining natural adfluvial populations of Bonneville Cutthroat Trout. The adfluvial life history form occasionally develops where dams have created lentic habitat (e.g. Strawberry Reservoir, UT; Knight et al. 1999). In relatively unaltered systems, multiple life history patterns within a metapopulation add to its biodiversity and resiliency (Lee et al. 1997). Unfortunately, migration blockages and establishment of non-native competitors and predators in downstream areas tend to increase mortality of migratory individuals making it difficult to maintain the migratory life history patterns in habitats extensively altered by humans. Improving connectivity by mediating migratory blockages is necessary for maintaining migratory Bonneville Cutthroat Trout and is a focus area for Bonneville Cutthroat Trout conservation efforts.

Bonneville Cutthroat Trout growth rates depend on life history, water temperatures, system productivity, and other factors. In the Logan River watershed (Utah), Bonneville Cutthroat Trout growth rates varied among tributaries and reaches, but were as high as 0.50 g/day (mean = 0.09 g/day), with growth being fastest at age-1 and decreasing in older fish (Budy et al. 2007). In tributaries of the Weber River system, Bonneville Cutthroat Trout exhibited relatively slow growth through age-5 (250 mm). However, after fluvial migratory pattern were expressed, growth increments increased markedly from age-6 through age-8, allowing Bonneville Cutthroat Trout to reach sizes exceeding 400 mm (Budy et al. 2020). Nielson and Lentsch (1998) described Bonneville Cutthroat Trout growth in Bear Lake as slow, averaging 50 mm TL annually, though longevity and late maturity allowed individuals to exceed 500 mm. More recently, Heller et al. (2022a) developed a von Bertalanffy growth model for adfluvial Bonneville Cutthroat Trout from Bear Lake based on otoliths. Her model estimated Bonneville Cutthroat Trout typically reach 200 mm TL by age-2, 350 mm by age-4, and 500 mm by age-8, with some individuals exceeding 600 mm by age-12. Presence and density of a competing species (Brown Trout) has been shown to negatively affect growth rates of Bonneville Cutthroat Trout in streams (McHugh and Budy 2005).

Bonneville Cutthroat Trout maturity, fecundity, and mortality rates may be affected by a variety of a biotic and abiotic factors. Fluvial and resident Bonneville Cutthroat Trout first mature at age-2 or age-3, with males tending to more often mature at the younger age (Wallace and Zaroban 2013). However, the adfluvial form of Bonneville Cutthroat Trout in Bear Lake matures much later, with normal age at first maturity being five or six (Nielsen and Lentsch 1988), though some individuals may delay first maturation additional years. Fecundity of adfluvial Bonneville Cutthroat Trout ranges from 1,800 to 2,000 eggs/kg of body weight, while resident Bonneville Cutthroat Trout is about 650 eggs/kg, based on data from the conservation aquaculture program. Resident and fluvial forms often possess fecundities towards the lower end of this range with adfluvial forms exhibiting higher fecundities (Wallace and Zaroban 2013). Riverine Bonneville Cutthroat Trout may exhibit relatively high and variable mortality rates which is not uncommon among congenerics. In the Weber River, apparent mortality rates equaled 67%, but in certain years approached 90% (Budy et al. 2020). Contrastingly, in the Logan River – a nearby more pristine system – mortality rates were lower, ranging from 23 to 67% (Budy et al. 2007). In the Bear River, total annual mortality of adult Bonneville Cutthroat Trout was estimated as 50% (Carlson and Rahel 2007).

Habitat Requirements

Quality BCT habitat includes well-oxygenated water, clean and well-sorted gravels with minimal fine sediments for successful spawning, minimally altered natural flow regimes, appropriate water velocities, cooler water temperatures in general, and complex in-stream habitat structure such as large woody debris and overhanging vegetation along banks. Optimal habitat is well connected allowing for seasonal movements to capitalize on a wide variety of habitats. In Idaho, Bonneville Cutthroat Trout utilize a wide variety of habitat types including high elevation small streams (1st and 2nd order streams from 1,400 to 2,600 m elevation), moderate elevation larger streams and rivers (1,350 – 1,850 m elevation), and Bear Lake (1,814 m; Caribou-Targhee National Forest 2001-2003; Colyer et al. 2005; Burnett 2003; Schrank and Rahel 2002). In a study of several tributaries to Bear Lake, Heller et al. (2022b) found that Bonneville Cutthroat Trout preferred lower elevation stream sections with diverse combinations of complex habitats. Bonneville Cutthroat Trout rarely occurred in reaches with homogeneous habitats. In their study, instream woody cover, larger substrates, and overhead canopy cover were important predictors of where Bonneville Cutthroat Trout were found, underscoring the importance of intact riparian corridors and minimizing fine sediments.

Though higher density populations are supported by quality habitat, Bonneville Cutthroat Trout possess the ability to survive in what is considered marginal salmonid habitat conditions (e.g., turbid water, relatively high proportion of fine sediments, warmer temperatures, poor structural habitat; Colyer et al. 2001; Colyer et al. 2005; Schrank et al. 2003) compared to other western native salmonids. This may be because Bonneville Cutthroat Trout evolved in a desert environment where climate may cause fluctuations in water, sediment regimes, and environmental condition (Behnke 1992). Schrank et al. (2003) reported that Bonneville Cutthroat Trout did not emigrate from warm stream reaches or experience mortality despite maximum daily water temperatures as high as 27°C. During their study, Bonneville Cutthroat Trout did not appear to be dependent upon localized coolwater refuges.

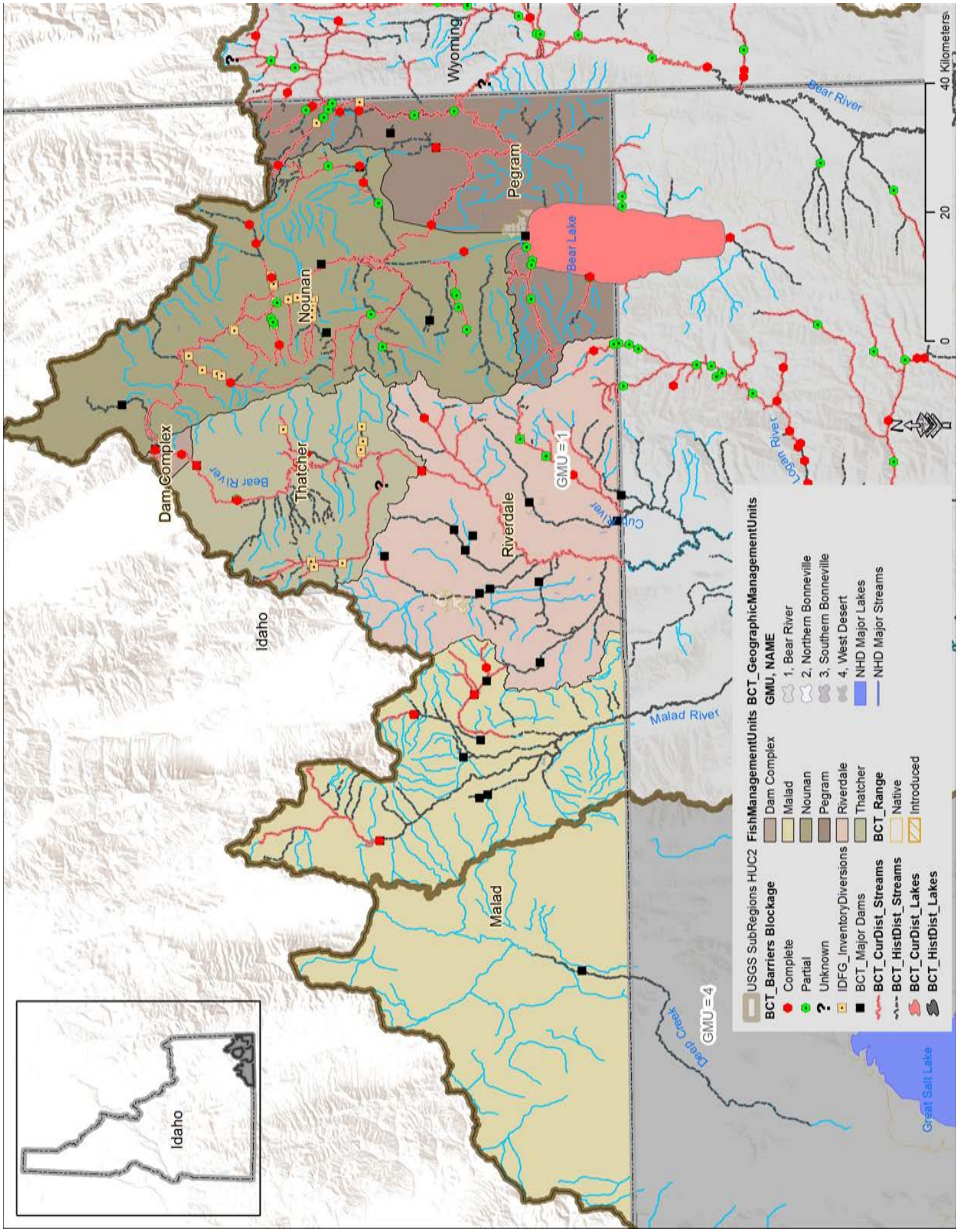

Figure 3. Locations of six fish management units within the range of Bonneville Cutthroat Trout within Idaho, including historical distribution (black lines) and current distribution (red lines). Dams, diversions and other known fish passage barriers based on Hillyard et al. (2010).

Feeding Habitats and Biotic Interactions

Bonneville Cutthroat Trout are opportunistic feeders that consume a wide variety of food items depending on many factors including prey type, availability, and densities as well as the presence of competing species, fish size, and water temperature. Generally, small Bonneville Cutthroat Trout especially those residing in headwater streams consume primarily invertebrates, both aquatic and terrestrial. For example, in Beaver Creek, Idaho, Bonneville Cutthroat Trout consumed primarily Diptera, terrestrial invertebrates, and Trichoptera (Hildebrand and Kershner 2004) with differences noted among habitat types and due to presence or absence of Brook Trout, *Salvelinus fontinalis*, a competing species. Ontogenetic shifts in prey preference have also been noted. Larger Bonneville Cutthroat Trout, often migratory forms, incorporate a higher percentage of fish in their diets. For instance, nearly all Bonneville Cutthroat Trout exceeding 550 mm from Bear Lake, ID/UT, were piscivorous (Nielsen and Lentsch 1988). Water temperature is an important factor that affects Bonneville Cutthroat Trout feeding activity. Bonneville Cutthroat Trout are most efficient at converting food to body tissue at approximately 13-18˚C, whereas feeding is known to become suppressed when maximum daily temperature exceeds 26˚C (Johnstone and Rahel 2003).

In the Idaho portion of their range, Bonneville Cutthroat Trout evolved with Green Sucker *Pantosteus virescens*, Utah Sucker *Catostomus ardens*, Mountain Sucker *Pantosteus platyrhynchus*, Northern Leatherside Chub *Lepidomeda copei*, Utah Chub *Gila atraria*, Redside Shiner *Richardsonius balteatus*, Longnose Dace *Rhinichthys cataractae*, Speckled Dace *R. osculus*, Mottled Sculpin *Cottus bairdi*, Paiute Sculpin *C. beldingi*, and Mountain Whitefish *Prosopium williamsoni* (Sigler and Miller 1963). In Bear Lake, Bonneville Cutthroat Trout evolved with four endemic species including Bear Lake Whitefish *P. abyssicola*, Bonneville Whitefish *P. spilonotus*, Bonneville Cisco *P. gemmifer*, and Bear Lake Sculpin *C. extensus*. Non-native fish, particularly Brook Trout, Yellowstone Cutthroat Trout (outside its native historical range), Rainbow Trout, and Brown Trout have been introduced within the historical range of Bonneville Cutthroat Trout in Idaho. Though genetic introgression is likely the largest concern (Campbell et al. 2007; BCTCT 2019), non-native salmonids may act as predators or may compete with Bonneville Cutthroat Trout for habitat or space, thereby reducing Bonneville Cutthroat Trout population abundances. The potential for Brook Trout invasions to displace Cutthroat Trout in stream habitats is well documented (Dunham et al. 2002; Novinger and Rahel 2003; Quist and Hubert 2004). Studies that investigate competition or predation interactions between Bonneville Cutthroat Trout and non-native species are limited. Buys (2002) and Hilderbrand (1998) completed competition studies between Bonneville Cutthroat Trout and Brook Trout in Beaver Creek, Idaho. These studies indicated competition with Brook Trout has contributed to declines in native Cutthroat Trout populations. Results from McHugh and Budy (2005) found competition with non-native Brown Trout led to reduced Bonneville Cutthroat Trout body condition when the two species were sympatric, and that Brown Trout presence most likely limited Bonneville Cutthroat Trout distribution in lower elevations stream reaches. No predation studies were identified.

A variety of diseases and parasites are found in waters containing Bonneville Cutthroat Trout. Infectious pancreatic necrosis, infectious hematopoietic necrosis, and whirling disease may occur in the Bear River area. The parasites plestophera and epitheliocystis have been found in the Bear River system. The bacterial diseases furunculosis and bacterial kidney disease are also found within the system. There is no literature that directly assesses the effect of these diseases on wild populations of Bonneville Cutthroat Trout. Furthermore, limited testing of wild Bonneville Cutthroat Trout populations has occurred.

Population Viability

Population viability is in essence the likely future status of a population or collection of populations from a conservation perspective (Morris and Doak 2002). Population viability in the simplest form is merely a function of the births and deaths in a population, but these are influenced by factors such as the life history, habitat quality, environmental conditions, and genetic diversity of the population of interest.

Genetic variation is important because low genetic diversity may lead to a loss of adaptive genetic variation and an increase in maladaptive genetic variation (Lande 1995). However, Lande (1988) argued that demography is likely to be more important than genetic risks in determining population viability for small populations.

Annual variation in trout populations may be considerable in terms of abundance (Dauwalter et al. 2009). For BCT in Idaho, the prevalence of the historical fluvial life history has been significantly reduced due to fragmentation, habitat degradation and stream flow alterations caused by dams and water diversions. As a result, most remaining Bonneville Cutthroat Trout populations in Idaho are relatively isolated. For such populations, higher levels of interannual variation in abundance increases the risk of population extirpation (Coleman and Fausch 2007). Populations may decrease to dangerously low abundances, below which demographic stochasticity and inbreeding depression become substantial risks to persistence (Morris and Doak 2002). Because such inter-annual fluctuations in abundance are often caused by large-scale auto-correlated climatic factors (i.e., the Moran effect), even isolated trout populations tend to vary synchronously in their abundance (e.g., Zorn and Nuhfer 2007), which inherently causes their population viability to vary synchronously as well.

Some of the smallest Bonneville Cutthroat Trout populations in Idaho may be at risk of demographic stochasticity, reduced fitness through inbreeding depression, or loss of genetic diversity over the long term. However, empirical evidence suggests that Cutthroat Trout may not exhibit such extinction risk patterns. For example, Rieman and Dunham (2000) found that small, isolated populations of Cutthroat Trout experienced no localized extinctions, despite extreme isolation and very low densities of fish. More recently, Cook et al. (2010) found Cutthroat Trout persisting in Wyoming streams that had been isolated for 25-44 years, occupying as little as 850 m of stream habitat, with adult populations as small as 12 fish. Similarly, Peterson et al. (2014) found that even in high elevation, steep gradient (14%) streams, Cutthroat Trout were likely to persist above barriers if as little as 0.2 km of quality habitat were available. If habitat quality was poor, persistence was still likely with only 1.7 km of available habitat. In Idaho, even the smallest Bonneville Cutthroat Trout populations will be managed to maximize their long-term probability of persistence, especially "Core Conservation" populations that have little to no indication of introgression.

Factors Affecting Status and Their Management

Many factors currently limit the abundance and distribution of Bonneville Cutthroat Trout in Idaho. These include water management (dams, reservoirs, and water diversions), land uses affecting habitat quality, non-native species, and other factors that increase mortality, such as avian predation and irrigation entrainment. In this section, we discuss the primary factors that affect Bonneville Cutthroat Trout in Idaho, genetic considerations for management and conservation, as well as population trends and extinction risk.

Dams and Reservoirs

Dams may have substantial negative effects to rivers by fundamentally altering ecosystem functions through a variety of mechanisms. Since European settlement in the West circa 1850, many irrigation and hydroelectric structures have been built on the streams inhabited by Bonneville Cutthroat Trout. Most notably, there are three hydropower facilities on the mainstem Bear River owned by PacifiCorp and operated by subsidiary Rocky Mountain Power, a private power utility. These projects are collectively called the "Bear River Hydroelectric Project" and include Soda, Grace-Cove, and Oneida dams (Figure 3). Construction began in 1909 and completed in 1927 to provide irrigation, flood control, and electricity. Lacking passage facilities, all of these facilities are currently barriers to upstream fish migration. Dams and diversions in the Bear River watershed have historically reduced Bonneville Cutthroat Trout populations and continue to pose a substantial risk throughout their range in Idaho.

Dams may affect the habitat of aquatic plants and animals (including Bonneville Cutthroat Trout) through alteration of hydrology, water quality, temperature, migration corridors, and other mechanisms not described here. Effects of water withdrawal or dam operations on Bonneville Cutthroat Trout include: barriers to movement and migration, direct mortality of fish lost in unscreened diversions or facilities, reduced flows and water quantity from diversion, increased summer water temperatures, mortality of fish trapped in dewatered tributaries, as well as habitat alteration and mortality resulting from altered flow regimes.

Hydrology

In general, dams alter hydrological and physical aspects of rivers by changing flow magnitude, timing, and variability. In addition, dams and reservoirs reduce overall watershed discharge by diverting water for other uses, and through increased evaporative losses (Allen 1995). Habitat for trout in the mainstem Bear River is marginal due to high, turbid flows in summer when irrigation water is delivered and return flows reenter the river. During the non-irrigation season, Bear River surface flows are utilized to refill storage accounts in Bear Lake, causing reduced base flows, reducing habitat quantity and quality for Bonneville Cutthroat Trout.

Flows in the Bear River have been substantially altered and regulated from a variety of diversion projects. Discharge in some reaches is higher than natural conditions and much lower than natural in others. Timing of peak flows also has shifted as a result of water project developments. Between Bear Lake and Grace Dam, flows are primarily regulated by withdrawals from Bear Lake, and to some extent the Lifton Pump Station at Bear Lake. Water storage in Bear Lake often decreases the magnitude of peak flow events in the Bear River, and shifts peak runoff timing into July (Oasis Environmental 2010). In this reach, water delivery leads to higher summer flows (approximately July 1 – September 1) than historical natural conditions.

In contrast, flows below Grace Dam in the "Grace Bypass" reach are entirely regulated by upstream reservoir management. Flows here are reduced as a result of water diversions. Flows in this reach are typically quite low, with much of the flow being the result of leakage from Grace Dam and

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40-70 cfs from nearby springs. In this reach, flows are typically stable, unless augmented by spill events or whitewater recreational boating pulse flow events (as agreed to within the Federal Energy Regulatory Commission (FERC) license requirements). During whitewater boating flows, discharge increases to 900 cfs, which typically occur over four weekends a year, and typically includes two or three events in spring (April – May) and one or two in September. Discharge in the Bear River below Oneida Dam is typically much higher. Flows typically remain between 400 and 1,200 cfs throughout much of the year and support a tailwater trout fishery primarily composed of sterile hatchery Rainbow Trout.

Under the Bear River Settlement Agreement, minimum instream flows (MIF) have been established in several reaches. Minimum instream flows below Soda Dam (Alexander Reservoir) are 150 cfs, or inflows, whichever is less. Minimum flows below Grace Dam are 63 cfs plus 2 cfs leakage or inflows, whichever is less. Minimum flows below Oneida Dam are 250 cfs plus 1 cfs leakage or inflows, whichever is less.

Temperature

Dams typically alter a river's longitudinal thermal profile relative to natural conditions, but the effects often depend on the size and nature of reservoirs, and how water is released. Small reservoirs with little residence time may increase downstream river temperatures (Chandesris et al. 2019). Additionally, dams alter the annual cycle of water temperatures, usually dampening the natural seasonal fluctuation of water temperatures, reducing seasonal variation. Hypolimnetic releases from large reservoirs may dramatically cool a river in summer, while warming water temperatures in winters. Conversely, epilimnetic releases may warm river temperatures and even dilute the formation of coolwater refugia. Hillyard and Keeley (2012) found epilimnetic releases from Bear Lake outlet were typically 1.0°C higher than inflows, and their results suggested high summer discharges buffered sources of potential thermal refugia for Bonneville Cutthroat Trout in segments of the Bear River. Their results highlighted the important contributions of tributary streams to cooling the mainstem Bear River.

Water temperatures in large sections of the Bear River often exceed those considered habitable for Bonneville Cutthroat Trout. In the reach directly upstream of Alexander Reservoir – a section partially regulated by upstream dams/reservoirs – previous studies show the daily maximum temperatures often exceed 22 °C during the summer (Oasis Environmental 2010). In the reach downstream of Grace Dam including Black Canyon, daily maximum water temperatures often exceeded the 22 °C salmonid threshold (i.e. the coldwater aquatic life beneficial use criteria established by Idaho Department of Environmental Quality). The authors concluded that increased discharge from Grace Dam would not likely increase stream temperatures, as stream temperatures were likely primarily influenced by weather affecting conditions in the Grace Reservoir (Oasis Environmental 2010), suggesting that the Grace Reservoir provides little, if any, potential cooling. Hypolimnetic releases below Oneida Dam maintain water temperatures that support a year-round trout fishery, primarily for stocked hatchery Rainbow Trout, as conditions do not support a robust Bonneville Cutthroat Trout population.

Hillyard and Keeley (2012) studied the influence of temperature on habitat availability for Bonneville Cutthroat Trout in both regulated and unregulated portions of the Bear River. They found the spatial distribution of habitat with suitable temperatures differed between regulated and unregulated segments of the Bear River. In the unregulated segments, Bonneville Cutthroat Trout selected cooler water temperatures during summer peak temperature. During the warmest part of the summer available maximum daily water temperatures averaged 25.2 °C (± 0.92 SE) and BCT used water temperatures that averaged 21.7 °C (± 0.57 SE). Habitat patches with suitable temperatures were larger, more frequent and closer to one another in the unregulated segments, while suitable patches were smaller, less frequent, and widely distributed in the regulated portions of the Bear River. Peak summer temperatures are an important factor affecting Bonneville Cutthroat Trout distribution in the Bear River. Reservoirs both increase water temperatures and water flows that dilute patches of cool water, and restrict fish movement and access to those thermal refugia.

Migration Barriers

In addition to the three dams on the Bear River Hydroelectric Project, many other streams in the Bonneville Cutthroat Trout distribution have also been dammed. An inventory of dams and diversions may be found in Figure 3 (Hillyard et al. 2010), but this inventory may not be a complete census of all fish passage barriers. Other dams within the Idaho portion of the Bonneville Cutthroat Trout range that block upstream fish movement include Daniels, Deep, Crowthers, Pleasantview, and Devil Creek reservoirs in the Malad River MU. In the Riverdale MU, Weston, Treasureton, Condie, Glendale, Lamont, and Johnson reservoirs all block upstream fish movement. Montpelier, and Little Valley reservoirs, and Georgetown Creek diversion dam are barriers to fish migration in the Nounan Valley MU.

Dams and other structures (e.g., culverts, irrigations diversions) that block fish migration reduce movement along stream networks and contribute to habitat fragmentation and population isolation. Fragmentation of once continuously distributed trout populations into smaller isolated populations has been shown to decreases the long-term viability of trout populations and generally increases risk of extirpation (Hilderbrand and Kershner 2000; Harig and Fausch 2002). Fragmentation reduces occupied stream length (occupied area) by splitting connected populations into shorter confined segments of habitat. Shorter confined segments of stream habitat may not have the complete set of spawning, rearing, overwinter and feeding habitats required to support a species entire life history and may reduce population size and productivity. The probability of persistence in trout populations typically increases with patch size with larger lengths of continuous stream habitats supporting larger, more secure populations. Fragmentation reduces the resiliency of trout populations due to stochastic events (such as drought, fire, debris flows) by impeding immigration or recolonization.

Dams and other barriers may impede access to high-quality spawning and rearing habitat, which may lower recruitment and productivity, and limit the diversity of life history strategies. Habitat fragmentation impedes gene flow, reducing the genetic diversity among populations, and increasing risk to long-term persistence. Isolated population segments, increased the risk of losing genetic diversity, and prevented Bonneville Cutthroat Trout from re-founding populations that have been extirpated. Dams and other barriers may also prevent or suppress the expansion of non-native fish populations and protect isolated Bonneville Cutthroat Trout populations from hybridization, competition, or predation from non-native fish species. In these instances, barriers may be a useful conservation tool when used to limit further spread of non-native species, or isolate important native populations from invasion.

Habitat Fragmentation and Irrigation Diversions

Much of the land in the lower elevation portions of the middle Bear River drainage has been converted to agriculture and is managed for livestock or crop production. Southeast Idaho is a relatively dry region, receiving about 38–46 cm of annual precipitation, characterized as a high desert, and private lands conducive to agriculture (associated with valley bottoms) are generally irrigated. Irrigation infrastructure including check dams and diversions are distributed across the drainage and generally associated with tributaries to the mainstem Bear River. While dams pose barriers to fish passage, other irrigation structures, such as simple diversions and canals may have fish effects despite their smaller size. In some cases, downstream movement of fishes is not impeded by dams, though fish movement downstream of small reservoirs may only occur during spill events associated with high runoff.

Diversion structures may limit upstream and downstream fish movement depending on design. Permanent diversions are associated with larger water delivery projects (i.e., >5 cfs) while seasonal diversions are constructed of push-up rock and soil material and are associated with lower volume water delivery. Structures belonging to the latter are typically reconstructed every year prior to high flow without fish passage. Permeant structures often allow for downstream fish movement; however, upstream movement may be difficult depending on design and overflow volume. Downstream fish migration is often the most important aspect of irrigation diversions because emigrating fish may become entrained in canals where they may be lost to the population. Irrigation diversions continue to present a challenge for Bonneville Cutthroat Trout conservation.

Such structures can contribute to population fragmentation, isolating once connected trout populations into smaller segments. Fragmentation can reduce movement between stream reaches, reduce productivity and decrease the abundance of Bonneville Cutthroat Trout. Irrigation diversions may form partial or complete barriers to fish migration, and fish entrained into irrigation canals may experience increased mortality and be unable to migrate back to their source water and population. Maintaining fish passage between isolated segments to larger populations is important for maintaining long-term persistence of Cutthroat Trout. Even small rates of immigration to isolated populations has been shown to notably decrease the likelihood of extirpation, highlighting the need to maintain connectivity among stream networks (Hilderbrand 2003).

Irrigation and Screening

Virtually all the streams and rivers identified as potential Bonneville Cutthroat Trout habitat in Idaho are also used for irrigation purposes. We estimate there are a minimum of 53 different irrigation diversion structures within the range of Bonneville Cutthroat Trout in Idaho (Figure 13; Appendix E; Hillyard et al. 2010). Kershner (1995) estimated unscreened irrigation diversions reduced survival of juvenile Bonneville Cutthroat Trout in Saint Charles Creek by 90% and a single irrigation canal on the Thomas Fork resulted in the mortality of 23% of radio-tagged adult Bonneville Cutthroat Trout as they attempted to move downstream after spawning (Schrank and Rahel 2004).

The potential for fish entrainment at individual points of diversion varies and is related to a number of factors, such as the proportion of stream flow diverted into the canal system, diversion or headgate configurations, habitat type the diversion or headgate is located in, or migratory behavior of the fish species or population. Bonneville Cutthroat Trout populations may be able to compensate for relatively low levels of entrainment and maintain moderate or high abundances. Contrastingly, relatively high levels of entrainment could lead to population declines or overall low population abundance.

Unfortunately, very few entrainment studies have been conducted within the range of Bonneville Cutthroat Trout in Idaho. However, the recent work of Heller et al. (2022b) underscores the importance of irrigation screening as a conservation strategy for migratory Bonneville Cutthroat Trout. These authors found that most wild-origin Bonneville Cutthroat Trout migrated from tributary streams to Bear Lake as age-1 or age-2 fish. Migrations primarily occurred during the low-flow period from early July to early September, overlapping with the irrigation season. There are several other river basins within Idaho where entrainment is well studied and where entrainment has led to population level declines of native salmonids. Therefore, in most locations, the department may only make generalizations on the likelihood of entrainment and population effects utilizing information provided by well-studied systems (i.e. the Lemhi River basin). When determining if a diversion is likely to have population-level effects and whether modification of a diversion would be beneficial to Bonneville Cutthroat Trout (i.e. screened), staff will consider proximity to important populations, quality of adjacent habitats, potential for increases in population abundances, and densities of non-native species, among other factors. Results from Heller et al. (2022b) highlight the need for both instream habitat improvements so that fish reach migratory age, as well continued efforts to screen diversions to prevent entrainment.

FERC renewed the license in 2003 for PacifiCorp to continue operating the Bear River Hydroelectric Project. Conditions of the new license required PacifiCorp to fund numerous projects to aid in the restoration of Bonneville Cutthroat Trout. Some of these conservation efforts include screening numerous irrigation diversions to reduce entrainment losses. In recent years, PacifiCorp and the associated Environmental Coordination Committee (ECC) have helped fund the cost associated with maintaining and operating 21 fish screens. More information is included in the “Entrainment and Fish Screens” section below under “Sources of Additional Mortality”.

During 2007, IDFG conducted an inventory of substantial irrigation diversions in Bear River tributaries with known Bonneville Cutthroat Trout occupancy. The inventory project did not assess every diversion in the Idaho portion of the drainage, but it did account for those thought to limit Bonneville Cutthroat Trout recovery (Hillyard et al. 2010). The project evaluated 40 diversions, and identified Bonneville Cutthroat Trout presence proximate to 22 diversions in 10 tributaries, and evaluated potential fish passage and entrainment into irrigation canals. Diversions were evaluated with a variety of measurements and characteristics to describe the potential effect a particular diversion may have on fish entrainment and migration. These measurements included: (1) water velocities, (2) plunge pool depth, defined as the pool immediately below the diversion caused by the diversion outlet, (3) plunge pool distance from outlet, defined as the distance from the diversion outlet or spillway to the maximum depth of the plunge pool, (4) maximum tail water control depth, defined as the riffle crest where gravel that is scoured from the outlet pool is deposited, (5) maximum tail water control distance from outlet defined as the distance between the outlet of the diversion and the location of the maximum tail water control, (6) water surface distance, as the difference between the water surface elevations above and below the diversion, and (7) stream plunge height, as the distance between the water surface elevation below the diversion to the lowest point where water is released from the diversion. A list of diversions, their locations, and associated dimensions and diversion discharge is presented in Appendix E. Entrainment was identified at 11 of those diversions, and 14 additional diversions were considered to have entrainment potential of Bonneville Cutthroat Trout, although it was not documented (see Hillyard et al. 2010 for full report). Based on the interaction between diversion configuration and stream discharge, 13 diversions were classified as being complete barriers to Bonneville Cutthroat Trout movement. An additional seven diversions caused complete dewatering of the stream below the diversion at the time of the survey, resulting in restrictions to Bonneville Cutthroat Trout movement. Only about 12% of the diversions with documented Bonneville Cutthroat Trout entrainment are screened. Ten diversions were evaluated through this study where the diverted flow exceeded 50% of the total streamflow, and none of those have been screened to-date.

The diversion inventory project provided information to inform ranking and prioritizing projects over the past decade. Screening projects have focused on streams that meet all, or most of, the following characteristics: 1) presence of Bonneville Cutthroat Trout, 2) potential to restore connectivity for fluvial or adfluvial Bonneville Cutthroat Trout, 3) low potential for colonization of nonnative species, 4) high proportion of streamflow diverted, 5) documentation of Bonneville Cutthroat Trout entrainment, and 6) high potential to improve Bonneville Cutthroat Trout access to quality habitat. Recognizing that screen projects require partnership with water users, projects that meet some of the criteria may rank high due to cooperative landowners and water users.

There are 31 screen projects in the Bear River and Bear Lake systems in Idaho (Table 2). Of those, 21 represent substantial projects that require routine operations and maintenance during the irrigation season (Table 2). Screening projects are scattered throughout Bear River tributaries, and the overall effectiveness of some of these projects has been somewhat mixed based on population trends. The 12 screening projects in Bear Lake tributaries (primarily St. Charles and Fish Haven creeks) have aided in the recovery of wild adfluvial Bonneville Cutthroat Trout in Bear Lake. Only one substantial large diversion remains unscreened (i.e., Lower South diversion; St. Charles Creek), and a screen design has been completed in order to facilitate implementation of that project in the future. Completed projects have focused on primary limiting factors and worked toward adult escapement objectives identified in Idaho and Utah's joint Bear Lake Management Plan (IDFG 2019). Monitoring data from Bear Lake have shown substantial increases in wild Bonneville Cutthroat Trout catch rates in gillnet and angler creel surveys (Figure 4).

Bear River Settlement Agreement

The Bear River Settlement Agreement was signed August 28, 2002 in compliance with the Federal Energy Regulatory Commission's 30-year license renewal for PacifiCorp's operations of the three aforementioned hydropower facilities. The settlement agreement and license require the provision of recreational enhancements, instream flows to benefit fishery resources, and various funds to conserve and benefit natural resources near the project. The Environmental Coordination Committee (ECC), a stakeholder group comprised of signatories to the Settlement Agreement, was formed to consult and make decisions regarding the use of funding and other license requirements for the Bear River Project. Parties to the settlement agreement with PacifiCorp are Idaho Department of Fish and Game, Idaho Department of Environmental Quality (ODEQ), U.S. Fish and Wildlife Service (USFWS), USDA Forest Service, U.S. National Park Service, Shoshone-Bannock Tribes, U.S. Bureau of Land Management, Idaho Department of Parks and Recreation, Idaho Rivers United, American Whitewater Association, Trout Unlimited, and Greater Yellowstone Coalition. Voting unanimity is always required among the IDFG, IDEQ, and USFWS unless a particular measure of consideration will occur on federal or tribal lands, in which case unanimity including the land management organization is also required.

Table 2. Name and location of 30 maintained fish screens throughout the Bear River drainage in Idaho.

Stream	Name	Lat	Long	Style	Subtype	Sponsor
Cottonwood Cr.	Cleveland	42.332054	-111.774013	Drum	Rotary	TU
	Treasureton	42.389009	-111.919115	Drum	Rotary	TU
	Davis	42.432163	-111.914391	Drum	Rotary	TU
Cub River	Knapp	42.067585	-111.764654	Drum	Rotary	TU
	Albert Moser	42.138377	-111.695042	Drum	Rotary	TU
St. Charles Cr.	Bear Lake Refuge - 0	42.125388	-111.338484	Drum	Undershot	USFWS
	Bear Lake Refuge - 1	42.130369	-111.341008	Drum	Undershot	USFWS
	Transtrum, Wayne - 02a	42.144518	-111.368587	Drum	Undershot	USFWS
	Transtrum, Wayne - 02b	42.145328	-111.372199	Drum	Undershot	USFWS
	Island	42.124408	-111.389612	Drum	Rotary	TU
	Transtrum, Todd	42.115871	-111.368947	Drum	Rotary	IDFG
	Transtrum, Dell	42.119163	-111.385035	Vertical	Fixed	IDFG
	Northfield	42.121231	-111.413218	Drum	Rotary	IDFG
	Upper South	42.115045	-111.440414	Drum	Rotary	IDFG
Fish Haven Cr.	Litchfield	42.036416	-111.410521	Drum	Rotary	TU
	Stock lower	42.036313	-111.403936	Drum	Rotary	TU
	Stock Upper	42.036321	-111.40425	Drum	Rotary	TU
	BLM Lower	42.040283	-111.429455	Horizontal	FCA	TU
	BLM Upper	42.041349	-111.433449	Horizontal	FCA	TU
Thomas Fork	Mumford	42.270515	-111.080651	Vertical	Brush	TU
	Peterson	42.216138	-111.075724	Drum	Rotary	TU
	Taylor	42.383539	-111.053864	Vertical	Brush	TU
Skinner Cr.	Lower	42.479471	-111.45078	Horizontal	Coanda	USFS
	Upper	42.475843	-111.461849	Horizontal	Coanda	USFS
Georgetown Cr.	Alleman Lower	42.476175	-111.37865	Drum	Undershot	USFS
North Cr.	Ovid	42.356732	-111.465651	Drum	Rotary (modified bubbler)	TU
Hoopes Cr.	Fox 1	42.396338	-111.763032	Horizontal	Bubbler	USFWS
	Fox 2	42.396766	-111.761611	Drum	Brush	USFWS
Paris Cr.	Max Bunderson	42.229269	-111.370377	Vertical	Fixed	TU
	Roy Bunderson	42.225093	-111.37449	Vertical	Fixed	TU

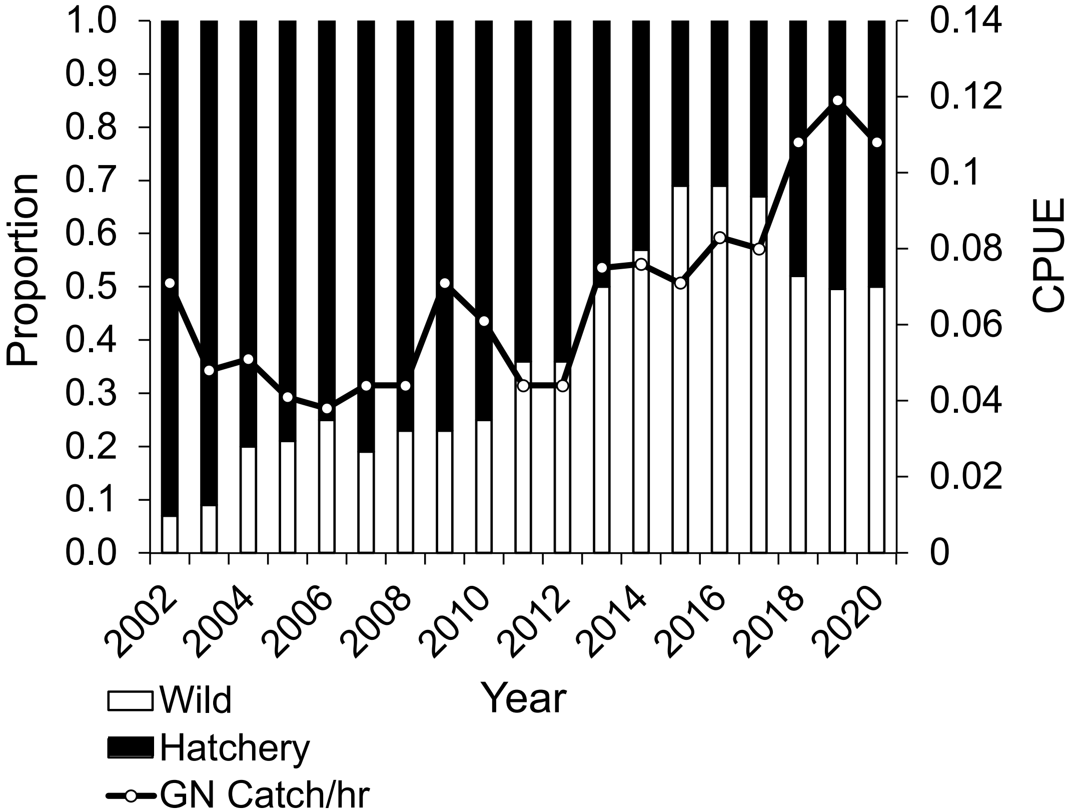

Figure 4. Time series of catch-per-unit-effort (CPUE; number of Bonneville Cutthroat Trout per gillnet hour) and the proportion of wild- and hatchery-origin Bonneville Cutthroat Trout from Bear Lake monitoring.

The combination of the ECC and Bear River Settlement Agreement have resulted in implementation of several actions important for conservation of Bonneville Cutthroat Trout. The ECC brings together technical professionals representing the above mentioned partners to make decisions concerning the use of mitigation funds specific to: 1) land and water conservation and acquisition or 2) habitat enhancement. In addition, a primary component of the settlement agreement is the implementation of the Bonneville Cutthroat Trout conservation aquaculture program operated by IDFG. The settlement agreement currently provides annual inflation-adjusted amounts of $167,400 for habitat enhancement, up to $300,000 for land and water conservation and acquisition, and $100,000 (escalated annually) for the conservation aquaculture operations at Grace Fish Hatchery. Projects funded so far include collection and analysis of trout from tributaries and reaches of the main stem Bear River for genetic analysis, radio telemetry of fluvial Bonneville Cutthroat Trout, numerous irrigation screens that prevent entrainment losses, conservation easements, establishment of a conservation hatchery for native Bonneville Cutthroat Trout, and many riparian fencing projects.

Habitat Quality

Physical Habitat Condition

Habitat alteration is one of the primary causes of extirpation of Bonneville Cutthroat Trout populations and continues to be a major challenge to their abundance and distribution (WNTI 2018). Extensive research has been conducted on the impacts of human-caused alterations to salmonid habitat (see for example Beschta et al. 1987; Chamberlin et al. 1991; Furniss et al. 1991; Meehan 1991; Sedell and Everest 1991; Frissell 1993; Henjum et al. 1994; McIntosh et al. 1994; Wissmar et al. 1994; U.S. Department of Agriculture and U.S. Department of the Interior

1996; Gresswell 1999; Trombulak and Frissell 2000).

The effects of livestock grazing on fisheries habitat and fish populations are well documented (Keller and Burnham 1982, Platts and Nelson 1985, Chaney et al. 1993, Fitch and Adams 1998). Where livestock grazing has altered aquatic habitat conditions, a variety of management and restoration techniques may be used to improve riparian vegetation, narrow stream channels, deepen pools, provide cooler water temperatures, stabilize stream banks, reduce sediment loading, increase insect production, and improve spawning and rearing success. Improved riparian habitat condition may increase carrying capacity for existing Bonneville Cutthroat Trout populations (Duff 1988; Platts 1991; Schrank and Rahel 2006).

Fine sediments in streams can reduce the quality of Bonneville Cutthroat Trout spawning, rearing and overwinter habitat. Road and trail building, maintenance, and use, logging, and agriculture, may negatively affect Bonneville Cutthroat Trout populations. Roads and road maintenance have the potential to deliver excess fine sediment. Improperly placed or sized culverts at road crossings in Bonneville Cutthroat Trout streams have the potential to block fish movement. Logging, if not done using appropriate best management practices, may increase sediment delivery to streams, and decrease large wood availability in riparian areas and streams, reducing habitat quality. However, the State of Idaho's Forest Practices Act has resulted in better compliance with rules and regulations for logging practices based on audits done by the IDEQ in conjunction with IDL. Vegetation buffers between agriculture operations and streams filter sediment and provide riparian habitat along stream or river banks.

Water Quantity

Bonneville Cutthroat Trout populations throughout their range, face substantial challenges from reduced water quantity. The 2019 Bonneville Cutthroat Trout Range-Wide Conservation Agreement and Strategy (BCTCT 2019), lists drought as "the most pervasive risk factor throughout the Bonneville Cutthroat Trout range with 72% (497/570) of the historical range at high risk." While agencies have worked to improve instream flows, reduced stream flows remain a substantial challenge to Bonneville Cutthroat Trout populations. The effects of water withdrawals are widespread throughout the subspecies range. Summer dewatering as a result of diversions is common in many streams throughout the Bear River drainage (Harris 2017). Reduced stream flows shrink the total available stream habitat and potentially increasing summer water temperatures. Reduced stream flows also have additional effects to the stream ecosystem by disrupting the natural geomorphic and ecological processes. These may include reduced channel width (from riparian encroachment), simplified channel morphology, increased patches of fine sediments, reduced abundance and diversity of macroinvertebrates, simplified riparian plant communities and changes in water chemistry (see Caskey et al. 2015 for review). Low streamflow may exacerbate habitat fragmentation and disconnect important migration pathways for both juvenile and adult Bonneville Cutthroat Trout. The IDFG should work collaboratively with the agriculture industry and the ECC to explore potential strategies to increase stream flows where they are a limiting Bonneville Cutthroat Trout populations.

Water Quality

Bonneville Cutthroat Trout continue to face substantial challenges from degraded water quality in many parts of their range, especially within the mainstem Bear River and many of its tributaries. Current information from the Idaho Department of Environmental Quality suggests several beneficial uses are impaired within the Bear River drainage (Esquivel 2020). On average, Idaho DEQ data indicates 53% of the stream km in the Bear River drainage currently do not meet water quality standards and do not support one or more beneficial uses. Impaired beneficial uses include but are not limited to cold water aquatic life and salmonid spawning. Sources of identified pollutants include livestock grazing, altered stream flows (e.g., water diversion, low flows), and degraded stream channels, roads, mining, recreation, mass wasting and wastewater treatment plants.

In June 2006, the Environmental Protection Agency (EPA) approved 127 Total Maximum Daily Loads (TMDLs) for 63 different waterbodies for the Bear River/Malad River Basin. The primary pollutants for most streams for which TMDLs were developed included total phosphorus and total suspended solids. The TMDLs were submitted by the IDEQ for EPA approval in a document entitled, Bear River/Malad River Subbasin Assessment and Total Maximum Daily Load Plan. EPA determined that the TMDLs met the regulatory and statutory requirements for approval under the Clean Water Act. The TMDL submittal of the IDEQ also included an implementation strategy for the TMDLs, pursuant to the TMDL Settlement Agreement of July 2002. Implementation is critical to realizing improvements in water quality for each of the TMDLs. The IDFG and land and resource management agencies will work with the IDEQ and other appropriate partners to ensure the necessary actions are taken to achieve the TMDL reductions. Improvements in water quality throughout the Bear River/Malad River Basin will benefit Bonneville Cutthroat Trout populations.

The most recent 5-year review of the Bear River/Malad River TMDL assessment by the IDEQ was published in 2017 (Harris 2017). The 5-year review shows streams throughout the Bear River drainage show a mix of water quality conditions. Several streams are meeting or under their TMDL targets, and are supporting coldwater biota. However, many sections of the Bear River and its tributaries continue to exceed TMDL targets. In general, patterns of water quality reflected adjacent channel conditions or flow manipulations for irrigation. The report also indicated most streams in the Malad subbasin exceeded TMDL targets as well. Summer dewatering associated with water withdrawal continues to reduce the quality and quantity of Bonneville Cutthroat Trout habitat quality in many streams throughout the basin (Harris 2017).

Temperature / Climate Change

Water temperature tolerances for Bonneville Cutthroat Trout were evaluated by Johnstone and Rahel (2003). This work estimated that the 7-d upper incipient lethal temperature (LT50) based on a constant thermal regime was 24.2°C. In addition, water temperature tolerances were examined in the wild. Study fish were able to survive a 7-d exposure to a diel cycle of 16–26°C, even with a 6-h daily exposure to temperatures (>24.2°C) that would be fatal under continuing exposure.

In 2006, IDFG studied water temperatures in the Bear River drainage. Water temperatures in the mainstem Bear River had a daily cycle of 19–26°C during the warmest part of the summer which includes a higher minimum than the Johnstone and Rahel (2003) study. In addition, the duration of elevated temperatures in the Bear River exceeded two weeks. No attempt was made to estimate mortality of Bonneville Cutthroat Trout associated with this temperature regime, but the higher minimum temperature and longer duration have the potential to cause increased stress and mortality.

Hillyard and Keeley (2012) studied habitat use by Bonneville Cutthroat Trout in association with water temperatures in a non-regulated segment (Pegram Management Unit) and a regulated segment (Nounan Management Unit). They found Bonneville Cutthroat Trout consistently sought out habitats with cooler water temperatures in greater proportion than they were available in both segments. They used thermal imagery data to classify available water temperatures into discrete habitat types based on water temperature as “hospitable” (< 22.0°C), “stressful” (22.0 – 24.1°C) and “lethal” (≥ 24.2°C). During mid-summer from July 1 – August 15, in the regulated portion, temperatures ranged from 18 – 28.1°C, with only 0.02% of available habitat falling below the 22°C stressful limit. However, Bonneville Cutthroat Trout only used habitats between 11.4 – 24.2°C., and 63% of habitat used was below 22°C. In the unregulated portion, temperatures of the Bear River ranged from 17.5 to 28.5°C, though 12% of available habitat fell below the 22°C stressful limit. Bonneville


Bonneville Cutthroat Trout in hand. CCBY Tyler Coleman

Cutthroat Trout used habitats between 18.5 and 24.8°C, with 59% of that falling below 22°C. The non-regulated segment had more and larger patches of hospitable water temperatures that were closer together compared to the regulated segment. In the regulated segment, hospitable patches were associated with tributary inputs. Bonneville Cutthroat Trout, during the warmest part of the summer, use these tributary confluences and are limited in their movement because of the distance to the next cool-water refugia. Therefore, in the Nounan Management Unit, cool water tributaries are essential for the distribution and persistence of Bonneville Cutthroat Trout in the Bear River.

Hydrologic Change

Southeast Idaho has a repeated history of experiencing drought conditions, with those in 2021-2022 being particularly dry. Drought conditions have impacted Bonneville Cutthroat Trout populations by decreasing available habitat and connectivity between habitats. The effects of this drought may become more severe if forecasted climate change scenarios occur. In an assessment on Idaho water supply, Humes et al. (2021) noted the following major concerns around water supply and water demand relative to the impacts of climate change in Idaho, specifically; anticipated shifts in precipitation from snow to rain, thus decreasing wintertime and early spring water storage capacity in mountains, associated shifts in magnitude and timing of natural streamflow that will impact surface water resources, most notably, forecasted average summertime streamflows are likely to be lower than in the past. Humes et al. (2021) also noted impacts of lower summertime streamflow will likely impact all water users, including agricultural production, aquaculture, and hydropower generation. The specific mechanisms for changes in water resources include; declining snowpack (Leung et al. 2004; Mote et al. 2005; Stewart et al. 2005; Regonda et al. 2005) and trends towards a decrease in snow water equivalent and a general increase in winter precipitation (in the form of rain) in the western United States, particularly at lower elevations (Regonda et al. 2005). Reduced snowpacks and warming temperatures may geographically isolate cold water stream fish in increasingly confined headwaters (Hauer et al. 1997). Altered streamflows may reduce available habitat for Bonneville Cutthroat Trout populations throughout their range, particularly those that persist in streams with already limited water resources (Fausch et al. 2002). Conservation actions focusing on the protection of connected habitats and diversity in life history strategies, restoring connectivity, and reintroducing populations have the potential to offset some of the negative consequences associated with climate change (Colyer 2006).

Cold-water Habitat Reaches

In response to climate change, the distribution of suitable habitats and native trout populations are likely to shift across the landscape and contract towards headwater areas. Identifying those streams where habitat conditions are most likely to continue supporting native trout in the future may be useful for strategic planning of future conservation efforts. We worked with Dan Isaak (USFS Rocky Mountain Research Station, Boise) to help identify potential cold-water refugia streams that can support key spawning and juvenile rearing life stages under future climate scenarios by applying the Climate Shield species distribution model (Isaak et al. 2015) to the Bonneville Cutthroat Trout distribution in Idaho. This analysis aimed to help identify those streams within the species range that might be the most climate resilient, and therefore present best opportunities for long-term conservation success.

The following is a summary of the methods used for this analysis, which are available in detail in Isaak et al. (2015). The modelling combined extensive geospatial and climate data to predict the extent and probability of occupancy of Bonneville Cutthroat Trout in cold-water natal habitat patches. Natal habitat patches consisted of contiguous stream reaches in headwater areas which had flows > 1 cfs (lower flow reaches are often intermittent), slopes < 15% (steeper reaches often have geological barriers to trout access), and mean August temperatures < 11ºC. The temperature criteria used to delimit natal patches should be viewed as conservative because the distribution of juvenile Cutthroat Trout may extend downstream into reaches with summer temperatures as warm as 13 – 14 °C. However, these warmer reaches are also susceptible to invasions by Brown Trout, Rainbow Trout, or hybridization between Rainbow Tout and Cutthroat Trout, which places populations in these areas at greater risk in future climates. The Climate Shield model predicted habitat distributions and population occupancy probabilities for three different climate periods: a baseline period, mid-21st century period (2030-2059 (2040s)) and a late 21st century period (2070-2099 (2080s)). The baseline conditions for summer flows used in the model represented the average over a 30-year climate period from 1970-1999 (1980s; Wenger et al. 2010) whereas the baseline period for summer stream temperatures covered a slightly different period (1993 – 2011; Isaak et al. 2017). However, future scenarios for both temperature and flow were consistent in terms of the two future periods and were associated with the A1B emissions scenario (Isaak et al. 2015). The Climate Shield patch occupancy scenarios also included the predicted effect of Brook Trout presence on the likelihood of Bonneville Cutthroat Trout occurrence in each habitat reach under each climate scenario. Brook Trout were included at three levels of prevalence: 0%, 50% and 100%.

In the baseline scenario, the total length of cold-water natal habitat patches was estimated at 248 km (Figure 5). By 2040, this was projected to decline 42% to 143 km (Figure 6). By 2080, the total extent of cold-water natal habitats is projected to decline by 67% to 81 km (Figure 7). Similarly, the total count of discrete cold-water habitats was projected to decline from 67 in the 1980s scenario, to 42 (2040s) and 22 (2080s). The presence of Brook Trout decreased the likelihood that these cold-water habitats would be occupied by Bonneville Cutthroat Trout in all climate scenarios (Figure 8). While the amount of cold-water reaches declined in future scenarios, Bonneville Cutthroat Trout were more likely to occupy reaches when Brook Trout were absent (Figure 8). While these data are limited to the Bonneville Cutthroat Trout range, Isaak et al. (2015) provides a comprehensive illustration of this relationship with a much larger dataset for Cutthroat Trout across Idaho and portions of additional subspecies ranges. Brook Trout decrease the likelihood of Cutthroat Trout occupying refugia, and also increase the length of stream needed to provide the same level of refuge when Brook Trout are present. This suggests that while the total amount of cold-water refugia will likely decline, removing Brook Trout (and other non-native salmonids) will be a critical strategy to building climate resiliency for Bonneville Cutthroat Trout.

This scenario is again probably conservative, as modelled Brook Trout presence was 50% and 100%. Currently, we estimate Brook Trout are present in roughly 30% of streams occupied by Bonneville Cutthroat Trout (Table 3). Still, these data underscore the increasing importance of managing non-native trout, especially when considering their potential expansion and impacts under future climate scenarios that restrict the total available cold-water habitat for native Bonneville Cutthroat Trout. The "climate shield" methodology applied here is not intended to be absolutely accurate. Instead, the approach is a conservative estimate of future available cold-water refugia based on empirical environmental criteria. The idea is to provide a strategic framework to help plan population monitoring efforts and prioritize conservation actions around areas where Cutthroat Trout persistence is most likely if future climatic conditions are realized.

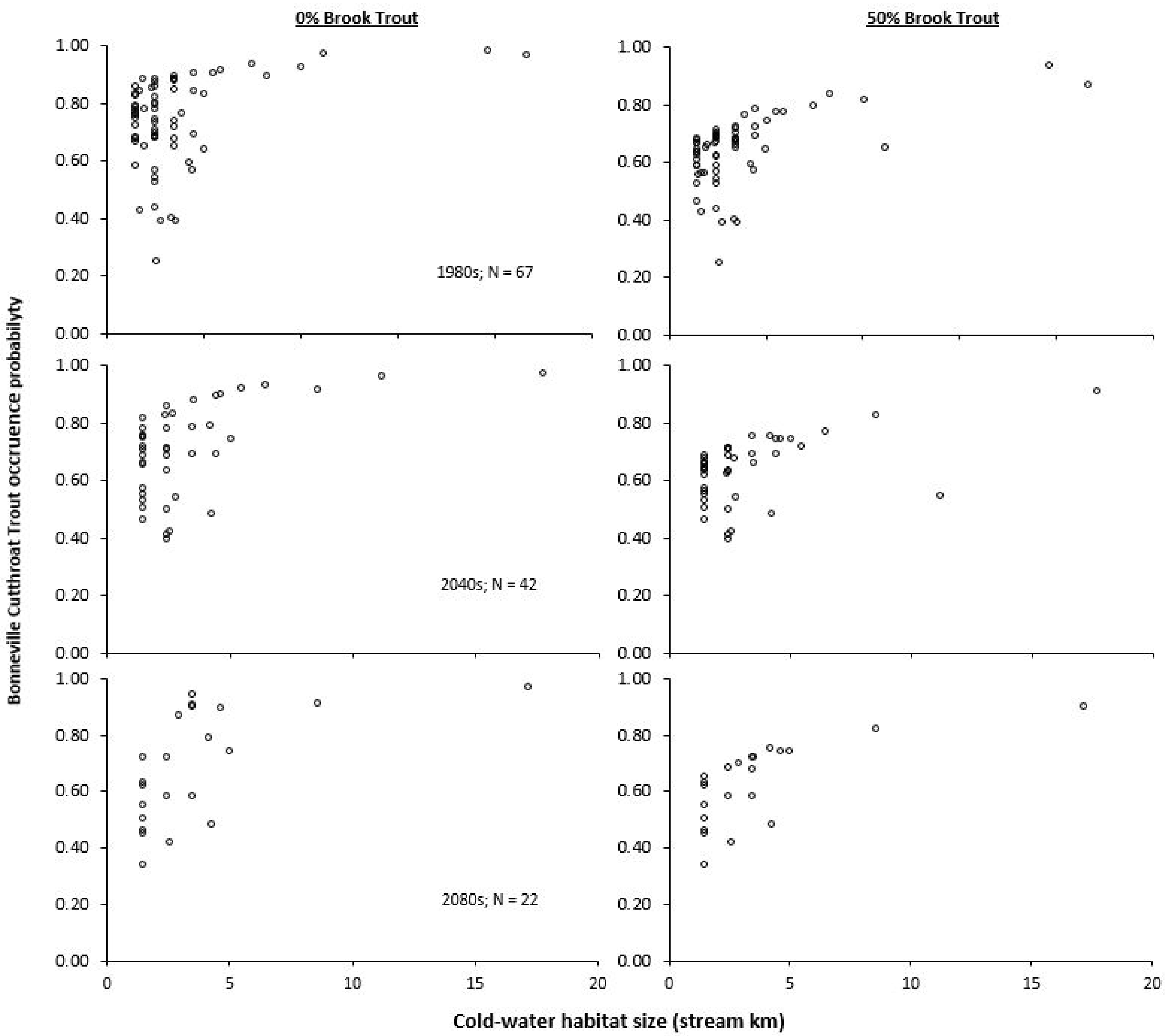

Figure 5. Probability clouds for Bonneville Cutthroat Trout juvenile occupancy of cold-water habitats across the species range in Idaho during different climate periods and under two levels of Brook Trout invasion (left column = 0% Brook Trout, right column = 50% Brook Trout).

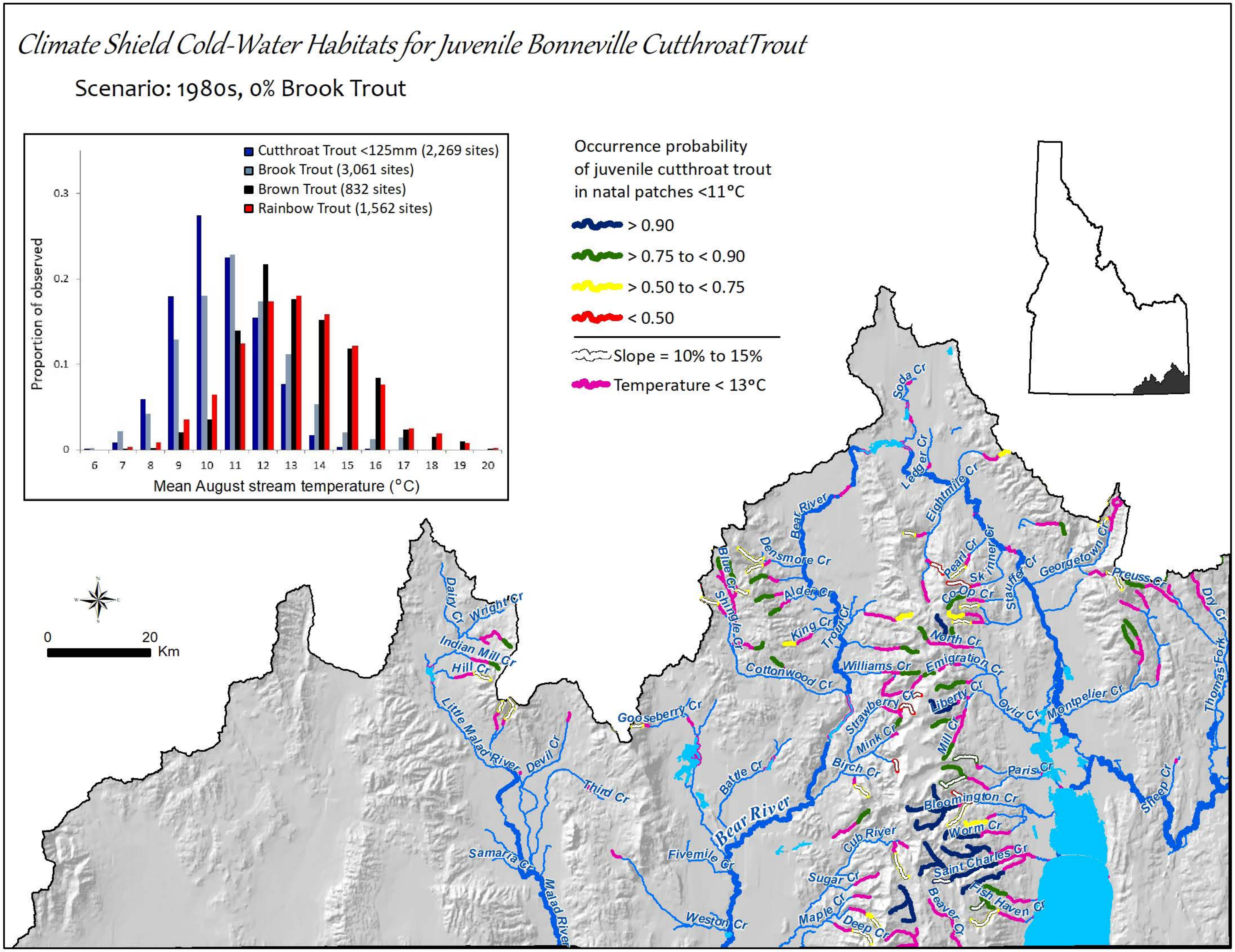

Figure 6. Distribution of cold-water reaches in the baseline scenario (1979-1990, or "1980s") and the probabilities of occupancy for juvenile Bonneville Cutthroat Trout at with prevalence of Brook Trout set to zero.

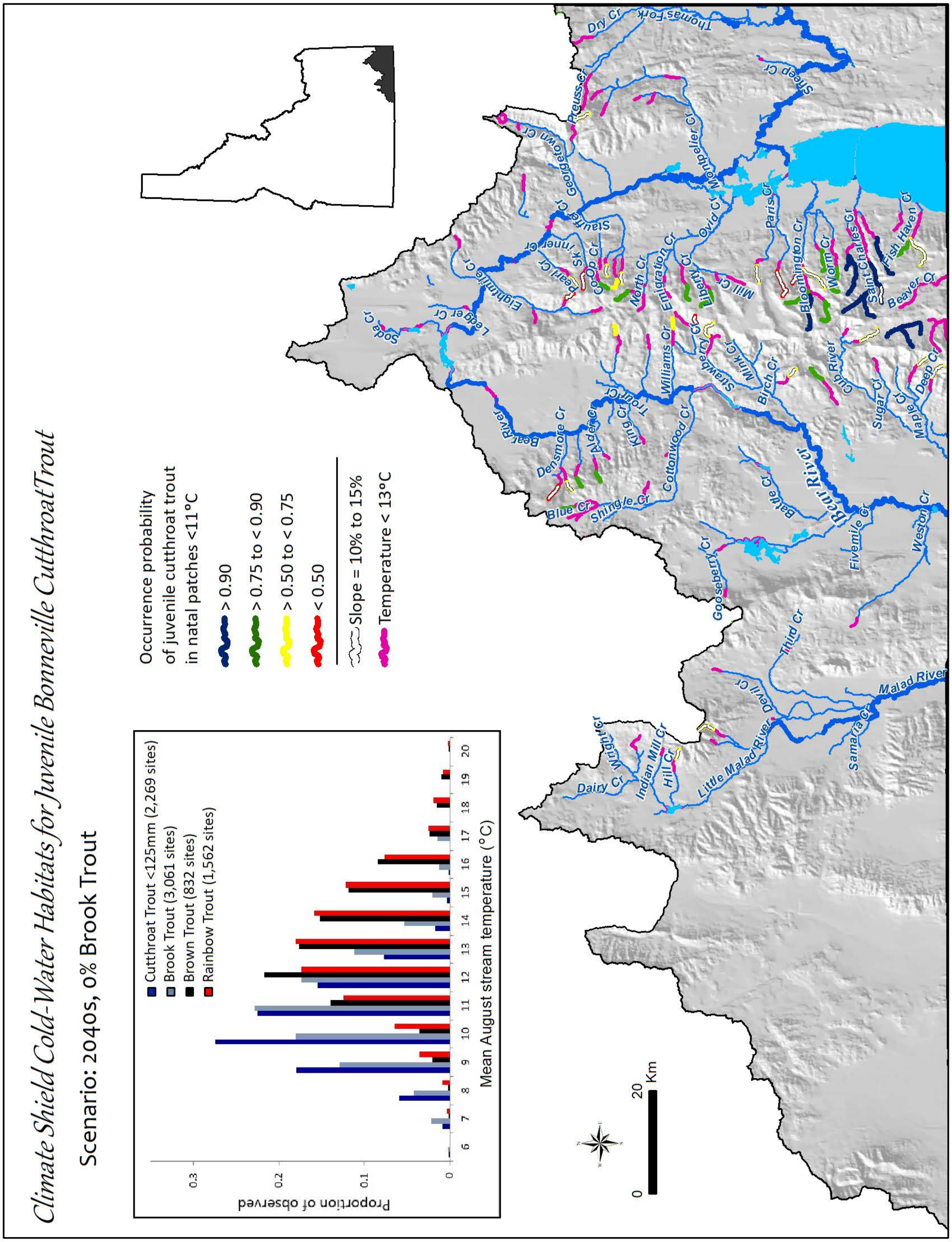

Figure 7. Distribution of cold-water reaches in the moderate climate change scenario (“2040s”) and the probabilities of occupancy for juvenile Bonneville Cutthroat Trout at with prevalence of Brook Trout set to zero.

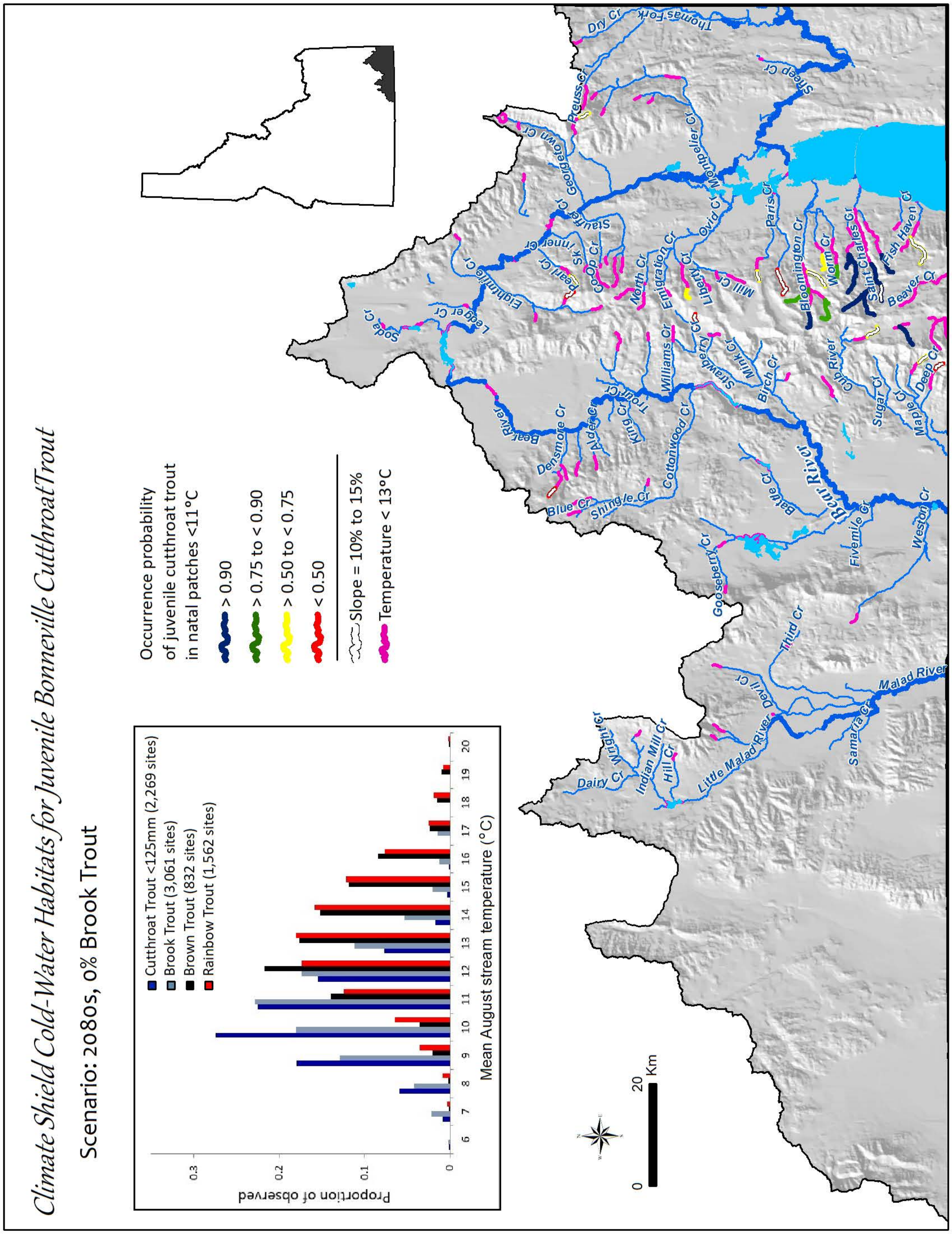

Figure 8. Distribution of cold-water reaches in the extreme scenario (2080s) and the probabilities of occupancy for juvenile Bonneville Cutthroat Trout at with prevalence of Brook Trout set to zero.

Habitat Restoration

PacificCorp has funded habitat restoration projects in the Bear River drainage to benefit Bonneville Cutthroat Trout since the settlement agreement was signed in 2002. The agreement provides up to $167,000 deposited into the habitat restoration fund. Approximately 300 habitat restoration projects using PacifiCorp funding have been completed.

Funding is available to any person or organization. The application consists of a "short-form" proposal with a brief overview of the project. Short forms are reviewed by the Environmental Coordination Committee (ECC). The short form review process determines if the project fits the PacifiCorp criteria for restoration projects. If the project fits the criteria, applicants are encouraged to submit a "long-form" proposal. Long forms go into more detail about the project and the potential benefits. The long forms are numerically ranked according to the expected benefit of the project on Bonneville Cutthroat Trout conservation. There is no limit on the amount of funds that may be requested, but typically the highest awards have approached $40,000-50,000 annually.

IDFG has participated in habitat restoration projects and studies in the Bear River drainage. Since 2002, IDFG has been involved or been the lead applicant in at least 37 projects, which have utilized $967,421 of PacifiCorp settlement agreement funds (Appendix A). IDFG identifies potential projects by working with landowners to identify a potential project that will improve steam connectivity, fish passage, improve land use practices, or physical habitat enhancement. Some of these projects include conservation easements.

PacifiCorp has a separate fund for land and water acquisition, which to date have been primarily allocated to conservation easements. These conservation easements have been secured by working with the local land trust (Sagebrush Steppe Land Trust; SSLT). Typically, easements are proposed by landowners or the SSLT. The ECC considers whether funds should be awarded to secure the easement by assessing the potential conservation benefits to Bonneville Cutthroat Trout and other wildlife.

Technical Assistance

IDFG is the principal state government agency speaking on behalf of Idaho's fisheries resources and habitats and has a responsibility to inform decision-makers and interested citizens of potential effects to those resources (IDFG 2019). As noted in previous sections, Bonneville Cutthroat Trout are affected by a variety of activities including range- or forest-land management, as well as development of water delivery, energy, or transportation infrastructure, among others. Water and land development proposals typically require approval from local, state, or federal agencies, which often require IDFG input regarding likely effects to fisheries resources. The US Forest Service (Caribou-Targhee), US Bureau of Land Management (Idaho Falls District Office and Pocatello Field Office), and Idaho Department of Lands (Southern Operations and Eastern Supervisory Area) manage substantial acreages within the Idaho range of Bonneville Cutthroat Trout. IDFG staff work closely with these agencies to ensure that activities are conducive to maintaining or improving populations of Bonneville Cutthroat Trout. IDFG staff will review and make recommendations on activities, within our authority, that have the potential to result in substantial loss of water quality or quantity and degradation of fish habitat or populations, and will suggest strategies and techniques which avoid, minimize, and mitigate for activities. If mitigation is warranted, IDFG staff will follow mitigation guidelines outlined in the Fisheries Management Plan 2019 – 2024 (IDFG 2019), or subsequent versions.

Establishment of non-native species

Establishment by historical stocking

Non-native species, especially fishes, remain a substantial challenge to Bonneville Cutthroat Trout population abundance and distribution in Idaho. The 2019 range-wide conservation strategy and conservation agreement indicated non-native trout were a substantial threat in over 60% of the sub-watersheds range-wide (Bonneville Cutthroat Trout 2019). Non-native fish species pose a threat to Bonneville Cutthroat Trout through a variety of mechanisms, including hybridization, competition, and predation. Table 3 identifies waters where Bonneville Cutthroat Trout coexist with non-native fish species and summarizes past stocking activities. We estimate that non-native salmonids of at least one species are sympatric with Bonneville Cutthroat Trout in approximately 70% of the occupied stream km (Table 3). Most of the non-native fish species that occur in historical Bonneville Cutthroat Trout habitat were historical introductions by management agencies (Appendix B); however, range expansions resulting from illegal introductions are also possible. Rainbow Trout, Brook Trout, and Brown Trout are the most common non-native salmonid species found in the Bear River drainage. Walleye *Sander vitreus*, Smallmouth Bass *Micropterus dolomieui*, and Common Carp *Cyprinus carpio* are also present and likely negatively affect Bonneville Cutthroat Trout populations.

Rainbow Trout


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Rainbow Trout may interbreed with Bonneville Cutthroat Trout resulting in introgression and hybridization. Rainbow Trout occupy about 522 km (about 49% of current Bonneville Cutthroat Trout habitat) of the river and stream habitat in the Bear and Malad River drainages, and are present in 44 (36%) of the 121 streams where Bonneville Cutthroat Trout are currently present (Table 3). The earliest records indicate IDFG introduced Rainbow Trout into the Bear River drainage as early as 1913 to Montpelier Creek, the Bear River (Franklin County), Cub River, and Paris Creek in 1920 (Appendix B). These early stocking actions predated widespread understanding of the potential consequences of introducing nonnative salmonids. IDFG may continue to stock triploid sterile Rainbow Trout for angling where interaction with Bonneville Cutthroat Trout is possible. Naturally-reproducing populations of Rainbow Trout in the Bear River drainage occur in Saint Charles, Georgetown, and Williams creeks. In those systems, hybridization with native Bonneville Cutthroat Trout has been documented. Genetic samples were collected from most of the major tributaries in the Malad and Bear River drainages (Figure 9) and results indicate that while genetic introgression continues to be a threat in some streams, most Bonneville Cutthroat Trout in Idaho have not been heavily affected by Rainbow Trout introgression (Table 4).

Brook Trout


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The current distribution of Brook Trout is best described by past stocking records (Appendix B; Table 3). The earliest records of Brook Trout introductions date back to 1913 in Montpelier and Soda creeks, the Little Malad River (1914), the Cub River (1915), Bloomington and Deep creeks (1916) and several others prior to 1920. Possible invasions by Brook Trout have occurred in only three waters in the Bear River drainage in Idaho (Bailey, Pearl, and Skinner creeks) tributaries in the Nounan Valley management unit. Upstream expansion of Brook Trout has occurred in tributary streams to Ovid and Montpelier creeks. Most of the populations appear to have been initiated by hatchery stocking, while some appear to be invasions, or upstream expansion (Table 3).

Brook Trout are potential competitors and predators of Bonneville Cutthroat Trout. They often replace Cutthroat Trout in the western United States and are therefore a significant threat to the persistence of Bonneville Cutthroat Trout (Peterson et al. 2004). Brook Trout occupy at least 36 streams in the Bear and Malad River drainages (Table 3). Based on a count of streams, Brook Trout currently inhabit at least 30% of streams currently occupied by Bonneville Cutthroat Trout in Idaho. Similar to Rainbow Trout, Brook Trout were introduced in the Bear and Malad drainages in the early 1900s. Interestingly, Brook Trout expansion from those initial stocking events appears to be relatively limited in the Bear River drainage.

Brown Trout


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Brown Trout occupy every reach of the mainstem Bear River in Idaho and three major tributaries (Thomas Fork River, Montpelier Creek, and Mink Creek). Brown Trout distribution may be explained primarily by past stocking records (Appendix B). IDFG records indicate Brown Trout were stocked relatively recently, beginning in 1974 in the mainstem Bear River, and on two occasions in Cottonwood Creek (1990, 1991). Brown Trout stocking was discontinued in 1998 to assist with Bonneville Cutthroat Trout conservation and restoration efforts. Brown Trout were most successful as a put-and-grow fishery downriver from Oneida Dam. A residual population of naturally-spawning Brown Trout remains in this reach, but at a much lower density than during years with fish stocking.

Brown Trout may negatively affect Bonneville Cutthroat Trout through competition and or predation (McHugh and Budy 2005), but do not pose risk through hybridization or introgression. Due to their limited distribution in tributaries, Brown Trout are not considered a substantial threat to most of the tributary Bonneville Cutthroat Trout populations.

Walleye


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Walleye occupy the Bear River in the Thatcher and Riverdale management units from introductions in Oneida Reservoir in 1976. Approximately 500,000 Walleye fry are stocked in Oneida Reservoir annually. Walleye migrated downstream through Oneida Dam and occupy all of the Bear River within the Riverdale management unit. Walleye are top predators in fish communities and will opportunistically feed on fish in Oneida Reservoir and the Bear River. Once Bonneville Cutthroat Trout habitat restoration is complete in the Thatcher and Riverdale management units, evaluation of the Walleye stocking program and resulting fishery should occur along with consideration of converting to sterile walleye stocking.

Smallmouth Bass


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The earliest documented introduction of Smallmouth Bass to the Bear River was in 1943 with 5,000 Smallmouth Bass stocked downstream of Oneida Dam. Smallmouth Bass were introduced in the Dam Complex MU of the Bear River in 1990-1991. Stocking included locations upstream and downstream of Alexander Reservoir (Appendix B). Since introduction, Smallmouth Bass have expanded to occupy all available downriver habitats. Their current distribution begins at Soda Dam and extends downriver to the Utah border (89 km). Smallmouth Bass appear to have successfully populated the Bear River and Oneida Narrows Reservoir. In standard reservoir surveys, Smallmouth Bass increased from not present in 1992 to 9% of the relative species composition in a 2001 survey (the most recent year of survey data available at this time). Despite no current stocking, anglers now catch more Smallmouth Bass than Walleye in Oneida Reservoir. In the river fishery downstream of Oneida Reservoir, Smallmouth Bass are targeted commonly by anglers. No specific studies have been completed on predation effects of Smallmouth Bass on Bonneville Cutthroat Trout in Idaho. However, Smallmouth Bass have been implicated in the decline of native species, including salmonids throughout the Pacific Northwest and Rocky Mountain regions. For this reason, Smallmouth Bass have are potentially a threat to Bonneville Cutthroat Trout populations from the former Cove Dam site to the Utah Border. Furthermore, SMB populations are likely to expand under typical climate change scenarios predicting warmer water temperatures throughout the Bonneville Cutthroat Trout range, expanding the habitat suitable for Smallmouth Bass invasion.

Table 3. Fish species distribution summary, Bonneville Cutthroat Trout total currently occupied (km), and species stocked (records back to 1913 when available) in the Bear and Malad River drainages. Asterisk indicate where stocking records did not specify the subspecies of Cutthroat Trout stocked.

	HUC12 Name	Parent stream	Stream name	BCT status	Total occupied (km)	RBT present	BKT present	BNT present	Other spp	BCT stocked	BKT stocked	BNT stocked	RBT stocked
Pegram FMU	Bear Hollow-Bear River	Great Salt Lake	Bear River	Present	24.8	X		X				X	X
		Bear River	Sheep Cr.	Present	0.1								
	Bear River-North Willow Cr.	Great Salt Lake	Bear River	Present	3.9	X		X	X	X*	X	X	X
	Bear River-Taylor Cr.	Great Salt Lake	Bear River	Present	40.1	X		X	X	X*	X	X	X
		Nuffer Canal (Bear River)	Sweetwater Cr.	Unknown									
		Bear River	Thomas Fork	Present	26.4				X	X*	X		X
		Sweetwater Cr.	Unnamed 15	Unknown									
	Dingle Swamp-Outlet Bear Lake	Spring Cr.	Big Cr.	Present	6.9	X	X				X		X
		Bear Lake	Little Cr.	Present	4.1	X	X						X
		Bear Lake	Spring Cr.	Present	7.3	X	X						X
	Fish Haven Creek-Frontal Bear River	Bear Lake	Fish Haven Cr.	Present	5.8		X			X	X		
		Fish Haven Canyon	White Pine Canyon	Unknown									
	Giraffe Cr.	Thomas Fork Bear River	Giraffe Cr.	Present	3.4					X*			
		Giraffe Cr.	Robinson Cr.	Unknown						X*			
		Giraffe Cr.	Salt Basin Cr.	Unknown									
		Salt Basin Cr.	Unnamed 30	Unknown									
		Giraffe Cr.	Unnamed 31	Present	2.1								
		Unnamed 31	Unnamed 33	Unknown									
		Robinson Cr.	Unnamed 36	Unknown									
	Indian Creek-Frontal Bear River	Bear Lake Outlet	Indian Cr.	Unknown									
	Pegram Cr.	Pegram Cr.	Horse Cr.	Unknown									
		Nuffer Canal	Pegram Cr.	Present	11.9								
	Preuss Cr.	Preuss Cr.	Beaver Cr.	Unknown									
		Preuss Cr.	Fish Cr.	Unknown									
		Bischoff Canyon	Geneva Ditch	Unknown									
		Geneva Ditch	Preuss Cr.	Present	16.3				X	X			X
		Preuss Cr.	Unnamed 29	Unknown									

Table 3. Continued.

	HUC12 Name	Parent stream	Stream name	BCT status	Total occupied (km)	RBT present	BKT present	BNT present	Other spp	BCT stocked	BKT stocked	BNT stocked	RBT stocked
Pegram FMU	Sheep Creek-Bear River	Bear River	Sheep Cr.	Present	7.2								
		Sheep Cr.	West Fork Sheep Cr.	Unknown									
		Sheep Cr.	Unnamed 26	Unknown									
		West Fork Sheep Cr.	Unnamed 27	Unknown									
		Sheep Cr.	Unnamed 41	Unknown									
		Sheep Cr.	Unnamed 42	Unknown									
		Unnamed 41	Unnamed 44	Unknown									
	St Charles Cr.	Saint Charles Cr.	Blue Pond Spring	Present	0.2								
		Saint Charles Cr.	MF Saint Charles Cr.	Present	2.7	X	X			X	X		X
		Saint Charles Cr.	NF Saint Charles Cr.	Present	0.8								
		Big Cr.	Saint Charles Cr.	Present	12.6	X	X			X	X		X
		Saint Charles Cr.	SF Saint Charles Cr.	Present	2.1								
	Thomas Fork-Bischoff Canyon	Thomas Fork Bear River	Bischoff Canyon	Unknown									
		Thomas Fork Bear River	Geneva Ditch	Unknown									
		Thomas Fork Bear River	Preuss Cr.	Unknown					X	X			X
		Bear River	Thomas Fork	Present	11.2				X	X	X		X
		Thomas Fork Bear River	Wood Canyon	Unknown									
		Bischoff Canyon	Unnamed 25	Unknown									
	Thomas Fork-Dry Cr.	Dry Cr.	Dip Cr.	Unknown									
		Bischoff Canyon	Dry Cr.	Unknown									
		Thomas Fork Bear River	Dry Cr.	Present	11.8					X*			X
		Thomas Fork Bear River	Salt Cr.	Present	0.8								
		Bear River	Thomas Fork	Present	11.5				X	X	X		X
		Dry Cr.	Unnamed 32	Unknown									
	Thomas Fork-Raymond Cr.	Thomas Fork Bear River	Raymond Cr.	Unknown									

Table 3. Continued.

	HUC12 Name	Parent stream	Stream name	BCT status	Total occupied (km)	RBT present	BKT present	BNT present	Other spp	BCT stocked	BKT stocked	BNT stocked	RBT stocked
Nounan	Alexander Reservoir	Great Salt Lake	Bear River	Present	6.3	X		X	X	X*	X	X	X
	Bailey Creek-Bear River	Bear River	Bailey Cr.	Present	8.1		X			X			
		Great Salt Lake	Bear River	Present	16.5	X		X	X	X*	X	X	X
		Sulphur Canyon	South Sulphur Canyon	Unknown									
		Bear River	Sulphur Canyon	Unknown									
		South Sulphur Canyon	Unnamed 67	Unknown									
		Bear River	Unnamed 81	Unknown									
		Bear River	Unnamed 82	Unknown									
	Bear Hollow-Bear River	Great Salt Lake	Bear River	Present	26.9	X		X	X	X	X	X	X
		Bear River	Ovid Cr.	Present	4.5			X	X	X*			X
	Bennington Hollow-Bear River	Great Salt Lake	Bear River	Present	9.8	X		X	X	X*	X	X	X
		Bear River	Sheep Hollow	Unknown									
	Big Canyon-Bear River	Great Salt Lake	Bear River	Present	11.1	X		X	X	X*	X	X	X
		Stauffer Cr.	Skinner Cr.	Present	7.5					X*			X
	Bloomington Cr.	Bear Lake Outlet	Bloomington Cr.	Unknown		X	X			X*	X		X
		North Fork Bloomington Cr.	Middle Fork Bloomington Cr.	Unknown									
		Bloomington Cr.	North Fork Bloomington Cr.	Unknown									
		Bloomington Cr.	South Fork Bloomington Cr.	Unknown									
	Eightmile Cr.	Bear River	Eightmile Cr.	Present	24.8	X	X			X	X		X
		Eightmile Cr.	Unnamed 64	Unknown									
	Lower Georgetown Cr.	Bear River	Georgetown Cr.	Present	6.4	X	X	X	X	X*	X		X
		Georgetown Canyon	Left Hand Fork Georgetown Canyon	Unknown						X	X		
		Georgetown Canyon	Right Hand Fork Georgetown Canyon	Unknown									
	Lower Montpelier Cr.	Montpelier Cr.	Home Canyon	Present	1.9	X		X					
		Montpelier Canyon	Montpelier Canyon	Unknown									
		Bear River	Montpelier Cr.	Present	3.6	X	X	X	X	X	X		X

Table 3. Continued.

	HUC12 Name	Parent stream	Stream name	BCT status	Total occupied (km)	RBT present	BKT present	BNT present	Other spp	BCT stocked	BKT stocked	BNT stocked	RBT stocked
Nounan	Mill Cr.	Mill Cr.	Liberty Cr.	Unknown							X		X
		Liberty Cr.	Mahogany Basin Spring Cr.	Unknown									
		Ovid Cr.	Mill Cr.	Present	11.9		X			X	X		X
		Mill Cr.	The Dell	Unknown									
		The Dell	Unnamed 79	Unknown									
	North Cr.	North Cr.	Copenhagen Canyon	Unknown									
		North Cr.	Emigration Cr.	Present	7.1								
		North Cr.	Meadow Cr.	Unknown									
		North Cr.	Mill Hollow	Unknown									
		Ovid Cr.	North Cr.	Present	19.6		X			X*	X		X
		Snyder Cr.	Pole Canyon	Unknown									
		North Cr.	Sago Hollow	Unknown									
		North Cr.	Snyder Cr.	Unknown									
		North Cr.	Unnamed 53	Unknown									
		North Cr.	Unnamed 54	Unknown									
		North Cr.	Unnamed 55	Unknown									
		Unnamed 55	Unnamed 56	Unknown									
		Unnamed 55	Unnamed 57	Unknown									
		North Cr.	Unnamed 58	Unknown									
		Emigration Cr.	Unnamed 72	Unknown									
	Ovid Cr.	Ovid Cr.	Hammond Cr.	Unknown									
		Bear River	Ovid Cr.	Present	19.7			X	X	X*			X
		Ovid Cr.	Unnamed 47	Unknown									
		Ovid Cr.	Unnamed 48	Unknown									
		Hammond Cr.	Unnamed 59	Unknown									
		Unnamed 59	Unnamed 59 sic	Unknown									
		Unnamed 59	Unnamed 78	Unknown									
	Paris Cr.	Bear Lake Outlet	Paris Cr.	Present	14.9	X	X			X*	X		X
		Paris Cr.	Sleight Cr.	Unknown									
		Paris Cr.	Unnamed 65	Present	0.9								

Table 3. Continued.

	HUC12 Name	Parent stream	Stream name	BCT status	Total occupied (km)	RBT present	BKT present	BNT present	Other spp	BCT stocked	BKT stocked	BNT stocked	RBT stocked
Nounan	Pearl Creek-Bear River	Great Salt Lake	Bear River	Present	2.5		X			X			X
		North Pearl Cr.	North Pearl Cr. sic	Present									
		Pearl Cr.	North Pearl Cr.	Present	4.6		X						X
		Skinner Cr.	North Skinner Cr.	Present	3.3								
		Bear River	Pearl Cr	Present	9.2		X			X			X
		Stauffer Cr.	Skinner Cr.	Present	3.6					X*			X
		Skinner Cr.	South Skinner Cr.	Present	2.6								
		North Skinner Cr.	Unnamed 47	Unknown									
		North Skinner Cr.	Unnamed 77	Unknown									
	Sleight Canyon-Outlet Bear Lake	Bear River	Bear Lake Outlet	Present	7.3								
		Bear Lake Outlet	Paris Cr.	Present	4.4	X	X			X*	X		X
		Paris Cr.	Sleight Cr.	Unknown									
	Soda Cr.	Soda Cr	Mammoth Spring	Unknown									
		Bear River	Soda Cr.	Unknown						X*	X		X
	Stauffer Cr.	Stauffer Cr.	Beaver Cr.	Unknown									
		Stauffer Cr.	Co-Op Cr.	Present	11.5								
		Stauffer Cr.	Fern Cr.	Present	3.5								
		Stauffer Cr.	North Stauffer Cr.	Present	5.9								
		Stauffer Cr.	Nounan Canal	Present	4.7								
		Stauffer Cr.	South Stauffer Cr.	Present	4.3								
		Stauffer Cr.	Spring Cr.	Unknown									
		Bear River	Stauffer Cr.	Present	16.1					X*			X
	Threemile Creek-Bear River	Great Salt Lake	Bear River	Present	10.8	X		X	X	X	X	X	X
	Trail Creek-Bear River	Great Salt Lake	Bear River	Present	15.9	X		X	X	X	X	X	X
	Upper Georgetown Cr.	Bear River	Georgetown Cr.	Present	14.1	X	X	X	X	X*	X		X
		Georgetown C.r	Lateral Canyon	Unknown									

Table 3. Continued.

	HUC12 Name	Parent stream	Stream name	BCT status	Total occupied (km)	RBT present	BKT present	BNT present	Other spp	BCT stocked	BKT stocked	BNT stocked	RBT stocked
Nounan	Upper Montpelier Cr.	Montpelier Cr.	Little Beaver Cr.	Unknown						X*			X
		Bear River	Montpelier Cr.	Present	9.2		X	X			X	X	X
		Montpelier Cr.	Snowslide Canyon	Present	1.6						X		X
		Montpelier Cr.	Whiskey Cr.	Present	4.8	X	X			X			X
		Whiskey Cr.		Unknown									
		Snowslide Canyon	Unnamed 60	Present	1.9								
		Whiskey Cr.	Unnamed 61	Unknown									
		Whiskey Cr.	Unnamed 62	Unknown									
		Unnamed 62	Unnamed 63	Unknown									
		Whiskey Cr.	Unnamed 68	Unknown									
		Little Beaver Cr.	Unnamed 69	Unknown									
		Little Beaver Cr.	Unnamed 70	Unknown									
		Unnamed 70	Unnamed 71	Unknown	Total								
Thatcher	China Hill	Bear River	Harris Spring	Restored	4.5					X			
		Harris Spring	Unnamed 118	Unknown									
	Densmore Cr.	Densmore Cr.	Caribou Cr.	Restored	11.4					X			
		Densmore Cr.	Cottonwood Cr. (Little)	Extirpated									
		Bear River	Densmore Cr.	Unknown						X			
		Densmore Cr.	Unnamed 96	Unknown									
	King Creek-Bear River	Bear River	Alder Cr.	Restored	9.2					X			
		Great Salt Lake	Bear River	Present	21.5	X		X	X	X	X	X	X
		Bear River	Burton Cr.	Extirpated									
		Bear River	Dry Cr.	Present	3.5								
		Bear River	King Cr.	Present	8.7								
		Bear River	Smith Cr.	Present	3.6								
		Bear River	Whiskey Cr.	Restored	4.4	X	X			X			X
		Bear River	Unnamed 84 (Steves Cr.)	Present	1.7								
		Unnamed 84	Unnamed 95 (NF Steves Cr.)	Present	8.2								
		Burton Cr.	Unnamed 97	Unknown									
		Unnamed 97	Unnamed 98	Unknown									

Table 3. Continued.

	HUC12 Name	Parent stream	Stream name	BCT status	Total occupied (km)	RBT present	BKT present	BNT present	Other spp	BCT stocked	BKT stocked	BNT stocked	RBT stocked
Thatcher	King Creek-Bear River	Alder Cr.	Unnamed 126	Unknown									
		Unnamed 97	Unnamed 128	Unknown									
		Burton Cr.	Unnamed 130	Unknown									
		Burton Cr.	Unnamed 137	Unknown									
	Lower Cottonwood Cr.	Bear River	Cottonwood Cr.	Present	9.4	X	X			X	X	X	X
	McPherson Canyon-Bear River	Great Salt Lake	Bear River	Present	17.1	X		X	X	X	X	X	X
		Bear River	Kackley Spring	Restored	2.6					X		X	
	Middle Cotton-wood Cr.	Bear River	Cottonwood Cr.	Present	14.3	X	X			X	X	X	X
		Shingle Cr.	Divide Cr.	Unknown									
		Cottonwood Cr.	Shingle Cr.	Present	8.2					X*			X
		Shingle Cr.	Spring Cr.	Unknown									
	Spring Creek-Bear River	Great Salt Lake	Bear River	Present	12.1	X		X	X	X	X	X	X
		Bear River	Hoopes Cr.	Present	4.1								
		Hoopes Cr.	North Hoopes Cr.	Present	1.3								
		Bear River	Unnamed 106	Unknown									
		Bear River	Unnamed 122	Unknown									
	Station Creek-Bear River	Great Salt Lake	Bear River	Present	7.8	X		X	X	X	X	X	X
	Trout Cr.	Bear River	Trout Cr.	Restored	28.4		X			X			X
		Trout Cr.	Unnamed Stream	Present	0.8								
	Upper Cottonwood Cr.	Cottonwood Cr.	Blue Cr.	Present	1.3								
		Cottonwood Cr.	Bullwhacker Canyon	Present	0.2								
		Bear River	Cottonwood Cr.	Present	15.9	X	X			X	X	X	X
		Cottonwood Cr.	Hog Wallow	Unknown									
		Cottonwood Cr.	Jacobson Cr.	Present	5.9								
		Cottonwood Cr.	Mill Canyon	Present	0.1								
		Cottonwood Cr.	Right Fork Cottonwood Cr.	Present	1.9								
		Cottonwood Cr.	Time Spring	Unknown									
	Upper Cottonwood Cr.	Cottonwood Cr.	Walker Gulch	Present	0.9								
		Walker Gulch	Unnamed 107	Unknown									
		Cottonwood Cr.	Unnamed 123	Unknown									
		Cottonwood Cr.	Unnamed 124	Unknown									
	Williams Creek	Bear River	Williams Cr	Present	5.7								

Table 3. Continued.

	HUC12 Name	Parent stream	Stream name	BCT status	Total occupied (km)	RBT present	BKT present	BNT present	Other spp	BCT stocked	BKT stocked	BNT stocked	RBT stocked
Riverdale	Beaver Cr.	Logan River	Beaver Cr.	Present	11.1		X				X		
		Beaver Cr.	Unnamed Stream	Present	0.5								
	Black Canyon	Weston Cr.	Black Canyon	Unknown									
		Bear River	Weston Cr	Unknown									
		Black Canyon	Unnamed 103	Unknown									
	Fivemile Creek-Bear River	Great Salt Lake	Bear River	Present	21.1	X		X	X	X	X	X	X
		Bear River	Fivemile Cr.	Unknown									
		Fivemile Cr.	Unnamed 105	Unknown									
		Bear River	Unnamed 134	Unknown									
		Bear River		Unknown									
	Hells Kitchen Canyon-Logan River	Logan River	Boss Canyon	Present	3.3								
		Logan River	Corral Hollow	Present	1.2								
		Logan River	Hodge Nibley Cr.	Present	2.9								
		Bear River	Logan River	Present	4.7								
		Logan River	White Canyon	Present	5.6								
		White Canyon	Unnamed 139	Present	0.9								
		Boss Canyon	Unnamed 140	Present	0.5								
	Lower Battle Cr.	Bear River	Battle Cr.	Unknown									
	Lower Mink Cr.	Mink Cr.	Birch Cr.	Present	7.9								
		Birch Cr.	Mill Canyon	Unknown									
		Bear River	Mink Cr.	Present	8.9			X		X*	X		X
		Birch Cr.	Unnamed 87	Unknown									
		Birch Cr.	Unnamed 121	Unknown									
	Maple Cr.	Maple Cr.	Crooked Cr.	Unknown									
		Maple Cr.	Deep Cr.	Unknown									
		Cub Cr.	Maple Cr.	Present	13.2	X		X		X*	X		X

Table 3. Continued.

	HUC12 Name	Parent stream	Stream name	BCT status	Total occupied (km)	RBT present	BKT present	BNT present	Other spp	BCT stocked	BKT stocked	BNT stocked	RBT stocked
Riverdale	Middle Cub River	Bear River	Cub River	Present	17.9	X	X	X		X	X		X
		Cub Cr.	Foster Cr.	Present	3.3								
		Sugar Cr.	Sawmill Spring	Unknown									
		Cub Cr.	Sugar Cr.	Present	8.0								
	Oxford Slough-Deep Creek	Bear River	Deep Cr.	Unknown									X
		Oxford Slough	Oxford Cr.	Unknown									
		Swan Lake Cr.	Stockton Cr.	Present	4.9								
	Pullum Hollow-Bear River	Great Salt Lake	Bear River	Present	0.3	X		X	X	X	X	X	X
	Spring Cr.	Cub River	Spring Cr.	Unknown									
	Squaw Springs-Deep Cr.	Twin Lakes Canal	Clifton Cr.	Unknown							X		X
		Clifton Cr.	Unnamed 85	Unknown									
		Clifton Cr.	Unnamed 86	Unknown									
	Station Creek-Bear River	Great Salt Lake	Bear River	Present	34.7	X		X	X	X	X	X	X
		Bear River	Station Cr.	Present	4.6						X		X
	Stockton Cr.	Swan Lake Cr.	Stockton C.	Present	4.9								
	Strawberry Cr.	Unnamed Stream	Mill Hollow	Unknown									
		Mink Cr.	Strawberry Cr.	Unknown						X*			
	Swan Lake	Swan Lake Cr.	Gooseberry Cr.	Unknown									
	Upper Battle Cr.	Bear River	Battle Cr.	Unknown									
	Upper Cub River	Cub Cr.	Carter Cr.	Unknown									
		Bear River	Cub River	Present	13.6	X	X	X		X	X		X
		Cub River	Hillyard Canyon	Unknown									
		Cub River	Self Help Hollow	Unknown									
	Upper Mink Cr.	Mink Cr.	Dry Cr.	Present	3.8								
		Bear River	Mink Cr.	Present	6.6		X				X		X
		Dry Cr.	South Fork Dry Cr.	Unknown									
	Weston Cr.	Bear River	Weston Cr.	Unknown						X*	X		X
		Weston Cr.	Unnamed 101	Unknown									
		Unnamed 101	Unnamed 136	Unknown									
	Middle Cub River	Bear River	Cub River	Present	7.0	X	X	X		X	X		X
		Cub River	Worm Cr.	Unknown						X*			
		Worm Cr.	Worm Cr. sic	Unknown									

Table 3. Continued.

	HUC12 Name	Parent stream	Stream name	BCT status	Total occupied (km)	RBT present	BKT present	BNT present	Other spp	BCT stocked	BKT stocked	BNT stocked	RBT stocked
Malad	Big Hollow-Malad River	Bear River	Malad River	Unknown					X	X*	X		X
	Brush Canyon-Malad River	Malad River	Burnett Canyon	Unknown									
		Malad River	Henderson Cr.	Unknown									
		Bear River	Malad River	Unknown									
		Malad River	Trail Cr.	Unknown									
	Dairy Cr.	Wright Cr.	Dairy Cr.	Present	16.2					X*	X		X
		Dairy Cr.	Mine Canyon	Unknown									
	Daniels Reservoir	Malad River	Little Malad River	Present	4.3						X		X
	Elkhorn Creek-Little Malad River	Little Malad River	Bill Morgan Canyon	Unknown									
		Little Malad River	Elkhorn Cr.	Extirpated									X
		Malad River	Little Malad River	Unknown						X*	X		X
	Kents Canyon-Little Malad River	Malad River	Little Malad River	Unknown									
	Lower Deep Cr.	Malad River	Deep Cr.	Present	14.9	X	X			X*			X
		Deep Creek	Twomile Cr.	Extirpated									
	Lower Devil Cr.	Devil Cr.	Davis Cr.	Unknown						X*			
		Malad River	Devil Cr.	Unknown		X	X			X*	X		X
		Devil Cr.	Evans Cr.	Unknown									
		Devil Cr.	Rattlesnake Cr.	Unknown									
		Devil Cr.	Spring Cr.	Unknown									
	North Canyon	Malad River	North Canyon	Unknown									
	North Canyon-Malad River	Bear River	Malad River	Unknown					X	X*	X		X
	Samaria Creek-Malad River	Bear River	Malad River	Unknown					X	X*	X		X
		Malad River	Samaria Cr.	Unknown									
	Stone Reservoir-Deep Cr.	Great Salt Lake	Deep Cr.	Extirpated									

Table 3. Continued.

	HUC12 Name	Parent stream	Stream name	BCT status	Total occupied (km)	RBT present	BKT present	BNT present	Other spp	BCT stocked	BKT stocked	BNT stocked	RBT stocked
Malad	Upper Deep Cr.	Malad River	Deep Cr.	Present	9.2	X	X			X	X		X
		Deep Cr.		Unknown									
		Deep Cr.	First Cr.	Present	6.9		X			X*			X
		Deep Cr.	Second Cr.	Present	8.6					X*			X
	Upper Deep Cr.	Deep Cr.	Third Cr.	Present	7.5					X*			X
		Unnamed 144	Unnamed 143	Unknown									
		Deep Cr.	Unnamed 144	Unknown									
	Upper Devil Cr.	Devil Cr.	Campbell Cr.	Unknown									
		Malad River	Devil Cr.	Present	5.7	X	X			X*	X		X
		Devil Cr.	New Canyon Cr.	Unknown									
	Wright Cr.	Reed Canyon	Cliff Canyon	Unknown									
		Wright Cr.	Farmers Canyon	Unknown									
		Wright Cr.	Indian Mill Cr.	Unknown									X
		Wright Cr.	Reed Canyon	Unknown									
		Wright Cr.	Tom Perry Canyon	Unknown									
		Little Malad River	Wright Cr.	Present	19.1						X		X
		Cliff Canyon	Unnamed 146	Unknown									
Dam Complex	McPherson Canyon-Bear River	Great Salt Lake	Bear River	Present	8.2	X		X	X			X	X

Identifying Bonneville Cutthroat Trout Hybrids in Streams by Phenotype

Common goals in many Cutthroat Trout conservation and management plans include identifying pure Cutthroat Trout populations in order to protect them from future introgression, and reducing introgression in Cutthroat Trout populations that are already hybridized by culling Rainbow Trout and hybrids. When categorizing Cutthroat Trout populations as pure or hybridized, or culling Rainbow Trout and hybrids from introgressed populations, it is currently impractical to determine genotype in the field. For example, weirs are often operated on spawning tributaries, where Cutthroat Trout are allowed to pass while Rainbow Trout and hybrids are culled (High 2010). In other instances, Rainbow Trout and hybrids are gradually culled from streams via repeated electrofishing passes (Meyer et al. 2017a) or by requiring anglers to cull any Rainbow Trout or hybrid that they catch (Heim et al. 2020), or incentivizing their harvest with rewards. In such instances, it is impractical to hold each captured Cutthroat Trout until genetic analyses are completed to identify hybridization and inform culling decisions. Likewise, for broad-scale status assessments (e.g., Meyer et al. 2006), genetic assessments of several locations within each population to draw conclusions about the purity of populations within individual rivers or entire drainages can be quite costly (Della Croce et al. 2016).

Simple visual characteristics such as spotting patterns and body coloration may be used to separate Bonneville Cutthroat Trout from Rainbow Trout and hybrids with >90% phenotypic accuracy, as has also been demonstrated for Westslope Cutthroat Trout (Robinson 2007) and Yellowstone Cutthroat Trout (Meyer et al. 2017b; Heim et al. 2020). Though any phenotypically based classification of Bonneville Cutthroat Trout individuals or populations will result in some level of error, the high degree of concordance between phenotype and genotype strengthens the conclusions that may be drawn regarding Cutthroat Trout purity in streams where genetic results are currently lacking or dated. The most useful phenotypic traits for separating Bonneville Cutthroat Trout from hybrids were: fish having no white on the leading tip of the pelvic fin, fewer than seven spots on the top of the head, and a prominent throat slash. The ability to visually detect admixture in hybrids was related to admixture level, with logistic regression model results predicting that biologists were more than 50% likely to visually detect O. mykiss admixture (based on phenotype traits) when the level of introgression in a fish was greater than 18% (Meyer, *unpublished data*).

Strategies to Reduce Impact of Non-native Fishes

Non-native fishes, especially Rainbow Trout and Brook Trout, are serious threats to Bonneville Cutthroat Trout conservation. Accordingly, there is a strong desire to remove non-natives fishes where they co-occur with Bonneville Cutthroat Trout. IDFG will attempt to balance the need for increasing the persistence and expanding the range of Bonneville Cutthroat Trout with the desire of anglers to maintain what may be locally important non-native trout fisheries. IDFG will assess and implement methods to reduce risk, and control or remove undesirable fish species where they pose substantial risks or can benefit the long term persistence and survival of Bonneville Cutthroat Trout.

Non-native fish control may be accomplished by a variety of options including chemical, physical, and biological methods. Decisions on whether to implement non-native fish removal projects will be based on a variety of factors such as probability of extirpation of the non-native species (i.e. success), habitat quality, and presence of barriers to prevent recolonization, the level of hybridization in the population, and angler and community support. Additionally, control actions should be implemented where population-level responses are expected, following successful control actions. Additionally, non-native fish removal projects should be prioritized in habitats that are most likely to provide cold-water refugia under future climate scenarios, as presented above in the Temperature / Climate Change section (see Isaak et al. 2015).

Bonneville Cutthroat Trout with "resident" life history. CCBY IDAHO FISH AND GAME

Chemical Treatment

The use of piscicide (i.e. fish toxicants such as rotenone) to reduce or remove non-native fish is an appropriate management strategy in some situations. Prior to piscicide applications, IDFG will conduct public outreach and consult with local officials and other state and federal agencies as appropriate (IDFG 2019). The IDFG 2019-2024 Fisheries Management Plan identifies some potential opportunities for piscicide treatment to help meet Bonneville Cutthroat Trout conservation goals. One of those is St. Charles Creek, where chemical and physical removal of Brook and Rainbow trout is identified as a strategy to increase Bonneville Cutthroat Trout populations.

Physical Removal

Physical removal methods to control undesirable species may not be as effective as piscicide treatment, but may be considered if conditions are conducive to successful implementation. Physical removal methods may include mechanical removal by electrofishing or netting, and dewatering and installing barriers to prevent fish movement and recolonization. Physical removal of non-native fishes may require multiple removals over several years (i.e. long-term commitment). Physical removal of non-native trout is sometimes ineffective as it is extremely difficult to remove all target individuals, except in small streams that lack complexity. Physical removal may be used to selectively remove hybrids and reduce the probability of hybridization over time.

Barrier Installation

Barrier installation may be considered to protect Bonneville Cutthroat Trout from invasion, or as interim structures to facilitate removing non-native species. Installing permanent physical barriers would require careful consideration of the tradeoffs between isolation and the threat of invasion by non-native species. Additionally, IDFG staff will work with the Idaho Fish and Game Commission to liberalize fishing regulations to encourage the harvest of non-native species where appropriate to help meet Bonneville Cutthroat Trout conservation goals.

Biological – YY Fish

Biological control may be a viable option for removing or reducing non-native species. Recent advancement in the development of hatchery-produced YY male fish, specifically Brook Trout, offer a potential biological control option in the future. In short, release of YY male fish in sufficient numbers for multiple generations leads to a gradual shift in a population's sex ratio towards more males as all offspring from YY males are male. Population modeling exercises indicate that releasing YY male fish for several consecutive years has the potential to extirpate isolated populations of non-native species. Techniques for rearing production-levels of YY Brook Trout have been developed and field-based research efforts to test efficacy are underway in several Idaho waters. Final results will be unavailable for several years. Currently, there are no plans to release YY Brook Trout or other YY species within the Idaho portion of Bonneville Cutthroat Trout range, though positive research findings would likely lead to implementation.

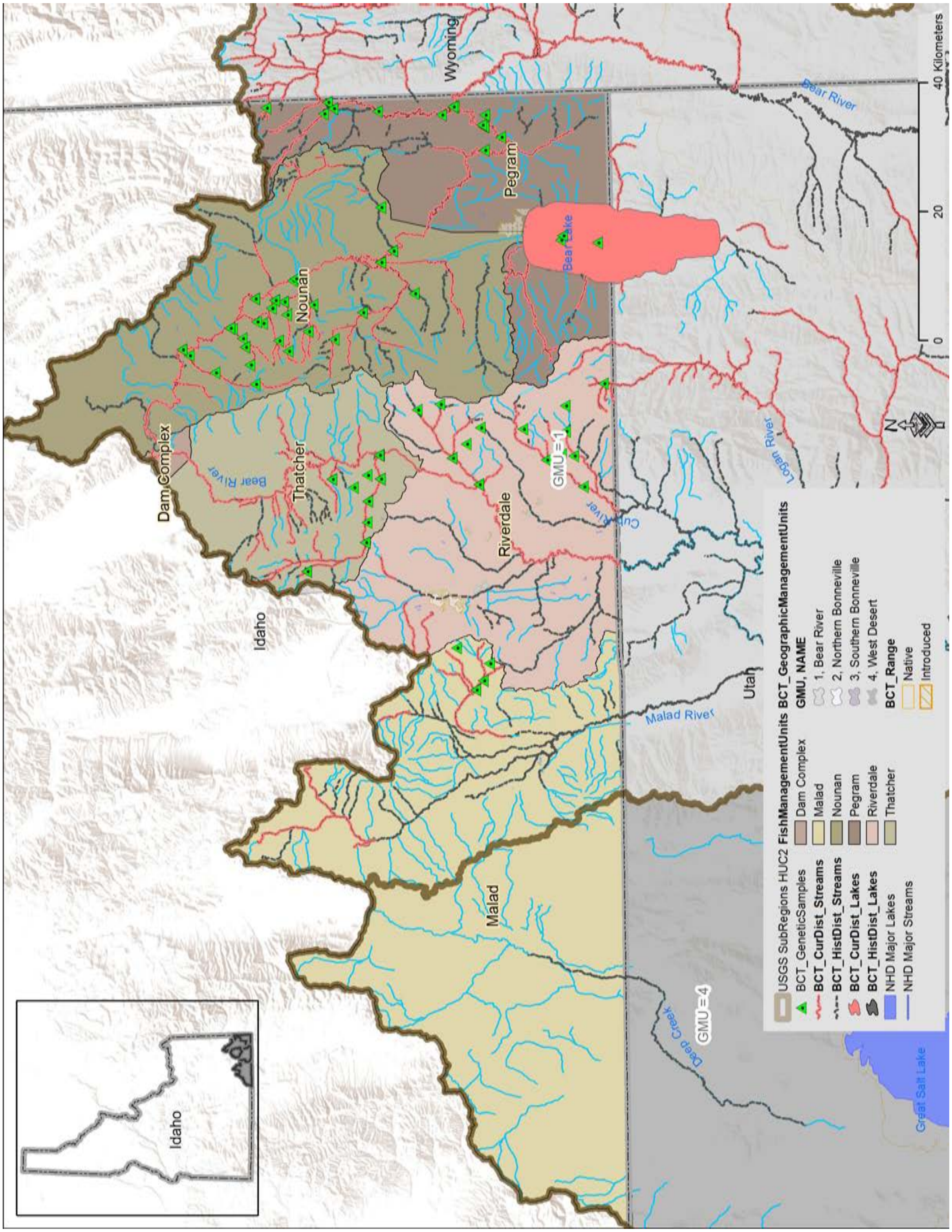


Figure 9. Distribution of genetic samples collected in each of the Management Units (MUs).

Table 4. The location of genetic samples collected from Bear and Malad river tributaries. The numbers of Rainbow Trout (RBT) hybrids and percent introgression values are provided.

Water Body	Pedigree	Latitude	Longitude	Sample year	N	Cutthroat Trout-like	Rainbow Trout-like	F1 hybrid	>F1 hybrid	% hybridization	% RBT introgression
Pegram MU											
Bear Lake	OcIBERL98C	42.06617	-111.31741	1998	35	35			0	0%	0%
Bear Lake	OcIBERL03C	42.32063	-111.35712	2003	26	25		1	0	4%	0%
Bear River	OcIBRSL05C	42.44028	-111.38314	2005	55	54	1		0	0%	0%
Bear River	OcIBRSL-05C_1N	42.49785	-111.41828	2005	11	10	1		0	0%	0%
Bear River	OcIBRSL-05C_1P	42.17045	-111.10866	2005	23	23			0	0%	0%
Bear River	OcIBRSL06C	42.17366	-111.10538	2006	48	48			0	0%	0%
Coantag Cr.	OcICOAN04C	42.36494	-110.76294	2004	36	36			0	0%	0%
Co-op Cr.	OcICOOP01C	42.45734	-111.42526	2001	10	10			0	0%	0%
Hobble Cr.	OcIHOBL03Ca	42.44551	-110.78029	2003	50	50			0	0%	0%
Hobble Cr.	OcIHOBL03Cb	42.44551	-110.78029	2003	23	23			0	0%	0%
Thomas Fork Bear River	OcITOFK99C_1	42.2133	-111.07029	1999	16	16			0	0%	0%
Thomas Fork Bear River	OcITOFK04C	42.21116	-111.06968	2004	37	37			0	0%	0%
Montpelier Cr.	OcIMONT05C	42.30377	-111.33587	2005	30	25	1		4	13%	2%
Preuss Cr.	OcIPREU03C	42.3799	-111.06509	2003	5	5			0	0%	0%
Giraffe Cr.	OcIGIRF03C	42.44587	-111.01637	2003	9	9			0	0%	0%
Swan Cr. (Utah)	MixSWAN04C	41.98636	-111.42035	2004	24	16	3	1	4	21%	14%
Nounan MU											
Eightmile Cr.	MixEMBR01C	42.60168	-111.50924	2001	21	3	18		0	0%	0%
Eightmile Cr.	OcIEMBR03C	42.60168	-111.50924	2003	5	5			0	0%	0%
Eightmile Cr.	OcIEMBR05C	42.60168	-111.50924	2005	2	2			0	0%	0%
Pearl Cr.	OcIPRLC01C	42.53401	-111.47149	2001	5	4			1	20%	2%
Pearl Cr.	OcIPRLC03C	42.53401	-111.47149	2003	7	7			0	0%	0%
North Pearl Cr.	OcINPRL01C	42.51315	-111.50812	2001	6	6			0	0%	0%
Skinner Cr.	OcISKNR01C	42.4697	-111.4223	2001	12	12			0	0%	0%

Water Body	Pedigree	Latitude	Longitude	Sample year	N	Cutthroat Trout-like	Rainbow Trout-like	F1 hybrid	>F1 hybrid	% hybridization	% RBT introgression
Nounan MU											
Skinner Cr.	OclSKNR03C	42.4697	-111.4223	2003	10	10			0	0%	0%
North Cr.	OclNORC01C	42.34814	-111.44928	2001	8	5			3	38%	3%
North Stauffer Cr.	OclNSTA01C	42.42455	-111.48239	2001	1	1			0	0%	0%
Thatcher MU											
Cottonwood Cr.	OclCOTB14C	42.34752	-111.80459	2014	213	208			5	2%	0%
Cottonwood Cr.	OclCOTB15C	42.35289	-111.88183	2015	207	201			6	3%	0%
Cottonwood Cr.	OclCOTB16C	42.35289	-111.88183	2016	158	152			6	4%	0%
Cottonwood Cr.	OclCOTB03Ca	42.33004	-111.7631	2003	13	11			2	15%	1%
Cottonwood Cr.	OclCOTB03Cb	42.33004	-111.7631	2003	8	6			2	25%	2%
Cottonwood Cr.	OclCOTB05C	42.3306	-111.71839	2005	20	15			5	25%	2%
Cove Cr.	HybCOVS19C	42.51895	-111.79429	2019	52			2	50	100%	68%
Hoopes Cr.	OclHOOP05C	42.39724	-111.76177	2005	16	16			0	0%	0%
Kackley Cr.	OclKACK20C	42.53313	-111.79239	2020	100	41	11	13	35	48%	24%
Shingle Cr.	OclSHNG16C	42.43563	-111.93384	2016	57	57			0	0%	0%
Riverdale MU											
Cub River	OclCUBR03C	41.89798	-111.87911	2003	35	35			0	0%	0%
Foster Cr.	OclFOST01C	42.09783	-111.73629	2001	2	2			0	0%	0%
Maple Cr.	OclMAPC01C	42.00027	-111.80031	2001	26	26			0	0%	0%
Maple Cr.	OclMAPC03C	42.00027	-111.80031	2003	15	15			0	0%	0%
Sugar Cr.	OclSUCB01C	42.07955	-111.74922	2001	24	24			0	0%	0%
Logan River	OclLOGN03C	41.74131	-111.95467	2003	22	22			0	0%	0%
Mink Cr.	OclMINK05C	42.19292	-111.77848	2005	28	24			4	14%	1%
Birch Cr.	OclBRCH03C	42.22912	-111.72759	2003	6	5			1	17%	1%
Dry Cr.	OclDCTF00C	42.38754	-111.05296	2000	20	19			1	5%	0%
Malad MU											
Second Cr.	OclSECD00C	42.20365	-112.16399	2000	4	3		1	0	25%	0%
Third Cr.	OclTHRD00C	42.19303	-112.14705	2000	3	3			0	0%	0%

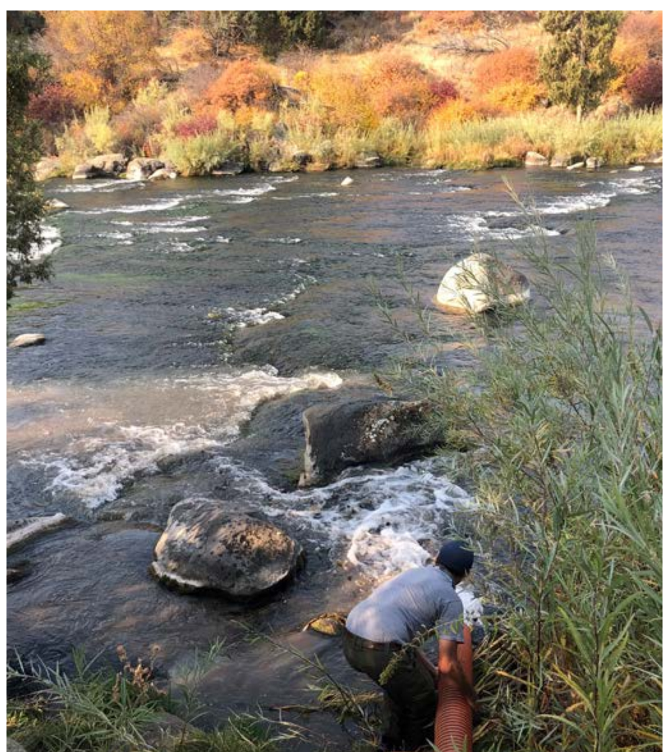
Contemporary Stocking Policies and Restoring Angling Opportunity

The primary fish management objectives of the IDFG are to conserve native fish populations and provide recreational fishing opportunities for a diverse angling constituency. The IDFG 2019-2024 Fisheries Management Plan states that "wild native populations of resident and anadromous fish species will receive priority consideration in management decisions" (IDFG 2019). In some waters where habitat remains in good condition, native fish populations meet both these needs. In those waters, IDFG conserves and manages those native fish populations with appropriate fishing seasons and harvest regulations. However, in areas where habitat is no longer capable of supporting abundant native fish populations and rehabilitating the habitat to support native species is not feasible, IDFG may provide sport fisheries with non-native fish.

When stocking hatchery trout, the IDFG 2019-2024 Fisheries Management Plan includes established policies to reduce negative effects to native trout populations (IDFG 2019). These hatchery trout stocking policies are applied broadly across the Bonneville Cutthroat Trout distribution as well. When stocking Rainbow Trout to meet fish management goals, the Department will only stock sterile (triploid) hatchery Rainbow Trout within the range of Bonneville Cutthroat Trout to reduce genetic risks and prevent any further establishment of self-sustaining Rainbow Trout populations. Hatchery Rainbow Trout stocking in streams uses catchable-sized fish (mean TL 254 mm) to provide put-and-take fishing opportunity. These put-and-take stocking events are provide short-term fisheries, and are focused around popular access points to encourage angler catch and harvest of hatchery trout. The Department discontinued stocking Brook Trout statewide, with the exception of YY male trout used for population control (as mentioned above), and sterile Brook Trout for Henrys Lake and Deer Creek Reservoir. Liberal harvest regulations encourage anglers to harvest Brook Trout throughout the Bonneville Cutthroat Trout range within Idaho.

Currently low densities of Bonneville Cutthroat Trout in the Bear River does not meet angling demands necessitating continued stocking of sterile Rainbow Trout and management of non-native game fish. These activities will continue to provide angling opportunities in reaches where there is high demand for harvest and minimal effects to Bonneville Cutthroat Trout. Management of other non-native game fish species like Walleye, Brown Trout, and Smallmouth Bass will depend on existing habitat conditions, angler demands, and the IDFG objective to balance sport fishing needs with restoration of Bonneville Cutthroat Trout. Management direction will vary by river section and will continue to be evaluated as growing Bonneville Cutthroat Trout populations enhancement/restoration projects provide increased opportunity for angling.

Fisheries in small irrigation reservoirs are a common example where IDFG provides angling opportunity with non-native fish within the Bonneville Cutthroat Trout distribution. While many small reservoirs do not currently support Bonneville Cutthroat Trout, irrigation reservoirs in southeast Idaho do provide fisheries for hatchery Rainbow Trout and bass and panfish.



Bear River Stocking CCBY IDAHO FISH AND GAME

Many Bonneville Cutthroat Trout populations continue to thrive upstream of the reservoirs and most of the non-native fish (e.g., perch, bass, Bluegill, and crappie) that occupy reservoirs do not use streams and should not affect upstream populations of Bonneville Cutthroat Trout. Furthermore, there is a strong desire by some landowners to stock private ponds. Department staff will consider Bonneville Cutthroat Trout conservation needs when permitting private ponds, and consideration of allowable species.

Sources of Additional Mortality

Avian Predation

Avian Predation may be a challenge for Bonneville Cutthroat Trout conservation in the Bear River drainage, primarily in the Black Canyon reach of the Thatcher Management Unit. IDFG has visually confirmed Double Crested Cormorant *Phalacrocorax auritus* (DCC) use in the Bear River, and on the Bonneville Cutthroat Trout broodstock ponds. There is a DCC rookery on nearby Blackfoot Reservoir.

Avian predation rates on Yellowstone Cutthroat Trout (*Oncorhynchus clarkii bouvieri*) (YCT) have been monitored at the Blackfoot Reservoir rookery for a number of years. Monitoring is conducted by recovering YCT PIT tags that have been deposited at the rookery. Coincident to the YCT study, IDFG tagged Bonneville Cutthroat Trout for an entrainment study on the lower end of the Black Canyon on the Bear River. During the YCT study 30% of the PIT tags implanted into Bonneville Cutthroat Trout as part of the entrainment study were recovered from the rookery at Blackfoot Reservoir. Bonneville Cutthroat Trout are now stocked in the fall of each year following migration away from the area. This enables the hatchery fish to reach a larger size and adequately disperse before Double Crested Cormorant return the following spring.

Sport Fishing

In Idaho, all of the native Cutthroat Trout subspecies, including Bonneville Cutthroat Trout, provide important recreational fisheries. The IDFG maintains dual management goals for native species that include conservation and maintaining recreational fishing opportunities. Maintaining fisheries -including harvest opportunity- is thought to be important for bolstering support for the subspecies and conservation programs designed to increase abundances. To meet those goals, IDFG offers recreational angling for native Cutthroat Trout but under relatively restrictive harvest regulations. As of the drafting of this plan, no harvest of Cutthroat Trout (i.e., catch-and-release only) is allowed in any portion of the Bear River and its tributaries in Idaho. This regulation has been in place since 2013. Bear Lake angling regulations resumed wild-origin Bonneville Cutthroat Trout harvest in 2022 with a 2-fish daily bag limit. This harvest opportunity follows substantial investment in habitat restoration and stream connectivity efforts. These efforts led to increased production of wild-origin Bonneville Cutthroat Trout, and population modeling indicated harvest of wild- or hatchery-origin Bonneville Cutthroat Trout under the existing 2-trout limit would be sustainable (see Heller et al. 2022a). Therefore, for the first time in decades the harvest of wild Bonneville Cutthroat Trout in Bear Lake is now being allowed.

High-profile fisheries where angler catch rates of wild Bonneville Cutthroat Trout are probably highest include the Cub River and the Bear River tailrace immediately downstream of Oneida Dam. The Cub River is a popular fishery and supports a population of Bonneville Cutthroat Trout. While no creel data are available for the Cub River, observations made during the past (frequent angler observations and contacts) indicate relatively high angler use. Anglers have good access to Cub River from a county road that runs parallel to the river. Despite high use, current fishing regulations appear to be protecting the population from excessive harvest. Currently, the Cub River is managed with an exception that protects Bonneville Cutthroat Trout from harvest and encourages harvest of nonnative trout. The reach downstream of Oneida Dam is the most heavily fished portion of the Bear River in Idaho, with an estimated 7,000 anglers fishing 13,000 h in this reach during 2003.

Genetic Consideration in Management and Conservation

Conservation Population Tiers

The IDFG manages Bonneville Cutthroat Trout populations according to different conservation classifications, consistent with a multi-state position paper on genetic considerations concerning Cutthroat Trout management (UDWR 2000). This position paper indicates that Cutthroat Trout management includes two distinct but equally important components that must be addressed including a conservation element and the sport fishery element. Further, the position paper indicates that there are two components of Cutthroat Trout conservation: 1) preservation and management of genetically pure populations referred to as core conservation populations, and 2) conservation populations which may be slightly introgressed but maintain the appropriate phenotypic characters of the subspecies with unique ecological, behavioral, or genetic traits. "Core conservation populations" are defined as those indicating >99% genetic purity, while "conservation populations" are those with >90% genetic purity. Populations with <90% genetic purity are referred to as "sportfish populations."

The IDFG's primary management goal for core conservation populations (>99% genetic purity) is to facilitate the long-term persistence of Cutthroat Trout subspecies in a genetically pure condition. Core conservation populations will serve as the primary source of gametes for introductions and reintroductions through transplants and broodstock development, and will be comprised of individuals that have been determined to be >99% pure from a genetic standpoint, and phenotypically true to the subspecies. For range expansion purposes, the IDFG will take care to utilize only those populations that exhibit desirable population characteristics such as large population size, full representation of age classes, and successful annual reproduction. Potential management options related to conservation and preservation of core conservation populations may include: 1) prevention of all non-native fish stocking or alternatively the stocking of only sterile hatchery fish, 2) managing sport fishing and harvest, 3) removal or suppression of non-native competitors, 4) habitat restoration and enhancement, 5) removal of gametes and individuals for genetic founders in range expansion efforts, and 6) collection of gametes for broodstock development. To ensure the long-term persistence of core conservation populations, the IDFG will strive to maintain metapopulations. High quality habitat that maintains connectivity is an essential component contributing towards the viability and survival of native trout populations.

For conservation populations (>90% genetic purity), the primary management goal is to preserve and conserve unique ecological and behavioral characteristics of the subspecies that exist on a population-by-population basis. Conservation populations retain all of the phenotypic attributes associated with the subspecies, although they exist in a slightly introgressed condition. In general, conservation populations possess less than 10% non-native species alleles, but introgression may be greater or extend to a higher level (e.g., up to 20%) depending upon the management circumstances and the values and attributes to be preserved (UDWR 2000; USFWS 2003). The unique ecological, behavioral, and genetic attributes may include: 1) the presence of migratory life histories, 2) genetic predisposition for large size, and 3) ecological adaptations to unique or extreme environmental conditions. There is a high probability that certain of these attributes are genetically linked to some degree.

Potential management options for conservation populations are the same as for core conservation populations. Conservation populations may be considered as sources for introductions or reintroductions if the objective is to duplicate the unique genetic, ecological, or behavioral attributes. The long-term persistence of conservation populations will be enhanced by the development of metapopulations and optimizing habitat conditions. Management efforts may focus on conservation populations to shift their status to core conservation populations by eradicating existing fish and subsequent reintroduction or genetic replacement.

Sportfish populations are the third classification and management options focus on providing recreations benefit to the public rather than for conservation purposes. For the sake of Bonneville Cutthroat Trout management and conservation, the IDFG will refer to these populations as hybridized or introgressed. Hybridized populations may or may not meet the subspecies phenotypic expression defined by morphological and meristic characters of Cutthroat Trout.

The IDFG generally will require specific information on the genetic status of Bonneville Cutthroat Trout before designating populations as core conservation, conservation, or sportfish populations, and subsequently determining the appropriate management scenarios. When specific local genetic data are not available, the IDFG will err on the side of being conservative. For example, where a river basin had a past history of fish stocking with non-native salmonids that posed a hybridization risk, but where stocking has not occurred for many years and hybridization has not been documented, we may designate populations as a conservation population versus core conservation because of uncertainty. Population designations will be updated as genetic information becomes available.

Conservation Aquaculture Program

Within the last decade, the Department has developed a conservation aquaculture program to further efforts to conserve genetically distinct populations and to enhance fishing opportunities for Bonneville Cutthroat Trout within their native range. In large part, funding for this program originated from PacifiCorp's mitigation settlement. Initial funding was utilized primarily for building necessary infrastructure and subsequent funding has been directed towards operational costs. Operational procedures for this program are described in detail within a 2012 document titled, "*Development of a Bonneville Cutthroat Trout Broodstock Program in the Bear River, Idaho*". Here, we provide a brief review and update of this program and identify future challenges and opportunities.

The Bonneville Cutthroat Trout conservation aquaculture program mimics other hatchery-based fish breeding and rearing programs such as those developed for anadromous fishes (i.e., the Department's Sockeye Salmon program). At the core of this program is a desire to ensure that genetic integrity and diversity are maintained or improved. Accordingly, the program incorporates genetic testing of prospective broodstock to assess relatedness and diversity as well as to prevent introduction of non-native alleles.

In addition, broodstock and resultant progeny will be managed on a MU-level basis to the greatest extent possible (i.e., inter-MU stocking is discouraged). However, cross-MU stocking will be used, as needed, to meet reintroduction and conservation supplementation priorities throughout the drainage when MU-specific broodstock cannot be developed and translocation may not be feasible due to low abundance of parental stocks. In these scenarios, we will use a nearest-neighbor approach, capturing prospective broodstook from the nearest geographically adjacent and most genetically similar MU. Furthermore, broodstock are managed to avoid domestication, and only the offspring from wild-caught parents (i.e., F1s) are released, and broodstock are replaced annually.

Currently the program has focused on the Thatcher MU with broodstock being collected from Cottonwood Creek. Broodstock are then genetically screened before being released into adult holding ponds. Volitional migration into a trap on the inlet of the brood holding ponds allows for the efficient collection of eggs. However, under certain conditions (i.e., the presence of piscivorous birds), alternative brood collection methods, such as seining or angling, are utilized. For the 10-year period between 2011 and 2020, the number of female Bonneville Cutthroat Trout spawned annually ranged from 29 to 103 with an average of 55. A complete summary of egg-take and spawning activities is shown in Appendix C. After brood collection, samples are collected from female Bonneville

New BCT Brood Ponds CCBY IDAHO FISH AND GAME

Cutthroat Trout to test for *Renibacterium salmoninarum* (the causative agent of Bacterial Kidney Disease) which allows for subsequent culling of progeny from females with high bacterial loads. During the last 10 years, mean annual fecundity has ranged from 491 to 873 eggs/female with an overall mean of 695 eggs/female. Fertilized eggs are then transferred to Grace Fish Hatchery for subsequent hatching. Survival to the eye-up stage has been remarkably high for a wild Cutthroat Trout strain. For the same 10-year period, mean annual eye-up rate has ranged from 72% to 88% with an overall mean of 80%. Hatchlings are fed and reared for about 13-17 months and then they are released. The target length at release approximates 8" with releases occurring from April through October.

Stocking sites are selected to meet the goals of this program – to provide additional sportfishing opportunity – for Bonneville Cutthroat Trout in habitats with poor spawning and rearing conditions resulting in low densities of wild, catchable-sized Bonneville Cutthroat Trout. Additionally, this program aims to boost re-introduction efforts after habitats have been restored or non-native fish have been removed, to expand the range and improve status of Bonneville Cutthroat Trout in Idaho. From 2011 to 2020, slightly more than 200,000 catchable-sized Bonneville Cutthroat Trout have been stocked, all within the Thatcher MU (Table 5, Figure 10). Variable brood availability and survival have caused annual stocking numbers to range from 8,902 to 37,442 catchables. More than 60% of the total production has been stocked in the Bear River, whereas the remaining have been stocked in Alder, Caribou, Cottonwood, Densmore, Trout, and Whiskey creeks, as well as Harris and Kackley springs. Limited evaluation have indicated that stocked Bonneville Cutthroat Trout catchables persist and contribute to recreational fisheries. Complete stocking information for each brood year and stream is provided below in Appendix D.

Several challenges have affected this program's ability to meet management goals consistently. Initially utilized broodstock ponds possessed relatively poor water quality leading to fish health concerns. Development of new ponds, first utilized in 2018, with better water quality and other habitat conditions has substantially reduced the need to cull progeny due to high BKD loads. However, the water source for the new ponds exhibits high CO_2 concentrations which may lead to Nephrocalcinosis. Several methods to reduce CO_2 are being assessed. Furthermore, volitional brood collection via fish ladder ascension into a trap is only partially effective requiring hook-and-line capture of some portion of necessary brood. Staff will continue to assess methods to increase the proportion of brood captured with the ladder and trap. Double Crested Cormorants frequently utilize the pond and prey upon broodstock. Overhead net screens have been installed to dissuade Double Crested Cormorants use of the ponds. We will continue to evaluate opportunities to reduce predation and other forms of broodstock mortality to maximize egg take.

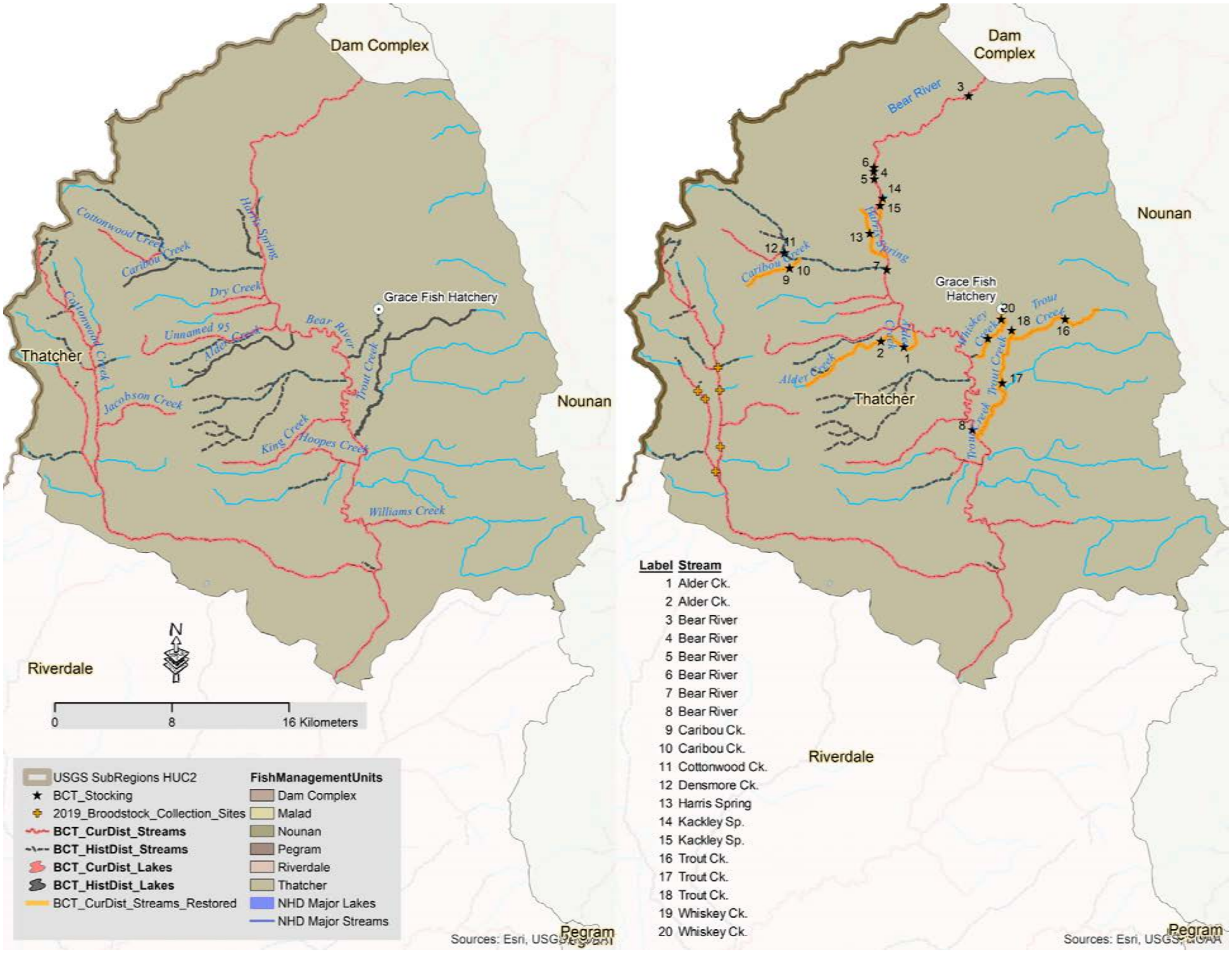


Figure 10. Map of the Thatcher MU of the Bear River illustrating Bonneville Cutthroat Trout distribution before the supplementation program stocking began (left) and current distribution (right) after supplementation, and associated stocking sites.

Table 5. Summary of Bonneville Cutthroat Trout conservation aquaculture stocking totals from 2011 to 2020. Detailed conservation aquaculture stocking records are presented in Appendix D.

Stream name	Total stocked
Alder Creek	2,819
Bear River	125,751
Caribou Creek	1,515
Cottonwood Creek	1,480
Densmore Creek	3,540
Harris Spring	5,136
Kackley Springs	18,407
Trout Creek	28,227
Whiskey Creek	15,276
Grand Total	**202,151**

Population Trends and Extinction Risk

Long-term monitoring suggests that Bonneville Cutthroat Trout occupancy and density are relatively stable in southeast Idaho though several factors must be considered before drawing a firm conclusion about current trends or long-term risks to extirpation. First, the sites selected for long-term monitoring are not random, and therefore may not accurately depict trends in the distribution or the density of Bonneville Cutthroat Trout and nonnative trout in Bear River and Bear Lake tributaries. Indeed, all long-term monitoring reaches were established where Bonneville Cutthroat Trout were known to be present; considering that native salmonids often occupy the last remaining quality stream habitat that has not already been invaded by nonnative salmonids, these reaches may give a false sense of optimism relative to other streams where Bonneville Cutthroat Trout have long been extirpated.

Management actions have been taken in several of these streams to benefit Cutthroat Trout and reduce nonnative trout, which may have produced an overly optimistic outcome regarding long-term trends in Bonneville Cutthroat Trout occupancy and density. Continuation of this long-term monitoring program is paramount, but surveying additional areas occupied by Bonneville Cutthroat Trout would help confirm or refute the more narrow conclusions that may be drawn from this trend monitoring program. Finally, the fact that the density of Bonneville Cutthroat Trout at these long-term monitoring sites was negatively related to the density of nonnative trout highlights the importance of any management actions designed to curtail the spread or abundance of nonnative trout throughout the Bear River drainage in Idaho.

Long-term trends in occupancy and abundance of Bonneville Cutthroat Trout and nonnative salmonids have been surveyed with backpack electrofishing multiple times during the last several decades. Currently, the Department samples a collection of 44 long-term monitoring sites spread across each of the MUs using single-pass or multi-pass electrofishing to estimate the abundance of trout (Table 6). For multi-pass depletions, trout abundance was estimated using the maximum likelihood model in the MicroFish software package (Van Deventer 1989). If no trout were captured on the second pass, we considered the catch on the first pass to be the estimated abundance. Using data from all multi-pass depletion surveys across all years (n = 128), we developed a linear relationship (with the origin through zero) between the numbers of trout captured in first passes and maximum-likelihood abundance estimates (F = 2877.3; P < 0.001 r^2 = 0.88). From this relationship, we then predicted trout abundance for surveys (n = 58) in which only a single removal pass was made (cf. Kruse et al. 1998). Because the length of age-0 fish was inconsistent across reaches and among species, at the trend monitoring reaches, fish <75 mm total length (TL) were not included in estimates of trout abundance. Rainbow trout and hybrids were clustered into one group for this analysis, and abundance was standardized to fish density/100 m^2 of stream surveyed.

To assess trends in density at individual sites, we used linear regression with sample year as the independent variable and loge transformations of trout density as the dependent variable. Because the natural logarithm is undefined for zero, we added 0.1 fish/100 m^2 to each estimate of density.

The slope of the regression line is equivalent to the intrinsic rate of change (*r*) for the population (Gerrodette 1987); this approach to monitoring trend assumes that the population changes in an exponential manner and that the rate of population change is constant over the sampling period. We generated point estimates of *r* at each of the sites sampled for any species detected in at least one of the surveys. Each point estimate of r was converted to an estimate of population growth rate (λ) by exponentiating *r*. We calculated an overall mean λ with 90% confidence intervals (CIs) for each species. Estimates of λ with 90% CIs that overlapped unity (i.e., 1.00) were assumed to be stable populations, whereas those populations with $\lambda < 1.00$ or > 1.00 were assumed to be declining or increasing in density, respectively. We used a significance level of $\alpha = 0.10$ for individual estimates and for the overall mean in order to increase the power of detecting trends in population density (Peterman 1990; Maxell 1999; Dauwalter et al. 2009).

A total of 184 backpack electrofishing estimates of trout population density were made from 1993 to 2020 at a subset of 34 trend monitoring sites located in 16 different Bear River tributaries occupied by Bonneville Cutthroat Trout (Table 6). These site are located across the Pegram, Nounan, Thatcher and Riverdale MUs and are depicted on those associated maps (Figures 9, 10, 12, and 13, respectively). Sites that were electrofished averaged 1,918 m in elevation (range 1,478 to 2,438 m), 2.3% in channel slope (0.1% to 5.6%), and 3.2 m in wetted width (0.9 to 8.1 m).

Bonneville Cutthroat Trout >75 mm TL were captured during 170 of the 184 electrofishing surveys conducted, whereas nonnative salmonids were captured during 80 surveys at 20 of the 34 long-term monitoring reaches. At three monitoring sites, Bonneville Cutthroat Trout were present during the initial survey but absent during the final survey, but there was also three sites where they were absent during the initial survey but present during the final survey (Table 7). Rainbow Trout were the most common nonnative salmonid encountered (captured in 43 surveys at 16 monitoring reaches), followed by Brook Trout (captured during 35 surveys at 8 monitoring reaches), and Brown Trout (captured during 26 surveys at 5 monitoring reaches). At 11 of the 34 sites, at least one nonnative trout either was newly detected or was no longer detected at the site from the beginning to the end of the time period (Table 7).

Trout density (all species combined) averaged 7.6 fish/100 m^2 of stream and ranged from a low of zero on one occasion to a high of 29.2 fish/100 m^2. Bonneville Cutthroat Trout density was negatively related to the density of nonnative trout at sites where they were sympatric (Figure 11).

Across all 34 sites, mean λ was 1.04 for Bonneville Cutthroat Trout, and 90% CIs overlapped unity (0.98-1.10; Table 7). Within individual sites, Bonneville Cutthroat Trout population growth rate was statistically declining at one site on Cottonwood Creek and one site on Montpelier Creek, and was statistically increasing at both sites on Kackley Spring. In comparison, estimates of mean λ for all nonnative trout combined averaged 0.93, and 90% CIs did not overlap unity (0.89-0.97), suggesting that nonnative trout in general were declining in the long-term monitoring sites over the time period included in these data.

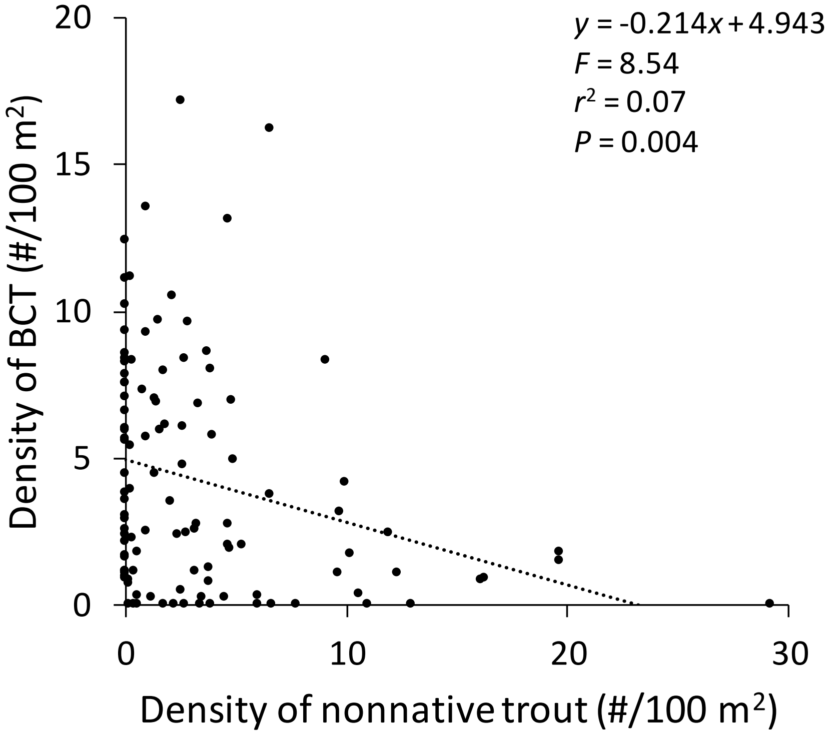


Figure 11. Relationship between the density of nonnative trout and Bonneville Cutthroat Trout (Bonneville Cutthroat Trout) for individual electrofishing surveys conducted at long-term monitoring reaches in Bear River tributaries of southeast Idaho where sympatry occurred.

Collecting tissue samples for genetic analysis CCBY IDAHO FISH AND GAME

Table 6. Location and channel characteristics for 44 long-term monitoring sites sampled repeatedly with backpack electrofishing to determine trends in occupancy and density of salmonids in Bear River tributaries of southeast Idaho. Site numbers correspond to those presented in Table 7 PVA analysis. Coordinates delineate the downstream boundary of each site (WGS84). Sites appear in each Management Unit map found in Figures 9, 10, 12 and 13.

Site	Stream	Latitude	Longitude	Wetted width (m)	Elevation (m)	Reach slope
			Pegram MU			
6	Dry Cr.	42.43466	-111.081166	2.0	2,016	2.2
7	Dry Cr.	42.444828	-111.092062	2.0	2,058	3.6
11	Giraffe Cr.	42.46879	-111.054570	1.8	2,183	2.0
12	Giraffe Cr.	42.469165	-111.060311	1.81	2,190	2.0
-	Preuss Cr.	42.410918	-111.095135	-	-	-
22*	Preuss Cr.	42.435796	111.125684	1.79	2,024	2.6
23	Preuss Cr.	42.438766	-111.129976	0.93	2,031	1.3
24	Preuss Cr.	42.450542	-111.148399	1.37	2,093	2.9
25*	Preuss Cr.	42.456303	111.159804	2.51	2,130	2.2
26*	Preuss Cr.	42.460563	111.165704	2.32	2,143	2.2
27	Preuss Cr.	42.463006	-111.168413	1.22	2,185	3.2
			Nounan MU			
-	Bailey Ck.	42.571918	-111.583963	-	-	-
-	Bailey Ck.	42.59199	-111.577154	-	-	-
8	Eightmile Cr.	42.532047	-111.577344	3.8	1,822	0.7
9	Eightmile Cr.	42.575362	-111.550327	3.6	1,900	1.8
10	Eightmile Cr.	42.50387	-111.578692	4.3	1,976	2.2
-	Georgetown Cr	42.475224	-111.380165	-	-	-
-	Georgetown Cr	42.496086	-111.303050	-	-	-
-	Georgetown Cr	42.499943	-111.284618	-	-	-
20	Montpelier Cr.	42.401811	-111.179392	5.32	2,055	4.3
21	Montpelier Cr.	42.331599	-111.230402	3.5	2,024	1.0
-	Pearl Cr.	42.529739	-111.475847	-	-	-
-	Pearl Cr.	42.515305	-111.496566	-	-	-
28	Stauffer Cr.	42.447871	-111.419459	2.34	1,800	0.1
29	Stauffer Cr.	42.420965	-111.449340	2.4	1,866	2.3
			Thatcher MU			
3	Cottonwood Cr.	42.336192	-111.787990	4.7	1,593	2.8
4	Cottonwood Cr.	42.435832	-111.915594	4.7	1,798	0.9
5	Cottonwood Cr.	42.363286	-111.911504	5.2	1,950	2.3
13	Hoopes Cr.	42.39604	-111.766272	2.6	1,585	5.1
14*	Kackley Spring	42.533360	111.793762	3.2	1,536	1.7
15*	Kackley Spring	42.533627	111.794683	3.2	1,535	1.7
-	North Hoopes Cr.	42.385412	-111.745965	-	-	-
32	Trout Cr.	42.456475	-111.703694	3.4	1,645	4.7
-	Trout Cr.	42.465661	-111.66459	-	-	-
33	Whiskey Cr.	42.456767	-111.720432	8.1	1,565	0.5
34	Whiskey Cr.	42.465867	-111.709795	5.4	1,575	1.1

Table 6. Continued.

Site	Stream	Latitude	Longitude	Wetted width (m)	Elevation (m)	Reach slope
			Riverdale MU			
1	Beaver Cr.	42.007065	-111.52319	3.4	2,342	1.6
2	Beaver Cr.	42.042044	-111.539249	3.0	2,438	1.2
16	Logan River	42.001393	-111.596636	3.9	2,349	1.7
17	Logan River	42.008539	-111.597564	2.6	2,319	2.8
18	Maple Cr.	42.03641	-111.755679	4.0	1,478	1.8
19	Maple Cr.	42.068553	-111.699006	3.7	1,791	5.6
30	Stockton Cr.	42.317779	-111.949121	2.5	1,567	3.2
31	Stockton Cr.	42.329886	-111.918972	1.7	1,664	3.1
			Malad MU			
-	First Cr.	42.254742	-112.124771	-	-	-
-	First Cr.	42.259277	-112.122488	-	-	-
-	Second Cr.	42.22548	-112.111043	-	-	-
-	Third Cr.	42.194403	-112.112606	-	-	-
-	Third Cr.	42.199533	-112.104533	-	-	-

Bear River CCBY IDAHO FISH AND GAME

Table 7. Mean density (with associated coefficient of variation, CV) and population growth rates (λ; with 90% lower and upper confidence limits, CI) for Bonneville Cutthroat Trout (Bonneville Cutthroat Trout) and nonnative trout at a subset of 34 long-term monitoring reaches in Bear River tributaries, ID. Nonnative trout species included Brook Trout (BKT), Brown Trout (BNT), and Rainbow Trout and hybrids (RBT). Arrows indicate whether a species appeared at or vacated a particular reach during the study. Bolded values are statistically different than one.

				Bonneville Cutthroat Trout					Nonnative trout					
				Fish/100m²					Fish/100m²					
Site	Stream	Time period	Number of surveys	Mean	CV	Est	LCI	UCI	Mean	CV	Est	LCI	UCI	Species present
1	Beaver Creek	2006-2017	6	3.62	0.80	0.95	0.77	1.16	1.19	1.47	**0.72**	**0.53**	**0.96**	BCT, BKT↑, RBT
2	Beaver Creek	2009-2017	5	1.81	1.30	1.22	0.66	2.28	5.24	0.49	0.95	0.81	1.11	BCT, BKT, RBT↓
3	Cottonwood Creek	2006-2019	8	8.83	0.56	**0.90**	**0.82**	**0.99**	1.14	0.99	0.92	0.71	1.19	BCT, RBT
4	Cottonwood Creek	2006-2019	6	1.79	0.48	0.96	0.88	1.04	0.05	2.45	0.97	0.87	1.09	BCT, RBT
5	Cottonwood Creek	2011-2017	4	8.05	0.41	0.96	0.67	1.38	0.47	1.40	0.78	0.37	1.63	BCT, RBT↓
6	Dry Creek	2008-2020	5	4.07	1.09	1.11	0.84	1.48	-					
7	Dry Creek	2012-2020	5	6.02	0.69	0.92	0.70	1.21	-					
8	Eightmile Creek	2010-2018	3	1.58	0.27	1.05	0.81	1.37	9.07	0.43	**0.89**	**0.86**	**0.92**	BCT, BKT
9	Eightmile Creek	2006-2018	7	0.55	1.60	0.87	0.69	1.10	8.96	0.39	0.98	0.90	1.08	BCT↓, BKT
10	Eightmile Creek	2010-2020	6	1.03	0.60	1.18	0.92	1.52	17.45	0.47	0.98	0.80	1.19	BCT, BKT, RBT↑
11	Giraffe Creek	2008-2020	6	14.48	0.29	0.99	0.92	1.06	-					
12	Giraffe Creek	2004-2020	7	14.25	0.47	1.08	1.02	1.15	-					
13	Hoopes Creek	2009-2019	5	2.73	0.87	1.13	0.92	1.38	-					
14	Kackley Spring	2009-2018	5	7.05	0.92	**1.71**	**1.28**	**2.28**	3.86	0.59	0.94	0.77	1.17	BCT↑, BNT↓, RBT↑
15	Kackley Spring	2009-2018	6	5.46	0.53	**1.58**	**1.20**	**2.08**	4.53	0.40	0.95	0.86	1.07	BCT↑, BNT↓, RBT↑
16	Logan River	2011-2019	3	9.66	0.25	1.04	0.80	1.34	0.11	1.73	0.82	0.60	1.12	BCT, RBT↓
17	Logan River	2001-2019	7	4.2	0.56	0.98	0.89	1.09	0.28	1.89	0.99	0.83	1.17	BCT, RBT
18	Maple Creek	2009-2019	6	7.47	0.49	0.88	0.80	0.97	1.77	1.02	1.14	0.71	1.82	BCT, BNT↑, RBT↓
19	Maple Creek	2006-2017	6	6.41	0.38	0.96	0.84	1.09	0.26	2.45	0.91	0.68	1.21	BCT, RBT
20	Montpelier Creek	2006-2020	6	0.23	2.04	**0.83**	**0.75**	**0.90**	2.75	0.48	0.95	0.83	1.08	BCT↓, BKT↓, BNT↑, RBT↓
21	Montpelier Creek	2006-2020	7	3.8	0.56	1.04	0.96	1.11	6.82	0.40	1.04	0.97	1.11	BCT, BKT, BNT↑, RBT
22	Preuss Creek	1993-2010	4	5.68	0.69	1.06	0.94	1.20	-					
23	Preuss Creek	2004-2020	7	4.43	0.79	0.98	0.89	1.08	-					

Table 7. Continued.

				Bonneville Cutthroat Trout					Nonnative trout					
				Fish/100m²					Fish/100m²					
Site	Stream	Time period	Number of surveys	Mean	CV	Est	LCI	UCI	Mean	CV	Est	LCI	UCI	Species present
24	Preuss Creek	1993-2020	6	7.92	0.76	0.93	0.77	1.11	-					
25	Preuss Creek	1993-2008	3	10.47	1.24	1.06	0.33	3.37	-					
26	Preuss Creek	1993-2008	3	9.91	0.76	1.16	0.81	1.67	-					
27	Preuss Creek	1993-2020	8	10.3	0.60	0.98	0.93	1.04	-					
28	Stauffer Creek	2012-2020	4	4.16	0.65	0.99	0.69	1.42	-					
29	Stauffer Creek	2012-2020	5	9.06	0.64	0.94	0.74	1.19	-					
30	Stockton Creek	2009-2019	7	2.9	0.71	1.06	0.94	1.19	-					
31	Stockton Creek	2010-2019	6	6.52	0.43	0.96	0.85	1.08	0.14	2.45	0.86	0.69	1.07	BCT, RBT↓
32	Trout Creek	20112019	4	6.35	0.42	1.07	0.85	1.35	1.87	0.37	1.01	0.80	1.29	BCT, BKT
33	Whiskey Creek	2011-2019	5	0.86	1.13	1.17	0.73	1.88	0.39	0.91	0.95	0.72	1.26	BCT↑, RBT
34	Whiskey Creek	2011-2019	5	0.36	1.28	0.81	0.56	1.19	0.122	0.74	0.89	0.66	1.20	BCT↓, RBT

Expanding Surveys and Monitoring

Long-term monitoring of Bonneville Cutthroat Trout population abundance in Idaho's portion of the Bear River drainage is currently being conducted by periodic resampling of various trend monitoring sites (Table 6). While these sites were not established in any random manner, and do not include all streams where Bonneville Cutthroat Trout currently reside, the importance of such long-term monitoring sites is evident in summaries of the status of other subspecies of Cutthroat Trout in portions of their range (e.g., Meyer et al. 2003, 2014a; Cook et al. 2010; Kennedy and Meyer 2015). Continued sampling of these long-term monitoring sites is invaluable for monitoring the status of Bonneville Cutthroat Trout in Idaho's portion of the Bear River drainage. However, the status of Bonneville Cutthroat Trout in many streams within Idaho is unknown at this time. Therefore, it is imperative to expand additional surveying and monitoring to streams where data are lacking.

New sampling surveys or expanding trend monitoring sites to new streams should follow a rigorous sampling design. A rigorous sampling design is important so that the status of populations can be described with confidence using appropriate statistical estimators. Future surveys should implement random, stratified, or systematic sampling schemes to describe species distribution and abundance. At a minimum, data should be collected to provide fish presence, species composition and abundance/densities. Multiple-pass samples that allow for abundance estimates are preferred. Any single-pass electrofishing sampling should be systematic and be combined with a subset of multiple-pass removal sampling methods to extrapolate densities. Meyer et al. (2014b) provides one example of a rigorous sampling methodology. While eDNA technology is still developing and has some limitations, this tool may also have utility for future sampling needs and should be considered where appropriate.

Backpack electrofishing to monitor fish populations. CCBY IDAHO FISH AND GAME

Broad Management Priorities: Conservation and Management Actions

In order to further improve the population status of Bonneville Cutthroat Trout additional efforts are needed. This plan described necessary steps to further improve the long-term status of Bonneville Cutthroat Trout in Idaho by delineating and prioritizing necessary conservation and management actions where feasible and desired. These recommended conservation and management actions may include the following:

1. Increase abundance of existing Bonneville Cutthroat Trout populations by improving riparian, aquatic habitats, and restoring streamflow.
2. Reestablish Bonneville Cutthroat Trout in portions of their range where extirpated.
3. Reduce negative effects of non-native fishes on Bonneville Cutthroat Trout populations.
4. Identify migratory barriers and improve passage.
5. Improve knowledge of the status of Bonneville Cutthroat Trout and other sympatric fishes by surveying streams where occupancy is unknown using rigorous sampling designs.
6. Continue monitoring long-term trends in Bonneville Cutthroat Trout distribution, abundance, occupancy, and limiting factors.
7. Monitor and assess genetic composition of Bonneville Cutthroat Trout populations.
8. Ensure fish community, habitat, and genetic information is cataloged into statewide databases.
9. Regularly update the range-wide assessment database managed by Utah Division of Wildlife Resources with current Idaho data and coordinate on related status assessments.
10. Determine whether fish diseases or pathogens are affecting BTC populations.
11. Educate and inform the public about Bonneville Cutthroat Trout conservation and fishing opportunities.
12. Conduct research necessary to conserve and manage Bonneville Cutthroat Trout.
13. Ensure adequate regulation, enforcement, or management of factors causing declines of Bonneville Cutthroat Trout populations.

Proposed Conservation Actions by MU

As mentioned before, the boundaries of the six MUs in this plan roughly define metapopulations where connectivity between spatially-explicit areas is rare or non-existent. Connectivity between populations within each MU has seldom been documented and is assumed to only occur in rare instances of downstream drift. Population connectivity is expected to increase the viability of each population, if facilitated where it is appropriate. We propose that increasing the available habitat (patch size) should factor into the prioritization of Bonneville Cutthroat Trout enhancement and restoration opportunities in each MU, particularly when considering the metapopulation concept.

One way to prioritize restoration work is by comparing the quality of habitats and populations to their vulnerability to future change (Williams et al. 2006). High quality habitat and strong populations should be protected. Priority protection should occur where high-quality habitat and populations are most vulnerable. The highest restoration priorities should be the best quality habitat and at a risk of further habitat degradation in the future (Figure 12). Once the best has been restored, efforts are invested in the next priority populations and habitat (next best populations and habitat). Investments in restoration are most likely to be retained in areas that are less vulnerable. Periodic monitoring should occur to ensure population abundance and habitat quality is maintained.

Based on the guidance above we identified the following strategies and priorities for enhancing overall Bonneville Cutthroat Trout populations in Idaho. To maximize efficiency of conservation activities, priorities were assigned to each of the conservation actions identified within each MU. For example, in the Nounan MU, conservation actions on Eightmile and Georgetown creeks received the highest priority rating. Both tributaries are relatively large systems with relatively high fish production. For Georgetown Creek, chemical renovation followed by Bonneville Cutthroat Trout reintroduction received a high priority rating. The rational for the high priority rating for this Bonneville Cutthroat Trout re-introduction opportunity included: 1) high fish production potential as indicated by an existing non-native trout population, 2) relatively long stream length (22.5 km) that could support Bonneville Cutthroat Trout, 3) a current status rating of "absent," and 4) because angling effort in the stream is low, replacement of non-native species with native Bonneville Cutthroat Trout should not negatively affect angling opportunities. Eightmile Creek received a high conservation priority for riparian protection and screening of irrigation diversions. Rationale for the high priority rating for these project types on Eightmile Creek included: 1) the stream is utilized as spawning habitat in the Nounan MU for

Vulnerability

Habitat and Population Integrity	Low	Mod Low	Mod Hi	High	
High	2	2	1	1	Protection
	2	2	1	1	Monitoring
Moderate High	4	4	3	3	Protection
	3	3	2	2	Monitoring
	1	1	2	2	Restoration
Moderate Low	6	6	5	5	Protection
	4	4	3	3	Monitoring
	3	3	4	4	Restoration
Low	5	5	4	4	Monitoring
	5	5	6	6	Restoration

Priority Rank

	1	2	3	4	5	6
Protection						
Restoration						
Monitoring						

Figure 12. Matrix for determining priorities for protection, restoration, and monitoring (Williams et al. 2006).

fluvial Bonneville Cutthroat Trout, 2) the stream is relatively long and may support a large Bonneville Cutthroat Trout population, and 3) riparian improvements and diversion screening should increase Bonneville Cutthroat Trout abundance. In addition to priority ratings, we identified a relative timetable for completing the conservation action. Conservation actions are denoted as short-term (5-year) or long-term goals (5-20 years). Ideally, many of the high priority actions may be completed within a 10-year period. However, completion of conservation actions will depend on project priority, funding, landowner and public support, as well as other factors.

Pegram MU

The Pegram MU extends south to the Utah border and east to the Wyoming border, and includes Bear Lake and its associated tributaries, and the Bear River and Thomas Fork Bear River drainages above the confluence with the Bear Lake Outlet (Figure 13). Bear Lake and the Thomas Fork River support arguably two of the most important Bonneville Cutthroat Trout populations in Idaho (Figure 13). The overarching fishery objective for the MU is to increase the resiliency of Bonneville Cutthroat Trout populations in Bear River, Bear Lake, and tributaries by restoring existing populations and their habitat, where possible, by replacing non-native fish populations with Bonneville Cutthroat Trout, and by reconnecting populations, where appropriate. Until recently, most of the conservation and restoration work for Bonneville Cutthroat Trout has been focused on the Bear Lake and Thomas Fork watersheds. Cutthroat Trout enhancement programs have been in place for Bear Lake since the 1970s. Population monitoring and habitat projects began for the Thomas Fork tributaries in the 1980s.

The Bear Lake population is the only natural adfluvial stock of Bonneville Cutthroat Trout in Idaho. The majority of tributary spawning habitat occurs in Fish Haven and St. Charles creeks. Due in part to unscreened diversions and migration barriers at the mouth of the spawning tributaries, natural reproduction of Bonneville Cutthroat Trout has been low until recently. The fishery in Bear Lake has largely been supported by hatchery fish to that provide harvest opportunity and augment catch rates. Over the past ten years, habitat projects in the Bear Lake system have focused on screening diversions to reduce mortality on downstream emigrants from Fish Haven and St. Charles creeks. In addition, an upstream migration barrier on Fish Haven was removed to facilitate Bonneville Cutthroat Trout access to important upstream spawning habitat. The barrier removal was coupled with chemical renovation to remove nonnative fishes in the system. As a result of these actions, and harvest management in the lake, wild origin Bonneville Cutthroat Trout in Bear Lake have become increasingly abundant.

In 2002, a local working group was established to develop a restoration plan for Bonneville Cutthroat Trout in Saint Charles and Fish Haven creeks. The working group includes irrigation company representatives, local politicians, private landowners, and government agency biologists. Screening irrigation diversions and improving upstream migration were identified as priorities and are being addressed. Initial steps included the modification of angling regulations to promote harvest of Brook Trout, Rainbow Trout and hybrids. Several important conservation actions were born out the stakeholder working group. The IDFG and Trout Unlimited, in partnership with water users and managers, screened multiple diversions in Fish Haven and St. Charles creeks to enhance fish passage and limit entrainment. In 2009, the IDFG performed a rotenone treatment in the Fish Haven drainage to remove nonnative Rainbow Trout and Brook Trout. To date, Fish Haven Creek is absent of nonnative salmonids. Lastly, a concrete flume which conveyed Fish Haven Creek under State Highway 89 was removed and replaced with a fish-passable channel. Prior to this project, high water velocity across the concrete structure prohibited Bonneville Cutthroat Trout movement from Bear Lake into Fish Haven Creek. As a result, Bonneville Cutthroat Trout were previously extirpated from the drainage. Fish monitoring is ongoing in Bear Lake tributaries and IDFG plans to consider chemical renovation in the St. Charles Creek drainage to remove nonnative salmonids.

Evening fishing on Bear Lake. CCBY IDAHO FISH AND GAME

The Thomas Fork River and its tributaries provide nearly 113 km of Bonneville Cutthroat Trout habitat (Table 8). Past research using telemetry identified barriers that inhibited fluvial Bonneville Cutthroat Trout passage. The barriers have since been modified to accommodate upstream and downstream fish passage. Conservation priorities for this area include continuing index monitoring of resident Bonneville Cutthroat Trout populations in Preuss, Giraffe, and Dry creeks, monitoring riparian habitat, monitoring the effectiveness of the Thomas Fork fish passage projects, and reconnecting tributaries to the Thomas Fork such as Dry and Preuss creeks.

Bloomington Creek may be a good candidate for Bonneville Cutthroat Trout restoration. This stream is a relatively large tributary (24.5 km) that drains into Mud Lake and has intermittent connection to Bear Lake. About 9.7 km of the stream occurs on public lands. Brook Trout and hatchery Rainbow Trout dominate the fish community. The stream may be a good candidate for chemical renovation because it has few tributary streams and a base flow of less than 20 cfs. Fishing effort is limited primarily to the upper most reach near USFS campgrounds.

Habitat improvements are needed to enhance the Bonneville Cutthroat Trout in Paris Creek. Loss of riparian habitat, irrigation withdrawal, and Brook Trout are potential limiting factors for the Paris Creek population. Table 9 summarizes conservation strategies and priorities for the Pegram MU.

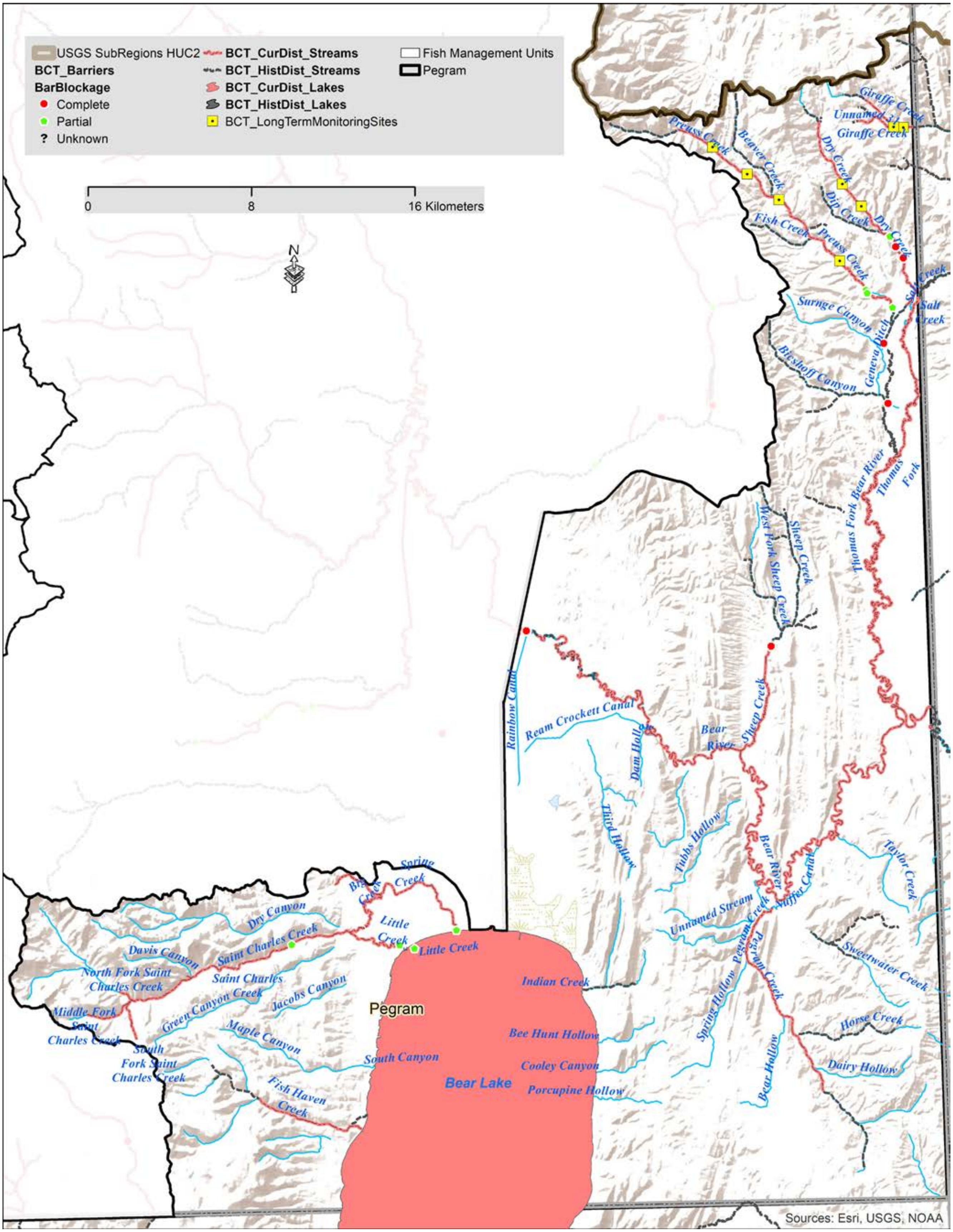


Figure 13. Map depicting the Pegram MU which includes Bear Lake and the Bear River from the Wyoming-Idaho state line, downstream to Stewart Dam. Bonneville Cutthroat Trout distribution is shown as historically occupied (black lines), current (red), and unknown (blue).

Table 8. Population status, abundance, and uniformity for Bonneville Cutthroat Trout in the Pegram MU. Bold fonts indicate streams containing segments that support core or conservation populations.

				Historical stream length (km)			Occupied stream length (km)								
HUC12 Name	Parent stream	Stream name	BCT status	Private	Public	Total	Private	Public	Total	Year Sampled	Abundance	Fish/ 100 m²	CV	Fish/ km	CV
Bear Hollow-Bear River	Great Salt Lake	**Bear River**	Present	24.1	0.7	24.8	24.1	0.7	24.8						
	Bear River	Sheep Cr.	Present	0.05		0.05	0.05		0.05						
Bear River-North Willow Cr.	Great Salt Lake	**Bear River**	Present	3.9		3.9	3.9		3.9						
Bear River-Taylor Cr.	Great Salt Lake	**Bear River**	Present	37.9	2.2	40.1	37.9	2.2	40.1						
	Nuffer Canal (Bear River)	Sweetwater Cr.	Unknown	2.7	0.2	2.9									
	Bear River	**Thomas Fork**	Present	26.4		26.4	26.4		26.4						
	Sweetwater Cr.	Unnamed 15	Unknown	2.6	2.0	4.6									
Dingle Swamp-Outlet Bear Lake	Spring Cr.	**Big Cr.**	Present	4.8	2.1	6.9	4.8	2.1	6.9						
	Bear Lake	**Little Cr.**	Present	4.1		4.1	4.1		4.1						
	Bear Lake	**Spring Cr.**	Present	5.8	1.5	7.3	5.8	1.5	7.3						
Fish Haven Creek-Frontal Bear River	Bear Lake	**Fish Haven Cr.**	Present	3.1	6.1	9.2	2.8	3.0	5.8	2020	Mod			54.0	1.5
	Fish Haven Canyon	White Pine Canyon	Unknown		0.4	0.4									
Giraffe Cr.	Thomas Fork Bear River	**Giraffe Cr.**	Present		4.6	4.6		3.4	3.4	2020	High	17.3	5.4	230.0	0.1
	Giraffe Cr.	Robinson Cr.	Unknown		0.7	0.7									
	Giraffe Cr.	Salt Basin Cr.	Unknown		1.5	1.5									
	Salt Basin Cr.	Unnamed 30	Unknown		0.5	0.5									
	Giraffe Cr.	**Unnamed 31**	Present		2.3	2.3		2.1	2.1						
	Unnamed 31	Unnamed 33	Unknown		1.0	1.0									
	Robinson Cr.	Unnamed 36	Unknown		1.0	1.0									
Indian Creek-Frontal Bear River	Bear Lake Outlet	Indian Cr.	Unknown	2.0	0.9	2.8									
Pegram Cr.	Pegram Cr.	Horse Cr.	Unknown	3.9	1.6	5.6									
	Nuffer Canal	Pegram Cr.	Present	13.7	3.1	16.8	9.4	2.5	11.9						

Table 8. Continued.

				Historical stream length (km)			Occupied stream length (km)								
HUC12 Name	Parent stream	Stream name	BCT status	Private	Public	Total	Private	Public	Total	Year Sampled	Abundance	Fish/ 100 m²	CV	Fish/ km	CV
Preuss Cr.	Preuss Cr.	Beaver Cr.	Unknown		6.3	6.3									
	Preuss Cr.	Fish Cr.	Unknown		3.6	3.6									
	Bischoff Canyon	Geneva Ditch	Unknown	1.0		1.0									
	Geneva Ditch	**Preuss Cr.**	Present	6.7	14.2	20.9	5.7	10.6	16.3	2020	High	6.6	2.2	120.0	0.7
	Preuss Cr.	Unnamed 29	Unknown		1.1	1.1									
Sheep Creek-Bear River	Bear River	Sheep Cr.	Present	10.7	6.3	17.0	7.0	0.2	7.2						
	Sheep Cr.	West Fork Sheep Cr.	Unknown	2.9	1.7	4.5									
	Sheep Cr.	Unnamed 26	Unknown		0.9	0.9									
	West Fork Sheep Cr.	Unnamed 27	Unknown		0.4	0.4									
	Sheep Cr.	Unnamed 41	Unknown	1.7		1.7									
	Sheep Cr.	Unnamed 42	Unknown		0.6	0.6									
	Unnamed 41	Unnamed 44	Unknown	1.0		1.0									
St Charles Cr.	Saint Charles Cr.	Blue Pond Spring	Present		0.2	0.2		0.2	0.2						
	Saint Charles Cr.	MF Saint Charles C.r	Present		2.7	2.7		2.7	2.7						
	Saint Charles Cr.	NF Saint Charles Cr.	Present		0.8	0.8		0.8	0.8						
	Big Cr.	Saint Charles Cr.	Present	2.6	10.0	12.6	2.6	10.0	12.6	2020				93.7	1.5
	Saint Charles Cr.	SF Saint Charles Cr.	Present		2.1	2.1		2.1	2.1						
Thomas Fork-Bischoff Canyon	Thomas Fork Bear River	Bischoff Canyon	Unknown	5.3	2.8	8.0									
	Thomas Fork Bear River	Geneva Ditch	Unknown	0.7		0.7									
	Thomas Fork Bear River	Preuss Cr.	Unknown	9.3		9.3									
	Bear River	**Thomas Fork**	Present	11.2		11.2	11.2		11.2						
	Thomas Fork Bear River	Wood Canyon	Unknown	2.3		2.3									
	Bischoff Canyon	Unnamed 25	Unknown	2.1		2.1									

Table 8. Continued.

				Historical stream length (km)			Occupied stream length (km)								
HUC12 Name	Parent stream	Stream name	BCT status	Private	Public	Total	Private	Public	Total	Year Sampled	Abundance	Fish/ 100 m²	CV	Fish/ km	CV
Thomas Fork-Dry Cr.	Dry Cr.	Dip Cr.	Unknown		4.2	4.2									
	Bischoff Canyon	Dry Cr.	Unknown	1.6		1.6									
	Thomas Fork Bear River	**Dry Cr.**	Present	4.1	8.5	12.5	4.5	7.3	11.8	2020	Mod	3.6	1.2	78.0	0.3
	Thomas Fork Bear River	**Salt Cr.**	Present	0.8		0.8	0.8		0.8						
	Bear River	**Thomas Fork**	Present	11.5		11.5	11.5		11.5	2007				0	0
	Dry Cr.	Unnamed 32	Unknown		0.3	0.3									
Thomas Fork-Raymond Cr.	Thomas Fork Bear River	Raymond Cr.	Unknown	1.1		1.1									
			Total	**211.4**	**99.2**	**310.6**	**162.5**	**51.3**	**213.8**						

Table 9. Suggested conservation actions for Bonneville Cutthroat Trout in the Pegram MU. Bold fonts indicate streams containing segments that support core or conservation populations.

Stream Name	Status	Priority	Required actions	Timetable
Bear Lake Outlet	present	3		
Bear River	**present**	**1**	**Conduct population surveys and identify spawning and rearing habitats**	**5 - 10 years**
Dry Creek	present	2	Improve riparian habitat through livestock management/ enforcement, implement long-term monitoring program	5 – 20 years
Fish Haven Creek	**present**	**1**	**Continue monitoring adfluvial Bonneville Cutthroat Trout population and Brook Trout occurrence.** **Seek land and stream flow protection opportunities.**	**5 – 20 years**
Giraffe Creek	present	2	Improve riparian habitat through livestock grazing agreements, implement long-term monitoring program, or install fencing where opportunities exist. Conduct population surveys on tributaries with unknown occupancy	5 – 20 years
Indian Creek	unknown	3	Limited data available. Conduct additional surveys to rectify whether BCT present.	1 - 5 years
Pegram Creek	present	3	Limited data available. Conduct additional surveys to rectify whether BCT present.	1 - 5 years
Preuss Creek	present	2	Improve riparian habitat through livestock management, implement long-term monitoring program, or install fencing where opportunities exist. Conduct surveys on tributaries with unknown occupancy	5 – 20 years
Sheep Creek	unknown	3	Limited data currently. Conduct populations surveys to rectify whether BCT present both above/below reservoir.	1 - 5 years
St. Charles Creek	**present**	**1**	**Improve migration conditions at confluence with Bear Lake**	**1 - 5 years**
St. Charles Creek	**present**	**1**	**Enhance passage and reduce entrainment at unscreened irrigation diversions, consider Brook Trout and Rainbow Trout removal.** **Seek land and water protection opportunities.**	**5 - 10 years**
Thomas Fork	**present**	**1**	**Maintain passage at irrigation diversions, decrease sediment sources, improve riparian habitat.** **Conduct population surveys on tributaries with unknown occupancy.** **Evaluate nonnative trout distribution to compliment fish passage project development.** **Seek opportunities for stream flow restoration.**	**5 – 20 years**

Nounan MU

The Nounan Valley Management Unit includes the Bear River from the outlet canal downstream to Soda Dam (Figure 14). To date, there have been limited efforts to enhance or restore Bonneville Cutthroat Trout in the Nounan MU. Exceptions to this include very recent work focused on removal of PacifiCorp's Paris Creek hydropower facility and redevelopment of associated irrigation infrastructure. In addition, recent projects by the IDFG and USFS Caribou-Targhee National Forest have focused on diversion consolidation and rebuild, as well as stream protection development in the Stauffer Creek drainage. Past work has generally focused on Skinner and Stauffer creeks, where livestock protections have been established along the riparian area. Collectively, ongoing and planned projects on Stauffer Creek are expected to enhance upstream passage for fluvial Bonneville Cutthroat Trout and reduce emigrant entrainment. The Paris Creek hydropower plant decommissioning will open the most habitat of any project completed in the Nounan MU to date. The project is being implemented by PacifiCorp in partnership with the Bear River ECC and will restore perennial streamflow to approximately 6.4 km of Paris Creek from the point of diversion at the former hydropower plant. This reach has been almost continually dewatered since the early 20th Century and limited population connectivity and access to spawning habitat for fluvial fish. The project is expected to be completed by 2024. Trout Unlimited is working with Paris Creek water users to design and plan a new diversion to facilitate water delivery after the plant is decommissioned. This will complement the broader conservation project and facilitate Bonneville Cutthroat Trout passage.

The Nounan MU contains more resident populations than any other MU. The Nounan MU includes Georgetown Creek and Bailey Creek, which are two important tributaries where Bonneville Cutthroat Trout have previously been documented, but now appear to be extirpated (Table 10). Bonneville Cutthroat Trout have not been observed in recent surveys of Georgetown Creek and are thought to be absent above the lowest irrigation diversion on that system. In Bailey Creek, surveys in the early 2000s collected only one Bonneville Cutthroat Trout, while none were observed in a more recent survey during 2020. Restoring populations to those tributaries should be the highest priorities for the Nounan MU (Table 11), particularly because those systems have unfettered connection to the Bear River. Successful reintroductions in Bailey and Georgetown creeks would increase the total occupied habitat in the Nounan MU by approximately 16.7 km, or roughly 5% of the currently-occupied habitat. Additionally, continued fishery monitoring data suggest that the Nounan reach of the Bear River supports a fluvial population of Bonneville Cutthroat Trout.

Bloomington Creek and the associated Middle, South and North forks, present an additional important conservation opportunity. Bloomington Creek contains up to 19 km of potential Bonneville Cutthroat Trout habitat, with an additional 9.8 km combined across the North, Middle, and South forks. Despite the extensive potential habitat, Bonneville Cutthroat Trout status remains unknown at this time. Future surveys to evaluate the fish community and Bonneville Cutthroat Trout status in this watershed should be a priority.

Small Stream Sampling CCBY IDAHO FISH AND GAME

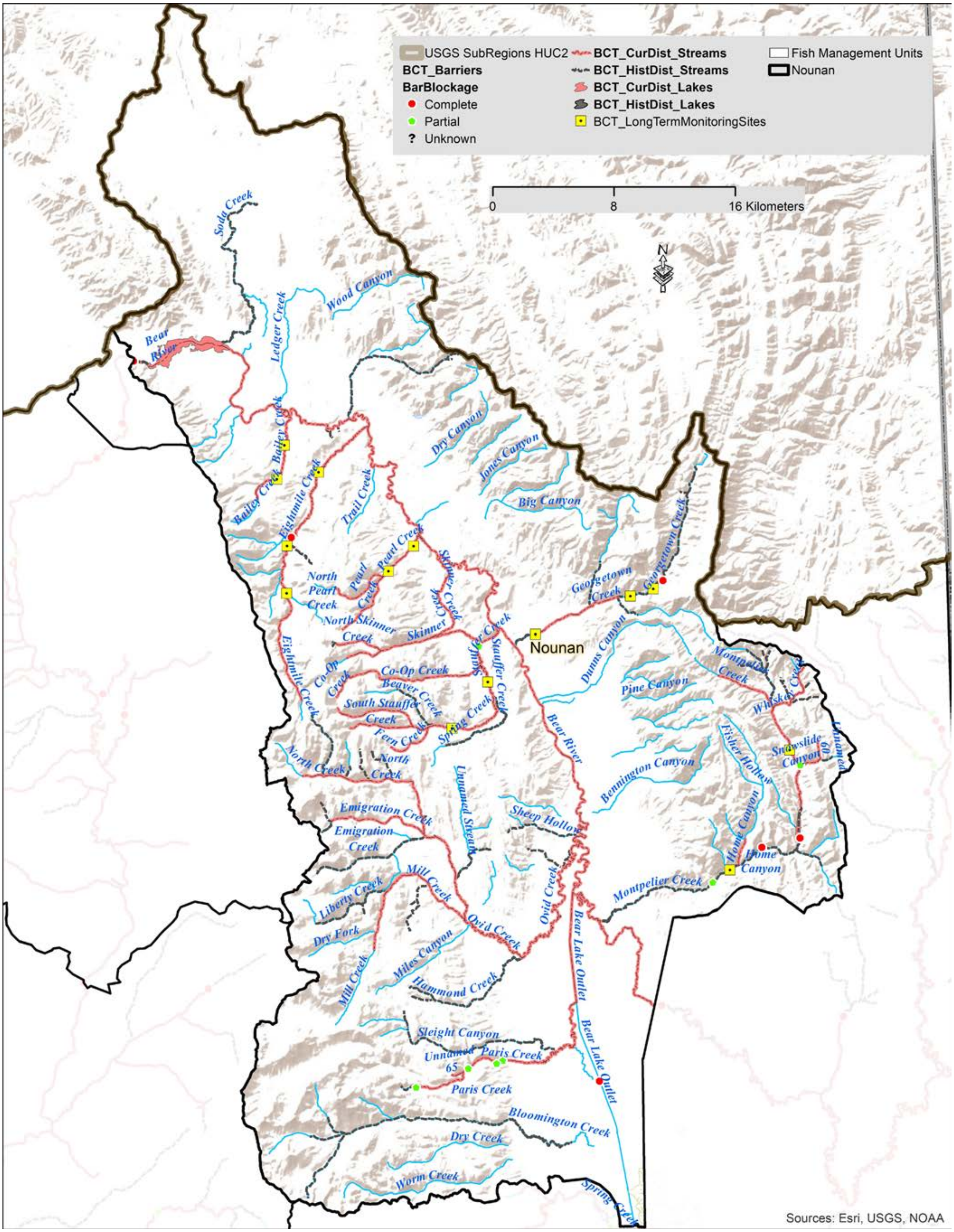


Figure 14. Map depicting the Nounan MU which includes the Bear River and tributaries from Stewart Dam, downstream to Soda Dam. Bonneville Cutthroat Trout distribution is shown as historically occupied (black lines), current (red), and unknown (blue).

Table 10. Population status, abundance, and uniformity for Bonneville Cutthroat Trout in the Nounan MU. Streams and tributaries which are contained within the conservation populations identified in Table 1 are shown in bold font.

				Historical stream length (km)			Occupied stream length (km)								
HUC12 Name	Parent stream	Stream name	BCT status	Private	Public	Total	Private	Public	Total	Year Sampled	Abundance	Fish/ 100 m²	CV	Fish/ km	CV
Alexander Reservoir	Great Salt Lake	**Bear River**	Present	6.79	0.69	7.48	6.14	0.19	6.32						
Bailey Creek-Bear River	Bear River	Bailey Cr	Extirpated	5.64	2.41	8.05				2020		0	0	0	-
	Great Salt Lake	**Bear River**	Present	13.63	2.83	16.45	13.63	2.83	16.45						
	Sulphur Canyon	South Sulphur Canyon	Unknown	2.63	4.38	7.01									
	Bear River	Sulphur Canyon	Unknown	5.05		5.05									
	South Sulphur Canyon	Unnamed 67	Unknown		0.37	0.37									
	Bear River	Unnamed 81	Unknown	0.46		0.46									
	Bear River	Unnamed 82	Unknown	0.91		0.91									
Bear Hollow-Bear River	Great Salt Lake	**Bear River**	Present	26.92		26.92	26.92		26.92						
	Bear River	Ovid Cr	Present	4.46		4.46	4.46		4.46						
Bennington Hollow-Bear River	Great Salt Lake	Bear River	Present	9.77		9.77	9.77		9.77						
	Bear River	Sheep Hollow	Unknown	5.14		5.14									
Big Canyon-Bear River	Great Salt Lake	**Bear River**	Present	5.38	5.75	11.14	5.38	5.75	11.14						
	Stauffer Cr	**Skinner Cr**	Present	7.46		7.46	7.46		7.46	2007				0	-
Bloomington Creek	Bear Lake Outlet	Bloomington Cr	Unknown	15.04	4.03	19.07									
	North Fork Bloomington Cr	Middle Fork Bloomington Cr	Unknown		2.52	2.52									
	Bloomington Cr	North Fork Bloomington Cr	Unknown		1.78	1.78									
	Bloomington Cr	South Fork Bloomington Cr	Unknown		5.49	5.49									
Eightmile Creek	Bear River	**Eightmile Cr**	Present	12.51	12.25	24.76	12.51	12.25	24.76	2020	Low	0.9	0.9	25	1.4
	Eightmile Cr	Unnamed 64	Unknown	0.03	2.26	2.30									

Table 10. Continued.

HUC12 Name	Parent stream	Stream name	BCT status	Historical stream length (km) Private	Historical Public	Historical Total	Occupied stream length (km) Private	Occupied Public	Occupied Total	Year Sampled	Abundance	Fish/ 100 m²	CV	Fish/ km	CV
Lower Georgetown Creek	Bear River	Georgetown Cr	Extirpated	8.66		8.66				2020		0	0	0	0
	Georgetown Canyon	LH Fork Georgetown Canyon	Unknown	2.22	1.01	3.23									
	Georgetown Canyon	RH Fork Georgetown Canyon	Unknown	0.12	1.91	2.03									
Lower Montpelier Creek	Montpelier Cr	Home Canyon	Present	0.17	1.75	1.91	0.17	1.75	1.91						
	Montpelier Canyon	Montpelier Canyon	Unknown		1.27	1.27									
	Bear River	Montpelier Cr	Present	13.37	11.48	24.85	2.17	1.40	3.56	2019	Mod	2.1	2.1	73	1.4
Mill Creek	Mill Cr	Liberty Cr	Unknown		6.17	6.17									
	Liberty Cr	Mahogany Basin Spring Cr	Unknown		0.85	0.85									
	Ovid Cr	**Mill Cr**	Present	5.50	6.39	11.88	5.50	6.38	11.87						
	Mill Cr	The Dell	Unknown	2.34	2.01	4.35									
	The Dell	Unnamed 79	Unknown	0.61		0.61									
North Creek	North Cr	Copenhagen Canyon	Unknown	2.55	5.29	7.84									
	North Cr	**Emigration Cr**	Present	3.32	4.95	8.27	3.32	3.79	7.11						
	North Cr	Meadow Cr	Unknown		5.09	5.09									
	North Cr	Mill Hollow	Unknown		0.93	0.93									
	Ovid Cr	**North Cr**	Present	10.80	8.90	19.70	10.73	8.90	19.63	2015	Mod			33	1
	Snyder Cr	Pole Canyon	Unknown	0.33		0.33									
	North Cr	Sago Hollow	Unknown	4.01		4.01									
	North Cr	Snyder Cr	Unknown	0.74		0.74									
	North Cr	Unnamed 53	Unknown	0.23		0.23									
	North Cr	Unnamed 54	Unknown	0.28		0.28									
	North Cr	Unnamed 55	Unknown		2.61	2.61									
	Unnamed 55	Unnamed 56	Unknown		0.10	0.10									
	Unnamed 55	Unnamed 57	Unknown		0.15	0.15									
	North Cr	Unnamed 58	Unknown		2.36	2.36									
	Emigration Cr	Unnamed 72	Unknown		1.60	1.60									

Table 10. Continued.

				Historical stream length (km)			Occupied stream length (km)								
HUC12 Name	Parent stream	Stream name	BCT status	Private	Public	Total	Private	Public	Total	Year Sampled	Abundance	Fish/ 100 m^2	CV	Fish/ km	CV
Ovid Creek	Ovid Cr	Hammond Cr	Unknown	9.17	1.46	10.62									
	Bear River	Ovid Cr	Present	19.78		19.78	19.73		19.73						
	Ovid Cr	Unnamed 47	Unknown	1.77		1.77									
	Ovid Cr	Unnamed 48	Unknown	2.82		2.82									
	Hammond Cr	Unnamed 59	Unknown	1.40	0.17	1.57									
	Unnamed 59	Unnamed 59 sic	Unknown	0.09		0.09									
	Unnamed 59	Unnamed 78	Unknown	0.10		0.10									
Paris Creek	Bear Lake Outlet	Paris Cr	Present	14.85	1.30	16.15	14.85	0.01	14.86						
	Paris Cr	Sleight Cr	Unknown	5.56		5.56									
	Paris Cr	Unnamed 65	Present	0.85		0.85	0.85		0.85						
Pearl Creek-Bear River	Great Salt Lake	**Bear River**	Present	2.51		2.51	2.51		2.51						
	North Pearl Cr	North Pearl Cr sic	Present		0.04	0.04									
	Pearl Cr	**North Pearl Cr**	Present		4.56	4.56		4.59	4.59	2001	Low			29	1.7
	Skinner Cr	**North Skinner Cr**	Present		3.55	3.55		3.27	3.27	2001	High			100	1.2
	Bear River	**Pearl Cr**	Present	4.03	5.19	9.22	4.03	5.19	9.22	2018	High			172	0.3
	Stauffer Cr	**Skinner Cr**	Present	2.16	1.48	3.64	2.16	1.48	3.64	2007				0	-
	Skinner Cr	**South Skinner Cr**	Present		2.58	2.58		2.58	2.58						
	North Skinner Cr	Unnamed 47	Unknown		0.30	0.30									
	North Skinner Cr	Unnamed 77	Unknown		0.38	0.38									
Sleight Canyon-Outlet Bear Lake	Bear River	Bear Lake Outlet	Present	5.32	2.02	7.34	5.32	2.02	7.34						
	Bear Lake Outlet	Paris Cr	Present	4.38		4.38	4.36		4.36						
	Paris Cr	Sleight Cr	Unknown	5.62	2.60	8.22									
Soda Creek	Soda Cr	Mammoth Spring	Unknown	0.01		0.01									
	Bear River	Soda Cr	Unknown	16.88		16.88									

Table 10. Continued.

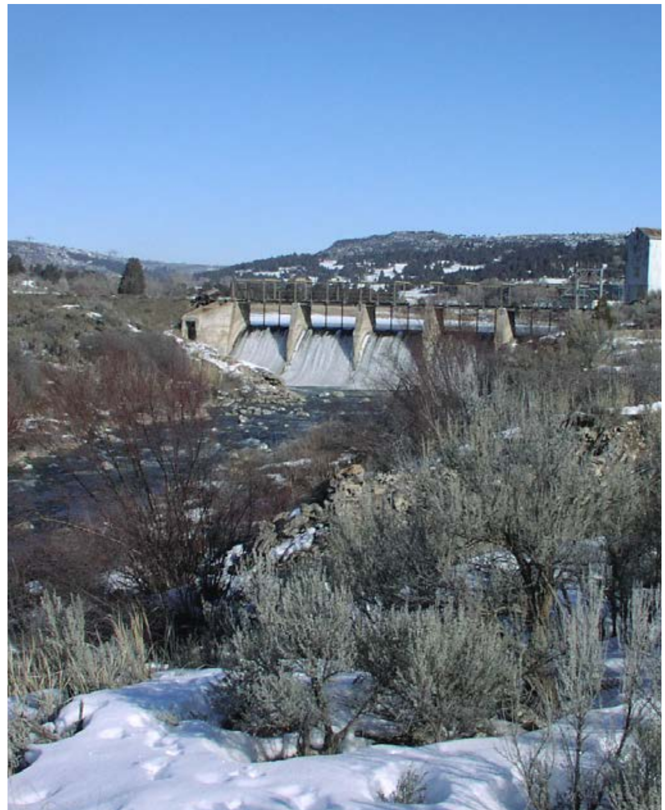
				Historical stream length (km)			Occupied stream length (km)								
HUC12 Name	**Parent stream**	**Stream name**	**BCT status**	**Private**	**Public**	**Total**	**Private**	**Public**	**Total**	**Year Sampled**	**Abundance**	**Fish/ 100 m²**	**CV**	**Fish/ km**	**CV**
Stauffer Creek	Stauffer Cr	Beaver Cr	Unknown	2.77	1.02	3.79									
	Stauffer Cr	**Co-Op Cr**	Present	4.21	7.31	11.52	4.21	7.31	11.52	2001	Mod			76	1.3
	Stauffer Cr	Fern Cr	Present	2.28	1.18	3.46	2.28	1.18	3.46						
	Stauffer Cr	**North Stauffer Cr**	Present	1.00	4.92	5.91	1.00	4.92	5.91	2001	Low			25	1.2
	Stauffer Cr	**Nounan Canal**	Present	4.66		4.66	4.66		4.66						
	Stauffer Cr	**South Stauffer Cr**	Present	0.47	3.86	4.33	0.47	3.86	4.33	2001	Low			10	1.4
	Stauffer Cr	Spring Cr	Unknown	7.21		7.21									
	Bear River	**Stauffer Cr**	Present	16.12		16.12	16.12		16.12	2020	High	7.8	6.4	190	1.2
Threemile Creek-Bear River	Great Salt Lake	**Bear River**	Present	8.75	2.05	10.81	8.75	2.05	10.81						
Trail Creek-Bear River	Great Salt Lake	**Bear River**	Present	15.53	0.41	15.95	15.53	0.41	15.95						
Upper Georgetown Creek	Bear River	Georgetown Cr	Present	2.04	10.03	12.07	2.04	12.03	14.07						
	Georgetown Cr	Lateral Canyon	Unknown		0.53	0.53									
Upper Montpelier Creek	Montpelier Cr	Little Beaver Cr	Unknown		4.48	4.48									
	Bear River	Montpelier Cr	Present		9.22	9.22		9.22	9.22						
	Montpelier Cr	**Snowslide Canyon**	Present		2.56	2.56		1.63	1.63	2006				48	-
	Montpelier Cr	Whiskey Cr	Present		4.27	4.27		4.84	4.84						
	Whiskey Cr		Unknown		0.57	0.57									
	Snowslide Canyon	**Unnamed 60**	Present		1.21	1.21		1.18	1.18						
	Whiskey Cr	Unnamed 61	Unknown		2.15	2.15									
	Whiskey Cr	Unnamed 62	Unknown		1.63	1.63									
	Unnamed 62	Unnamed 63	Unknown		0.45	0.45									
	Whiskey Cr	Unnamed 68	Unknown		0.55	0.55									
	Little Beaver Cr	Unnamed 69	Unknown		2.06	2.06									
	Little Beaver Cr	Unnamed 70	Unknown		1.65	1.65									
	Unnamed 70	Unnamed 71	Unknown		0.61	0.61									
			Total	**339.4**	**197.9**	**537.3**	**217.0**	**111.0**	**328.0**						

Table 11. Suggested conservation actions for Bonneville Cutthroat Trout in the Nounan MU. Bold fonts indicate streams containing segments that support core or conservation populations.

Stream Name	Status	Priority	Required actions	Timetable
Bailey Creek	present	2	Remove Brook Trout Investigate connectivity with Bear River Conduct population surveys on tributaries with unknown occupancy	5 – 20 years
Bear River (Nounan)	present	**1**	**Conduct population surveys and identify spawning and rearing habitats. Assess riparian and instream conditions; work with landowners to improve riparian and instream condition as well as connectivity where necessary**	**5 – 10 years**
Bloomington Creek	extirpated	2	Conduct population surveys on tributaries with unknown occupancy Remove Brook Trout and reintroduce Bonneville Cutthroat Trout after identifying preferred donor stock	5 – 20 years
Eightmile Creek	present	**1**	**This is the most important spawning tributary in the Nounan MU. Work with landowners to improve riparian and instream condition as well as connectivity where necessary. Seek land and water protection opportunities.**	**5 - 10 years**
Georgetown Creek	extirpated	**1**	**Remove Brook and Rainbow Trout.** **Reintroduce Bonneville Cutthroat Trout after identifying the preferred donor stock.** **Install fish passage facilities and screen diversions.** **Conduct population surveys on tributaries with unknown occupancy.** **Seek opportunities for stream flow restoration.**	**5 - 10 years**
Montpelier Cr	unknown	2	Collect genetic samples from Montpelier Creek and its tributaries. Reduce potential deleterious interactions from naturally reproducing Brook, Rainbow, and Brown Trout. Complete removal of Brook Trout unlikely. Improve riparian habitat. Conduct population surveys on tributaries with unknown occupancy	5 – 20 years
Ovid Creek	present	3	Reduce potential deleterious interactions from naturally reproducing Brook Trout. Assess riparian and instream conditions; work with landowners to improve riparian and instream condition as well as connectivity, especially to the Bear River, where necessary. Conduct population surveys on tributaries with unknown occupancy	5 – 20 years
Paris Creek	present	2	Remove Brook Trout if necessary. Assess riparian and instream conditions; work with landowners to improve riparian and instream condition as well as connectivity, where necessary. Improve water-use practices by cooperating with private landowners. Collaborate with partners on fish passage at decommissioned Paris Creek hydropower plant.	5 – 20 years
Pearl Creek	present	2	Assess riparian and instream conditions; work with landowners to improve riparian and instream condition as well as connectivity, especially to the Bear River, where necessary. Seek land and water protection opportunities.	5 – 20 years
Soda Creek	unknown	3	Conduct population surveys	5 – 20 years
Stauffer Creek	present	1	Assess riparian and instream conditions; work with landowners to improve riparian and instream condition as well as connectivity, especially to the Bear River, where necessary. Conduct population surveys on tributaries with unknown occupancy	5 – 20 years

Dam Complex MU

The Dam Complex MU includes the Bear River between Soda and Grace dams (Figure 15). Until at least 2033, PacifiCorp is not required under the current FERC operations license to provide fish passage at any of the large hydroelectric facilities on the Bear River. Given that there are no tributary streams that provide suitable habitat in the Dam Complex MU (Soda Dam downstream to Grace Dam), establishing a self-sustaining Bonneville Cutthroat Trout population is highly unlikely (Table 12). In 2006, PacifiCorp decommissioned Cove Dam and removed it, increasing upstream access to fish within the Thatcher MU, resulting in about 10.5 km of the Bear River through Black Canyon being reconnected to tributary spawning habitat. Passage at the other facilities should be investigated during the next FERC licensing period (approximately 25 years). Suggested conservation actions for the Dam Complex MU are presented in Table 13.



Cove Dam Before Removal CCBY IDAHO FISH AND GAME

Cove Dam Removal CCBY IDAHO FISH AND GAME

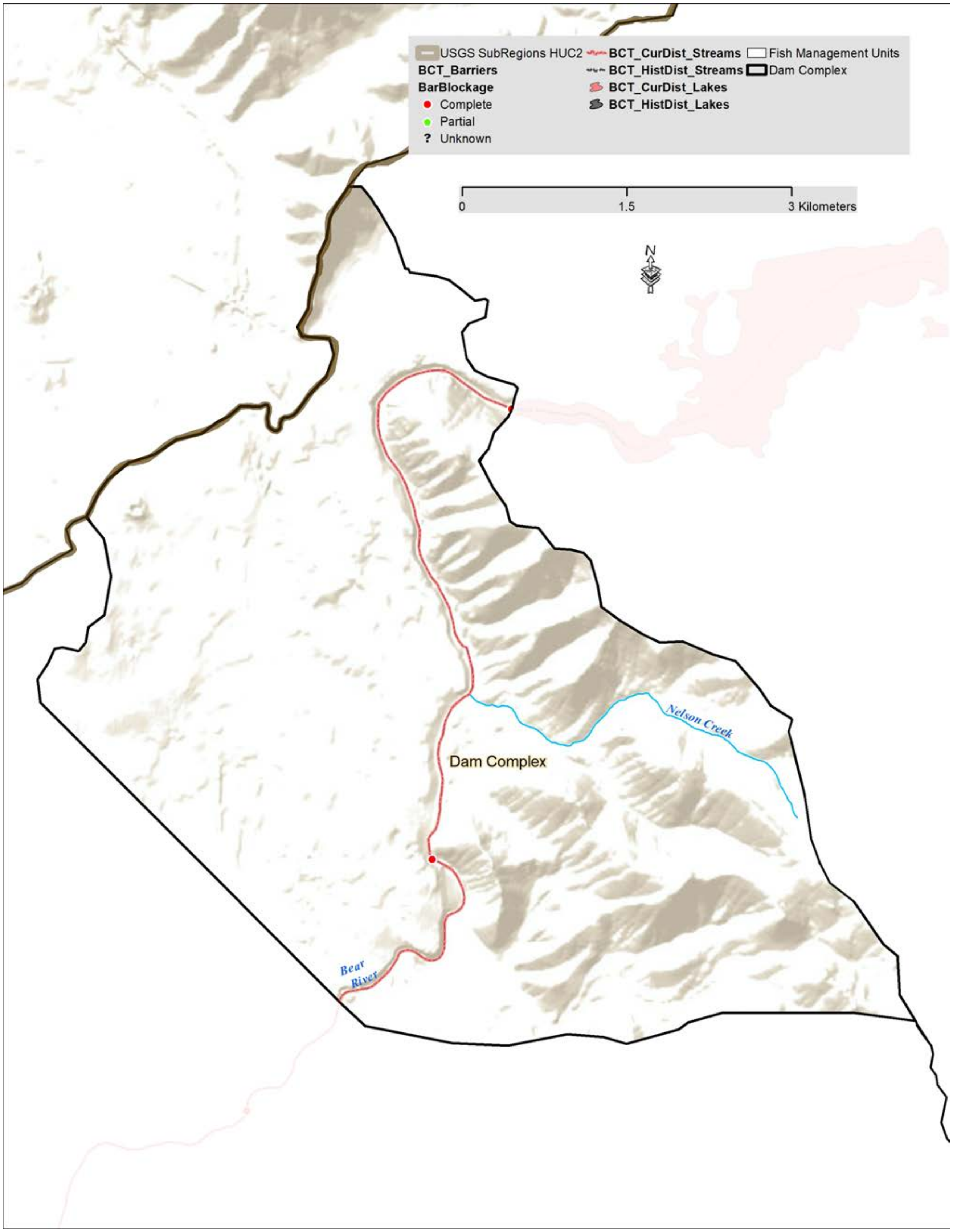


Figure 15. Map depicting the Dam Complex MU which includes the Bear River between Soda and Grace dams. Bonneville Cutthroat Trout distribution is shown as historically occupied (black lines), current (red), and unknown (blue).

Table 12. Population status, abundance, and uniformity for Bonneville Cutthroat Trout in the Dam Complex MU.

				Historical stream length (km)			Occupied stream length (km)								
HUC12 Name	**Parent stream**	**Stream name**	**BCT status**	**Private**	**Public**	**Total**	**Private**	**Public**	**Total**	**Year Sampled**	**Abundance**	**Fish/ 100 m^2**	**CV**	**Fish/ km**	**CV**
McPherson Canyon-Bear River	Great Salt Lake	Bear River	Present	3.4	4.8	8.2	3.4	4.8	8.2	-	-	-	-	-	-
			Total	**3.4**	**4.8**	**8.2**	**3.4**	**4.8**	**8.2**						

Table 13. Suggested conservation actions for Bonneville Cutthroat Trout in the Dam Complex MU.

HUC12 Name	Status	Priority	Required Actions	Timetable
Nelson Creek	Unknown	3	Conduct population survey on tributaries with unknown occupancy	5 – 20 years

Thatcher MU

The Thatcher MU includes the Bear River and tributaries from Grace Dam, downstream to Oneida Dam (Figure 16). Enhancing the fluvial Bonneville Cutthroat Trout population is a top priority for Thatcher. Most of the tributaries in the Thatcher MU are relatively small and may not provide continuous natural flow necessary to support long-term persistence of resident Bonneville Cutthroat Trout. Population monitoring should focus on building trend data for index tributaries and opportunistically sampling other tributaries to assess broader range shifts and MU status.

Kackley Spring, Cottonwood, Williams, and Trout creeks offer substantial Bonneville Cutthroat Trout restoration opportunities. Cottonwood Creek is the largest system within this MU and currently supports a viable Bonneville Cutthroat Trout population. In Cottonwood Creek, conservation efforts should focus on removing Brook Trout, improving habitat and identifying and treating migration barriers. Williams Creek is a productive stream that supports robust wild Rainbow Trout and Brook Trout populations (Table 14). Access to Williams Creek is very limited and angling effort is considered negligible. Williams Creek could be an important spawning tributary for fluvial Bonneville Cutthroat Trout in the Thatcher MU. Similar to all other Bear River MUs, there is a paucity of information regarding population abundance and important habitats used by fluvial Bonneville Cutthroat Trout. IDFG should continue to develop a relationship with landowners along Williams Creek to help collect data to address factors limiting Bonneville Cutthroat Trout. Survey information is a necessary prerequisite to identifying conservation measures. Table 15 summarizes the suggested conservation actions for the Thatcher MU.

The Thatcher MU has been the focus of ECC funded restoration efforts by IDFG over the course of the 2007 plan. Of course, IDFG has worked opportunistically to address habitat related issues outside of this MU using the PacifiCorp funded program; however, the conservation aquaculture program has focused enhancement exclusively in this MU. In addition, habitat projects in this MU have received higher priority for implementation because they may be coupled with reintroduction efforts from locally-sourced hatchery Bonneville Cutthroat Trout.

There are still several priority habitat projects in the Thatcher MU for ECC funding. Those projects include renovation and reintroduction at Williams Creek, reconnection of Steves Creek with its channel and the Bear River, reconnection of Alder Creek, and reconnection of Cottonwood Creek. In addition, through the ECC land and water conservation fund, the IDFG should opportunistically sponsor projects that conserve habitat on important private parcels and maintain streamflows suitable for fish populations. In addition, continued conservation efforts on Kackley Spring Creek may focus on nonnative trout removal and habitat restoration to improve fluvial Bonneville Cutthroat Trout spawning and rearing conditions.

BCT Cottonwood CCBY IDAHO FISH AND GAME

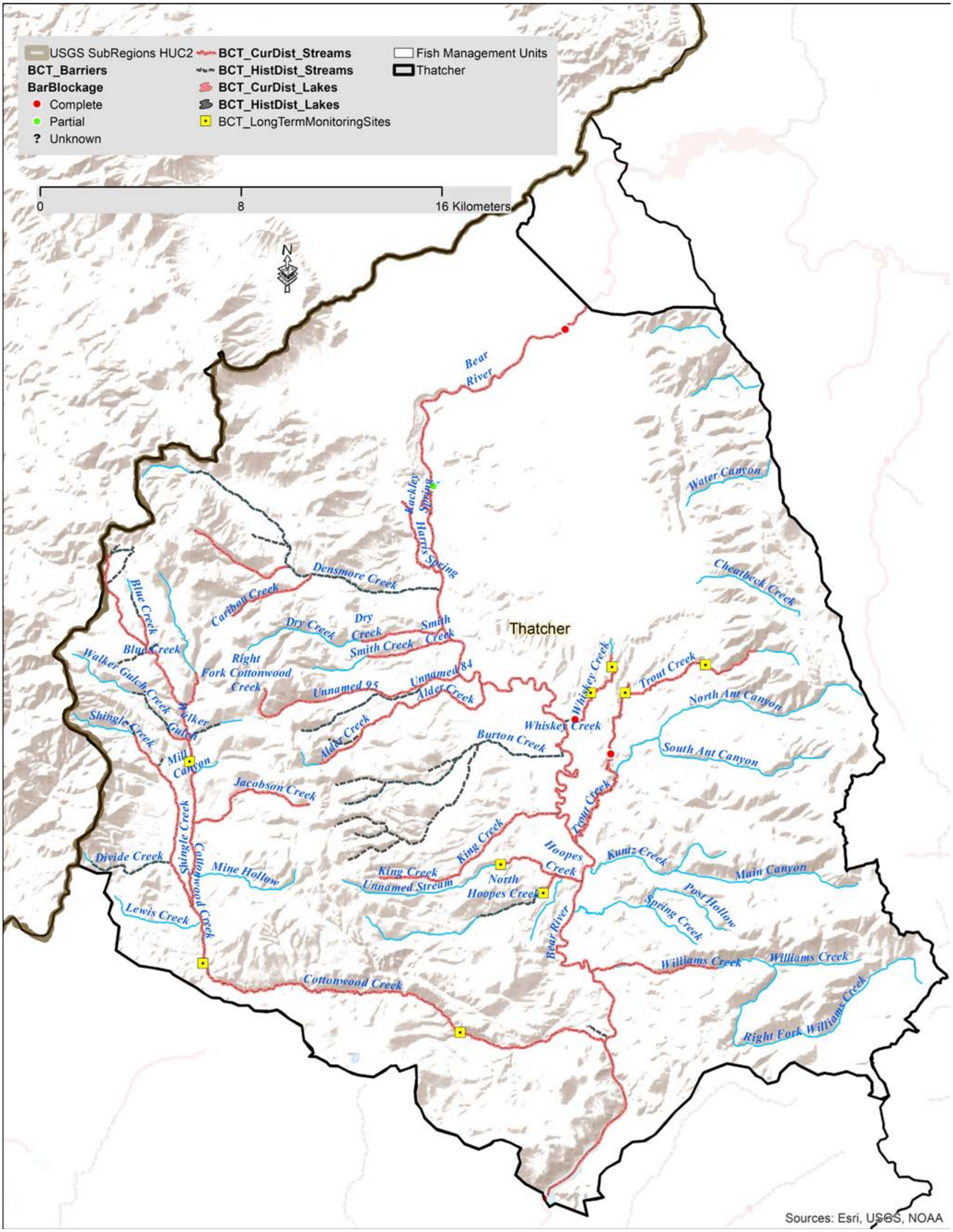


Figure 16. Map depicting the Thatcher MU which includes the Bear River and tributaries from Grace Dam, downstream to Oneida Dam. Bonneville Cutthroat Trout distribution is shown as historically occupied (black lines), current (red), and unknown (blue).

Table 14. Population status, abundance, and uniformity for Bonneville Cutthroat Trout in the Thatcher MU. Streams and tributaries which are contained within the conservation populations identified in Table 1 are shown in bold font.

				Historical stream length (km)			Occupied stream length (km)								
HUC12 Name	Parent stream	Stream name	BCT status	Private	Public	Total	Private	Public	Total	Year Sampled	Abundance	Fish/ 100 m2	CV	Fish/ km	CV
China Hill	Bear River	Harris Spring	Restored	4.51		4.51	4.51		4.51	2020	Low			30	1.5
	Harris Spring	Unnamed 118	Unknown	0.11		0.11									
Densmore Cr.	Densmore Cr.	Caribou Cr.	Restored	3.81	3.81	7.63	6.87	4.56	11.44						
	Densmore Cr.	Cottonwood Cr. (Little)	Extirpated	4.58	4.58	9.16									
	Bear River	Densmore Cr.	Unknown	12.16	0.90	13.06				2009				0	-
	Densmore Cr.	Unnamed 96	Unknown	1.61	0.07	1.68									
King Creek-Bear River	Bear River	Alder Cr.	Restored	8.25	0.90	9.15	8.25	0.90	9.15						
	Great Salt Lake	**Bear River**	Present	21.53		21.53	21.53		21.53						
	Bear River	Burton Cr.	Extirpated	8.20	2.24	10.44				2009				0	-
	Bear River	Dry Cr.	Present	3.51		3.51	3.51		3.51	2006	Mod			46	1.1
	Bear River	King Cr.	Present	8.65	3.31	11.95	8.11	0.54	8.65	2009				0	-
	Bear River	Smith Cr.	Present	3.59		3.59	3.59		3.59	2006				0	-
	Bear River	Whiskey Cr.	Restored	4.94		4.94	4.41		4.41	2019	Low	0.35	0.35	17	1.4
	Bear River	Unnamed 84 (Steves Cr.)	Present	5.40	1.84	7.24	1.67		1.67						
	Unnamed 84	Unnamed 95 (NF Steves Cr.)	Present	3.51	4.63	8.15	3.51	4.63	8.15						
	Burton Cr.	Unnamed 97	Unknown	6.16	2.68	8.83									
	Unnamed 97	Unnamed 98	Unknown	0.81	1.66	2.47									
	Alder Cr.	Unnamed 126	Unknown	1.33	0.15	1.48									
	Unnamed 97	Unnamed 128	Unknown		1.43	1.43									
	Burton Cr.	Unnamed 130	Unknown	1.27	0.04	1.31									
	Burton Cr.	Unnamed 137	Unknown	1.34	0.73	2.06									

Table 14. Continued.

				Historical stream length (km)			Occupied stream length (km)								
HUC12 Name	Parent stream	Stream name	BCT status	Private	Public	Total	Private	Public	Total	Year Sampled	Abundance	Fish/ 100 m2	CV	Fish/ km	CV
Lower Cottonwood Cr.	Bear River	**Cottonwood Cr.**	Present	7.31	2.11	9.43	7.31	2.11	9.43	2019	Mod	1	0.4	35	1.1
McPherson Canyon-Bear River	Great Salt Lake	**Bear River**	Present	13.66	3.47	17.13	13.66	3.47	17.13						
	Bear River	Kackley Spring	Restored	1.32		1.32	2.64		2.64	2018	High			672	0.1
Middle Cottonwood Cr.	Bear River	**Cottonwood Cr.**	Present	5.79	8.13	13.92	6.08	8.20	14.28	2019	Mod	1	0.4	35	1.1
	Shingle Cr.	Divide Cr.	Unknown	2.16	1.59	3.75									
	Cottonwood Cr.	Shingle Cr.	Present	4.98	3.89	8.87	4.98	3.18	8.16	2009	High			173	-
	Shingle Cr.	Spring Cr.	Unknown		0.51	0.51									
Spring Creek-Bear River	Great Salt Lake	**Bear River**	Present	12.10		12.10	12.10		12.10						
	Bear River	Hoopes Cr.	Present	4.07		4.07	4.07		4.07						
	Hoopes Cr.	North Hoopes Cr.	Present	4.09		4.09	1.27		1.27	2019	Low	3.7		29	-
	Bear River	Unnamed 106	Unknown	0.02		0.02									
	Bear River	Unnamed 122	Unknown	1.04		1.04									
Station Creek-Bear River	Great Salt Lake	**Bear River**	Present	2.17	5.65	7.82	2.17	5.65	7.82						
Trout Cr.	Bear River	Trout Cr.	Restored	15.09	2.75	17.84	22.94	5.50	28.44	2019	High	5.6	0.2	158	0.4
	Trout Cr.	Unnamed Stream	Present		0.77	0.77		0.77	0.77						

Table 14. Continued.

				Historical stream length (km)			Occupied stream length (km)								
HUC12 Name	Parent stream	Stream name	BCT status	Private	Public	Total	Private	Public	Total	Year Sampled	Abundance	Fish/ 100 m2	CV	Fish/ km	CV
Upper Cottonwood Cr.	Cottonwood Cr.	Blue Cr.	Present		2.37	2.37		1.33	1.33						
	Cottonwood Cr.	Bullwhacker Canyon	Present		1.39	1.39		0.23	0.23						
	Bear River	**Cottonwood Cr.**	Present	4.26	12.67	16.94	4.26	11.61	15.87	2019	Mod	1	0.4	35	1.1
	Cottonwood Cr.	Hog Wallow	Unknown		1.31	1.31									
	Cottonwood Cr.	Jacobson Cr.	Present	3.31	5.87	9.17	2.00	3.86	5.87						
	Cottonwood Cr.	Mill Canyon	Present		0.14	0.14		0.14	0.14						
	Cottonwood Cr.	Right Fork Cottonwood Cr.	Present		1.86	1.86		1.86	1.86						
	Cottonwood Cr.	Time Spring	Unknown		0.57	0.57									
	Cottonwood Cr.	Walker Gulch	Present		3.29	3.29		0.91	0.91						
	Walker Gulch	Unnamed 107	Unknown		0.20	0.20									
	Cottonwood Cr.	Unnamed 123	Unknown	0.07	1.73	1.80									
	Cottonwood Cr.	Unnamed 124	Unknown		0.58	0.58									
Williams Cr.	Bear River	Williams Cr.	Present	5.29	0.37	5.66	5.29	0.37	5.66	2007	Low			3	2.4
			Total	**192.0**	**90.2**	**282.2**	**154.7**	**59.8**	**214.6**						

Table 15. Suggested conservation actions for Bonneville Cutthroat Trout in the Thatcher MU. Bold fonts indicate streams containing segments that support core or conservation populations.

Stream Name	Status	Priority	Required actions	Timetable
Alder Creek	unknown	3	Monitor reintroduction of Bonneville Cutthroat Trout	5 – 10 years
Bear River (Thatcher)	**present**	**1**	**Monitor fluvial Bonneville Cutthroat Trout**	**1 - 5 years**
Burton Creek	unknown	3	Conduct population surveys	5 – 10 years
Cottonwood Creek	**present**	**1**	**Remove Rainbow Trout** **Improve riparian habitat** **Seek land and streamflow protection opportunities.**	5 – 20 years
			Maintain fish screens and seek opportunities to reconnect lower reach with the Bear River. Conduct population survey on tributaries with unknown occupancy	5 – 10 years
Densmore Creek	unknown	3	Monitor reintroduction of Bonneville Cutthroat Trout. Conduct population surveys on tributaries with unknown occupancy	**1 - 5 years**
Dry Creek	unknown	3	Conduct population surveys	**5 – 10 years**
Kackley Spring Creek	**present**	**1**	**Operate trap to facilitate Bonneville Cutthroat Trout passage and limit nonnative trout expansion. Conduct population survey. Work with Bear River ECC and PacifiCorp on Kackley Pond demolition and stream habitat enhancement. Consider nonnative trout removal if invasions have occurred.**	**1 - 5 years**
King Creek	unknown	3	Conduct population survey to assess potential Bonneville Cutthroat Trout reintroduction	**1 - 5 years**
Smith Creek	present	3	Conduct population surveys	**5 – 10 years**
Trout Creek	extirpated		Monitor reintroduction of Bonneville Cutthroat Trout	5 - 10 years
Whiskey Creek	extirpated	3	Monitor reintroduction of Bonneville Cutthroat Trout	5 - 10 years
Williams Creek	**present**	**1**	**Assess riparian and instream conditions; work with landowners to improve riparian and instream conditions as well as connectivity, where necessary.**	**5 – 10 years**

Riverdale MU

The Riverdale MU includes the Bear River and tributaries from Oneida Dam downstream to the Idaho-Utah border, as well as the Cub River (Figure 17). In general, the tributaries in the Riverdale MU support the highest densities of Bonneville Cutthroat Trout in Idaho. There are no streams within the MU where Bonneville Cutthroat Trout have been recently extirpated; however, Bonneville Cutthroat Trout have been extirpated from several tributaries in the Riverdale MU such as Weston, Fivemile, and Battle creeks. The fluvial component of Bonneville Cutthroat Trout in the Riverdale MU appears to be declining precipitously based on recent surveys. Populations of resident Bonneville Cutthroat Trout in tributaries may provide sources of outmigrants to refound or expand fluvial populations, but without return access to tributary spawning habitats the fluvial population will continue to decline (Table 16). Therefore, the primary focus of conservation in the Riverdale MU should focus on protecting existing populations from habitat alteration and reconnecting tributary spawning habitats for mainstem fluvial populations. Fortunately, Brook and Rainbow Trout are not widespread in tributary habitats, expect in the Cub River headwaters where a robust population of Brook Trout occurs. Fluvial populations of Bonneville Cutthroat Trout may interact with Rainbow Trout, Brown Trout, Smallmouth Bass, and Walleye in the mainstem Bear River. A comprehensive evaluation of the fish community in this section of river is warranted to understand the existing fish assemblage in the Bear River and to provide baseline data for an evaluation of how that assemblage changes through time. If nonnative species interactions are found to be limiting the Bonneville Cutthroat Trout populations, removal or reduction of non-native species from the mainstem Bear River should be investigated. Currently, fishing regulations and mechanical suppression would likely provide the best tool to minimize nonnative species interactions with Bonneville Cutthroat Trout. Table 17 summarizes conservation actions for the Riverdale MU.

Upper Riverdale CCBY IDAHO FISH AND GAME

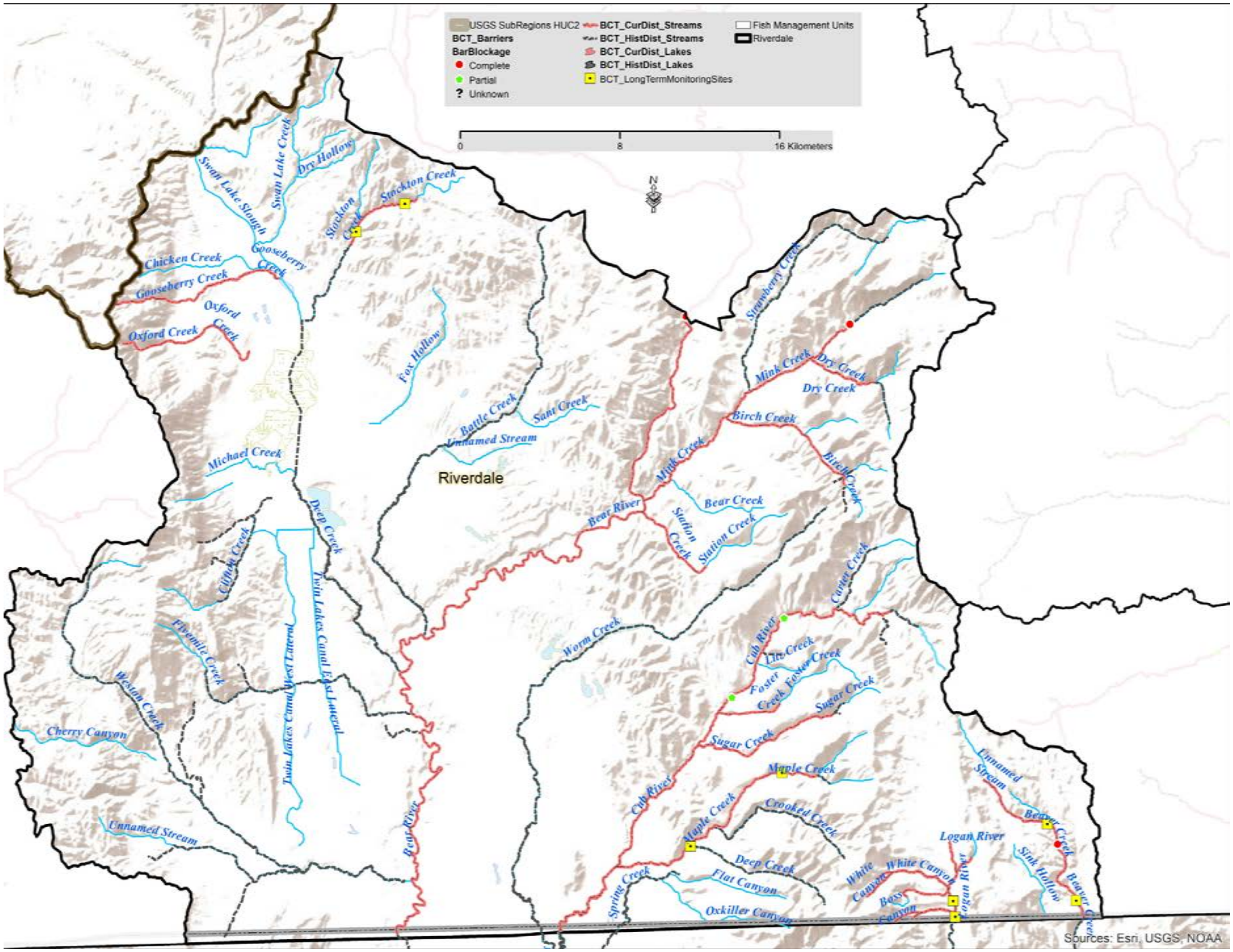


Figure 17. Map depicting the Riverdale MU including the Bear River and tributaries from Oneida Dam downstream to the ID-UT border. Bonneville Cutthroat Trout distribution is shown as historically occupied (black lines), current (red), and unknown (blue).

Table 16. Population status, abundance, and uniformity for Bonneville Cutthroat Trout in the Riverdale MU. Streams and tributaries which are contained within the conservation populations identified in Table 1 are shown in bold font.

				Historical stream length (km)			Occupied stream length (km)								
HUC12 Name	Parent stream	Stream name	BCT status	Private	Public	Total	Private	Public	Total	Year sampled	Abundance	Fish/ 100 m²	CV	Fish/ km	CV
Beaver Cr.	Logan River	**Beaver Cr.**	Present		10.68	10.68		11.14	11.14	2019	Mod	1.7	0.4	43	0.8
	Beaver Cr.	Unnamed Stream	Present		0.49	0.49		0.49	0.49						
Black Canyon	Weston Cr.	Black Canyon	Unknown	10.08		10.08									
	Bear River	Weston Cr.	Unknown	7.51		7.51									
	Black Canyon	Unnamed 103	Unknown	3.46		3.46									
Fivemile Creek-Bear River	Great Salt Lake	Bear River	Present	21.05		21.05	21.05		21.05						
	Bear River	Fivemile Cr.	Unknown	11.21	3.23	14.44									
	Fivemile Cr.	Unnamed 105	Unknown		1.62	1.62									
	Bear River	Unnamed 134	Unknown	0.10		0.10									
	Bear River		Unknown	2.42		2.42									
Hells Kitchen Canyon-Logan River	Logan River	Boss Canyon	Present		3.28	3.28		3.28	3.28						
	Logan River	**Corral Hollow**	Present		1.15	1.15		1.18	1.18						
	Logan River	**Hodge Nibley Cr.**	Present		2.93	2.93		2.93	2.93						
	Bear River	Logan River	Present		4.70	4.70		4.70	4.70	2019	High	2.5	1.8	256	0.9
	Logan River	**White Canyon**	Present		5.59	5.59		5.59	5.59						
	White Canyon	**Unnamed 139**	Present		0.90	0.90		0.90	0.90						
	Boss Canyon	Unnamed 140	Present		0.54	0.54		0.54	0.54						
Lower Battle Cr.	Bear River	Battle Cr.	Unknown	15.84		15.84									

Table 16. Continued.

				Historical stream length (km)			Occupied stream length (km)								
HUC12 Name	Parent stream	Stream name	BCT status	Private	Public	Total	Private	Public	Total	Year sampled	Abundance	Fish/ 100 m²	CV	Fish/ km	CV
Lower Mink Cr.	Mink Cr.	**Birch Cr.**	Present	4.13	3.76	7.88	4.13	3.76	7.88	2001	Low			14	1.4
	Birch Cr.	Mill Canyon	Unknown		0.63	0.63									
	Bear River	Mink Cr.	Present	8.88		8.88	8.88		8.88	2001	Low			4	2.6
	Birch Cr.	Unnamed 87	Unknown		1.47	1.47									
	Birch Cr.	Unnamed 121	Unknown		0.64	0.64									
Maple Cr.	Maple Cr.	Crooked Cr.	Unknown	2.47	6.44	8.92									
	Maple Cr.	Deep Cr.	Unknown	3.27	4.65	7.91									
	Cub Cr.	**Maple Cr.**	Present	10.29	3.71	14.00	10.29	2.95	13.24	2019	High	2.4	1.5	156	0.9
Middle Cub River	Bear River	**Cub River**	Present	10.86		10.86	17.88		17.88	2015	High			383	0.9
	Cub Cr.	**Foster Cr.**	Present	3.05	0.28	3.33	3.05	0.28	3.33	2001	Mod			60	N/A
	Sugar Cr.	Sawmill Spring	Unknown		0.36	0.36									
	Cub Cr.	**Sugar Cr.**	Present	4.76	4.04	8.80	4.76	3.26	8.02	2001	High			168	1
Oxford Slough-Deep Creek	Bear River	Deep Cr.	Unknown	21.34	2.05	23.39				2020				0	N/A
	Oxford Slough	Oxford Cr.	Unknown	7.24	2.48	9.72									
	Swan Lake Cr.	Stockton Cr.	Present	9.09	3.24	12.34	1.75	3.24	4.99	2019	High	2.5	0.3	112	0.9
Pullum Hollow-Bear River	Great Salt Lake	Bear River	Present	0.28		0.28	0.28		0.28						
Spring Cr.	Cub River	Spring Cr.	Unknown	6.68		6.68									
Squaw Springs-Deep Cr.	Twin Lakes Canal	Clifton Cr.	Unknown	5.05	0.16	5.21									
	Clifton Cr.	Unnamed 85	Unknown	4.59	0.32	4.91									
	Clifton Cr.	Unnamed 86	Unknown	1.49	0.22	1.71									
Station Creek-Bear River	Great Salt Lake	Bear River	Present	30.04	4.70	34.74	30.04	4.70	34.74						
	Bear River	Station Cr.	Present	4.63		4.63	4.63		4.63						
Stockton Cr.	Swan Lake Cr.	Stockton Cr.	Present	7.06	3.24	10.30	1.75	3.24	4.99	2019	High	2.5	0.3	112	0.9

Table 16. Continued.

				Historical stream length (km)			Occupied stream length (km)								
HUC12 Name	Parent stream	Stream name	BCT status	Private	Public	Total	Private	Public	Total	Year sampled	Abundance	Fish/ 100 m²	CV	Fish/ km	CV
Strawberry Cr.	Unnamed Stream	Mill Hollow	Unknown		0.07	0.07									
	Mink Cr.	Strawberry Cr.	Unknown	8.81	5.03	13.84									
Swan Lake	Swan Lake Cr.	Gooseberry Cr.	Unknown	7.32	2.26	9.58									
Upper Battle Cr.	Bear River	Battle Cr.	Unknown	16.11		16.11									
Upper Cub River	Cub Cr.	Carter Cr.	Unknown	1.41	2.62	4.03									
	Bear River	**Cub River**	Present	5.53	10.03	15.57	5.53	8.08	13.61	2015	High			383	0.9
	Cub River	Hillyard Canyon	Unknown		2.17	2.17									
	Cub River	Self Help Hollow	Unknown	0.70	0.49	1.20									
Upper Mink Cr.	Mink Cr.	Dry Cr.	Present	1.30	2.49	3.79	1.30	2.49	3.79	2001	High			165	1.2
	Bear River	Mink Cr.	Present	6.81	4.50	11.31	6.57		6.57	2001	Low			4	2.6
	Dry Cr.	South Fork Dry Cr.	Unknown		2.39	2.39									
Weston Cr.	Bear River	Weston Cr.	Unknown	21.49	2.66	24.14									
	Weston Cr.	Unnamed 101	Unknown	6.61		6.61									
	Unnamed 101	Unnamed 136	Unknown	0.06		0.06									
Middle Cub River	Bear River	Cub River	Present	7.02		7.02	7.02		7.02	2015	High			383	0.9
	Cub River	Worm Cr.	Unknown	31.26	6.29	37.55									
	Worm Cr.	Worm Cr. sic	Unknown	0.02		0.02									
			Total	**331.3**	**118.5**	**449.8**	**128.9**	**62.7**	**191.6**						

Table 17. Suggested conservation actions for Bonneville Cutthroat Trout in the Riverdale MU.

Stream Name	Status	Priority	Required actions	Timetable
Battle Creek	unknown	3	Conduct population surveys	5 – 10 years
Bear River (Riverdale)	**present**	**1**	**Monitor trends in fluvial Bonneville Cutthroat Trout and investigate the effects of nonnative fish species. Assess riparian and instream conditions; work with landowners to improve riparian and instream condition as well as connectivity, where necessary.**	**5 – 10 years**
Cub River	present	1	Monitor non-native trout populations. Consider nonnative trout removal. Maintain and improve fish passage infrastructure	5 - 10 years
Cub River	present	1	Investigate connectivity with the Bear River. Protect and improve riparian habitat address trail effects on riparian habitat, address dispersed campsite effects upon riparian areas, stabilize eroding streambanks in Cub River, reduce Brook Trout in Cub River. Consider altering current catchable Rainbow Trout stocking in Cub River with Bonneville Cutthroat Trout. Evaluate Brook Trout suppression or removal in Cub River. Conduct population survey on tributaries with unknown occupancy. Maintain and improve fish passage infrastructure to restore fluvial BCT contributions to the Cub River drainage. Seek opportunities for stream flow restoration.	5 - 10 years
Deep Creek	unknown	3	Conduct population surveys	5 –10 years
Fivemile Creek	unknown	3	Conduct population surveys	5 – 10 years
Gooseberry Creek	unknown	3	Conduct population surveys	5 – 10 years
Logan River	present	2	Assess riparian and instream conditions; work with landowners to improve riparian and instream condition as well as connectivity, where necessary.	5 –20 years
Mink Creek	present	1	Remove Brook Trout. Investigate barriers to fish migration, Mink Creek is likely the best spawning tributary in this MU for fluvial population. Conduct population surveys on tributaries with unknown occupancy. Seek land and streamflow protection opportunities.	5 – 20 years
Oxford Creek	unknown	3	Conduct population surveys	5 – 10 years
Stockton Creek	present	3	Conduct population surveys	5 – 10 years
Weston Creek	unknown	3	Conduct population surveys	5 – 10 years

Malad River MU

The Malad River MU encompasses all of the Malad River subbasin and its tributaries within Idaho, totaling approximately 347 km of historical stream habitat (Figure 18). Taxonomic studies suggest that the Bonneville Cutthroat Trout of the Malad River subbasin are of the more divergent "Great Basin" clade, distinguishing them from the Bonneville-Yellowstone clade found in the Bear River (Loxterman and Keeley 2012; Campbell et al. 2018). The Malad and Little Malad rivers originate at several springs along the east slope of the Pleasantview Hills, and form a confluence near Samaria, Idaho. The Malad River then flows south into Utah and parallels the Bear River for much of its course downstream of Cutler Dam. Historically, the Malad River joined the Bear River at the town of Corrine, UT near the termination of the Bear River at the Great Salt Lake. The Malad River MU also encompasses "sinks" drainages in the Curlew Valley—Deep and Black Pine creeks. Current information suggests that the Curlew Valley sinks have been isolated from the Malad River prior to Euro-American settlement and are likely absent of Bonneville Cutthroat Trout.

The Malad River MU contains approximately 40 streams with 347 km of potential habitat. Those tributaries include 39 km of public and 309 km of privately-accessible sections of streams (Table 18). The most substantial tributaries to the Malad River include the Little Malad River, Devil Creek, and Deep Creek. Stream surveys conducted in 2010–2020 identified approximately 93 km of occupied tributary habitat. Existing information suggests that the only occupied habitat occurs in the Deep Creek (i.e., First, Second, and Third creeks), Little Malad River (Dairy Creek) and Mill Creek drainages. The natural drainage of Mill Creek is actually within the range of Yellowstone Cutthroat Trout (connection to the Portneuf River); however, Mill Creek was diverted into Devil Creek for irrigation purposes, and now functions as part of the range of Bonneville Cutthroat Trout.

Water use and development, as well as livestock grazing result in the most substantial effects to Bonneville Cutthroat Trout in the Malad River MU, resulting in reduced habitat quality. Water use in this MU leads to lack of stream connectivity, reduction in water quality, and direct fish mortality through entrainment in diversions. There are eight substantial irrigation reservoirs within the MU: Crowthers Reservoir, Daniels Reservoir, Deep Creek Reservoir, Devil Creek Reservoir, Upper Pleasantview Reservoir, Samaria Lake, St. John Reservoir, and Stone Reservoir. Reservoirs within the Malad MU generally support warmwater fisheries and seasonal coldwater fisheries, with the exception of Deep Creek and Devil Creek Reservoir. Both of these reservoirs support two-story fisheries and limited populations of adfluvial Bonneville Cutthroat Trout. Until recently, adfluvial Bonneville Cutthroat Trout were often encountered in Daniels Reservoir as well; however, recent survey data, combined with a lack of angler reports, suggest that adfluvial Bonneville Cutthroat Trout are no longer present in Daniels Reservoir.

Habitat alteration across landscapes with intense livestock grazing (e.g., sloughing banks, sedimentation, high stream width to depth ratio, homogeneous annual riparian vegetation) is common throughout most of the MU. The area within this MU is used extensively for direct livestock and stored animal feed production. As such, valley bottoms and riparian areas are used extensively for grazing and hay crops.

Stream habitat conditions in headwater tributaries to Deep Creek and the Little Malad River are good, but it is thought that Bonneville Cutthroat Trout are probably absent from these areas. Within these subdrainages, the best habitat typically exists on federal lands administered by the Bureau of Land Management or US Forest Service. Currently, it is unknown whether natural or anthropogenic circumstances have resulted in absence of Bonneville Cutthroat Trout from the uppermost portions of these drainages. Future monitoring should employ more robust sampling to verify absence of Bonneville Cutthroat Trout in tributaries with high habitat quality in this MU. Monitoring should be coupled with physical habitat assessments to further evaluate factors affecting occurrence and relative abundance in this MU.

Crowthers Reservoir CCBY Glenna Gomez

Fisheries for Bonneville Cutthroat Trout are nonexistent in much of the MU and relatively underutilized in streams where Bonneville Cutthroat Trout do occur (i.e., Deep Creek). Adfluvial Bonneville Cutthroat Trout in Devil Creek and Deep Creek reservoirs display low abundance and angling encounters are incidental to effort targeting other coldwater salmonids in those systems. Put-and-take fisheries for triploid catchable-size Rainbow Trout are supported in most irrigation reservoirs in the MU, and a very popular put-grow-and-take Rainbow Trout fishery is provided in Daniels Reservoir. Currently, all Rainbow Trout stocked into this MU are sterilized to avoid naturalization and introgression with native Bonneville Cutthroat Trout. Naturalized populations of Rainbow Trout exist in portions of the MU; however, much of the remaining stream habitat in the MU is unsuitable for any coldwater salmonid species.

Population status for most of the tributary habitat as the mainstem Malad and Little Malad rivers has been updated since the 2007 plan (Table 18). Bonneville Cutthroat Trout occupancy was evaluated for 12 streams during 2019 and 2020. Of those streams, Bonneville Cutthroat Trout were only detected at Devil and Dairy creeks. In addition, Bonneville Cutthroat Trout were not detected at twelve streams (Table 18). Management direction in this MU should focus on the additional occurrence and habitat quality data through spatially robust sampling and monitoring (Table 19). Fishery monitoring efforts in the Malad River MU occur biennially and are focused on three index tributaries (i.e., First, Second, and Third creeks). In addition to index stream monitoring, sampling occurs opportunistically throughout the MU to assess Bonneville Cutthroat Trout occupancy, thus filling knowledge gaps about status and distribution.

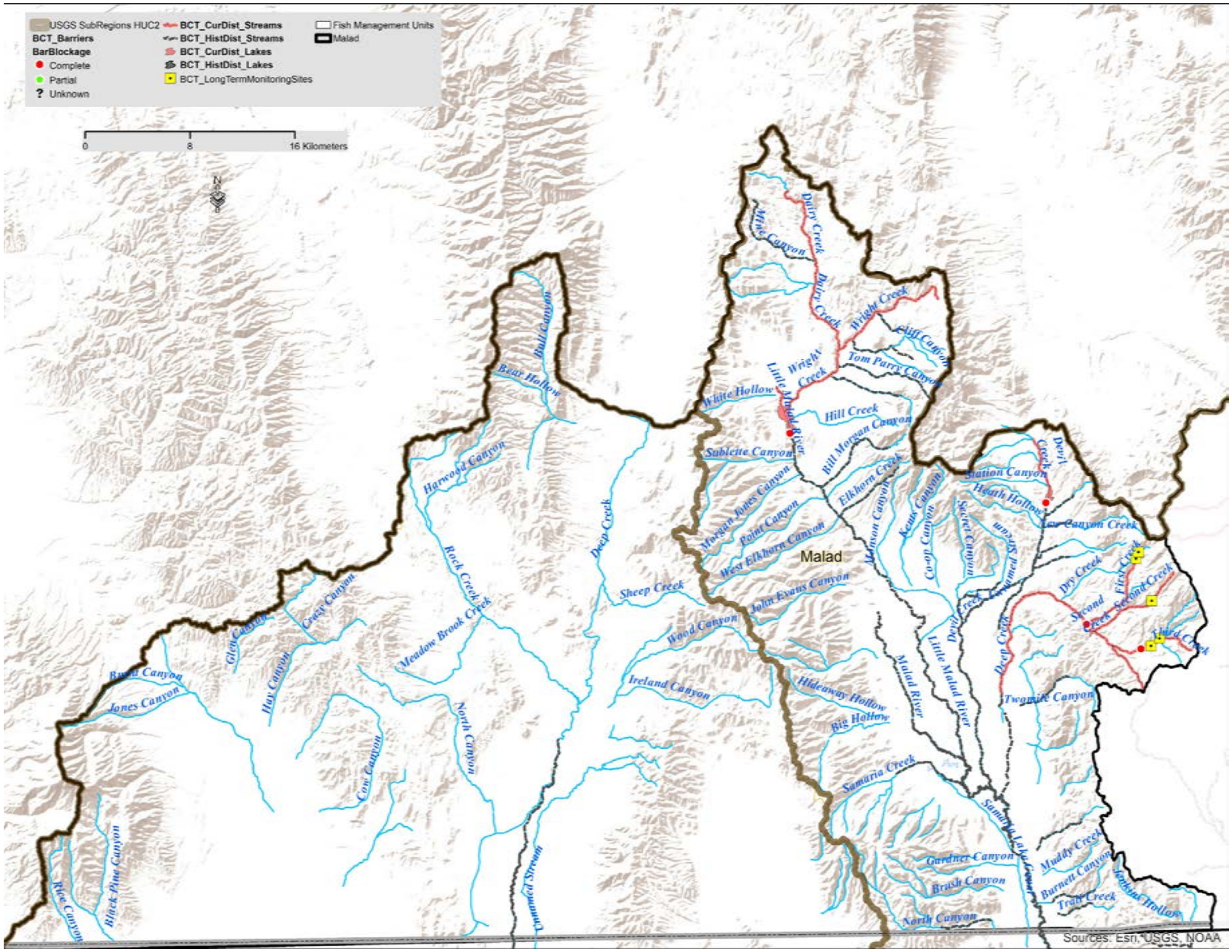


Figure 18. Map depicting the Malad MU which includes the Malad River and tributaries between its headwaters and the Idaho-Utah state line. In addition, the Malad MU encompasses streams within the Curlew Valley and southern Black Pine region, west of the Malad River proper. Bonneville Cutthroat Trout distribution is shown as historically occupied (black lines), current (red), and unknown (blue).

Table 18. Population status, abundance, and uniformity index for Bonneville Cutthroat Trout in the Malad MU. Streams and tributaries which are contained within the conservation populations identified in Table 1 are shown in bold font.

				Historical stream length (km)			Occupied stream length (km)								
HUC12 Name	Parent stream	Stream name	BCT status	Private	Public	Total	Private	Public	Total	Year sampled	Abundance	Fish/ 100 m²	CV	Fish/ km	CV
Big Hollow-Malad River	Bear River	Malad River	Unknown	14.61		14.61									
Brush Canyon-Malad River	Malad River	Burnett Canyon	Unknown	2.23	1.61	3.83									
	Malad River	Henderson Cr.	Unknown	2.27	2.53	4.80									
	Bear River	Malad River	Unknown	21.90		21.90									
	Malad River	Trail Cr.	Unknown	2.36	0.76	3.12									
Dairy Cr.	Wright Cr.	Dairy Cr.	Present	14.82	1.39	16.20	14.82	1.39	16.20	2020	Mod			33	1.6
	Dairy Cr.	Mine Canyon	Unknown	8.18	0.75	8.93									
Daniels Reservoir	Malad River	Little Malad River	Present	4.33		4.33	4.33		4.33						
Elkhorn Creek-Little Malad River	Little Malad River	Bill Morgan Canyon	Unknown	5.71	2.49	8.19									
	Little Malad River	Elkhorn Cr.	Extirpated	3.64	2.61	6.26									
	Malad River	Little Malad River	Unknown	9.39		9.39									
Kents Canyon-Little Malad River	Malad River	Little Malad River	Unknown	30.01		30.01									
Lower Deep Cr.	Malad River	Deep Cr.	Present	23.76		23.76	14.91		14.91						
	Deep Cr.	Twomile Cr.	Extirpated	1.96	2.90	4.86									
Lower Devil Cr.	Devil Cr.	Davis Cr.	Unknown	6.26		6.26									
	Malad River	Devil Cr.	Unknown	28.99		28.99									
	Devil Cr.	Evans Cr.	Unknown	3.11		3.11									
	Devil Cr.	Rattlesnake Cr.	Unknown	2.86		2.86									
	Devil Cr.	Spring Cr.	Unknown	5.46		5.46									
North Canyon	Malad River	North Canyon	Unknown	4.02		4.02									
North Canyon-Malad River	Bear River	Malad River	Unknown	11.03		11.03									

Table 18. Continued.

				Historical stream length (km)			Occupied stream length (km)								
HUC12 Name	**Parent stream**	**Stream name**	**BCT status**	**Private**	**Public**	**Total**	**Private**	**Public**	**Total**	**Year sampled**	**Abundance**	**Fish/ 100 m²**	**CV**	**Fish/ km**	**CV**
Samaria Creek-Malad River	Bear River	Malad River	Unknown	10.11		10.11									
	Malad River	Samaria Cr.	Unknown	7.47		7.47									
Stone Reservoir-Deep Cr.	Great Salt Lake	Deep Cr.	Extirpated	21.50	1.48	22.98									
Upper Deep Cr.	Malad River	Deep Cr.	Present	6.80	1.87	8.67	7.28	1.87	9.15						
	Deep Cr.		Unknown	0.48		0.48									
	Deep Cr.	**First Cr.**	Present	3.45	1.17	4.62	3.45	3.48	6.92	2019	High	4.9		112	-
	Deep Cr.	**Second Cr.**	Present	5.12	1.98	7.11	5.12	3.51	8.63	2019	Low	1.2		30	-
	Deep Cr.	**Third Cr**	Present	2.67	4.85	7.52	2.67	4.85	7.52	2019	High	3.4	0	294	0.2
	Unnamed 144	Unnamed 143	Unknown		0.05	0.05									
	Deep Cr.	Unnamed 144	Unknown		0.01	0.01									
Upper Devil Cr.	Devil Cr.	Campbell Cr.	Unknown	2.88		2.88									
	Malad River	Devil Cr.	Present	7.75		7.75	5.72		5.72						
	Devil Creek	New Canyon Cr.	Unknown	2.28		2.28									
Wright Cr.	Reed Canyon	Cliff Canyon	Unknown	1.10		1.10									
	Wright Cr.	Farmers Canyon	Unknown	1.71	1.57	3.27									
	Wright Cr.	Indian Mill Cr.	Unknown	4.77	1.22	5.99									
	Wright Cr.	Reed Canyon	Unknown	2.87		2.87									
	Wright Cr.	Tom Perry Canyon	Unknown	4.77	3.97	8.73									
	Little Malad River	Wright Cr.	Present	14.31	4.77	19.09	14.31	4.77	19.09						
	Cliff Canyon	Unnamed 146	Unknown	1.54	0.55	2.10									
			Total	**308.5**	**38.5**	**347.0**	**72.6**	**19.9**	**92.5**						

Table 19. Suggested conservation actions for Bonneville Cutthroat Trout in the Malad River MU. Bold fonts indicate streams containing segments that support core or conservation populations.

Stream Name	Status	Priority	Required actions	Timetable
Burnett Creek	unknown	3	Conduct population surveys, assess riparian and in-stream habitat conditions and implement habitat improvement projects where needed.	5 – 10 years
Dairy Creek	present	3	Conduct population surveys, assess riparian and in-stream habitat conditions and implement habitat improvement projects where needed.	5 – 10 years
Deep Creek-Curlew	unknown	3	Conduct population surveys, assess riparian and in-stream habitat conditions and implement habitat improvement projects where needed.	5 – 10 years
Deep Creek-Malad	**present**	**1**	**Remove Brook Trout.** **Investigate connectivity with Deep Creek. Investigate the potential to establish an adfluvial population of Bonneville Cutthroat Trout in Deep Creek Reservoir.** **Assess riparian and in-stream habitat conditions and implement habitat improvement projects where needed. Conduct population surveys on tributaries with unknown occupancy**	**10 years**
Devil Creek	present	3	Conduct population surveys, assess riparian and in-stream habitat conditions and implement habitat improvement projects where needed.	5 –10 years
Elkhorn Creek	unknown	3	Conduct population surveys, assess riparian and in-stream habitat conditions and implement habitat improvement projects where needed.	5 – 10 years
Indian Mill Creek	no fish	3	Conduct population surveys, assess riparian and in-stream habitat conditions and implement habitat improvement projects where needed.	5 – 10 years
Little Malad River	unknown	3	Conduct population surveys, assess riparian and in-stream habitat conditions and implement habitat improvement projects where needed. Explore adfluvial Bonneville Cutthroat Trout presence in Daniels Reservoir and opportunities to establish Bonneville Cutthroat Trout fishery.	5 –10 years
Malad River	unknown	3	Conduct population surveys, assess riparian and in-stream habitat conditions and implement habitat improvement projects where needed.	5 –10 years
Meadow Brook	unknown	3	Conduct population surveys, assess riparian and in-stream habitat conditions and implement habitat improvement projects where needed.	5 – 10 years
New Canyon Creek	unknown	3	Conduct population surveys, assess riparian and in-stream habitat conditions and implement habitat improvement projects where needed.	5 – 10 years
Rock Creek	unknown	3	Conduct population surveys, assess riparian and in-stream habitat conditions and implement habitat improvement projects where needed.	5 – 10 years
Samaria Creek	unknown	3	Conduct population surveys, assess riparian and in-stream habitat conditions and implement habitat improvement projects where needed.	5 – 10 years
Wright Creek	unknown	3	Conduct population surveys, assess riparian and in-stream habitat conditions and implement habitat improvement projects where needed.	5 – 10 years

Outreach and Education

Bear Lake Bonneville Cutthroat Trout CCBY IDAHO FISH AND GAME

Public support and knowledge of the importance of Bonneville Cutthroat Trout conservation efforts should be increased through education and outreach efforts. Fisheries staff will continue to work cooperatively with IDFG Communications Bureau staff to distribute news and information regarding current Bonneville Cutthroat Trout conservation efforts. Informational content may include a variety of articles, news releases, photos and videos distributed across IDFG's channels including website, email and various social media platforms. Content should focus on the importance of maintaining populations of native species, water quality, intact habitat, and also highlight specific programs addressing these conservation needs. Additional messaging should address illegal species introductions, risks of private ponds to native species, and threats to fish habitat. IDFG will also work with other partners including the ECC, state, tribal and federal agencies, and NGOs, to look for outreach opportunities to highlight cooperative Bonneville Cutthroat Trout restoration and conservation projects.

In addition to Fisheries and Communication staff, Conservation Officers often play a critical role in public outreach and education, raising awareness of fisheries conservation efforts as well as fishing rules. Enforcement staff often interact directly with anglers and therefore have great potential to provide information on the importance of native trout and current IDFG efforts to conserve them.

PacifiCorp also continues to be active in outreach and education efforts. In cooperation with the ECC, PacifiCorp had developed and installed a number of kiosks throughout the Bear River system. These kiosks describe the importance of Bonneville Cutthroat Trout as a native trout species and describe PacifiCorp's numerous efforts to help conserve them.

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Appendices

Appendix A. IDFG-sponsored projects that have been funded by the PacifiCorp settlement agreement funding available for habitat restoration.

Year	Project	Requested Funds
2006	Irrigation Inventory Study	$45,530
2008	Screen Tender	$14,000
2008	Stauffer Creek Fence	$112,320
2009	Bailey Creek Headwaters Fencing	$5,000
2009	Screen Tender	$12,000
2010	Cub River Telemetry Study	$5,000
2010	Whiskey and Trout Creek Restoration	$40,000
2010	Screen Tender	$12,000
2011	Kackley Springs Fine Sediment Removal	$58,067
2011	North Hoopes Creek Fish Screen	$10,000
2011	Screen Tender	$12,000
2012	Thatcher MU Canal Entrainment Study	$8,200
2012	Harris Spring Repairs	$7,500
2012	Screen Tender	$12,000
2013	Pearl Creek Reconnect Engineering	$25,904
2013	Screen Repair	$20,000
2013	Screen Tender	$12,000
2014	Bonneville Cutthroat Trout Broodstock Ponds	$178,871
2014	Harris Spring Habitat Restoration	$70,542
2014	Stauffer Culvert Replacement	$23,436
2014	Screen Tender	$12,000
2015	Cub River Flow Monitoring	$10,000
2015	SNP Markers for Bonneville Cutthroat Trout	$20,000
2015	Whiskey Creek Spawning Channel	$58,055
2015	Screen Tender	$12,000
2016	Cub River Bonneville Cutthroat Trout Migration and Entrainment Study	$32,814
2016	Screen Repair	$10,000
2016	Harris Spring Renovation	$25,000
2016	Screen Tender	$12,000
2017	Screen Tender	$12,000
2018	Screen Tender and Repairs	$16,700
2019	Screen Tender	$12,000
2019	Screen Repair	$8,000
2020	Screen Tender	$30,000
2020	Screen Repair	$5,000
2020	Bonneville Cutthroat Trout Broodstock Pond Tarps	$1,482
2020	Thomas Fork Fish Ladder Repair	$6,000
	Total	$967,421

Appendix B. Fish stocking history for the Bear River, Malad river and their tributaries. Total number (cumulative) of fish stocked by species from 1913 to 2020. These records represent information available from IDFG historical archives and current databases. While information is generally accurate, record keeping between 1913-1960s was incomplete. Therefore, this table is a conservative summary of actual stocking effort.

Water	County	Species	Total
Alder Creek	Caribou	Bear River Cutthroat Trout	2,819
Alexander Reservoir	Caribou	Channel Catfish	335,862
	Caribou	Cutthroat	40,032
	Caribou	Hayspur Rainbow Trout	52,515
	Caribou	Hayspur Rainbow Triploid Trout	10,166
	Caribou	Henrys Lake Cutthroat	1,250
	Caribou	Largemouth Bass	505
	Caribou	Shepard Of The Hills Rainbow	1,505
	Caribou	Triploid Troutlodge Kamloop	67,468
	Caribou	Unspecified Crappie	1,200
	Caribou	Unspecified Rainbow	105,617
	Caribou	White Crappie	2,530
Bailey Creek	Caribou	Bear River Cutthroat	13,215
Bear Lake	Bear Lake	Blueback Salmon	170,000
	Bear Lake	Brook Trout	61,600
	Bear Lake	Cutthroat	3,251,359
	Bear Lake	Lake Trout	1,292,835
	Bear Lake	Redband Trout	75,000
	Bear Lake	Sockeye Salmon	45,000
	Bear Lake	Steelhead X Cutthroat	94,080
	Bear Lake	Unspecified Cutthroat	45,748
	Bear Lake	Unspecified Rainbow	820,341
Bear River	Caribou	Bear River Cutthroat	129,865
	Franklin		24,000
	Caribou	Blue Catfish	34,018
	Franklin	Kokanee	238,000
	Franklin	Brook Trout	6,000
	Bear Lake	Brown Trout	96,576
	Caribou		255,999
	Franklin		312,994
	Bear Lake	Channel Catfish	6,977
	Caribou		181,377
	Franklin		10,000
	Bear Lake	Cutthroat	808,686
	Caribou		410,568
	Franklin		109,500
	Bear Lake	Domestic Kamloops	2,500
	Caribou		14,800
	Franklin		14,560
	Caribou	Hayspur Kamloops Triploid	750
	Bear Lake	Hayspur Rainbow	21,623

Appendix B. Continued.

Water	County	Species	Total
Bear River	Caribou		120,931
	Franklin		85,297
	Bear Lake	Hayspur Rainbow Triploid	1,360
	Caribou		38,434
	Franklin		39,809
	Bear Lake	Mt Lassen Rainbow	1,250
	Caribou		7,750
	Franklin		7,013
	Bannock	Redband Trout	18,000
	Bear Lake		12,500
	Caribou		104,470
	Franklin		71,840
	Bear Lake	Shepard Of The Hills Rainbow	6,330
	Caribou		45,718
	Franklin		9,535
	Caribou	Smallmouth Bass	2,200
	Franklin		5,000
	Bear Lake	Triploid Troutlodge Kamloop	2,150
	Caribou		91,356
	Franklin		198,270
	Bear Lake	Troutlodge Rainbow Trout	1,752
	Caribou		9,767
	Franklin		8,015
	Bear Lake	Unspecified Rainbow	127,142
	Caribou		36,200
	Bear Lake	Unspecified Rainbow	202,565
	Caribou		2,286,659
	Franklin		1,634,584
Beaver Creek	Franklin	Brook Trout	8,070
	Bear Lake	Cutthroat	30,935
Bennington Canyon Creek	Bear Lake	Unspecified Rainbow	3,540
Bennington Rearing Pond	Bear Lake	Unspecified Rainbow	85,000
Bennington Release Pond	Bear Lake	Unspecified Rainbow	3,200
Big Creek	Bear Lake	Brook Trout	22,500
	Bear Lake	Unspecified Rainbow	25,528
Birch Creek	Franklin	Fine Spotted Cutthroat	1,005
Bloomington Creek	Bear Lake	Brook Trout	108,075
	Bear Lake	Cutthroat	17,480
	Bear Lake	Hayspur Rainbow	14,483
	Bear Lake	Hayspur Rainbow Triploid	7,239
	Bear Lake	Redband Trout	20,000
	Bear Lake	Shepard Of The Hills Rainbow	3,381
	Bear Lake	Triploid Troutlodge Kamloop	13,028
	Bear Lake	Unspecified Rainbow	537,455

Appendix B. Continued.

Water	County	Species	Total
Bloomington Lake	Bear Lake	Bear Lake Cutthroat	3,000
	Bear Lake	Bear River Cutthroat	7,116
	Bear Lake	Cutthroat	293,950
	Bear Lake	Fine Spotted Cutthroat	32,008
	Bear Lake	Hayspur Rainbow Triploid	4,101
	Bear Lake	Henrys Lake Cutthroat	10,000
	Bear Lake	Triploid Troutlodge Kamloop	33,556
	Bear Lake	Unspecified Rainbow	90,021
Campbell Creek	Caribou	Cutthroat	4,000
Caribou Creek	Caribou	Bear River Cutthroat	1,515
Clifton Creek	Franklin	Brook Trout	1,750
	Franklin	Unspecified Rainbow	7,325
Condie Reservoir	Franklin	Bluegill	2,032
	Franklin	Cutthroat	6,300
	Franklin	Domestic Kamloops	1,950
	Franklin	Hayspur Rainbow	53,415
	Franklin	Hayspur Rainbow Triploid	17,089
	Franklin	Mt Lassen Rainbow	3,900
	Franklin	Rainbow X Cutthroat	8,000
	Franklin	Shepard Of The Hills Rainbow	18,281
	Franklin	Tiger Muskie	861
	Franklin	Troutlodge Rainbow Trout	8,120
	Franklin	Unspecified Rainbow	402,865
Cottonwood Creek	Caribou	Bear River Cutthroat	1,480
	Franklin		20,000
	Franklin	Brook Trout	12,000
	Franklin	Brown Trout	2,057
	Franklin	Cutthroat	326,072
	Franklin	Fine Spotted Cutthroat	5,025
	Franklin	Unspecified Cutthroat	28,852
Crowthers Reservoir	Oneida	Brook Trout	5,000
	Oneida	Cutthroat	11,479
	Oneida	Domestic Kamloops	10,909
	Oneida	Hayspur Kamloops Triploid	2,325
	Oneida	Hayspur Rainbow	22,078
	Oneida	Hayspur Rainbow Triploid	18,122
	Oneida	Mt Lassen Rainbow	24,183
	Oneida	Triploid Troutlodge Kamloop	68,383
	Oneida	Troutlodge Rainbow Trout	9,801
	Oneida	Unspecified Cutthroat	35,401
	Oneida	Unspecified Rainbow	335,213
Cub River	Franklin	Bear Lake Cutthroat	4,680
	Franklin	Brook Trout	177,498
	Franklin	Cutthroat	904,482
	Franklin	Domestic Kamloops	500

Appendix B. Continued.

Water	County	Species	Total
Cub River	Franklin	Hayspur Rainbow	26,320
	Franklin	Hayspur Rainbow Triploid	15,758
	Franklin	Henrys Lake Cutthroat	3,000
	Franklin	Shepard Of The Hills Rainbow	6,759
	Franklin	Triploid Troutlodge Kamloop	57,808
	Franklin	Unspecified Cutthroat	125,290
	Franklin	Unspecified Rainbow	480,287
Cub River Pond	Franklin	Cutthroat	20,400
	Franklin	Unspecified Rainbow	27,000
Dairy Creek	Oneida	Arlee Rainbow	500
	Oneida	Brook Trout	20,250
	Oneida	Cutthroat	16,000
Daniels Reservoir	Oneida	Bear Lake Cutthroat	11,250
	Oneida	Bear River Cutthroat	28,360
	Oneida	Cutthroat	894,620
	Oneida	Domestic Kamloops	72,198
	Oneida	Gammarus	-
	Oneida	Hayspur Rainbow	85,383
	Oneida	Hayspur Rainbow Triploid	153,470
	Oneida	Lahontan Cutthroat	95,938
	Oneida	Mt Lassen Rainbow	53,852
	Oneida	Mt Whitney Rainbow	17,500
	Oneida	Rainbow X Cutthroat	147,698
	Oneida	Triploid Troutlodge Kamloop	308,851
	Oneida	Troutlodge Rainbow Trout	56,012
	Oneida	Unspecified Rainbow	461,271
Davis Creek	Oneida	Cutthroat	4,424
	Oneida	Unspecified Cutthroat	1,888
Dayton Creek	Franklin	Brook Trout	1,500
Deep Creek	Oneida	Bear River Cutthroat	15,000
	Oneida	Brook Trout	50,791
	Oneida	Cutthroat	60,620
	Franklin	Unspecified Rainbow	900
	Oneida		149,607
Deep Creek Reservoir	Oneida	Cutthroat	987,632
	Oneida	Domestic Kamloops	115,660
	Oneida	Early Spawner Kokanee	100,820
	Oneida	Hayspur Kamloops Triploid	27,100
	Oneida	Hayspur Rainbow	22,502
	Oneida	Hayspur Rainbow Triploid	32,897
	Oneida	Lake Trout	4,232
	Oneida	Late Spawner Kokanee	4,500
	Oneida	Mt Lassen Rainbow	61,002
	Oneida	Mt Whitney Rainbow	16,800
	Oneida	October Spawner Kokanee	45,040

Appendix B. Continued.

Water	County	Species	Total
Deep Creek Reservoir	Oneida	Rainbow X Cutthroat	6,996
	Oneida	Triploid Troutlodge Kamloop	231,764
	Oneida	Troutlodge Rainbow Trout	75,153
	Oneida	Unspecified Cutthroat	40,703
	Oneida	Unspecified Rainbow	456,572
Densmore Creek	Caribou	Bear River Cutthroat	3,540
Devil Creek	Oneida	Bear River Cutthroat	15,000
	Oneida	Brook Trout	20,000
	Oneida	Cutthroat	415,001
	Oneida	Unspecified Cutthroat	43,151
	Oneida	Unspecified Rainbow	387,063
Devils Creek Reservoir	Oneida	Brook Trout	500
	Oneida	Cutthroat	634,400
	Oneida	Domestic Kamloops	104,965
	Oneida	Early Spawner Kokanee	313,318
	Oneida	Hayspur Kamloops Triploid	52,522
	Oneida	Hayspur Rainbow	69,002
	Oneida	Hayspur Rainbow Triploid	84,554
	Oneida	Lake Trout	8,420
	Oneida	Late Spawner Kokanee	6,701
	Oneida	Mt Lassen Rainbow	60,595
	Oneida	October Spawner Kokanee	37,955
	Oneida	Rainbow X Cutthroat	9,010
	Oneida	Shepard Of The Hills Rainbow	3,505
	Oneida	Splake	3,414
	Oneida	Triploid Troutlodge Kamloop	243,836
	Oneida	Troutlodge Rainbow Trout	77,455
	Oneida	Unspecified Rainbow	426,074
	Oneida	Unspecified Cutthroat	9,525
Dingle Gravel Pond	Bear Lake	Brook Trout	2,000
	Bear Lake	Domestic Kamloops	2,000
	Bear Lake	Hayspur Rainbow	16,906
	Bear Lake	Hayspur Rainbow Triploid	15,618
	Bear Lake	Mt Lassen Rainbow	2,000
	Bear Lake	Triploid Troutlodge Kamloop	25,121
	Bear Lake	Troutlodge	2,000
	Bear Lake	Unspecified Rainbow	1,000
Dry Creek	Bear Lake	Cutthroat	20,911
	Bear Lake	Unspecified Rainbow	7,500
Eight Mile Creek	Bear Lake	Brook Trout	110,512
	Caribou		174,074
	Caribou	Unknown Species	2,000
	Bear Lake	Unspecified Rainbow	29,962
	Caribou		59,574

Appendix B. Continued.

Water	County	Species	Total
Eightmile Creek	Caribou	Bear River Cutthroat	19,500
	Caribou	Brook Trout	22,267
	Caribou	Hayspur Rainbow	15,727
	Caribou	Hayspur Rainbow Triploid	8,242
	Caribou	Shepard Of The Hills Rainbow	2,613
	Caribou	Triploid Troutlodge Kamloop	19,569
	Caribou	Unspecified Rainbow	88,156
Elkhorn Creek	Oneida	Unspecified Rainbow	2,475
First Creek	Oneida	Cutthroat	18,496
	Oneida	Unspecified Rainbow	4,531
Fish Haven Canyon	Bear Lake	Bear Lake Cutthroat	47,700
	Bear Lake	Cutthroat	7,158
Fish Haven Creek (Bear Lake)	Bear Lake	Brook Trout	46,669
	Bear Lake	Cutthroat	12,445
Foster Reservoir	Franklin	Arlee Rainbow	206
	Franklin	Domestic Kamloops	1,000
	Franklin	Hayspur Kamloops Triploid	5,220
	Franklin	Hayspur Rainbow	29,647
	Franklin	Hayspur Rainbow Triploid	34,236
	Franklin	Mt Lassen Rainbow	3,000
	Franklin	Rainbow X Cutthroat	4,800
	Franklin	Shepard Of The Hills Rainbow	11,561
	Franklin	Triploid Troutlodge Kamloop	118,443
	Franklin	Troutlodge Rainbow Trout	4,000
	Franklin	Unspecified Rainbow	1,000,610
Georgetown Creek	Bear Lake	Brook Trout	206,995
	Bear Lake	Cutthroat	142,920
	Bear Lake	Domestic Kamloops	750
	Bear Lake	Hayspur Rainbow	10,255
	Bear Lake	Hayspur Rainbow Triploid	6,281
	Bear Lake	Perch	57,190
	Bear Lake	Redband Trout	388,183
	Bear Lake	Shepard Of The Hills Rainbow	1,310
	Bear Lake	Triploid Troutlodge Kamloop	6,612
	Bear Lake	Unspecified Rainbow	173,737
Gibbons Lake	Franklin	Unspecified Rainbow	4,013
Gibson Lake	Franklin	Brook Trout	800
	Franklin	Unspecified Rainbow	6,493
Giraffe Creek	Bear Lake	Cutthroat	21,499
Glendale Reservoir	Franklin	Black Crappie	500
	Franklin	Domestic Kamloops	2,000
	Franklin	Hayspur Rainbow	66,451
	Franklin	Hayspur Rainbow Triploid	33,383
	Franklin	Mt Lassen Rainbow	7,750
	Franklin	Rainbow X Cutthroat	30,404

Appendix B. Continued.

Water	County	Species	Total
Glendale Reservoir	Franklin	Shepard Of The Hills Rainbow	19,510
	Franklin	Triploid Troutlodge Kamloop	139,734
	Franklin	Troutlodge Rainbow Trout	7,001
	Franklin	Unspecified Crappie	400
	Franklin	Unspecified Rainbow	1,114,430
	Franklin	White Crappie	230
Grace Rearing Pond	Caribou	Cutthroat	45,000
	Bannock	Redband Trout	5,000
	Bannock	Unspecified Rainbow	19,040
	Caribou		199,750
Harris Spring	Caribou	Bear River Cutthroat	5,136
Hart Pond	Franklin	Unspecified Rainbow	220
Hobbs Pond	Franklin	Largemouth Bass	15
	Franklin	Perch	50
Indian Mill Creek	Oneida	Unspecified Rainbow	10,470
Jack Crane	Bear Lake	Unspecified Rainbow	2,656
Johnson Reservoir	Franklin	Domestic Kamloops	900
	Franklin	Hayspur Rainbow	25,957
	Franklin	Hayspur Rainbow Triploid	7,787
	Franklin	Mt Lassen Rainbow	10,400
	Franklin	Rainbow X Cutthroat	4,800
	Franklin	Shepard Of The Hills Rainbow	12,427
	Franklin	Tiger Muskie	684
	Franklin	Triploid Troutlodge Kamloop	35,786
	Franklin	Unspecified Rainbow	244,023
Kackley Springs	Caribou	Bear River Cutthroat	18,407
Kelly Park Pond	Caribou	Domestic Kamloops	1,750
	Caribou	Hayspur Rainbow	14,225
	Caribou	Hayspur Rainbow Triploid	4,678
	Caribou	Mt Lassen Rainbow	500
	Caribou	Triploid Troutlodge Kamloop	29,325
	Caribou	Troutlodge	500
	Caribou	Unspecified Rainbow	1,251
Kids Pond-Preston	Franklin	Unspecified Crappie	3,500
L F Georgetown River	Bear Lake	Brook Trout	4,656
Lamont Reservoir	Franklin	Bluegill	200
	Franklin	Cutthroat	16,714
	Franklin	Domestic Kamloops	1,600
	Franklin	Early Spawner Kokanee	15,402
	Franklin	Gammarus	-
	Franklin	Hayspur Kamloops Triploid	4,680
	Franklin	Hayspur Rainbow	36,286
	Franklin	Hayspur Rainbow Triploid	24,986
	Franklin	Largemouth Bass	1,000
	Franklin	Mt Lassen Rainbow	3,400

Appendix B. Continued.

Water	County	Species	Total
Lamont Reservoir	Franklin	Rainbow X Cutthroat	23,945
	Franklin	Shepard Of The Hills Rainbow	10,634
	Franklin	Tiger Muskie	998
	Franklin	Triploid Troutlodge Kamloop	68,700
	Franklin	Troutlodge Rainbow Trout	4,499
	Franklin	Unspecified Rainbow	1,137,773
Ledge Creek	Bannock	Brook Trout	40,000
	Caribou		81,944
	Caribou	Rainbow Brood Stock	300
	Caribou	Redband Trout	2,250
	Caribou	Unspecified Rainbow	32,036
Ledger Creek	Caribou	Brook Trout	14,250
	Caribou	Hayspur Rainbow	4,163
	Caribou	Unspecified Rainbow	150
Lefeure Pond	Franklin	Largemouth Bass	15
	Franklin	Perch	50
Left Hand Fork Georgetown Canyon	Bear Lake	Bear River Cutthroat	3,000
Legacy Lake	Franklin	Triploid Troutlodge Kamloop	3,521
Liberty Creek	Bear Lake	Brook Trout	3,333
	Bear Lake	Unspecified Rainbow	20,131
Little Beaver Creek	Bear Lake	Cutthroat	2,163
	Bear Lake	Unspecified Rainbow	6,354
Little Creek	Bear Lake	Unspecified Rainbow	16,620
Little Malad River	Oneida	Brook Trout	54,830
	Oneida	Channel Catfish	999
	Oneida	Cutthroat	65,000
	Oneida	Hayspur Rainbow	4,850
	Oneida	Unspecified Rainbow	258,902
Little St Charles Creek	Bear Lake	Unspecified Rainbow	6,000
Little Valley Reservoir	Bear Lake	Bear Lake Cutthroat	14,790
	Bear Lake	Bear River Cutthroat	6,000
	Bear Lake	Fine Spotted Cutthroat	3,015
	Bear Lake	Hayspur Rainbow	18,848
	Bear Lake	Shepard Of The Hills Rainbow	5,600
	Bear Lake	Triploid Troutlodge Kamloop	23,654
	Bear Lake	Unspecified Rainbow	25,532
Lower Pleasantview Reservoir	Oneida	Domestic Kamloops	5,070
	Oneida	Early Spawner Kokanee	5,414
	Oneida	Hayspur Rainbow	5,603
	Oneida	Mt Lassen Rainbow	4,400
	Oneida	Mt Whitney Rainbow	2,860
	Oneida	Rainbow X Cutthroat	20,640
	Oneida	Tiger Muskie	100
	Oneida	Unspecified Rainbow	53,428

Appendix B. Continued.

Water	County	Species	Total
Malad River	Oneida	Brook Trout	30,830
	Oneida	Channel Catfish	6,417
	Oneida	Cutthroat	49,113
	Oneida	Redband Trout	9,460
	Oneida	Unspecified Rainbow	179,268
Maple Creek	Franklin	Brook Trout	10,000
	Franklin	Cutthroat	46,044
	Franklin	Unspecified Rainbow	28,250
Miles Creek	Bear Lake	Cutthroat	1,875
Mill Creek	Bear Lake	Brook Trout	17,572
	Bear Lake	Cutthroat	48,117
	Bear Lake	Triploid Troutlodge Kamloop	2,250
	Bear Lake	Unspecified Rainbow	3,900
Mink Creek	Franklin	Brook Trout	97,000
	Franklin	Cutthroat	254,320
	Franklin	Unspecified Cutthroat	45,720
	Franklin	Unspecified Rainbow	265,849
Mink River	Franklin	Brook Trout	6,000
	Franklin	Cutthroat	15,600
Montpelier	Bear Lake	Unspecified Rainbow	17,500
Montpelier Creek	Bear Lake	Bear Lake Cutthroat	113,011
	Bear Lake	Bear River Cutthroat	3,000
	Bear Lake	Brook Trout	179,033
	Bear Lake	Cutthroat	197,910
	Bear Lake	Hayspur Rainbow	32,894
	Bear Lake	Hayspur Rainbow Triploid	15,502
	Bear Lake	Redband Trout	13,333
	Bear Lake	Shepard Of The Hills Rainbow	10,727
	Bear Lake	Triploid Troutlodge Kamloop	57,501
	Bear Lake	Unspecified Rainbow	970,135
	Caribou		5,930
Montpelier Pond	Bear Lake	Domestic Kamloops	1,610
	Bear Lake	Hayspur Rainbow	6,000
	Bear Lake	Mt Lassen Rainbow	500
	Bear Lake	Triploid Troutlodge Kamloop	500
	Bear Lake	Unspecified Rainbow	406,515
Montpelier Rearing Pond	Bear Lake	Domestic Kamloops	750
	Bear Lake	Hayspur Rainbow	8,115
	Bear Lake	Hayspur Rainbow Triploid	9,181
	Bear Lake	Mt Lassen Rainbow	750
	Bear Lake	Triploid Troutlodge Kamloop	44,143
	Bear Lake	Troutlodge	1,065
	Bear Lake	Unspecified Rainbow	3,450

Appendix B. Continued.

Water	County	Species	Total
Montpelier Reservoir	Bear Lake	Bear Lake Cutthroat	39,895
	Bear Lake	Bear River Cutthroat	23,660
	Bear Lake	Cutthroat	330,350
	Bear Lake	Early Spawner Kokanee	104,754
	Bear Lake	Hayspur Rainbow	39,042
	Bear Lake	Hayspur Rainbow Triploid	39,120
	Bear Lake	Late Spawner Kokanee	4,544
	Bear Lake	October Spawner Kokanee	9,943
	Bear Lake	Shepard Of The Hills Rainbow	11,804
	Bear Lake	Triploid Troutlodge Kamloop	148,609
	Bear Lake	Troutlodge Rainbow Trout	2,000
	Bear Lake	Unspecified Rainbow	198,217
	Bear Lake	Tiger Trout (Brook X Brown Hybrid)	6,252
Mud Lake	Bear Lake	Perch	16,000
N F Burton	Franklin	Brook Trout	500
N F Montpelier Creek	Bear Lake	Unspecified Rainbow	900
North Canyon	Bear Lake	Brook Trout	12,452
	Bear Lake	Cutthroat	15,337
	Bear Lake	Unspecified Cutthroat	5,000
	Bear Lake	Unspecified Rainbow	3,900
North Creek	Bear Lake	Cutthroat	10,099
Nounan Creek	Bear Lake	Unspecified Rainbow	9,000
Oneida Narrows Reservoir	Franklin	Channel Catfish	14,989
	Franklin	Sauger	415,840
	Franklin	Spot Tail Shiner	18,000
	Franklin	Triploid Troutlodge Kamloop	999
	Franklin	Walleye	18,487,770
Oneida Reservoir	Franklin	Blueback Salmon	75,915
	Franklin	Brook Trout	4,000
	Franklin	Cutthroat	60,800
	Franklin	Redband Trout	34,320
	Franklin	Sockeye Salmon	35,000
	Franklin	Unspecified Rainbow	21,306
Ovid Creek	Bear Lake	Brook Trout	19,958
	Bear Lake	Cutthroat	1,040
	Bear Lake	Redband Trout	13,333
	Bear Lake	Unspecified Rainbow	120,196
Oxford Lake #1	Franklin	Hayspur Rainbow Triploid	200
	Franklin	Triploid Troutlodge Kamloop	976
Paris Creek	Bear Lake	Brook Trout	69,291
	Bear Lake	Cutthroat	20,500
	Bear Lake	Hayspur Rainbow	4,681
	Bear Lake	Hayspur Rainbow Triploid	2,616
	Bear Lake	Redband Trout	13,333
	Bear Lake	Shepard Of The Hills Rainbow	552

Appendix B. Continued.

Water	County	Species	Total
Paris Creek	Bear Lake	Triploid Troutlodge Kamloop	8,412
	Bear Lake	Unspecified Rainbow	259,762
Pearl Creek	Caribou	Bear Lake Cutthroat	500
	Caribou	Bear River Cutthroat	3,000
	Bear Lake	Cutthroat	18,056
	Caribou		10,340
	Caribou	Fine Spotted Cutthroat	4,000
	Caribou	Hayspur Rainbow	650
	Bear Lake	Unspecified Cutthroat	5,000
	Bear Lake	Unspecified Rainbow	5,460
Pleasantview Lake #01 (Samari	Oneida	Rainbow Brood Stock	250
	Oneida	Redband Trout	4,061
	Oneida	Unspecified Rainbow	305,837
Pleasantview Lake #02 (Samari	Oneida	Unspecified Rainbow	65,049
Preston Rearing Pond	Franklin	Unspecified Rainbow	118,500
Preuss Creek	Bear Lake	Cutthroat	100,601
	Caribou		1,000
	Bear Lake	Rainbow X Cutthroat	1,680
	Bear Lake	Unspecified Cutthroat	13,840
	Bear Lake	Unspecified Rainbow	27,800
	Franklin		4,500
Rice Creek	Oneida	Cutthroat	9,200
Riverdale Pond	Franklin	Unspecified Rainbow	10,112
Riverdale Rearing Pond	Franklin	Unspecified Rainbow	15,600
Robinson Creek	Bear Lake	Cutthroat	3,270
S F Burton	Franklin	Brook Trout	500
S F Cub River	Franklin	Cutthroat	5,245
Saint Charles Creek	Bear Lake	Bear Lake Cutthroat	98,991
	Bear Lake	Brook Trout	16,625
	Bear Lake	Cutthroat	118,946
	Bear Lake	Unspecified Rainbow	130,296
Saint Johns Reservoir	Oneida	Bluegill	380
	Oneida	Domestic Kamloops	10,154
	Oneida	Hayspur Rainbow	17,590
	Oneida	Largemouth Bass	336
	Oneida	Mt Lassen Rainbow	19,195
	Oneida	Mt Whitney Rainbow	2,860
	Oneida	Triploid Troutlodge Kamloop	3,225
	Oneida	Troutlodge Rainbow Trout	1,606
	Oneida	Unspecified Crappie	17
	Oneida	Unspecified Rainbow	67,206
Samaria Lake	Oneida	Brook Trout	21,780
	Oneida	Perch	16,000
Second Creek	Oneida	Cutthroat	12,064
	Oneida	Unspecified Rainbow	6,180

Appendix B. Continued.

Water	County	Species	Total
Shingle Creek	Bannock	Cutthroat	4,992
	Franklin		25,890
	Bannock	Fine Spotted Cutthroat	1,005
	Bannock	Unspecified Rainbow	6,000
Skinner Creek	Bear Lake	Cutthroat	19,374
	Caribou		515
	Bear Lake	Unspecified Rainbow	5,460
Snowslide Canyon	Bear Lake	Brook Trout	12,800
	Bear Lake	Unspecified Rainbow	14,564
Soda Creek	Caribou	Brook Trout	59,000
	Caribou	Cutthroat	13,360
	Caribou	Domestic Kamloops	2,000
	Caribou	Hayspur Rainbow	8,022
	Caribou	Hayspur Rainbow Triploid	1,000
	Caribou	Mt Lassen Rainbow	2,500
	Caribou	Unknown Species	12,000
Soda Point Reservoir	Bear Lake	Cutthroat	92,058
Soda Springs Rearing Pond	Caribou	Unspecified Rainbow	65,000
Sorenson Pond	Bear Lake	Unspecified Rainbow	1,647
Spring Creek	Franklin	Cutthroat	1,088
	Bear Lake	Unspecified Rainbow	17,000
St Charles Creek (Bear Lake)	Bear Lake	Brook Trout	48,550
	Bear Lake	Cutthroat	33,249
	Bear Lake	Redband Trout	20,000
	Bear Lake	Unspecified Rainbow	511,422
St Johns Reservoir	Oneida	Unspecified Rainbow	30,987
Station Creek	Bannock	Brook Trout	14,619
	Bannock	Unspecified Rainbow	3,700
Stauffer Creek	Bear Lake	Cutthroat	1,059
	Bear Lake	Unspecified Rainbow	5,460
Stone Creek	Oneida	Brook Trout	5,000
	Oneida	Unspecified Rainbow	15,200
Stone Reservoir	Oneida	Cutthroat	82,224
	Oneida	Domestic Kamloops	43,110
	Oneida	Erwin Rainbow	8,000
	Oneida	Hayspur Kamloops Triploid	6,687
	Oneida	Hayspur Rainbow	26,287
	Oneida	Hayspur Rainbow Triploid	9,069
	Oneida	Largemouth Bass	19,380
	Oneida	Mt Lassen Rainbow	23,510
	Oneida	Mt Whitney Rainbow	4,000
	Oneida	Yellow Perch	39,200
	Oneida	Shepard Of The Hills Rainbow	8,280
	Oneida	Triploid Troutlodge Kamloop	135,079
	Oneida	Troutlodge Rainbow Trout	10,127

Appendix B. Continued.

Water	County	Species	Total
Stone Reservoir	Oneida	Unspecified Crappie	105,066
	Oneida	Unspecified Rainbow	376,832
	Oneida	White Crappie	300
Strawberry Creek	Franklin	Fine Spotted Cutthroat	1,005
	Franklin	Unspecified Cutthroat	1,696
Strong Arm Reservoir	Franklin	Hayspur Rainbow	1,040
	Franklin	Hayspur Rainbow Triploid	800
Swan Lake	Bannock	Brook Trout	17,667
	Bannock	Redband Trout	3,500
	Caribou	Unspecified Rainbow	4,300
Swan Lake #03	Caribou	Unspecified Rainbow	32,144
Swan Lake #03	Caribou	Unspecified Rainbow	7,432
Third Creek	Oneida	Cutthroat	12,064
	Oneida	Unspecified Rainbow	6,180
Thomas Fork	Bear Lake	Brook Trout	54,500
	Bear Lake	Cutthroat	631,133
	Bear Lake	Yellow Perch	57,190
	Bear Lake	Unspecified Cutthroat	89,280
	Bear Lake	Unspecified Rainbow	31,475
Thomas Fork Bear River	Bear Lake	Brook Trout	44,240
	Bear Lake	Cutthroat	88,660
	Bear Lake	Unspecified Rainbow	15,739
Thomas Fork Cr	Bear Lake	Redband Trout	388,183
Tingey Reservoir	Franklin	Unspecified Rainbow	50,780
Treasureton Reservoir	Franklin	Bear Lake Cutthroat	6,000
	Franklin	Brook Trout	10,530
	Franklin	Cutthroat	32,000
	Franklin	Domestic Kamloops	11,930
	Franklin	Hayspur Kamloops Triploid	8,552
	Franklin	Hayspur Rainbow	166,105
	Franklin	Hayspur Rainbow Triploid	63,702
	Franklin	Lahontan Cutthroat	4,400
	Franklin	Mt Lassen Rainbow	11,120
	Franklin	Rainbow X Cutthroat	9,010
	Franklin	Shepard Of The Hills Rainbow	55,735
	Franklin	Triploid Rainbowxcutthroat Hybrid	20,687
	Franklin	Triploid Troutlodge Kamloop	176,606
	Franklin	Unspecified Cutthroat	4,950
	Franklin	Unspecified Rainbow	1,135,737
Trout Creek	Caribou	Bear River Cutthroat	31,227
	Bannock	Brook Trout	88,000
	Caribou		78,490
	Franklin		15,600
	Bannock	Cutthroat	10,000
	Caribou		3,000

Appendix B. Continued.

Water	County	Species	Total
Trout Creek	Caribou	Domestic Kamloops	500
	Caribou	Hayspur Rainbow	9,726
	Caribou	Hayspur Rainbow Triploid	4,253
	Caribou	Shepard Of The Hills Rainbow	4,560
	Caribou	Triploid Troutlodge Kamloop	7,521
	Bannock	Unspecified Rainbow	58,233
	Caribou		218,203
	Franklin		3,750
Twin Lakes Reservoir	Franklin	Bluegill	450
	Franklin	Cutthroat	168,116
	Franklin	Domestic Kamloops	12,460
	Franklin	Hayspur Kamloops Triploid	6,525
	Franklin	Hayspur Rainbow	346,147
	Franklin	Hayspur Rainbow Triploid	28,107
	Franklin	Largemouth Bass	159
	Franklin	Rainbow X Cutthroat	191,258
	Franklin	Redband Trout	3,780
	Franklin	Shepard Of The Hills Rainbow	17,079
	Franklin	Smallmouth Bass	9,000
	Franklin	Tiger Muskie	3,600
	Franklin	Triploid Troutlodge Kamloop	126,325
	Franklin	Unspecified Crappie	4,500
	Franklin	Unspecified Rainbow	2,709,606
Upper Deep Creek Reservoir	Oneida	Cutthroat	20,250
Upper Nash Lake	Franklin	Largemouth Bass	30
	Franklin	Yellow Perch	200
Upper Pleasantview Reservoir	Oneida	Channel Catfish	2,136
	Oneida	Cutthroat	15,000
	Oneida	Hayspur Kamloops Triploid	2,000
	Oneida	Hayspur Rainbow Triploid	1,000
	Oneida	Mt Lassen Rainbow	2,002
	Oneida	Rainbow X Cutthroat	2,400
	Oneida	Triploid Troutlodge Kamloop	38,139
	Oneida	Unspecified Rainbow	40,625
Warm Springs Creek	Franklin	Brook Trout	6,100
	Franklin	Unspecified Rainbow	16,445
Weston Creek	Franklin	Brook Trout	14,250
	Franklin	Cutthroat	26,000
	Franklin	Unspecified Rainbow	28,960
Weston Creek Reservoir	Oneida	Domestic Kamloops	1,400
	Oneida	Hayspur Rainbow	42,458
	Oneida	Hayspur Rainbow Triploid	21,811
	Oneida	Mt Lassen Rainbow	1,400
	Oneida	Rainbow X Cutthroat	13,880
	Oneida	Shepard Of The Hills Rainbow	14,408

Appendix B. Continued.

Water	County	Species	Total
Weston Creek Reservoir	Oneida	Triploid Troutlodge Kamloop	62,728
	Oneida	Troutlodge Rainbow Trout	4,000
	Oneida	Unspecified Rainbow	193,974
Weston Reservoir	Franklin	Unspecified Rainbow	29,350
	Oneida		131,012
Whiskey Creek	Caribou	Bear River Cutthroat	15,276
	Caribou	Cutthroat	1,200
	Caribou	Hayspur Rainbow	10,081
	Caribou	Hayspur Rainbow Triploid	3,275
	Caribou	Shepard Of The Hills Rainbow	2,710
	Caribou	Triploid Troutlodge Kamloop	998
	Bear Lake	Unspecified Rainbow	4,338
	Caribou		90,711
Whiskey Flat Creek	Bear Lake	Cutthroat	21,072
Williams Creek	Caribou	Bear River Cutthroat	3,000
	Franklin	Brook Trout	44,260
	Caribou	Unspecified Rainbow	17,060
	Franklin		38,118
Winder Reservoir	Franklin	Domestic Kamloops	10,000
	Franklin	Hayspur Rainbow	58,760
	Franklin	Hayspur Rainbow Triploid	11,209
	Franklin	Lahontan Cutthroat	10,465
	Franklin	Rainbow X Cutthroat	21,037
	Franklin	Shepard Of The Hills Rainbow	6,044
	Franklin	Triploid Troutlodge Kamloop	30,319
	Franklin	Troutlodge Rainbow Trout	9,750
	Franklin	Unspecified Cutthroat	11,550
	Franklin	Unspecified Rainbow	179,456
Wood Lake	Bear Lake	Unspecified Rainbow	23,420
Wood Lake (Canyon)	Bear Lake	Unspecified Rainbow	8,220
Worm Creek	Franklin	Cutthroat	1,648
Wright Creek	Oneida	Brook Trout	20,250
	Oneida	Cutthroat	468,320
	Oneida	Unspecified Rainbow	13,575
Grand Total			**70,801,448**

Appendix C. Spawning and egg-take summary for Bonneville Cutthroat Trout conservation aquaculture program in Idaho from 2010-2020.

Year	Number of females spawned	Green eggs	Green eggs culled	Eyed eggs	Eyed eggs culled	Comments
2010	36	26,648	-	23,324	5,304	Eyed eggs were culled due to presence of *Renibacterium salmoninarum*.
2011	29	25,328	-	21,879	2,362	1,821 eyed eggs were culled due to presence of *Renibacterium salmoninarum*; 541 eyed eggs culled due to relatedness
2012	35	29,148	-	22,671	996	Eyed eggs were culled due to presence of *Renibacterium salmoninarum*.
2013	47	32,414	-	27,107	494	Eyed eggs were culled due to presence of *Renibacterium salmoninarum*.
2014	81	42,745	-	35,818	3,080	Eyed eggs were culled due to presence of *Renibacterium salmoninarum*.
2015	103	60,460	-	46,811	5,859	Eyed eggs were culled due to presence of *Renibacterium salmoninarum*.
2016	43	21,129	-	16,158	-	
2017	60	38,585	9,005	21,355	-	Green eggs were culled due to presence of *Renibacterium salmoninarum*.
2018	67	46,677	2,596	34,488	-	Green eggs were culled due to lack of fertilization, never eyed-up.
2019	32	26,961	5,849	16,941	-	Green eggs were culled due to lack of fertilization, never eyed-up.
2020	52	39,715	2,758	30,091	-	Green eggs were culled due to lack of fertilization, never eyed-up.

Appendix D. Bonneville Cutthroat Trout stocking information for the conservation aquaculture program from 2010-2020.

Date Stocked	Waterbody	Pounds stocked	Fish per pound	Fish stocked	Mean TL (in)	Brood year
4/20/2011	Kackley Springs	37	19.5	722	5.3	2010
4/20/2011	Kackley Springs	30	9.4	282	6.8	2010
6/2/2011	Kackley Springs	48	10.7	514	6.5	2010
6/2/2011	Trout Creek	95	10.7	1,017	6.5	2010
6/2/2011	Whiskey Creek	150	10.7	1,605	6.5	2010
6/14/2011	Trout Creek	100	10.2	1,020	6.6	2010
6/14/2011	Caribou Creek	75	10.2	765	6.6	2010
6/14/2011	Cottonwood Creek	145	10.2	1,480	6.6	2010
6/14/2011	Densmore Creek	200	10.2	2,040	6.6	2010
7/18/2011	Bear River	876	6.32	0	7.8	2010
2011 Total				**17,003**		
5/18/2012	Bear River	235	8.55	0	7.0	2011
7/3/2012	Kackley Springs	190	5.3	1,007	8.0	2011
7/5/2012	Densmore Creek	300	5	1,500	8.0	2011
7/9/2012	Trout Creek	95	5.2	0	8.0	2011
7/9/2012	Whiskey Creek	175	5.2	910	8.0	2011
2012 Total				**8,902**		
4/5/2013	Bear River	270	13.1	0	6.0	2012
5/16/2013	Kackley Springs	120	6.7	804	7.5	2012
5/16/2013	Trout Creek	300	6.7	2,010	7.5	2012
5/16/2013	Whiskey Creek	150	6.7	1,005	7.5	2012
5/16/2013	Harris Spring	30	6.7	201	7.5	2012
5/17/2013	Alder Creek	202	6.7	0	7.5	2012
9/20/2013	Kackley Springs	169	2.95	499	10.0	2012
9/20/2013	Bear River	1,098	2.95	0	10.0	2012
2013 Total				**19,544**		
4/1/2014	Bear River	735	12	0	6.0	2013
4/2/2014	Kackley Springs	23	13	500	6.0	2013
4/21/2014	Whiskey Creek	99	10.1	1,000	6.7	2013
5/16/2014	Trout Creek	30	6.66	200	7.3	2013
10/20/2014	Bear River	2,565	3.16	0	9.7	2013
10/24/2014	Kackley Springs	200	2.5	0	9.7	2013
2014 Total				**27,624**		
2/24/2015	Bear River	132	22.8	0	5.0	2014
4/22/2015	Kackley Springs	29	10.5	500	6.3	2014
4/22/2015	Trout Creek	48	10.5	500	6.3	2014
4/22/2015	Whiskey Creek	95	10.5	0	6.3	2014
9/2/2015	Kackley Springs	117	4.3	1,000	8.3	2014
9/10/2015	Trout Creek	525	5.71	0	7.5	2014
9/10/2015	Bear River	350	5.83	2,041	7.5	2014
9/11/2015	Kackley Springs	322	4.66	1,501	8.1	2014
9/11/2015	Bear River	102	4.66	0	8.1	2014
2015 Total				**29,351**		

Appendix D. Continued.

Date Stocked	Waterbody	Pounds stocked	Fish per pound	Fish stocked	Mean TL (in)	Brood year
1/25/2016	Bear River	262	65.34	17,119	3.6	2015
11/3/2016	Kackley Springs	296	3.38	3,000	9.5	2015
11/3/2016	Trout Creek	444	3.38	2,500	9.5	2015
11/3/2016	Whiskey Creek	444	3.38	1,500	9.5	2015
11/3/2016	Alder Creek	89	3.38	300	9.5	2015
11/3/2016	Bear River	2,071	3.38	7,000	9.5	2015
11/3/2016	Harris Spring	591	3.38	2,000	9.5	2015
11/14/2016	Trout Creek	888	3.38	3,000	9.5	2015
11/14/2016	Whiskey Creek	296	3.38	1,000	9.5	2015
2016 Total				**37,419**		
8/24/2017	Kackley Springs	114	4.37	2,500	7.3	2016
8/24/2017	Whiskey Creek	145	5.17	750	7.9	2016
8/24/2017	Bear River	1,146	5.1	5,845	7.9	2016
8/25/2017	Trout Creek	229	4.37	2,000	7.3	2016
8/25/2017	Whiskey Creek	193	5.17	1,000	7.9	2016
8/28/2017	Alder Creek	63	4.74	300	8.1	2016
8/28/2017	Harris Spring	52	4.74	0	8.1	2016
9/27/2017	Trout Creek	203	4.89	993	8.4	2016
2017 Total				**14,823**		
7/25/2018	Kackley Springs	123	6.13	750	7.3	2017
8/6/2018	Bear River	980	7.14	6,997	7.0	2017
9/11/2018	Trout Creek	280	5.35	0	8.0	2017
9/12/2018	Whiskey Creek	234	5.35	1,251	8.0	2017
9/26/2018	Trout Creek	207	4.84	1,000	8.2	2017
9/26/2018	Whiskey Creek	103	4.84	500	8.2	2017
9/27/2018	Kackley Springs	16	4.84	77	8.2	2017
9/27/2018	Alder Creek	52	4.84	252	8.2	2017
9/27/2018	Harris Spring	155	4.84	750	8.2	2017
2018 Total				**14,322**		
4/3/2019	Bear River	100	15.96	1,599	5.6	2018
5/31/2019	Trout Creek	115	8.69	1,000	6.7	2018
5/31/2019	Whiskey Creek	115	8.73	1,004	6.6	2018
5/31/2019	Bear River	573	8.73	5,002	6.6	2018
6/6/2019	Kackley Springs	81	9.26	750	6.7	2018
6/6/2019	Trout Creek	108	9.26	1,000	6.7	2018
6/6/2019	Whiskey Creek	54	9.26	500	6.7	2018
6/6/2019	Alder Creek	27	9.26	250	6.7	2018
6/6/2019	Caribou Creek	54	9.26	500	6.7	2018
6/6/2019	Harris Spring	54	9.26	500	6.7	2018
6/25/2019	Bear River	643	7.78	8,227	7.2	2018
7/16/2019	Trout Creek	176	7.57	1,332	7.2	2018
2019 Total				**21,664**		

Appendix D. Continued.

Date Stocked	Waterbody	Pounds stocked	Fish per pound	Fish stocked	Mean TL (in)	Brood year
10/6/2020	Kackley Springs	524	4.77	2,500	8.3	2019
10/6/2020	Trout Creek	105	4.77	0	8.3	2019
10/6/2020	Whiskey Creek	157	4.77	750	8.3	2019
10/7/2020	Alder Creek	53	4.7	250	8.3	2019
10/7/2020	Bear River	1,165	4.72	5,499	8.3	2019
10/7/2020	Caribou Creek	53	4.7	250	8.3	2019
10/7/2020	Harris Spring	53	4.7	250	8.3	2019
2020 Total				**11,499**		
Grand total				**202,151**		

BCT Sac Fry CCBY IDAHO FISH AND GAME

Appendix E. Index of diversions throughout the Bonneville Cutthroat Trout distribution (Bonneville Cutthroat Trout) within Idaho, showing location, dimensions (in meters), Bonneville Cutthroat Trout present, discharge (cfs), and the discharge diverted (proportion).

										BCT Present			Discharge			
Stream	**Lat**	**Long**	**Construction**	**Span (%)**	**Length**	**Height**	**Type**	**Screened**	**Headgate**	**Above**	**Below**	**Ditch**	**Above**	**Below**	**Ditch**	**Discharge diverted**
Cotton-wood Cr	42.432076	-111.914458	Rock/Burlap	75	4.5	1.04	Ditch	No	No	33	29	23	2.85	1.61	2.29	0.8
Cub River	42.103099	-111.728399	Concrete	100		1	Ditch	No	Yes	4	20	1	41.18	23.73	17.43	0.42
Cub River	42.138395	-111.695127	Concrete/ Rock	100	7.8		Ditch						38.96	39.37	Flow too low	
Eightmile Cr	42.548926	-111.560509	Rock/Timber	100	3.18	N/A	Ditch	No	No				1.73	0.19	1.78	1
Eightmile Cr	42.55598	-111.556321	Rock	0	N/A	0.68	Ditch	No	No	1	1	2	12.8	3.95	0.81	0.06
Eightmile Cr	42.576046	-111.548554	Earth	100	10	0.2	Ditch	No	No	1	4	0	13.47	6.8	7.21	0.54
Eightmile Cr	42.594017	-111.520641	Metal/ Timber	100	2.6	N/A	Ditch	No	No	2	0	0	8.82	9.83	1.21	0.14
Georgetown Cr	42.472783	-111.393714	Culvert/ Tarps	100	1.45	0.34	Ditch	No	No	2	0	0	3.18	0.47	1.89	0.59
Georgetown Cr	42.473517	-111.389789	Timber/Tarps	100	4	1.5	Ditch	No	No	0	0	0	1.19	1.19	No Water	
Georgetown Cr	42.475704	-111.379462	Concrete/ Timber/Tarps	100	3.04	1	Ditch	No	No	0	0	0	1.1	0.39	0.71	0.65
Georgetown Cr	42.477108	-111.374142	None	0			Ditch	No	Yes	1	0	0	5.16	3.18	1.86	0.36
Pearl Cr	42.529766	-111.475871	Concrete/ Tarps	100	1.15	0.7	Ditch	No	No	11		35	0.36	No Water	0.31	0.86
Pearl Cr	42.531715	-111.472806	Concrete	100	1.05	0.6	Ditch	No	No				0.09	No Water	No Water	
Preuss Cr	42.389505	-111.064791	Concrete/ Earth	100	1.5	1.5	Ditch	No	No		2	0	Flow too deep	0.01	0.26	
Preuss Cr	42.406491	-111.089587	Earth/Metal	100	0.88	0.88	Pipe	No	No	0	0		1.21	0.66	N/A	
Preuss Cr (Geneva Ditch)	42.373768	-111.070617	Concrete/ Metal / Timber	100	2.47	1.6	Ditch	No	No	0	0		Flow too low	Flow too low	No Water	
Shingle Cr	42.389027	-111.919044	Concrete/ Timber	100	3.66		Ditch	No	No	11	2	19	6.99	0.32	6.75	0.97

Appendix E. Continued.

										BCT Present			Discharge			
Stream	Lat	Long	Construction	Span (%)	Length	Height	Type	Screened	Headgate	Above	Below	Ditch	Above	Below	Ditch	Discharge diverted
Shingle Cr	42.428157	-111.924819	Concrete/ Timber	100	2.2	0.31	Ditch	No	No	9	32		2.87	2.66	No Water	
Skinner Cr	42.47456	-111.467095	Concrete	100	3	1.43	Pipe	Yes	Yes	0	0		1.94	Flow too low	No Ac- cess	
Spring Cr	42.418231	-111.422337	Earth/Timber	100	2.09	0.27	Ditch	No	No	9	0	0	0.13	Flow too low	Flow too low	
Stauffer Cr	42.420146	-111.425522	Metal/Rock/ Earth	25			Ditch	No	No	12	12		0.22	0.22	No Water	
Stauffer Cr	42.420878	-111.441706	Rock	100	3.9	0.1	Ditch	No	No	25	21	8	Flow too low	1.15	Flow too low	
Stauffer Cr	42.421645	-111.455082	Rock	100	6.9	0.76	Ditch	No	No	30	40		0.43	0.43	No Water	
Stauffer Cr	42.42211	-111.425536	Metal/ Timber/Earth	100	7.5	0.45	Ditch	No	No	20	158	16	0.28	0.19	0.04	0.14
Stauffer Cr	42.426135	-111.418208	Metal/Earth	100	8	0.61	Ditch	No	No	18	1	1	0.5	0.06	Flow too low	
Stauffer Cr	42.440666	-111.41698	Earth/ Timber/ Other	100	6.8	0.85	Ditch	No	No	0	0	0	0.74	Flow too low	Flow too low	
Stauffer Cr	42.444779	-111.417785	Metal/ Timber	100		0.88	Ditch	No	No	0	0	0	0.73	Flow too low	No Water	
Stauffer Cr	42.445888	-111.417513	Metal/ Timber/Earth	100	6.5	1.5	Ditch	No	Yes	0	0	0	Flow too low	Flow too low	Flow too low	
Stauffer Cr	42.453568	-111.420446	Concrete/ Metal/ Timber	100			Ditch	No	No	0	0	0	Flow too low	Flow too low	No Water	
Stauffer Cr	42.471334	-111.423789	Concrete/ Metal/Earth	100	24	2.1	Ditch	No	No	0	0		1.34	1.34	N/A	

Appendix E. Continued.

										BCT Present			Discharge			
Stream	Lat	Long	Construction	Span (%)	Length	Height	Type	Screened	Headgate	Above	Below	Ditch	Above	Below	Ditch	Discharge diverted
Thomas Fork	42.27046	-111.080676	Concrete	100	4.8	1.6	Ditch	Yes	Yes	0	0		Flow too low	Flow too low	No Water	
Thomas Fork	42.346128	-111.053516	Concrete/ Rock/Earth	100	4.3	0.34	Ditch	No	Yes	0	0	0	Flow too low	Flow too low	Flow too low	
Trout Cr	42.43762	-111.711981	Concrete/ Metal/ Timber	100	5	1.4	Pipe	Yes	No				None taken	None taken	None taken	
Trout Cr	42.465732	-111.664594	Rock	25	1.7	0.2	Ditch	No	No	0	0	0	10.64	11.18	0.46	0.04
Wiliams Cr	42.354712	-111.691192	Rock/Other	100	3	0.35	Ditch	No	No	0	0	0	2.59	1.57	1.77	0.68
Wiliams Cr	42.356002	-111.690842	Rock/Other	100	1.75	0.35	Pipe	No	No	0	0	0	2.83	4.28	2.72	0.96
Wiliams Cr	42.356002	-111.690842	Rock/Other	75	1.55	0.23	Ditch	No	No	0	0	0	6.49	2.7	4.06	0.63
Williams Cr	42.356821	-111.663372	Rock/Timber	25	0.5	0.2	Ditch	No	No	0	0	0	18.86	16.21	0.47	0.02
Williams Cr	42.358462	-111.712653	Metal/Rock/ Other	75	6.5		Ditch	No	No	0	1		3.79	3.06	No Water	
Williams Cr	42.359113	-111.706419	Rock/ Timber/ Other	100	8.1	0.4	Ditch	No	No	0	0	0	5.84	2.71	3.82	0.65

Management Plan for the

Conservation of Bonneville Cutthroat Trout in Idaho

2022