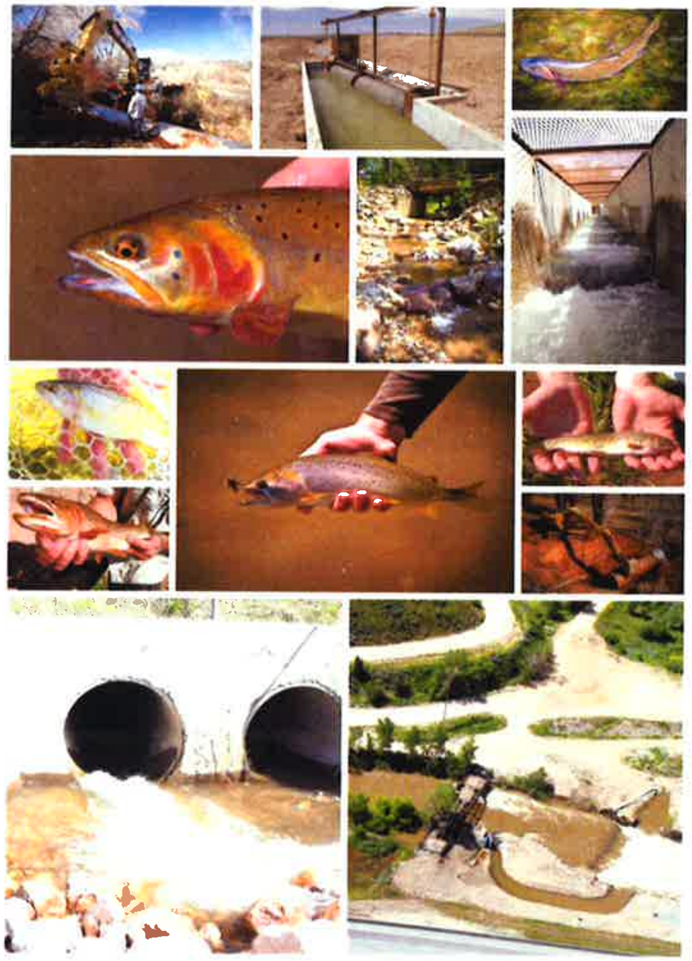
BONNEVILLE CUTTHROAT TROUT RANGE-WIDE CONSERVATION AGREEMENT AND STRATEGY



Publication Number 18-11

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Division of Wildlife Resources
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Michal D. Fowlks
Director

December 2019

Acknowledgements

We thank all of the involved agencies for assisting in the development and production of this document. It outlines, reiterates, and summarizes information provided by personnel from the Idaho Department of Fish and Game, Nevada Department of Wildlife, Utah Division of Wildlife, Wyoming Department of Fish and Game, Confederated Tribes of the Goshute Reservation, Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, and the U.S. Forest Service. The majority of this document was authored by Randy Oplinger and Paul Birdsey. The authors thank Paul Thompson, Matt McKell, Maureen Wilson, Heath Korell, Cassie Mellon, Jon Reynolds, George Weekley, Paul Burnett, Hilda Sexauer, Mike Golden, Mike Hadley, Scott Tolentino, and biologists from U.S. Forest Service Regions 1, 6, and 8 for reviewing this document. We also thank members of the Bonneville Basin Conservation and Recovery Team, the Bonneville Cutthroat Trout technical workgroup, and other involved parties for their interest, cooperation, and contribution in developing this Agreement.

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Conservation Agreement

This Conservation Agreement (Agreement) has been developed with the purpose of coordinating the implementation of conservation measures for Bonneville Cutthroat Trout (*Oncorhynchus clarkii utah;* BCT) within its historic range. It outlines, reiterates, and summarizes the conservation measures specified in the previous Agreement (Lentsch et al. 2000). The implementation and execution of BCT conservation measures, specified in Lentsch et al. (2000), is the responsibility of the respective management agencies. This document simply the collaborative and cooperative efforts needed to ensure the long-term conservation of BCT.

Goal

The primary goal of this Agreement is to ensure the long-term existence of BCT within its historic range by coordinating conservation efforts among states, tribal governments, Federal management agencies, and other involved parties.

Objectives

Two objectives have been identified that are required to meet the goals of this Agreement. Each general objective has specific components that must also be met. These objectives were developed and quantified using the best available expertise and information. A viability analysis is outlined in the conservation strategy that will further define the objectives.

I) Manage for the following minimums within each Geographic Management Unit (GMU)

A) 30 populations that have BCT genetic purity of > 90%

B) 2 adfluvial or fluvial populations within both the Northern and Bear River GMU's

C) 15 disjunct peripheral populations (Haak et al. 2010b) within the Southern and West Desert GMU's

D) Either 10 replicate populations, 5 persistent populations, or 2 stronghold populations (27.8-50.0 km connected habitat) within each sub-basin within the Northern Bonneville and Bear River GMU's. Either 10 replicate populations, 5 persistent populations, or 2 stronghold populations per GMU within the West Desert and Southern Bonneville GMU's. All replicate, persistent, or stronghold population goals within a GMU can be substituted with the creation of a single metapopulation (>50.0 km connected habitat) within that GMU.

E) Maintain a BCT population with greater than 90% genetic purity at Bear Lake

F) Establish/maintain at least one lacustrine population within the Northern Bonneville GMU

II) Mitigate against threats to the long-term persistence of BCT.

A) Eliminate or significantly reduce threats that cause any present or potential destruction, modification, or curtailment of habitat or range as outlined in the conservation strategy.

B) Eliminate or significantly reduce threats caused by disease, predation, competition and hybridization as outlined in the conservation strategy.

C) Eliminate all impacts associated with over harvesting for commercial, recreational, scientific, or educational purposes as outlined in the conservation strategy.

D) Eliminate or significantly reduce all threats caused by inadequate regulatory mechanisms as outlined in the conservation strategy.

E) Eliminate and/or significantly reduce detrimental impacts associated with threats caused by other natural or human induced factors affecting the continued existence of the species as outlined in the conservation strategy.

These objectives will be reached through implementation of the specific management actions that benefit BCT as detailed in state and national conservation strategies (Oplinger et al. 2017 [this document]), species management plans, and land management plans. The range-wide conservation strategy (Strategy), outlined below, summarizes the information contained in these documents.

Jurisdiction for the conservation of BCT, and the habitat upon which the species is dependent, resides with four States, eight National Forests, five BLM Field Offices, one National Park, one Indian tribe, and the US Fish and Wildlife Service. Representatives from these entities are the signatories to the range-wide BCT Conservation Agreement. They recognize that there must be a strong commitment towards conservation and a clear allocation of resources for that purpose. To be most effective, the elements of this rangewide strategy, state-wide conservation strategies, species management plans, forest management plans, and resource management plans that benefit BCT must be implemented in their entirety.

The signatories also agree that the conservation progress of BCT will be evaluated annually. Amendments will be added to address newly identified BCT recovery issues and to ensure program effectiveness as needed.

I. Other Species Involved

The primary focus of this Agreement is the conservation and enhancement of BCT and the ecosystems upon which they depend; however, other species occurring within or adjacent to BCT habitat may also benefit. Some of these species include Bonneville Cisco (*Prosopium gemmiferum*), Bonneville Whitefish (*Prosopium spilonotus*), Bear Lake Whitefish (*Prosopium abyssicola*), Bear Lake Sculpin (*Cottus extensus*), Paiute Sculpin (*Cottus beldingi*), Northern Leatherside Chub (*Lepidomeda copei*), Southern Leatherside Chub (*Lepidomeda aliciae*), Bluehead Sucker (*Catostomus discobolus*), mottled sculpin (*Cottus bairdii*), speckled dace (*Rhinichthys osculus*), Columbia Spotted Frog (*Rana luteiventris*) and Boreal Toad (*Anaxyrus boreas*). Using an ecosystem approach, the Range-wide Conservation Agreement for BCT could reduce or possibly eliminate threats for several of these species, which could preclude their need for Federal listing pursuant to the ESA.

II. Involved Parties

Idaho Fish and Game Department
600 So. Walnut
Boise, Idaho 83720-0065

Nevada Department of Wildlife
6980 Sierra Center Parkway #120
Reno, Nevada 89511

Utah Department of Natural Resources
Utah Division of Wildlife Resources
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Salt Lake City, Utah 84114-6301

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5400 Bishop Blvd
Cheyenne, Wyoming 82006

Confederated Tribes of the Goshute Reservation
PO Box 6104
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United States Department of the Interior
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Pacific Southwest Region
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Pacific Region
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Portland, Oregon 97232

United States Department of the Interior
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Boise, Idaho 83709-1657

Nevada State Office
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Reno, Nevada 89502

Utah State Office
324 S. State St.
Salt Lake City, Utah 84145-0155

Wyoming State Office
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Cheyenne, Wyoming 82009

United States Department of the Interior
National Park Service
Pacific West Region
600 Harrison Street, Suite 600
San Francisco, California 94107-1372

United States Department of Agriculture
Forest Service Intermountain Region (Representing all other involved regions)
Federal Office Building 324 25th St.
Ogden, Utah 84401

Utah Reclamation Mitigation and Conservation Commission
230 South 500 East, Ste 230
Salt Lake City, Utah 84102

Trout Unlimited
1777 N. Kent Street
Suite 100
Arlington, Virginia 22209

III. Authority

- The signatory parties hereto enter into this Conservation Agreement and the attached Conservation Strategy under Federal and State law, as applicable.
- All parties to this Agreement recognize that they each have specific statutory responsibilities that cannot be delegated, particularly with respect to the management and conservation of these fish, their habitat or the management, development and allocation of water resources.
- Nothing in this Agreement or the Strategy is intended to abrogate any of the parties' respective responsibilities. There may not be statutory authority to implement all actions, but signatories have authority to coordinate with agencies with those specific statutory responsibilities.
- This Agreement is subject to and is intended to be consistent with all applicable Federal and State laws and interstate compacts.
- This instrument in no way restricts the parties involved from participating in similar activities with other public or private agencies, organizations or individuals.
- Modifications within the scope of this instrument shall be made by the issuance of a bilaterally-executed modification prior to any changes being performed.
- This Agreement may be executed in several counterparts, each of which shall be an original, and all of which shall constitute one and the same agreement.
- Performance of all activities described in this Agreement are contingent upon the involved parties' annual receipt of adequate funding.

IV. Conservation Actions

To meet the goal and objectives of this Agreement, the following conservation actions, as defined and summarized in the Strategy, should be implemented:

1) Determine BCT population demographic and life history characteristics.
2) Genetically characterize populations of BCT.
3) Protect the genetic integrity of BCT populations.
4) Maintain all current BCT populations
5) Expand BCT populations and distribution through introduction or reintroduction from either transplanted or a broodstock of BCT.
6) Monitor Populations
7) Describe BCT habitat requirements

8) Enhance and maintain habitat
9) Monitor Habitat Quantity and Quality
10) Control non-native species
11) Control and prevent the spread of whirling disease
12) Enforce regulatory mechanisms to ensure compliance
13) Ensure funding of conservation measures
14) Reduce social-political conflicts
15) Implement an information and education program

Coordinating Conservation Activities

- Administration of the conservation agreement will be conducted by a range-wide Coordination Team. The team will consist of a designated representative from each signatory to this Agreement and may include technical and legal advisors and other members as deemed necessary by the signatories.
- The designated team leader will be the Utah Division of Wildlife Resources' Coldwater Sportfish Coordinator.
- Authority of the Coordination Team is limited to making recommendations for the conservation of BCT to the Administrators of the Involved Parties.
- The Coordination Team will meet annually to develop range-wide priorities, coordinate tasks and resources to most effectively implement the workplan, and review and revise the Strategy as required.
- Modifications within the scope of this instrument shall be made by the issuance of a bilaterally executed modification prior to any changes being performed.
- The Coordination Team will also meet on an annual basis to report on progress and effectiveness of the Conservation Strategy implementation.
- Coordination Team meetings will be open to the public. Minutes of the meetings and progress reports will be distributed to the Coordination Team. Other interested parties may obtain minutes and progress reports upon request.

Implementing Conservation Schedule

- Conservation actions will be scheduled and reviewed on an annual basis by the signatories on recommendations from the Coordination Team. The Team Leader has the responsibility to coordinate conservation activities and monitor conservation actions conducted by participants of this Agreement to determine if all actions are in accordance with the Range-wide Strategy and annual schedule.

Funding Conservation Actions

- Expenditures to implement this Agreement have been identified in conservation strategies (Lentsch et al. 1997), species management plans, and land management plans. It is projected that expansion of habitat and population actions will require the greatest expense.
- Funding for the actions required to implement the Conservation Agreement will be provided by a variety of sources.
    - Federal sources may include, but are not limited to, U.S. Forest Service (USFS), U.S. Fish and Wildlife Service (USFWS), National Park Service (NPS), Bureau of Land

Management (BLM), Utah Reclamation Mitigation and Conservation Commission, Land and Water Conservation funds and the Natural Resource Conservation Service.

- State funding sources may include, but are not limited to, direct appropriation of funds by the legislature, Community Impact Boards, Water Resources Revolving funds, State Department of Agriculture (ARD), and State Resource Management Agencies.
- Local sources of funding may be provided by water districts, Native American affiliations, cities and towns, counties, local irrigation companies, and other supporting entities and may be limited due to factors beyond local control.

It is understood that all funds expended in accordance with this Agreement are subject to approval by the appropriate local, state or Federal appropriations. This instrument is neither a fiscal nor a funds obligation document. Any endeavor involving reimbursement or contribution of funds between the parties to this instrument will be handled in accordance with applicable laws, regulations, and procedures, including those for Government procurement and printing.

Conservation Progress Assessment

An annual range-wide assessment of progress towards implementing actions identified in this Agreement will be summarized in a table that will be provided to the signatories by the Coordination Team Leader. Every five years, a detailed status assessment report will be prepared by the Coordination Team Leader.

V. Duration of Agreement

The initial term of this Agreement shall be 10 years. Prior to the end of the 10 year period, a thorough analysis of actions implemented for the species will be conducted by the Coordination Team and a decision on the need to extend the Agreement will be made. The agreement may be extended if not all of the conservation goals identified in this strategy are met. Any party may withdraw from this Agreement on sixty (60) days written notice to the other parties.

VI. National Environmental Policy Act (NEPA) Compliance

Signing of this Agreement is covered under authorities outlined in section III listed above. We anticipate that any survey, collection or non-land disturbing research activities conducted through the Conservation Agreement will not entail significant Federal actions under the NEPA and will be given a categorical exclusion designation. However, each signatory agency holds the responsibility to review planned actions for their area of concern to ensure conformance with existing land use plans and to conduct any necessary NEPA procedures for those actions within their area.

VII. Policy for the Evaluation of Conservation (PECE) Compliance Efforts (68 FR 15100)

The Agreement and Strategy, working in concert, will ensure that the conservation efforts will be implemented, and that when implemented the conservation efforts will be effective. The Strategy document will be designed to meet the requirements of a conservation agreement as specified in the USFWS PECE. To ensure PECE compliance, FWS cooperators participated directly in the development of the agreement and strategy by reviewing and providing input on the documents.

VIII. Federal Agency Compliance

During the performance of this Agreement, the participants agree to abide by the terms of Executive Order 11246 on non-discrimination and will not discriminate against any person because of race, color, national origin, age, religion, gender, disability, familial status or political affiliation. No member or delegate to Congress or resident Commissioner shall be admitted to any share or part of this Agreement, or to any benefit that may arise there from, but this provision shall not be construed to extend to this Agreement if made with a corporation for its general benefit.

IX. Signatories

Idaho Fish and Game Department
600 So. Walnut
Boise, Idaho 83720-0065

Director 2/27/2018
Date

<u>BONNEVILLE CUTTHROAT TROUT RANGE-WIDE CONSERVATION AGREEMENT AND STRATEGY</u>

Nevada Department of Wildlife
6980 Sierra Center Parkway #120
Reno, Nevada 89511

<u>Legal Authorities and Regulatory Status of Nevada Department of Wildlife:</u> By authority of Nevada Revised Statutes (NRS) 501.105 and 501.331, NDOW is responsible for administering the policies and regulations necessary for the preservation, protection, management and restoration of Nevada's resident wildlife species. NRS 501.351 provides authority for the Director of NDOW to enter into cooperative agreements for the purpose of the management of wildlife. NRS 503.584-503.589 directs NDOW to cooperate with other states and legal entities to the maximum extent practicable for the conservation, protection, restoration and propagation of species of native fish, and the perpetuation of the populations and habitats of such species. The activities described in this agreement are consistent with the NDOW's mission for the protection, preservation and restoration of the state's wildlife and will be supported to the extent practicable by the Department. The Bonneville cutthroat trout is classified as a Game Fish species in the State of Nevada under Nevada Administrative Code (NAC) 503.060(1)(a).

By signing this document below, the NDOW acknowledges that it is also signing as a party and participant to the whole of the Bonneville Cutthroat Trout Conservation Strategy as contained in the Bonneville Cutthroat Trout Range-Wide Conservation Agreement.

Tony Wasley   4/19/18

Tony Wasley, Director   Date

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Utah Division of Wildlife Resources
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ACTING DIRECTOR
2/9/18

Director Date

2/1/18

Financial Mgr. Date
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Wyoming Game and Fish Department
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Director   Date

Confederated Tribes of the Goshute Reservation
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Ibapah, Utah 84034

10/17/19

Chairman Date

United States Department of Interior
U.S Fish and Wildlife Service
Mountain-Prairie Region
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Denver, Colorado 80225

12/10/2018

Utah Field Office Supervisor — Date

United States Department of Interior
Bureau of Land Management-Idaho State Office
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Boise, Idaho 83709-1657

4/18/2018

Acting State Director Date

United States Department of Interior
U.S Fish and Wildlife Service
Pacific Southwest Region
2800 Cottage Way
Sacramento, California 95825

_______________________________ 12/6/2018
Reno Field Office Supervisor Date

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Edwin L Roberson 6-12-2018

State Director Date

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Buddy W. Green 7/18/2018
State Director Date
Acting

United States Department of Interior
National Park Service Pacific West Region
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Stan Austin 11/20/18

Stan Austin — Date
Regional Director
Pacific West Region

United States Department of Agriculture
Forest Service Intermountain Region (Representing all involved regions)
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Regional Forester Date

Utah Reclamation Mitigation and Conservation Commission
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Mark A. Holden 2/21/18

Executive Director Date

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2/28/2018

Executive Director   Date

Conservation Strategy

Introduction

As stated in the Bonneville Cutthroat Trout (BCT) Conservation Agreement (Agreement), implementation of specific conservation actions detailed in this Range-Wide Conservation Strategy will reduce threats to the future persistence of BCT. The primary purpose of this document is to describe the specific technical procedures and strategies required to provide for the long-term conservation of BCT. Some actions implemented pursuant to this Strategy may reduce or eliminate threats and improve habitat for related aquatic and terrestrial sensitive species as well.

Our conceptual strategy is based on Trout Unlimited's Conservation Success Index (Williams et al. 2007). The Conservation Success Index (CSI) is built on the fundamental principles of conservation biology to protect the best remaining habitats and restore degraded areas by reestablishing habitat connectivity and integrity. Therefore, protecting, reconnecting, and restoring are the three basic components of this Strategy. For BCT, the high quality areas for protection are typically high elevation federal lands. Maintaining the integrity of these backcountry lands improves water quality downstream and provides a stronghold for native fish and other species. The mid-elevations are often of mixed ownership and support a variety of land uses that have fragmented the waters and lands with roads, diversions, and dams, frequently preventing access to the important higher elevation habitats. Removing obsolete dams and diversions, fixing culverts, increasing flows, and reconnecting the headwaters to the valleys gives fish the opportunity to move when disturbances such as wildfires and floods make habitats unsuitable. Finally, the valley bottoms typically have the lowest quality habitat due to land conversion and development but they often hold the highest restoration potential with far-reaching benefits to fish, wildlife and local communities. Long-term, however, climate change may render many low elevation habitats unsuitable for BCT.

Development of a place-based conservation strategy that implements the protect-reconnect-restore model must take into account current conditions of habitats and populations as well as future threats, such as climate change. It must also be realistic and recognize where the costs of restoration are too great, or where threats are too powerful and imminent, and when limited resources are better spent elsewhere.

Results from the CSI and associated analyses in conjunction with local knowledge and expertise provide the components necessary to create a framework for a conservation plan that, if fully implemented, will facilitate the long-term survival of BCT across its historic range.

Background

General Description of Bonneville Cutthroat Trout

Once thought to be extinct, BCT were rediscovered in recent decades and relatively pure populations continue to persist within the Bonneville Basin in Utah, Idaho, Wyoming, and Nevada (Figure 1). Bonneville Cutthroat Trout evolved in ancient Lake Bonneville and its tributaries during the Pleistocene Epoch, and mixed with Cutthroat Trout from the Bear River after the Bear River was diverted from the Snake River drainage into the Great Basin by a massive lava flow. The subspecies is currently considered a species of special management concern in all of the states where it is found.

Like Lahonton Cutthroat Trout, BCT have adapted to survive in relatively warm water and marginal habitats, and migratory life forms historically grew to be quite large in lakes and large rivers.

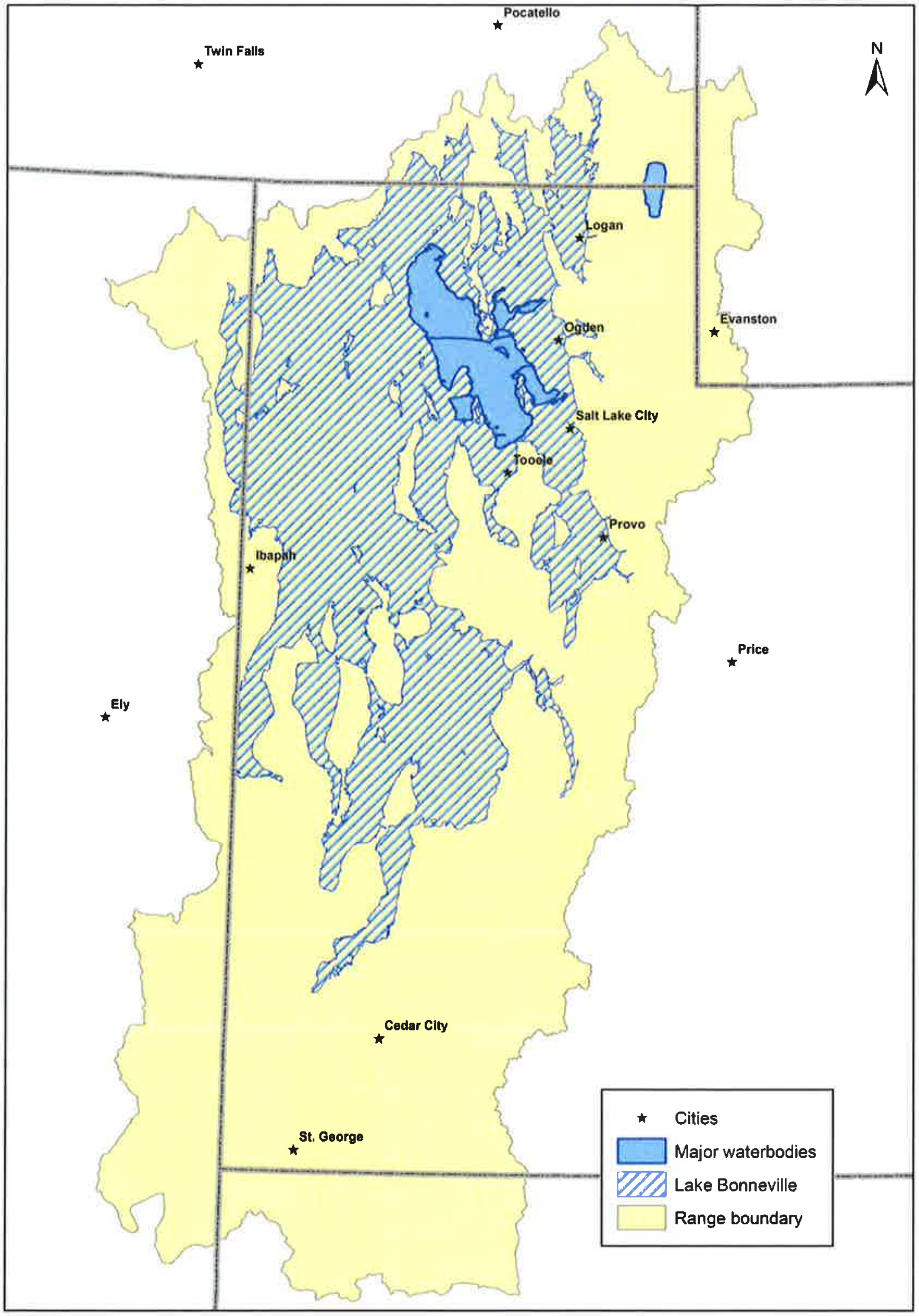

Figure 1: Map of the range of Bonneville Cutthroat Trout including the historic extent of Lake Bonneville.

Some populations within the Bear River drainage near the nexus of Idaho, Wyoming and Utah continue to exhibit the species' impressive range of life history strategies and habitat requirements, migrating seasonally between turbid, lower elevation main stem rivers and cold, clear, high-elevation tributary streams.

During early settlement of Utah, BCT were exploited through private and commercial fishing. An extensive reduction in numbers of native trout in Utah led to protective legislation for trout as early as 1874 (Utah Territorial Legislation of 1874). Traditionally, cutthroat trout management actions included the use of fishing regulations and stocking programs to protect native cutthroat trout. However, as these methods failed to provide adequate protection and as the importance of preserving genetic integrity increased, management efforts began to focus on the ecology and conservation of the various subspecies of cutthroat trout. Furthermore, management and protection of native cutthroat trout has been elevated, particularly in the last two decades, through increased public conservation awareness and increased sport fishing demand. Protection and conservation of native cutthroat trout not only provides sport fishing opportunity, but in light of pressures of habitat loss and non-native fish introductions, is necessary to ensure the natural long-term persistence of this Cutthroat Trout subspecies in the native range.

BCT Systematics

Bonneville Cutthroat Trout probably evolved as the top predator of minnows, suckers and whitefish predecessors in ancient Lake Bonneville. With desiccation of the large pluvial lake, BCT dispersed among remaining lakes and into upstream reaches of lake tributaries. In historical (mid 1800's) times, only Panguitch Lake, Utah Lake, and Bear Lake retained lacustrine populations in Utah, and most streams with adequate habitat retained fluvial BCT populations. Currently, all natural lake populations except that of Bear Lake are extinct, and stream populations are mainly restricted to isolated headwater reaches.

Researchers have not reached consensus on the evolutionary history of BCT. It has been proposed that ancestral Coastal Cutthroat Trout gave rise to all interior subspecies from an invasion through the Columbia River system (Behnke 1981, Hickman 1978). From the Columbia River, the ancestral trout are thought to have migrated into the Spokane, Pend Oreille, and Snake Rivers prior to the formation of barrier falls. Cutthroat trout then, hypothetically, gained access to the Alvord and Lahontan Basins from the middle Snake River and Cutthroat Trout from the upper Snake River invaded the Yellowstone and Colorado River drainages and the Bonneville Basin. Loudenslager and Gall (1980a) suggested an alternative hypothesis to the invasion of inland Cutthroat Trout based upon the distribution of fish species. It has been demonstrated that there is a greater similarity between the upper Snake River, Bonneville Basin, Lahontan Basin, and the Klamath and/or Sacramento River systems than between the middle Snake River, the Great Basin, and the Columbia River systems (Hubbs and Miller 1948, Miller 1965, Smith 1978). Additionally, there is zoogeographic and fossil evidence to suggest a connection between the Snake River and Klamath lakes during the Pliocene (Malde 1965, Miller 1965). Miller (1965) hypothesized that the Snake River drained toward the Pacific coast through the Sacramento or Klamath drainages. He argues that the Snake River was then impounded to form a large lake in southwestern Idaho and became connected to the Columbia River system during the Pleistocene. Loudenslager and Gall (1980a) consider this information and suggest that perhaps present inland subspecies of Cutthroat Trout could be the result of multiple invasions. In contrast, Loxterman and Keeley (2012) divided BCT into two lineages. One, the Bonneville-Yellowstone lineage is most closely related to the Lahontan, westslope, and coastal subspecies and is found in the Bear River drainage today (Loxterman and Keeley 2012). The second, the Great Basin lineage is most closely related to the greenback, Rio Grande, and Colorado River lineages (Loxterman and Keeley 2012). Despite the disagreement on the taxonomic origins of BCT, there is a consensus that there are two to four purported distinct groups of BCT.

Past conservation agreements (Lentsch et al. 2000) have divided BCT into four groups that include: 1) those in the Bear River of Northern Utah, Southeast Idaho and Southwest Wyoming, 2) those in the Snake Valley region on the Utah-Nevada border, 3) those in the main Bonneville Basin and 4) a Southern Bonneville type. These groups can be differentiated based on morphological, ecological and molecular evidence (Lentsch et al. 2000).

Cutthroat Trout native to the Bear River (Bear River Geographic Management Unit) of the Bonneville Basin are a fluvial-adapted form that persist in harsh, highly fluctuating stream environments (Behnke 1981). Morphologically, Bear River Cutthroat Trout are differentiated by a higher number of scales and pyloric caeca than their Basin counterparts. However, it has been argued that the morphological differences are not sufficient to warrant recognition as a separate subspecies of BCT (Hickman 1978, Hickman and Duff 1978) and thus the Bear River Cutthroat Trout is managed as a variation of BCT. Molecular evidence based on allozyme data (Loudenslager and Gall 1980b, Martin et al. 1985), however, provide evidence that Bear River Cutthroat are quite distinct from BCT in the Bonneville Basin and are, in fact, more genetically similar to Yellowstone Cutthroat Trout than they are to BCT in either the main Bonneville Basin or Snake Valley. For this reason, Loudenslager and Gall (1980b) suggest that BCT have only two variations, the Snake Valley form and those in the main Bonneville Basin. Data from mitochondrial DNA RFLP (restriction fragment length polymorphism) analysis and single nucleotide polymorphisms also support the concept that Bear River Cutthroat are more recently derived from Yellowstone Cutthroat Trout than BCT in the main Bonneville Basin (Shiozawa and Evans 1997, Toline et al. 1999, Campbell et al. 2011, Houston et al. 2012, Loxterman and Keeley 2012). That is, at the molecular level, Bear River Cutthroat are more similar to Yellowstone Cutthroat Trout than to BCT. Historically, the Bear River flowed to the Snake River, but volcanic activity during the Pleistocene changed course into the Bonneville Basin. The increased flow into Lake Bonneville caused overflow approximately 30,000 years ago at Red Rock Pass emptying much of Lake Bonneville into the Snake River (Behnke 1992). Both genetic and geologic evidence identify Cutthroat Trout in the middle and upper Bear River as remanants of Yellowstone Cutthroat Trout.

The divergent group of BCT native to the Snake Valley region (West Desert GMU) differs from other BCT both morphologically and molecularly. They have, on average, a greater number of gillrakers and basibranchial teeth and lower scale counts along the lateral line (Hickman 1978, Behnke 1979). Additionally, they have a more even distribution of spots on the body, longer head, more compressed body and a long dorsal fin positioned more posterior than other BCT (Hickman 1978). Molecular evidence, based upon variation at a few allozyme loci, indicates that Snake Valley populations to be divergent at the LDH locus (Klar and Stalnaker 1979). Similarly, Loudenslager and Gall (1980b) reported Snake Valley Cutthroat are divergent from BCT along the Wasatch Front at the SDH-1 locus. However, at this same locus, they found that Snake Valley Cutthroat Trout are similar to BCT from the Sevier drainage. Evidence in support of divergence has been found in other species occupying the Snake Valley area. For example, Utah Chub (*Gila atraria*) found in springs of Snake Valley appear to be a dwarfed form and a dwarfed Speckled Dace (*Rhinichthys osculus*) has been noted from springs in this region (Hubbs et al. 1974).

The opportunity for divergence of the Snake Valley populations existed during the presence of Lake Bonneville. At the maximum elevation, Snake Valley was an arm of Lake Bonneville and it has been argued that following declines in lake elevation, Snake Valley became isolated from the rest of the basin (Behnke 1976). However, it has also been suggested that Snake Valley Cutthroat Trout may represent the original Cutthroat Trout of the Bonneville basin from pre-pluvial times, which were replaced by a later invader throughout most of the basin. Another possible scenario is an invasion of Snake Valley Cutthroat Trout from south to north. Due to allelic patterns shared between Snake Valley Cutthroat Trout and Colorado River Cutthroat Trout (Loudenslager and Gall 1980b, Martin et al. 1985), it is possible that fish migrated from the lower Colorado River drainage into the Snake Valley region.

Some of the confusion in understanding the historical biogeography of the Snake Valley region is due to limited data. Most samples for both morphometric and molecular analyses have been taken from Trout Creek, Birch Creek, Pine Creek and populations that were stocked from Pine Creek. These sites fall within the Snake Valley and are located in historical Snake Bay of Lake Bonneville. However, some of these samples (e.g., Trout Creek) are also located on the east side of the Deep Creek range and some reports refer to samples as being from the Deep Creek area. However, Deep Creek falls to the west of the Deep Creek range and represents an area that was also covered by an arm of Lake Bonneville. A single sample from this creek was measured for meristic traits (Behnke 1976) and no differences were found between this sample and those found in Snake Valley. However, it might be expected that populations in the Deep Creek range should be distinct.

Lake Bonneville did not reach as far south as the town of Ibapah, just west of the Deep Creek range. Molecular evidence from other species sampled in this area suggests that populations to the west of the Deep Creek range are distinct. Molecular analysis based on mtDNA RFLP analysis of Spotted Frog (*Rana luteiventris*; Toline and Seitz 1999) and Speckled Dace (Toline et al. unpublished data) from streams and springs in the area surrounding the town of Ibapah suggest that this area may have been isolated from Lake Bonneville for a much longer period of time than any of the surrounding areas. Indeed, no mitochondrial haplotypes are shared between the Deep Creek samples and those found in the Snake Valley for either species.

BCT Life History

May et al. (1978) found that BCT become sexually mature during the second year for males and the third year for females. Both the age at maturity and the annual timing of spawning vary geographically with elevation, temperature and life history strategy (Behnke 1992; Kershner 1995). Lake resident trout may begin spawning at two years and usually continue throughout their lives, while adfluvial individuals may not spawn for several years (e.g., Kershner 1995). In Manning Meadow Reservoir BCT males matured at age-2 and stocked females reached maturity at age-3 (Hepworth et al 2000). Annual spawning of BCT usually occurs during the spring and early summer at higher elevations (Behnke 1992) at temperatures ranging from 4-10^{o}C (May et al. 1978). May et al. (1978) reported BCT spawning in Birch Creek, Utah beginning in May and continuing into June. Bonneville Cutthroat Trout in Bear Lake began spawning in late April and completed spawning in June (Nielson and Lentsch 1988). The wild BCT brood population in Manning Meadow Reservoir (9,500 ft. elevation) spawns from late June to early July (Hepworth and Ottenbacher 1995, Hepworth et al 2000).

Typical of most trout, BCT require relatively cool, well oxygenated water and the presence of clean, well-sorted gravels with minimal fine sediments for successful spawning. Kershner (1995) found substrate size to be proportional to body size. For example, large adfluvial BCT typically spawn in large gravels or cobbles, while smaller, stream resident BCT spawn over coarse sand or small gravels.

Information exists to document fecundity of wild BCT. Hepworth et al (2000) reported fecundity for BCT in Manning Meadow Reservoir ranged from 657 to 1267 eggs/female. The Idaho Department of Fish and Game monitored fecundity for 7 years and determined the relationship between total length and fecundity within its brood program (Figure 2; Teuscher, personal communication). The average total length of females within the brood program was 269 mm with an average fecundity of 660 eggs. The average size of the mature females ranged from 13.4 to 15.8 inches. Incubation times for wild BCT have not been verified but may be approximated from other wild Cutthroat Trout such as Yellowstone Cutthroat Trout that average 30 days of incubation (Gresswell and Varley 1988). In general, growth of trout tends to be slower in high elevation headwater drainages than in lentic environments; however, growth and reproductive rates of BCT depend greatly on stream productivity and habitat conditions. For more detailed life history information, see the BCT review by Kershner (1995).

Summary of Historical BCT Status

Conservation efforts for BCT have been ongoing since the early 1970's. At that time, there were only a few known BCT populations. The range of the sub-species had been greatly reduced by the introduction and introgression with non-native fishes. This prompted the listing of BCT as a "Species of Greatest Conservation Need" by the States of Utah and Wyoming, as a "Sensitive Species" by the US Forest Service, as a "Rangewide Imperiled (Type 2) Species" by the BLM, as a "Species of Management Concern" by the National Park Service, and as a "Vulnerable Species" by the State of Idaho. This species was petitioned, but precluded for listing as Threatened or Endangered by the US Fish and Wildlife Service (66 Fed. Reg. 51362 on October 9, 2001). The decision was made after a "Full Status Review," following a 90-day finding published at 63 Fed. Reg. 67640 on December 8, 1998 [16 U.S.C. §1533(b) (3) (A)]. The Service finding was based on the following considerations: (1) the overall status of BCT had improved in every GMU since the 1970's, (2) almost every major drainage within the GMU's supported core (genetic purity >99%) BCT populations, (3) a major reduction in threats has occurred during recent years, and (4) a recognition of past, present, and planned BCT conservation actions. The FWS decision

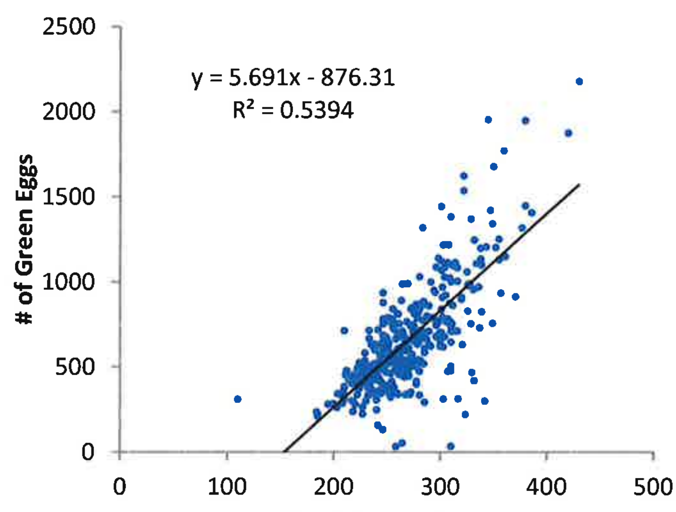

Figure 2: Relationship between total length and fecundity determined within the Idaho Department of Fish and Game wild broodstock program.

not to list was challenged in court (Center for Biological Diversity v. Morgenweck, 351 F.Supp.2d 1137, D. Colo. 2004). On March 7, 2007, the District Court of Colorado dismissed the civil action challenging the USFWS 12-month status review decision relating to the listing of BCT as "Not Warranted".

Conservation efforts for BCT were formalized in the 1990's when the BCT Conservation Team was formed. Conservation Agreements and Strategies or management plans for BCT were completed in Utah (Lentsch et.al 1997), Nevada (Nevada Department of Wildlife 2006) and Idaho (Teuscher and Capurso 2007). The Range-wide Conservation Agreement and Strategy was completed in 2000 (Lentsch et. al 2000). In 2004, the Utah Conservation Team completed a Post Implementation Assessment to present progress and accomplishments in BCT conservation in the State of Utah. Also during 2004, a comprehensive Range-Wide Status Review was completed and published (May and Albeke 2005).

Today it is estimated that there are 202 conservation populations of BCT occupying 39% of their historic habitat (2015 Range-Wide Species Update, P. Burnett, un-published data). This increase in the range of BCT is a collaborative effort among many agencies. Each agency has experienced its own successes. Examples of these successes include:

Weber River, Utah:

The Utah Division of Wildlife Resources (UDWR) has completed several projects to help restore a fluvial BCT population in the Weber River. A population of BCT including large individuals was known to occur in the Lower Weber River (Peterson downstream to the mouth of Weber Canyon), however, the UDWR did not know what was sustaining this population lower in the drainage in spite of high Brown Trout densities. A graduate project to was funded in 2011 and the results concluded that this population was highly migratory (fluvial) and BCT attempted to or utilized 7 major tributary streams for spawning. This segregation of juvenile BCT from Brown Trout likely has been what has sustained this population through time. Very few fluvial BCT populations remain and this population was threatened by fragmented habitat. The graduate study identified major barriers to movement in all of the spawning tributaries as well as four mainstem barriers that fragmented the population. In 2014, a partnership was coalescing in the Weber River and a guiding management document was developed. Bonneville Cutthroat Trout were identified as a conservation target in the watershed, which highlighted this fluvial population to other partners in the Weber River. By the end of 2018, six tributary barriers will have been removed allowing full BCT spawning access into 6 of the 7 spawning streams. This work was partnered largely with irrigation companies and private landowners, however, one fish ladder was installed in a 380 foot long Utah Department of Transportation culvert resulting in BCT spawning access into this stream for the first time in more than 50 years. In addition, fish passage has been achieved at two of the the mainstem barriers and a re-licensing project on a third mainstem diversion will result in a fish ladder that likely will be close to two million dollars when it has been constructed, likely in 2021-2022.

Otter Creek, Utah:

Historically, BCT occupied presumably the entire Otter Creek drainage in Rich County, Utah. However, multiple factors likely led to the decline and eventual extirpation of BCT from the drainage, including competitive interactions with non-native trout species (brook trout and brown trout) and the effects of habitat fragmentation. The last record of BCT in the drainage was during UDWR fish population surveys in 1954 when their numbers were very low and they were sharing habitat with brook trout. Following much planning, extensive restoration of habitat connectivity through a large number of diversion and road crossing improvement projects was completed by Trout Unlimited, the Bureau of Land Management, and UDWR, with the cooperation of multiple private landowners. In addition, a permanent migration barrier was constructed below the three primary forks of Otter Creek and the drainage was reclaimed in 2016 through two successive rotenone treatments. Two weeks later, BCT were re-introduced, ending their half-century-long absence from the drainage. In fact, BCT are now swimming those waters with two other native fish species, Mottled Sculpin and Northern Leatherside Chub, making Otter Creek a native fish success story.

Bear Lake, Utah/Idaho

The Utah Division of Wildlife Resources (UDWR) and Idaho Department of Fish and Game (IDFG) working in conjunction with Trout Unlimited (TU), irrigation companies and several real estate developers have completed several projects to help restore the adfluvial-BCT population in the Bear Lake drainage. Both agencies began working on a myriad of projects in the early 2000's and as of 2017, 15 fish screens have been installed to prevent BCT loss to irrigation ditches, five culverts have been replaced to enhance BCT spawning access and connectivity, 3 fish ladders have been installed to enhance BCT spawning access and connectivity, two highway bridges have been replaced to enhance BCT spawning access, and two rotenone treatments (Swan Creek, UT and Fish Have Creek, ID) have been completed to remove hybridized BCT and non-native rainbow trout and brook trout. In both of these streams, populations of native BCT populations have been established. In addition, a graduate study was completed by Utah State University (USU) to delineate the timing of BCT out-migration from tributary streams and quantify the return of naturally recruited BCT. The UDWR demonstrated in 2002 the naturally recruited BCT made up only 7% of the BCT caught in lake-wide, standardized gill-netting effort, but as of 2017, naturally recruited BCT now make up 69% of the BCT caught in the same lake-wide, standardized gill netting. Even more pronounced is the percentage of naturally-recruited BCT returning to the Swan Creek spawning trap. In 2002, only 12% of the returning, adult BCT were naturally recruited fish, but as of 2017, over 90% of the BCT returning as adults were naturally recruited.

Big Wash and Silver Creek, Nevada

There are two projects that stand out as success stories in Nevada, one is Big Wash and the other is Silver Creek. The chemical restoration of Big Wash in 2001 and Silver Creek in 2013 allowed Bonneville Cutthroat Trout to occupy 26.8 km (16.6 miles) of quality habitat. Of the 26.8 km of stream that was restored, approximately 12.1 km (7.5 miles) was on private property. Without the cooperation of these landowners the two streams would not have been treated and Nevada would have two fewer BCT streams.

The Crouch family owns the property that 6.4 km (4 miles) of Big Wash flow through. The Crouch's expressed interest in restoring BCT in Big Wash and using a pond on BLM property as a brood pond for Bonneville Cutthroat Trout. BCT have occupied the pond since 2003, however, using the pond as a donor source has been limited. Fortunately, that brood pond will be put to use with the future reintroduction efforts of two streams lost to recent wildfires. The project on Big Wash allowed for the fostering of a partnership that may benefit BCT conservation for years to come.

Clear Creek, Utah

Clear Creek is one of the largest tributaries of the Sevier River in the Southern Bonneville GMU. The Clear Creek drainage (which includes several tributaries) encompasses 65 miles (105 km) of trout habitat. Prior to 2010, BCT were restricted to just 4 miles (6.5 km) of stream habitat. Widespread losses of non-native trout in Clear Creek and its tributaries following the 2010 Twitchell Canyon wildfire prompted expansion of previously finalized plans for restoration of BCT, from just three tributaries to include the entire drainage. From 2011 to 2014, rotenone was applied to 61 miles (98 km) of stream in the drainage to remove remaining non-native trout. BCT were stocked throughout Clear Creek and its tributaries from 2012 to 2016. Surveys conducted in 2017 found that stocked fish have experienced exceptional survival and growth, and that successful spawning has also commenced. The restoration project increased the level of historic habitat occupied by BCT in the Southern Bonneville GMU from 10% to 14%. This is a significant step forward in BCT conservation. Clear Creek also now sustains the largest population of native cutthroat trout in southern Utah by a factor of three. This is the most expansive native cutthroat trout restoration in Utah to date. Four other native fish species (Mottled Sculpin, Mountain Sucker, Speckled Dace, and Southern Leatherside Chub) have been able to re-establish and expand in Clear Creek following the removal of non-native trout. The Clear Creek drainage now represents the largest stream drainage in the state of Utah inhabited solely by native fish species.

Great Basin National Park, Nevada

There are six historic BCT streams that originate in Great Basin National Park. In the 1990's, it was believed that BCT had been extirpated from all of them. However, in 1999 pure BCT were discovered in Mill Creek, kick starting the Park's restoration program. By 2005, BCT were reintroduced to an additional four streams – South Fork Big Wash in 2000, Strawberry Creek in 2002, and the upper section of Snake Creek and the South Fork of Baker Creek in 2005. In 2010, it was confirmed that brook trout had compromised the BCT restoration area in the upper section of Snake Creek. The Park, still fully committed to BCT restoration, salvaged as many BCT as possible and planned a second piscicide treatment. Before the treatment was carried out, the Park secured funding to construct a fish barrier near the boundary. With the construction of the barrier in 2014, the Park had the ability to treat both the upper and lower sections of Snake Creek adding an additional 2.5 miles of stream to the restoration area. The rotenone treatment was conducted in 2016 and BCT are expected to be released into Snake Creek in 2019.

Idaho Conservation Hatchery

As part of the mitigation for operating hydroelectric facilities on the Bear River in Idaho, PacifiCorp is funding the development and maintenance of a Bonneville cutthroat trout stocking program. The first three years of funding were defined as the development phase. After the development phase, funding has been used to maintain broodstock and pay for rearing and stocking. The Idaho Department of Fish and Game is implementing the program and began collecting potential broodstock in 2007. Because of unique genetic characteristics documented in the population, there are several clades of fish that have been managed separately. Therefore, one stock of cutthroat trout will not be used to supplement all areas of the Bear River in Idaho. Because of past habitat improvements and the number of unoccupied tributaries, the Thatcher Management Area was chosen as the first reach to implement the hatchery program. This reach of the Bear River is between Oneida and Alexander reservoirs.

To date, 2,001 sub-adult Bonneville cutthroat trout have been collected from Cottonwood Creek and its tributaries. A small percentage of these fish have been genetically classified as hybrids with rainbow trout and are culled from the population. Relatedness analysis was also completed on all of the potential donor stock. Those findings indicated that the donor population contained sufficient genetic diversity to implement a random one-on-one mating strategy. Fish that passed the genetic tests have been released into a broodstock rearing pond. To minimize the potential negative impacts of domesticating the stock, only first generation fish have been released. The broodstock population has been maintained by repopulating the brood pond with wild trout from Cottonwood Creek.

The first ripe fish were collected from the broodstock pond in 2010. In total, the program has produced over 212,043 eyed eggs. Fish produced are reared at the Grace State Fish Hatchery and released in the spring and fall of the following year. Since 2011, we have stocked 155,759 cutthroat trout. Stocking locations include eight tributaries and several sites along the Bear River.

A goal of this program is to release fish in streams that have sufficient habitat to reproduce naturally and eventually hatchery supplementation will no longer be necessary. Once we document success in the Thatcher Management Area, it is anticipated that the program will be expanded to other areas of the Bear River. Based on need and many ongoing successful habitat projects, we anticipate moving the hatchery program to the Nounan Reach of the Bear River above Alexander Reservoir or the Riverdale Reach below Oneida reservoir.

Future Threats and Risks

Despite the many BCT conservation success stories, more can be done to ensure the long-term persistence of the subspecies. The Bear River and Northern Bonneville geographic areas are considered BCT strongholds with populations occupying a high percentage of historic habitat (Bear River: 51 %, Northern Bonneville: 52%). The situation is much different in the Southern Bonneville and West Desert geographic areas where only 14% and 22%, respectively, of the historically occupied stream-kilometers are presently occupied. Unlike the situation to the north, these populations are highly fragmented and scattered throughout the historic range with only a few adjacent occupied sub-watersheds.

Population integrity of BCT varies dramatically between the relatively well-connected populations in the Bear River and Northern Bonneville geographic areas and naturally more fragmented populations in the Southern Bonneville and West Desert areas. Isolation of small populations in headwater tributaries of the Southern Bonneville and West Deserts has helped maintain their genetic purity and insulate them from disease and non-native salmonids. However, their isolation comes at the cost of life history diversity and population extent.

Small, isolated populations have a greater risk of extinction than larger connected populations. Their small stream habitats are vulnerable to stochastic events such as wildfire, floods, and prolonged droughts, each expected to increase in a warming climate. These can be lethal to a population if they are isolated from downstream habitats. Furthermore, their small population size contributes to a loss of genetic variability that may be necessary to adapt to environmental change.

In order to identify those populations that have an inherent risk of extinction due simply to their population size and extent, we conducted a population level analysis of persistence. The methodology was based on the findings of Hilderbrand and Kershner (2000) and the need to maintain an effective population size of 500 reproducing adults, which is equivalent to a census population of about 1,000 – 2,000. To achieve this level, Hilderbrand and Kershner (2000) determined that 9.3 km of stream habitat is required for populations at high abundance while 27.8 km is needed if the population has a low density. For larger rivers or interconnected stream systems, we relied on previous analyses of bull trout suggesting that populations in >10,000 ha of habitat have a high likelihood of persistence, whereas populations with <5,000 ha face a substantially higher probability of extinction (Dunham and Rieman 1997).

The persistence analysis for BCT found that just 83 of the 202 conservation populations (41%) analyzed met the minimum threshold for persistence. These 83 populations are found in 3707 km (87%) of the currently occupied habitat, while the remaining 119 populations occupy just 547 km (13%) of habitat. Unlike the situation that exists for many inland trout, BCT still have some large connected populations, with the largest occupying over 500 km of connected habitat in the Smiths Fork and

Thomas Fork of the Bear River. The 10 most highly connected populations occupy over 50% (1,708 km) of the current habitat, while the remaining populations (93%) are found in less than ½ the habitat.

High quality habitat is essential to restoring the integrity of remaining populations. Over ½ of the occupied sub-watersheds occur on public lands, including road-less areas, wilderness, and other protected landscapes that provide important opportunities for expanding populations and re-establishing life history variability.

Many factors threaten the persistence of current BCT populations (Utah Division of Wildlife Resources 2015). Oil and gas development, resource extraction, and sheep and cattle grazing are moderate, widespread threats while land conversion, in-stream mining, and hydropower development are major threats but occur only minimally throughout most of the range. However, the potential for small headwater dams as a mitigation effort for climate change and reduced snowpack could emerge as a threat in the future.

Data from the latest Rangewide Assessment (P. Burnett, un-published data) shows that introduced species are a significant threat with over 60% (128/209) of the sub-watersheds having a high risk from non-native trout. All but one of these is located in either the Bear River or Northern Bonneville geographic areas where higher levels of connectivity also make the populations more vulnerable to non-natives. Road networks and associated public access in areas that are currently free of non-natives can increase the risk for future exotic species introductions and spread of disease. Angler education and control of exotics will be important components of any restoration activities that increase connectivity and population extent. It has been suggested that migratory populations that have access to a wider range of habitat types may be more resistant to non-native fishes (Colyer et al.2005).

Water management is a significant threat to BCT. Agencies have worked towards improving water management for the benefit of BCT by removing barriers and improving in-stream flows. Climate change also poses a significant long-term threat to BCT and climate change effects can be exacerbated by poor water management. Assuming a 3.6°F (2°C) global warming scenario, which is consistent with global circulation model projections for the Western United States by 2050, 87% (497/570) of the sub-watersheds within the historic range are at high risk for at least one of the indicators (temperature, precipitation, flooding, and wildlife) analyzed (Williams et al. 2009; Haak et al. 2010a; Wenger et al. 2011). This includes 83% (173/209) of the sub-watersheds that contain conservation populations.

Drought is the most pervasive risk factor throughout the BCT range with 72% (408/570) of the historic range at high risk, including 53 % (110/209) of the occupied sub-watersheds. Drought has the potential to compound the effects of other factors such as wildfire. Nearly 25% of the occupied sub-watersheds are at high risk for both wildfire and drought. Obviously if a large wildfire ignites, it could spread to sub-watersheds that have been identified as low risk for the start of a fire. These low risk sub-watersheds could still burn in a manner that is lethal to populations and potentially susceptible to post-fire channel altering events.

Adverse post-fire effects on drainages are generally associated with large storm events that result in excessive overland flow and erosion caused by vegetation loss and channel-altering floods. Due to the variability in global climate models, changes in precipitation were not included in this series of climate change analyses. However, warmer winter temperatures commonly projected by global climate models are likely to result in uncharacteristic winter flooding due to an increase in late winter rain on snow events. This risk factor is most prevalent in the mid-elevations of the Northern Bonneville and Bear River basins. Most of the high risk sub-watersheds are at a slightly lower elevation than the high risk fire zone, but not all. Forty-three of the occupied sub-watersheds, primarily in the Northern Bonneville, are at high risk for both fire and flood.

Geographic Management Units

The historical range of BCT has previously been divided into four Geographic Management Units (GMU); Bear River, Northern Bonneville, West Desert, and Southern Bonneville (Figure 3; BCT Conservation Team 2004). Within each GMU, conservation areas are further subdivided into subunits and six digit Hydrologic Unit Code areas. The use of the HUC 6 area ensures that all fisheries management practices within a drainage are compatible with the BCT conservation efforts. Project planning and implementation will be conducted on smaller geographic units (i.e., HUC12) but evaluations of success will be scaled up to the GMU level.

Identification of Conservation Goals and Future Restoration Plans

Concepts used in this Strategy

This Strategy will be in effect for ten years and supplants the previous version completed in 2000. The Strategy is intended to provide a list of conservation activities, which if completed and maintained will compliment past actions that have contributed to the lon-term resilience of BCT populations.

During the course of development of this Strategy, we discussed various metrics that might be used to assess "success". Typically, conservation strategies have focused on defining targets related to a total number of populations or kilometers of occupied historical stream habitat. Although both of these are valuable parameters and relate directly to the criteria used for the determination of listing under the Endangered Species Act, we elected to use a different set of metrics for the BCT. Our decision to use different metrics was based on several factors; 1) often times the selection of number of populations or kilometers of occupied habitat is arbitrary and may not sufficiently address existing threats, 2) there may not be adequate representation across the geographic range of the species to prevent extirpation within a portion of the range, and 3) the use of number of populations or proportion of occupied habitat does not always adequately address long term threats such as climate change to ensure population resiliency. For these reasons, this Strategy uses recent techniques developed by Trout Unlimited scientists to assess conservation priorities and determine the likelihood of population persistence.

The desire is to continue to improve the security of BCT during the period of this Strategy. To achieve that goal, this Strategy focuses on the following objectives:

1. Protect existing conservation populations
2. Complete conservation projects that are on-going
3. Complete conservation projects that are planned for initiation during the next 10 years
4. If conservation goals are not met, identify and complete additional restoration that will work towards meeting these goals

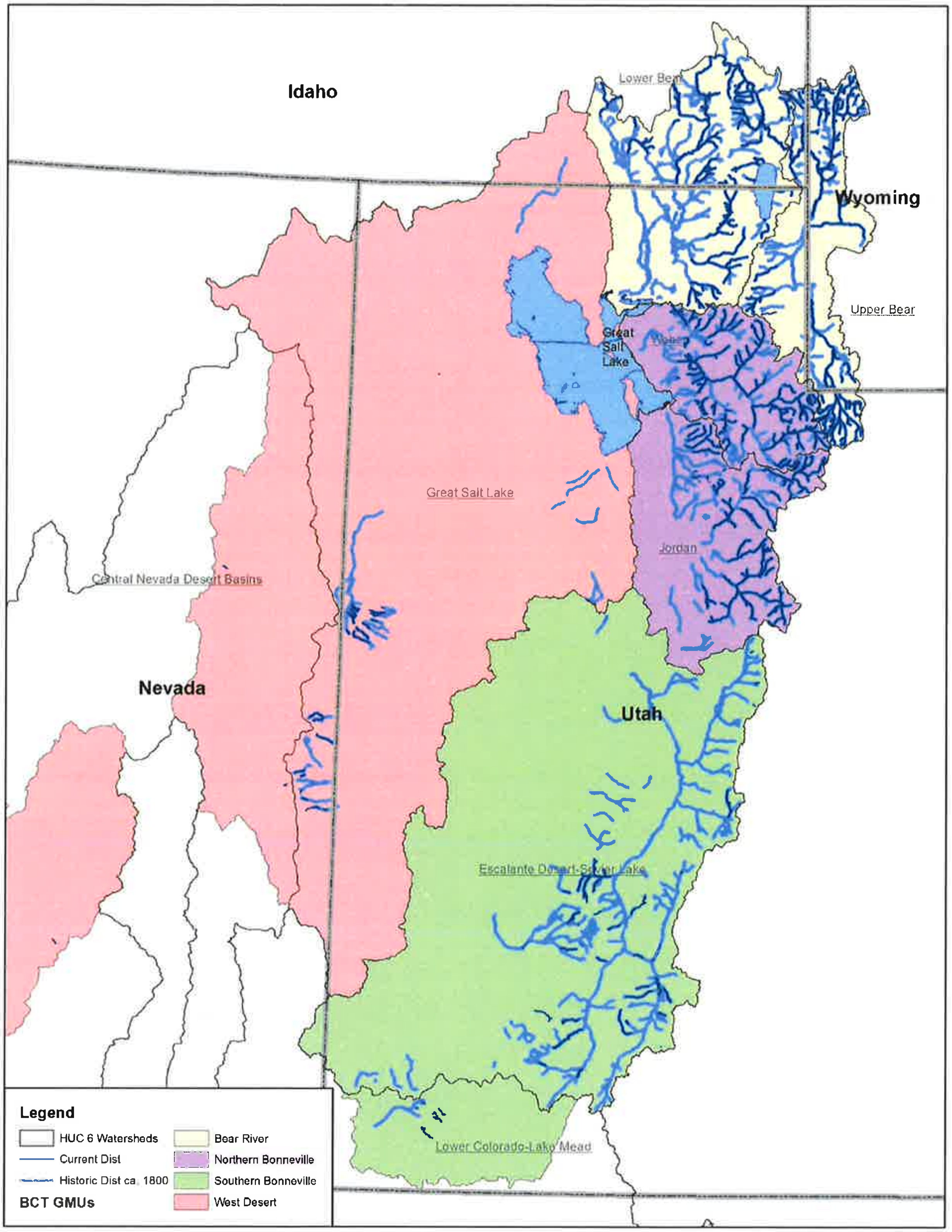

Figure 3: Regional map indicating the Major Subbasins (HUC6 watersheds), Geographic Management Units (GMU's), current and historical distribution of BCT, and state boundaries.

5. Move towards the monitoring and adaptive management of BCT after the identified restoration activities are completed.

The completion of the actions described in this Strategy should ensure the future security of BCT. Regardless, there will be additional BCT conservation work that could be completed. Opportunistic work may occur outside this Strategy that would further increase the security of BCT.

Definitions

Several terms used within the Strategy are defined as follows:

Metapopulation: A population with an extent greater than 50 km with a habitat patch size greater than 25,000 ha. Metapopulations also have a migratory life-history component (Haak et al. 2011).

Stronghold population: A population extent of greater 27.8 km with a habitat patch size greater than 10,000 ha (Haak et al. 2011).

Subpopulation: Defined based on hydrologic unit code (HUC). Subwatersheds are hierarchical units with a 12 digit HUC code.

Watershed: Defined based on hydrologic unit code (HUC). Watersheds are hierarchical units with a 10 digit HUC code.

Conservation Strategies

Developing rangewide conservation strategies for BCT requires a multi-scalar approach that captures the variability of population and habitat conditions across the historical range. Trout Unlimited's Conservation Portfolio analysis provides a valuable framework for defining conservation goals for each GMU, based on the contribution of existing populations to the rangewide diversity of BCT while taking into account the historical context.

The Conservation Portfolio approach is grounded in one of the basic principles of conservation biology: diversity provides stability. Biologically diverse communities are better able to withstand disturbance and swings in environmental conditions that would destabilize communities dominated by few species or populations. This concept is applicable to entire ecosystems as well as individual species or subspecies. A diverse conservation portfolio for native trout spreads the risk of loss across a variety of habitats and populations through the inclusion of at least some proportion of the life history, habitat and genetic diversity that has allowed these fishes to succeed and persist over time despite disturbances and changes to their environment.

In order to provide a structure to describe existing and potential future levels of diversity within a conservation portfolio, we adopt the 3-R framework of **Representation** (protecting/restoring diversity), **Resilience** (having sufficiently large populations and intact habitats to facilitate recovery from rapid environmental change), and **Redundancy** (saving enough different populations so that some can be lost without jeopardizing the species) (Shaffer and Stein 2000). These same principles have been applied by the US Fish and Wildlife Service in developing recovery plans for listed species (Carroll et al. 2006). The

3-R principles are discussed in detail below and have been used in the development of the goals and objectives for BCT restoration described in the following sections.

- **Representation** encompasses three population attributes important to diversification of the subspecies' portfolio: genetic purity, life history, and geography. Each of these elements are quantified based on the number of conservation populations that are genetically pure, exhibit a migratory life history form (fluvial or adfluvial), or occupy a unique geographic region as indicated by the presence of peripheral populations.
- **Resilience** in the portfolio is quantified based on the presence of strongholds or metapopulations, applying criteria on stream habitat extent and patch size from Hilderbrand and Kershner (2000) and Rieman et al. (2007).
- **Redundancy** provides a spatial hedge against losses by securing multiple populations within each sub-basin of the historical range. In order for a population to count towards redundancy it must satisfy criteria for both genetic purity and persistence. The genetic purity standard allows for some introgression (up to 10%) while the determination of persistence applies criteria on occupied habitat extent, patch size and population density from Hilderbrand and Kershner (2000) and Rieman et al. (2007). For arid regions that do not have adequate available or potential habitat to meet Hildebrand and Kershner's (2000) habitat length criterion, we have developed a modified indicator for meeting redundancy. In these areas we retain the goal of an effective population size of 500 interbreeding adults (or 2,500 total population size for fish greater than or equal to 75 mm TL, or 1,250 total population size for fish greater than or equal to 150 mm TL) but eliminate the habitat requirement (Haak et al. 2011).

Table 1 summarizes the conservation portfolio for BCT by GMU. The analysis is based on the 2015 Range-wide Status Assessment Database (P. Burnett, un-published data). Populations that exist outside of the historical range as well as those populations located in small isolated ponds and classified as 'brood stock' were not included.

In addition to the quantitative summary, the 3-R framework also incorporates a spatial characterization of the conservation portfolio for BCT. Reviewing the spatial distribution of the portfolio elements is important in the development of place-based strategies that take into account both the historical diversity that was present in a basin as well as the current conditions that may limit restoration opportunities.

After reviewing the results of the 3-R analysis for BCT as described in Table 1, it is possible to establish goals (Table 2) for each of the GMUs based on their current and historical contribution to the rangewide conservation portfolio. As is typical of virtually all native trout, habitat fragmentation and degradation and pressure from non-native species have resulted in a significant reduction in resiliency, life history diversity and genetic purity when compared to historical conditions. Contraction of the historical range has also had a disproportionate effect on the persistence of peripheral populations when compared to the core (Haak et al. 2010). The conservation goals identified in Table 2 are based on the largest number between what is present in the current conservation portfolio or what is recommended in the literature (Hilderbrand and Kershner 2000; Rieman et al. 2007; Haak et al. 2010b). The goals were selected in this manner because there are instances where the number of populations that currently exists exceeds what is recommended in the literature and despite the recommendations, there is value in maintaining current populations.

Habitat differences occur among GMUs and consequently, various attributes of the historical distribution of BCT vary among GMUs. The Northern Bonneville and Bear River GMUs are less arid and have more continuous habitat and historically had more total populations. In contrast, the habitat in the West Desert and Southern Bonneville GMUs are less connected. Historically, there were more

Table 1: The current Conservation Portfolio summary by GMU for Bonneville Cutthroat Trout. Abbreviations used in the table include: Pops = populations, adfl = adfluvial, fluv = fluvial, both = adfluvial and fluvial, and disj = disjunct.

			Representation			Resiliency		Redundancy
GMU	**Total Number of Pops.**	**Occupied Stream Habitat (Km)**	**Genetic Integrity (# of Pops.)**	**Life Hist. Diversity (# of Pops.)**	**Geographic Diversity (# of Pops.)**	**Stronghold (# of Pops.)**	**Meta-populations (# of Pops.**	**Replicate or Persistent & <= 10% Introgressed**
Bear River	44	2273	32	5 adfl 9 fluv 2 both	N/A	9	5	24
Northern Bonneville	85	1521	65	2 adfl. 5 fluv.	N/A	10	2	39
Southern Bonneville	42	308	35	N/A	12 disj.	1	1	12
West Desert	29	152	29	N/A	29 disj.	0	0	8
Total	**202**	**4,254**	**163**	**23**	**43**	**20**	**8**	**83**

Table 2: Conservation goals for Bonneville Cutthroat Trout

Management Goal	Component	Indicator of Success	Northern Bonneville and Bear River Goals (# of Populations/ GMU)	West Desert and Southern Bonneville Goals (# of Populations/ GMU)
Representation	Genetic Integrity	>90% Genetic Purity	30	30
	Life History Diversity	Adfluvial Populations Present	2	0
		Fluvial Populations Present	2	0
	Geographic Diversity	Disjunct Peripheral Populations	0	15
Resilience	Stronghold Population	27.8 km Interconnected Habitat	10	2
	Metapopulation	Migratory life history + 50 km Habitat	1	0
Redundancy		a) Replicate Populations, or	10/Sub-Basin	10/GMU
		b) Persistent Populations, or	5/Sub-Basin	5/GMU
		c) Stronghold Populations, or	2/Sub-Basin	2/GMU
		d) Metapopulation	1/GMU	1/GMU

metapopulations, fluvial populations, and adfluvial populations and no peripheral populations in the Northern Bonneville and Bear River GMUs. There were fewer metapopulations in the Southern Bonneville GMU and none in the West Desert GMU. Peripheral populations were common in these GMUs. Based on these habitat and historical distribution differences, the conservation goals (Table 2) for the Northern Bonneville and Bear River GMUs are different than those for the West Desert and Southern Bonneville GMUs. Historically, BCT were found in Bear Lake, Utah Lake, Panguitch Lake, and Lake Alice. The goals outlined in Table 2 do not pertain to those populations. Additional goals include maintaining BCT populations in Bear Lake and Lake Alice and at least one lacustrine population within the Northern Bonneville and Southern Bonneville management units that contain fish from the respective GMU. Populations in Panguitch Lake and Utah Lake have been extirpated, although, Panguitch Lake (in the Southern Bonneville GMU) has been re-stocked with BCT from Bear Lake (Bear River GMU) to provide sport-fishing opportunities.Utah Lake no-longer provides suitable habitat for BCT.

Developing Strategies using the Conservation Success Index

Once conservation goals have been established for each of the GMUs, the Conservation Success Index (Williams et al. 2007) can then be used to develop spatially explicit conservation strategies for achieving the portfolio goals. The CSI integrates a variety of spatial data sets to conduct baseline analyses for 20 indicators of conservation status at the sub-watershed scale (6th Hydrologic Unit Code; approximately 15,000 to 30,000 acres). These indicators are grouped into four general categories (Figure 4):

1. Range-wide conditions

   These five indicators (Figure 4) provide a comparison between historical (pre-colonial) and current distribution of BCT at various geographic scales (e.g. sub-watershed, sub-basin) and across diverse habitat types (e.g. lake, stream order). Collectively these five indicators describe the 'recent' trajectory of the subspecies across its historical range.

2. Population integrity

   The *Population Integrity* indicators (Figure 4) are based on population data collected and compiled in the most current BCT Range-wide Status Assessment database. Sub-watershed scores represent an aggregation of all population segments contained within an individual sub-watershed and are thus not necessarily an indicator of the status for any single population in its entirety.

3. Habitat integrity

   Habitat Integrity uses a variety of publicly available spatial data sets typically developed by state and federal agencies to characterize watershed and stream channel conditions (Figure 4). In order to minimize bias in the analysis, only those data sets that encompass the complete historical range of BCT are used. Finer scale information that is available for only a portion of the range may be used in more detailed analyses that focus on a more limited geographic

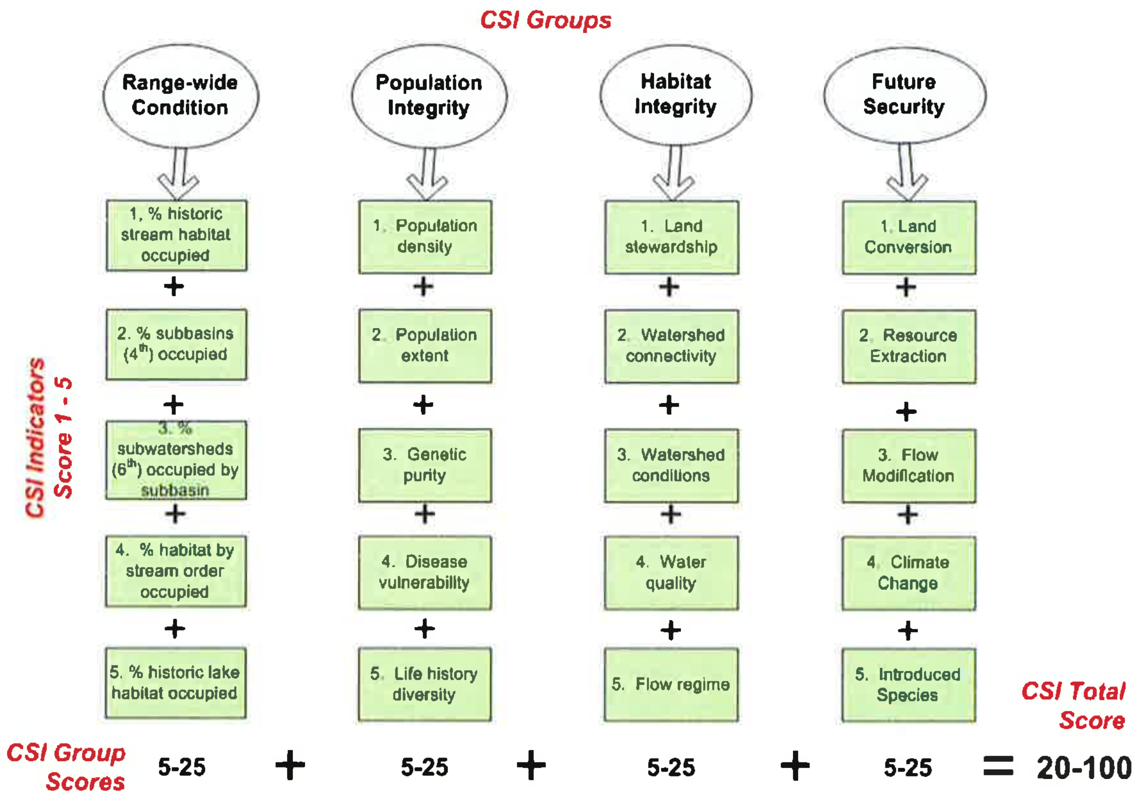

Figure 4: The CSI for BCT comprises 20 indicators, which are divided into four categories. Each indicator is scored from 1-5 for every subwatershed in which BCT occur, resulting in 100 possible points.

extent. When data for a specific metric such as flow are not available, appropriate surrogates are used (e.g. dams, diversions).

4. Future security

The vulnerability of populations within a sub-watershed to future threats is characterized by the *Future Security* indicators (Figure 4). These indicators are intended to identify long-term regional threats (e.g. climate change, land conversion, resource extraction) based on current landscape conditions and future projections. More immediate site-specific threats from locally driven proposals (e.g. roads, diversions, small-scale hydropower) are not captured in this analysis. Each indicator is scored from 1 to 5 based on a standard CSI rule set (see Williams et al. 2007; Appendix A) designed to include major factors that influence salmonid persistence.

One of the primary purposes of the CSI analysis is to prioritize management actions for protection, monitoring, restoration and reintroduction for a species of interest based on accepted conservation principles. To accomplish this, the composite scores from the population and habitat integrity indicator groups may be used to derive general conservation strategies at the sub-watershed scale.

- Where both population and habitat integrity scores are high, the conservation strategy is **protect**.
- Where habitat integrity scores are high and population integrity low, the conservation strategy becomes **enhance population**.
- Conversely, in sub-watersheds where habitat integrity is low but population integrity is high, we assign a conservation strategy of **enhance habitat**.

Where both population and habitat integrity are low the conservation strategy becomes **enhance population and habitat**.

- Sub-watersheds where target species are absent or severely limited but habitat integrity remains high and vulnerability is low or moderate are targeted for **reintroduction**.
- The lowest priority sub-watersheds will be those where BCT have been extirpated and where current habitat integrity is very low. These sub-watersheds are assigned a conservation strategy of **restore then reintroduce.** Reintroduction priority can be further broken down into moderate and high priorities based on existing habitat conditions and vulnerability to future threats.

Using the Conservation Portfolio and Conservation Success Index methodologies addresses the three shortfalls of the traditional metrics of number of populations and kilometers of occupied habitat identified earlier. The system also provides a quantifiable and defensible method for prioritizing future projects that are intended to help meet conservation goals.

Climate Change and Future Persistence

Restoration efforts require significant investment from management agencies. In addition, these agencies, their partners, and public would like to ensure future persistence of BCT. Climate change is a potentially serious threat to the persistence of BCT and should be considered when identifying future conservation projects. Special consideration should be made when planning restoration activities that occur in locations where climate change threatens the long-term persistence of BCT. Climate change does not only influence stream temperature. Increased air temperatures are also associated with decreases in snowpack, earlier run-off, reduced summer stream flow, increased floods, drought, fire frequency and intensity (Haak et al. 2010b). Temperatures are expected to rise by 2-3^{o}C in the next century (Climate Impacts Group 2016).

Anticipated increases in temperature should be considered when future restoration projects are selected. Johnstone and Rahel (2003) performed laboratory tests and determined the 7 d upper incipient lethal temperature for BCT is 24.2^{o}C. Williams et al. (2009) compared the historic range of BCT with temperature data from a 30 year national air temperature dataset (PRISM 2016) and found that the range of BCT was limited to waters with a mean July air temperature of ≤ 24^{o}C. Habitats with temperatures of 22.1-24^{o}C were considered marginal for BCT (Williams et al. 2009). Within this century, global mean July air temperatures are expected to increase by 2^{o}C (Climate Impacts Group 2016). Data from these studies suggests that BCT cannot tolerate temperatures greater than 24^{o}C. Schrank et al. (2003) however, found in the field that under fluctuating temperature conditions that BCT can tolerate maximum daily temperatures as high as 27^{o}C. These data suggest that BCT perform best at temperatures <24^{o}C but can tolerate brief periods where daytime temperatures reach 27^{o}C.

In the future, it is recommended that only projects where temperatures are anticipated to remain suitable for BCT are pursued. A model was developed for this Strategy for the purpose of identifying where temperatures may remain suitable in the future (see below). Other reliable models exist as well. The NorWeST model also provides estimates of both current stream temperatures and temperatures under different climate change scenarios (Isaak et al. 2017). These models typically predict temperatures on a broad landscape scale. Temperatures on a local scale can often differ from model predictions. Thus, data collected in the field can also be used to determine temperature and the likelihood of future BCT persistence.

For the purposes of this Strategy, a climate change model was developed using the PRISM dataset (PRISM 2016) with an anticipated increase in July air temperature of 2°C (Climate Impacts Group 2016). Habitats with current air temperatures ≤ 22°C were assumed to remain suitable for BCT at the end of the century (i.e., temperatures in these habitats would remain below the 24°C threshold identified in Williams et al. 2009). Mean July air temperatures from 1981-2010 were inputted into ArcGIS (PRISM 2016) and mean elevations where air temperatures currently exceed 20 and 22°C were identified. The effect of latitude on temperature was addressed by stratifying Utah (encompasses the majority of the BCT range) into five, 1° latitudinal bands. Other climate models predict climate change scenarios on a stream-by-stream basis but are often based on limited data from the range of BCT. Elevation provides a crude proxy for temperature. Data from this climate change model are presented in Table 3. Elevations where current air temperatures exceed 22°C are anticipated to warm with climate change to above the threshold that BCT can tolerate (Williams et al. 2009). Elevations where current temperatures exceed 20°C but are less than 22°C are expected to provide marginal habitat in the future and elevations where current temperatures are less than 20°C are expected to provide suitable future habitat for BCT. It is recommended that this model be used as a tool when prioritizing future restoration efforts. Top priority projects should occur at elevations where temperatures are projected to remain below 22°C. Projects at elevations where temperatures are expected to exceed 24°C should be pursued with great caution because it is possible that that these projects will not contribute to the long-term persistence of BCT. It is acknowledged, however, that there are lower elevation habitats that may be beneficial to BCT. For example, fluvial and adfluvial populations may utilize lower elevation sites during certain times of the year.

Table 3: Estimated elevations where mean July air temperatures are expected to remain < 22° C, between 22 and 24°C and above 24°C. Estimates are stratified by latitude. Elevations where temperatures are expected to remain <22°C are expected, despite climate change, to provide adequate habitat for Bonneville Cutthroat Trout through the end of the century. Elevations where temperature exceeds 24°C are considered un-suitable for Bonneville Cutthroat Trout. Intermediate elevations are expected to provide "marginal" habitat. Temperature ranges do not overlap because they are based on averages.

Zone	Latitude	Elevation Where Future Temperature Predicted to be < 22°C (meters)	Elevation Where Future Temperature Predicted to be 22-24°C (meters)	Elevation Where Future Temperature Predicated to Exceed 24°C (meters)
1	41°N - 41.99°N	>1937	1410-1581	<1410
2	40°N - 40.99°N	>2109	1645-1910	<1645
3	39°N - 39.99°N	>2259	1680-1995	<1680
4	38°N - 38.99°N	>2269	1743-2010	<1743
5	37°N - 37.99°N	>2213	1780-1962	<1780

Other anticipated climate change effects (e.g., earlier run-off, drought, increased fire intensity) are more difficult to model. Future BCT conservation efforts should target the establishment of populations that meet the habitat criteria developed by Hilderbrand and Kershner (2000) as populations that meet these criteria will be more resilient to other perturbations that are expected to correspond with climate change.

Trade-off Between Isolation and Invasion

Non-native fishes can significantly affect BCT through competition, predation, and hybridization. This creates a trade-off, however, because increasing stream connectivity can reduce BCT extinction risk but also increase the risk of non-native fish invasion. This means that managers must consider the risk of invasion when deciding what barriers should be removed. When BCT conservation decisions are made, the trade-off between increased connectivity and non-native risk needs to be considered. Fausch et al. (2009) provides a conceptual model of how this trade-off should be considered. It is recommended that this model (Figure 5) is considered when management decisions are made. Isolation is appropriate when it prevents invasion by non-native fish. Isolating barriers should be removed, however, when it is possible to improve connectivity without leaving a BCT population at risk of non-native invasion.

Conservation Goals/Objectives

Data from the latest Range-wide assessment for BCT (Table 1; P. Burnett, un-published data) indicate there are a total of 202 BCT populations occupying 4,254 km of stream. Of these populations, 163 (81%) are greater than 90% pure BCT. There are currently a total of 23 populations that

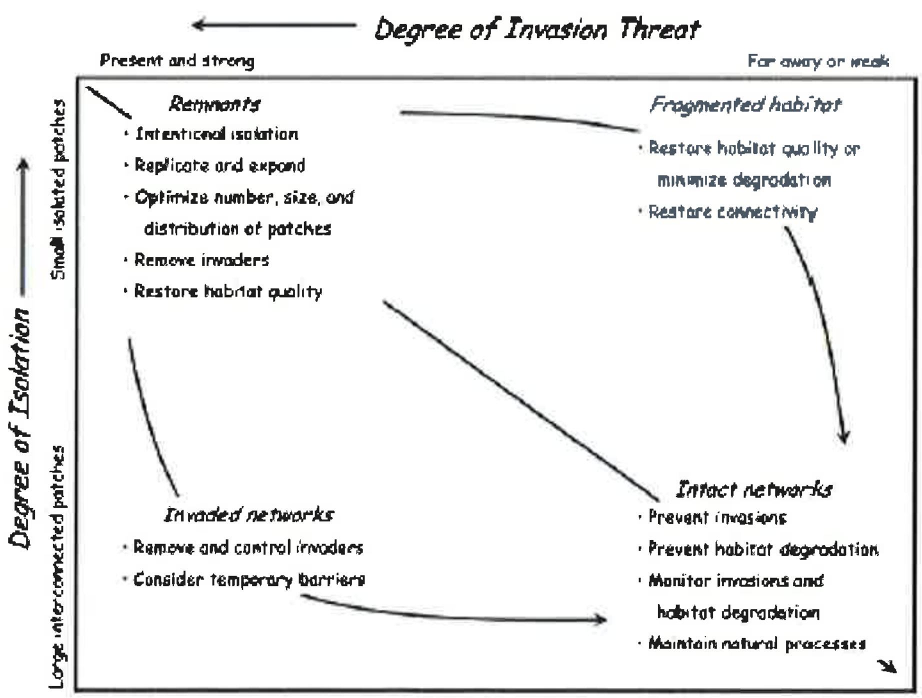

Figure 5: A conceptual model of the opportunities for strategic decisions when managing the joint invasion-isolation trade-off for BCT. Figure taken from Fausch et al. (2009).

demonstrate life history diversity (fluvial or adfluvial life history stage present) and 40 populations that provide geographic diversity (disjunct or peripheral populations). There are a total of 19 stronghold populations, 8 metapopulations, and 83 populations that meet the redundancy criteria.

The purpose of this plan is to describe the how security of BCT can be improved in the next 10 years. The goals and objectives of this plan are as follows:

Goal 1: Complete on-going or currently planned BCT restoration efforts (specific projects described in more detail below); meet restoration targets for each GMU as identified in Table 2.

Goal 2: Monitor BCT populations. Protect all critical BCT populations (critical populations are considered those that are genetically pure, that meet stronghold or metapopulation criteria, have adfluvial or fluvial life-history components, or are peripheral). The value of a population should be considered before protecting populations that have a low probability of future persistence due to mitigating factors such as climate change and habitat loss.

Goal 3: Proactively respond to significant changes in population and habitat "quality" that are observed during monitoring. Identify opportunities to improve habitat for the benefit of fisheries.

Objective 1: Work with landowners to maintain/improve current land management activities.

Objective 2: When necessary, perform in-stream and riparian restoration

Objective 3: Whenever introgression or significant population declines that can be attributed to predation or competition are observed in critical populations , utilize targeted efforts to mechanically remove non-native fish. Also, keep abreast of and utilize new technologies (e.g., YY supermale or Trojan Y fish; Schill et al. 2016) that can be utilized to help remove non-native fishes. Continue to use piscicides as necessary when other methods cannot successfully remove non-native fishes.

Objective 4: Utilize the latest science (e.g., Trout Unlimited's BCT population viability analysis) to proactively enact management responses that will protect key populations that are anticipated to be lost.

Goal 4: Promote the fluvial and adfluvial life-history forms/metapopulations by maintaining or improving stream connectivity.

Objective 1: Prevent new barriers to fish movement:

i. Work with water providers to ensure that new or reconstruction of existing water structures will permit the upstream movement of fish
ii. Work with municipal and private utility companies to ensure that new or existing stream crossings will allow the upstream movement of fish
iii. Work with transportation authorities and private citizens to ensure that new or existing road crossings will allow the upstream movement of fish.

Objective 2: Where appropriate, modify or remove existing fish migration barriers

Objective 3: Work with irrigation companies to reduce entrainment by screening high-risk irrigation structures. Evaluating entrainment impacts prior to spending limited resources on fish screen should be a priority.

Objective 4: Maintain or enhance instream flow

i. When necessary, explore instream flow leases for fish
ii. When possible, work with the operators of water control structures to time flow releases for the benefit of BCT
iii. Work with landowners to improve irrigation efficiencies that can mutually benefit BCT populations

Goal 5: Reduce the potential for BCT introgression with Rainbow Trout and other Cutthroat Trout by eliminating the stocking of fertile Rainbow Trout and other non-native cutthroat trout subspecies. Only stock non-native *Oncorhynchus* spp. that are 100% sterile into waters that lack barriers separating BCT from non-natives. Non-native *Oncorhynchus* spp. that are >90% sterile can be stocked into watersheds that contain BCT provided that barriers are installed separating these non-natives from BCT.

Goal 6: Maintain at least one brood population representing each GMU.

Goal 7: Manage sportfisheries that contain BCT to maintain "balance" between providing sportfishing opportunity and ensuring BCT persistence. Alter stocking/harvest regulations as necessary to maintain this balance.

Goal 8: Work with partners (other agencies or non-governmental organizations) to complete GMU/subunit goals identified below. Also work with these partners to "opportunistically" complete other projects that benefit BCT.

Objective 1: Encourage and enable partners to perform restoration that benefits the BCT fisheries.

Objective 2: Maintain relationships with these partners through regular communication

Objective 3: Continue hosting annual BCT rangewide meeting

Goal 9: Protect BCT from any existing or newly emerging pathogens.

Goal 10: Continue surveying waters that are suspected to contain BCT. Perform genetic testing on these fish with the goal of identifying additional BCT populations.

Goal 11: Increase public awareness and appreciation of BCT by marketing the sportfish and conservation value of the sub-species.

All of these goals should be addressed and implemented after the enactment of this plan. Particular immediate emphasis should be placed on goal 1 with the objective of completing this goal in the next 10 years. The completion of goal 1 should allow more emphasis to be placed on the remaining goals. The remaining goals will help ensure the future persistence of BCT.

Climate Change Effects

Climate change is recognized as factor that can have significant direct and indirect effects throughout the range of BCT (Williams et al. 2009; Haak et al. 2010a; Wenger et al. 2011) and must be considered when managing BCT. As a result, the effects of climate can threaten the long-term persistence of BCT. It is important to identify waters that currently contain BCT as those waters may no longer support BCT in the future. In addition, future conservation projects should not be planned in waters where there is a low probability of long-term persistence.

A temperature-based model was used to identify populations that are threatened by climate change. Indirect effects of climate change (e.g., increased flooding and wildfire risk; Williams et al. 2009) were not considered in the model. In the future, this model may be replaced by more sophisticated analyses (e.g., Trout Unlimited's population viability analysis). To develop this model, the PRISM air temperature dataset (Prism 2016) was projected across the current BCT range and the effects of a 3°C increase in temperature were determined. The results (Figure 6) indicate that it is likely that temperatures in the year 2100 will remain optimal for BCT across 95.4% of the current range. The streams where losses of BCT are projected to occur are shown in Table 4. Substantial (>20%) losses in BCT habitat are projected to occur in the West Desert GMU. Despite these losses in habitat, it is likely that BCT will persist in higher elevation areas of the GMU. It is projected that no optimal temperature habitat will remain in South Ash (Southern Bonneville GMU) and Basin Creeks (West Desert GMU) and complete loss of these populations is possible. Small losses in BCT range in the Northern Bonneville and Bear River GMU's would not be detrimental given the extensive ranges of BCT within these GMU's. Complete losses in the three Southern Bonneville streams identified in Table 4, although possible but

Table 4: Streams where temperatures across a portion of the habitat are projected to warm too much (>24.0°C) to support Bonneville Cutthroat Trout (BCT) by the year 2100. The percentage of habitat within each stream that are projected to be too warm for BCT (>24.0°C), marginal (22.0-23.9°C), and optimal (<22.0°C) for BCT are shown. NB represents Northern Bonneville, SB represents Southern Bonneville, and WD represents West Desert.

GMU	Stream Name	8-Digit Hydrologic Unit Code	Projected Temperature > 24.0°C (%)	Projected Temperature 22.0-23.9°C (%)	Projected Temperature <22.0°C (%)
NB	Emigration Creek	16020204	6.5	58.4	35.1
NB	Parleys Creek	16020204	3.6	28.2	68.2
NB	Peteetneet Creek	16020202	3.1	40.2	56.7
SB	Leeds Creek	15010008	29.2	25.5	45.2
SB	South Ash Creek	15010008	51.4	48.6	0.0
SB	Leap Creek	15010008	26.3	52.6	21.1
WD	Birch Creek	16020306	8.8	27.9	63.3
WD	Trout Creek	16020306	9.2	6.7	84.1
WD	Indian Farm Creek	16020306	21.7	36.6	41.6
WD	Toms Creek	16020306	8.6	24.8	66.6
WD	Basin Creek	16020306	75.8	24.2	0.0

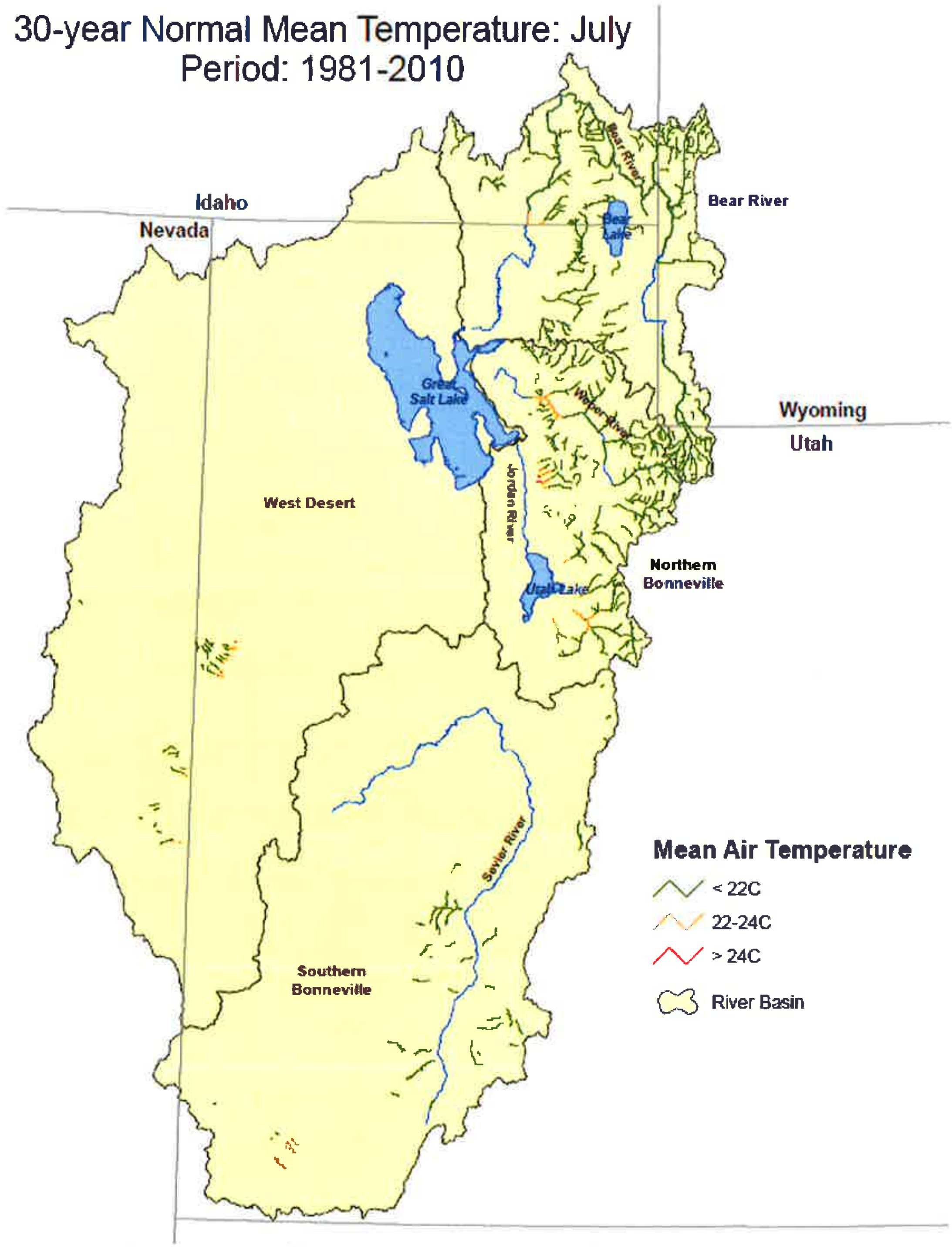

Figure 6: Projected temperatures for the current distribution of Bonneville Cutthroat Trout (BCT) at the year 2100. Green lines represent streams where temperatures are projected to remain optimal for BCT (<22^{o}C) and red lines represent streams where temperatures are projected to be too great for BCT to persist (>24^{o}C). Yellow lines represent streams where temperatures are projected to provide marginal habitat for BCT (22.0-23.9^{o}C).

not necessarily likely would reduce the amount of occupied habitat within the Southern Bonneville GMU by 5.1%. In contrast, 28.7% of the occupied habitat within the West Desert GMU would be lost if the five populations identified in Table 4 were lost.

Northern Bonneville GMU

The Northern Bonneville GMU contains more BCT populations (85) than any other GMU. The GMU meets the benchmarks identified in Table 2. Within the GMU, there is currently 1,521 km of occupied habitat. Of the BCT populations within in the Northern Bonneville GMU, 65 have < 10% introgression with non-native species, two are adfluvial, and five are fluvial. In addition, there are 10 stronghold populations and two metapopulations. A total of 39 populations meet the population persistence criteria. The Northern Bonneville GMU is managed within two HUC 6 Basins, the Weber River and Jordan River. For management purposes, the Northern Bonneville GMU has been further divided into five subunits: 1) Weber River, 2) Ogden River, 3) Wasatch Front, 4) Provo River - Utah Lake and 5) the Jordan River subunits.

The Northern Bonneville GMU is among the most secure GMUs. The conservation strategies within the GMU (Haak et al. 2011) are generally either "Protect" or "Enhance Population". BCT are more secure in the Weber River and Ogden River drainages than in the Jordan River and Provo River drainages. Since the conservation goals identified in Table 2 are met within the GMU, future efforts within the Northern Bonneville GMU should emphasize the completion of projects that are currently planned. Opportunistic projects that benefit BCT should continue to be completed. Goals for the five Northern Bonneville subunits are as follows:

Weber River Subunit

BCT populations within the Weber River system are secure and the system operates as a metapopulation. Thus, extensive restoration activity (non-native fish removal + BCT reintroduction) within the Weber River is not needed. Regardless, projects that improve habitat connectivity may improve the security of BCT within the Weber River. Many of these projects can be performed by UDWR partners or with minimal UDWR investment and are considered low-priority.

Subunit Goal 1: Maintain all populations within subunit.

Subunit Goal 2: Improve connectivity within the mainstem of the lower Weber River (town of Ogden upstream to Stoddard Diversion; Table 5).

Subunit Goal 3: Improve connectivity between lower Weber River and tributaries (Table 5)

Subunit Goal 4: Reduce number of barriers, improve connectivity and habitat within Chalk Creek (Table 5).

Subunit Goal 5: Work with landowners to improve stream and riparian land management within Lost Creek (below Lost Creek Reservoir). Perform in-stream habitat improvement, as needed (Table 5).

Subunit Goal 6: Collaborate with Utah Department of Transportation to ensure fish passage in Echo Creek. Also, work with landowners to improve land management practices and perform in-stream restoration, as needed (Table 5).

Subunit Goal 7: Survey the Upper Weber River to determine how connected this population is with its tributaries. If appropriate, improve connectivity in this section.

Subunit Goal 8: Develop a Weber River brood population.

Ogden River Subunit

The Ogden River subunit includes the Ogden River, which has three major tributaries: the North, Middle and South Forks. The two major flood control/irrigation reservoirs in this subunit are Pineview Reservoir on the Ogden River mainstem and Causey Reservoir on the South Fork; however, many other complete and partial barriers to fish movement exist. Several small, isolated BCT conservation populations remain in the Ogden River subunit. Brown Trout and Rainbow Trout have been historically stocked throughout the subunit and consequently, these species have established naturalized populations. Brook Trout only occupy a few, small streams in the drainage. The primary BCT CSI strategies for this subunit are to enhance and restore populations (52.5% and 29.0% of the watershed area respectively) with the remaining 18.5% of the drainage having a CSI strategy of protection. The Middle Fork of the Ogden River has a small BCT population and good habitat, and non-native fish removal would improve the security of the sub-species within the watershed.

Subunit Goal 1: Maintain all populations within subunit

Subunit Goal 2: Identify a barrier site and remove non-native fish and restore BCT within the Middle Fork of the Ogden River, if all landowners agree (Table 5).

Subunit Goal 3: Maintain/enhance BCT in the North Fork of the Ogden River by working with landowners to improve land management practices. The UDWR should perform in-stream restoration as needed.

Wasatch Front Subunit

The Wasatch Front Subunit includes small streams in Box Elder, Weber, and Davis counties that have either been disconnected from the Weber River due to irrigation practices or historically flowed into the Great Salt Lake. These streams are either fishless because of the

Table 5: Projected timeline for meeting goals in the Northern Bonneville GMU. Information is divided by subunit and the subunit goal refers to the numbered goal as described in the text for the subunit. Grey shaded cells represent years where work towards a goal is projected to occur.

Subunit	Subunit Goal	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Weber River	2										
	3										
	4										
	5										
	6										
Ogden River	2										
	3										
Provo River	2										
	3										

heavy flooding that occurred in the early 1980s or they contain non-native trout. The CSI strategy for most of these streams is to restore habitat and reintroduce BCT. Most un-restored

waters in this subunit have limited habitat and are at low elevation. This means that the likelihood of long-term persistence of BCT in these waters is low. It is recommended that unless opportunities for low-cost restoration are presented that no restoration activities occur in this subunit.

Subunit Goal 1: Monitor and maintain all populations within subunit

Provo River Basin

There are currently 7 BCT populations within the Provo River subunit that currently occupy 245 km of habitat. Included in this are two genetic integrity populations, one adfluvial population, three stronghold populations, and six populations that meet the redundancy criterion. The adfluvial population and the majority of occupied stream habitat within the subunit is in the Provo River. The primary CSI conservation strategies that have been identified within the subunit are to re-introduce fish (63% of available habitat) and to protect existing fish populations (28% of available habitat).

Subunit Goal 1: Maintain all populations within subunit

Subunit Goal 2: Identify opportunities to increase the number of BCT populations within the subunit from 7 to 10 (Table 5)

Subunit Goal 3: Ensure the long-term security of the Provo River adfluvial population

Objective 1: Work with water users to maintain adequate water flow and fish passage

Objective 2: Maintain/improve fish habitat within the Provo River

Objective 3: Pursue opportunities to increase the range available for the Provo River adfluvial population

Jordan River Subunit

There are currently 18 BCT populations within the Jordan River subunit and those populations occupy a total of 92 km of habitat. Of those 18 populations, 13 meet the genetic integrity criterion and three meet the redundancy criterion. The Jordan River subunit encompasses Salt Lake City and is the most urbanized subunit. There are likely few remaining restoration efforts that can be performed within the subunit and the majority of the subunit is too low in elevation to ensure the long-term persistence of BCT. No future restoration efforts are recommended for the GMU and efforts should instead be placed towards protecting habitat and maintaining the current populations within the subunit.

Subunit Goal 1: Maintain all populations within subunit

Utah Lake Subunit

There are currently two BCT populations within the Utah Lake subunit and those populations occupy 20 km of habitat. Neither population meets the criteria required for a genetic integrity population, stronghold population, metapopulation, or redundancy. Historically, there were 33 populations within the subunit. Unfortunately, most of the subunit is too low in elevation to ensure long-term persistence of BCT. Thus, no future restoration efforts are recommended for the subunit. Efforts instead should be placed toward protecting the habitat and maintaining the current populations within the subunit.

Subunit Goal 1: Maintain all populations within subunit

Bear River GMU

The Bear River GMU is perhaps the most secure GMU in the BCT range and already meets the goals identified in Table 2. The Bear River GMU has the second most populations (44) and more kilometers of stream (2,273) than any other GMU. The average length of stream occupied by the sub-species is 51.7 km. There are five adfluvial populations, eight fluvial populations, and two populations that demonstrate both adfluvial and fluvial characteristics within the GMU. There are 10 stronghold populations and five metapopulations within the GMU. Conservation strategies of "Protect" (28% of habitat), "Restore Population" (27% of habitat), and "Restore Habitat" (32% of habitat) were identified as primary needs for the GMU using Trout Unlimited's CSI. The following goals have been identified for the GMU.

GMU Goal 1: Maintain all populations within GMU

GMU Goal 2: Install a barrier and perform a chemical treatments to remove non-native fishes from Big Creek in 2018-2019. Reintroduce BCT after the second treatment (Table 6)

GMU Goal 3: Renovate Deadman Creek

Objective 1: Complete habitat improvement and barrier construction

Table 6: Projected timeline for meeting goals in the Bear River GMU. GMU goals refers to the numbered goal as described in the text. Grey shaded cells represent years where work towards a goal is projected to occur.

GMU Goal	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
2										
3										
5										
6										
7										
8										

Objective 2: Perform 2-3 chemical treatments to remove non-native fish (Table 6).

Objective 3: Reintroduce BCT after non-native fish have been removed

GMU Goal 4: Minimize the effects of a proposed Temple Fork Dam on the Logan River BCT population, if a reservoir is built.

Objective 1: Work with the dam operator to minimize thermal and flow effects on BCT

Objective 2: Manage the reservoir with a fishery that is compatible with BCT conservation

Objective 3: Monitor the fishery annually for 10 years after dam construction is complete and take proactive steps if the data indicates that the reservoir is having a negative effect on BCT.

GMU Goal 5: Explore opportunities for restoring the South Fork of the Little Bear River drainage for BCT through removal of non-native Brown Trout

GMU Goal 6: Minimize the effects of domestic cattle and sheep grazing in the Thomas Fork and Smiths Fork watersheds.

Objective 1: Work with land management agencies to decrease impacts from domestic grazing to upland and riparian habitats

Objective 2: Work with land management agencies to increase willow production and success in the Smiths Fork and Thomas Fork watersheds, particularly in the Smiths Fork Allotment

Action: Work with permittees and land management agencies with the development of BDA's to enhance willows

Action: Work with permittees and land management agencies to develop creative ways or use traditional methods to protect willows from browsing

Action: Work with permittees and land management agencies with the enhancement of willows using flood irrigation methods

GMU Goal 7: Improve habitat and fish passage within the Thomas Fork and Smiths Fork watersheds

Objective 1: Work with land management agencies to improve fish passage in the Dry Fork watershed

Objective 2: Work with land management agencies and Trout Unlimited to identify additional fish passage issues

Objective 3: Work with land management agencies and Trout Unlimited to improve stream habitat, fish passage, and water quality in the Thomas Fork near the salt mine

Objective 4: Continue to work with land management agency and private landowners to improve stream habitat conditions and fish passage in Coal Creek, tributary to the Thomas Fork.

GMU Goal 8: Continue addressing objectives in Idaho's BCT management plan (Teuscher and Capurso 2007) including:

Objective 1: Continue working with landowners and the St. Charles Irrigation Company to screen the lower south diversion

Objective 2: Complete population surveys and evaluation brook trout removal and BCT reintroduction potential on Bloomington Creek

Objective 3: Remove brook trout and reintroduce BCT into Georgetown Creek and Williams Creek

Objective 4: Improve fish passage at highway crossings along Mink Creek

Objective 5: Update population surveys and evaluate riparian habitat conditions on the Malad and Little Malad Rivers

West Desert GMU

The West Desert GMU contains 29 BCT populations that occupy 152 km of habitat. The average habitat patch size within the West Desert GMU (4.9 km) is the shortest among the GMU's, which indicates that populations within this GMU are less resilient than other GMU's. Drainages within the West Desert GMU are truncated and small patch size is expected. Of the 29 populations, all are considered genetic integrity populations, which makes the average genetic purity of BCT within the West Desert the highest among the GMUs. Only the resident form of BCT is present within the West Desert but this is likely consistent with historical conditions of BCT within the GMU. All populations are considered disjunct and would be highly vulnerable to disturbance. There are no stronghold populations or metapopulations within the GMU. Only three populations meet the persistence criteria. The stronghold and replicate population goals (Table 2) are not met within the GMU. Overall, opportunities for future restoration are limited within the GMU.

There are nine HUCs (8 digit) within the West Desert GMU and BCT currently occupy two of those HUCs. There are three additional HUCs that likely historically supported BCT, but the range of BCT within those HUCs was limited and the average patch size within these HUCs was small (average = 2.4 km). Historically, BCT occupied fewer kilometers of habitat in the West Desert GMU (695) than any other GMU (range of remaining GMUs: 2744-4439). It is estimated that the current range of BCT within the West Desert GMU is 22% of the historical range.

Historically, BCT within the West Desert GMU occupied relatively small, isolated patches and there is limited ability to support any stronghold populations or metapopulations within the GMU (currently, adequate habitat does not exist). It is likely that the resident form of BCT is the only form that historically occupied the West Desert GMU. Thus, among the 3-R's, it is not possible to increase life history diversity and resiliency (stronghold or metapopulations) within the GMU. The best way to improve the Conservation Portfolio of BCT within the West Desert GMU is by increasing redundancy. The Trout Unlimited CSI identified the primary conservation strategies within the GMU to include fish reintroduction (42% of historic habitat), restoring habitat followed by fish reintroduction (32% of historic habitat).

GMU Goal 1: Maintain all populations within GMU

GMU Goal 2: Revise and renew the "Conservation Agreement and Strategy of Bonneville Cutthroat Trout in the State of Nevada" (Table 7).

GMU Goal 3: Within 10 years, achieve goal of having 5 populations that meet persistence criteria by improving habitat within two populations. That would give the GMU 10 populations that meet the redundancy criteria with five of those also meeting the persistence criteria. The 2015 Range-wide Distribution Data (P. Burnett, un-published data) indicates that there are six streams that are greater than 5 km in length that have reasonably high fish densities (>150 fish/km). These streams are the best candidates for establishing persistent populations and include (listed in order from best candidate to worst candidate) Birch Creek, Toms Creek, Deadman Creek, Snake Creek, Granite Creek, and Spring Creek.

GMU Goal 4: Completed restoration of Snake Creek by 2020 (Table 7).

GMU Goal 5: Restore Strawberry Creek by 2028 (Table 7).

GMU Goal 6: Continue development of a broodstock within Big Wash via interagency agreement (NDOW, BLM, NPS; Table 7).

GMU Goal 7: Continue augmenting Silver Creek with BCT following the 2013 chemical treatment to remove non-native trout (Table 7).

GMU Goal 8: Monitor and evaluate Hampton Creek and Strawberry Creek for future BCT reintroductions following wildfires in 2014 and 2016, respectively.

GMU Goal 9: Perform habitat and population surveys to help maintain and enhance long-term datasets for BCT streams in Nevada

GMU Goal 10: Anticipate climate change contributing to the loss of up to five populations. Explore opportunities to restore two to four new populations to offset these losses. The ultimate goal is to maintain 30 replicate populations within the GMU. The number of populations that will need restoration will depend on the persistent populations restored in GMU Goal 2.

GMU Goal 11: If necessary for the completion of GMU Goal 3, explore the possibility of restoring populations within the south side of the Raft River Mountains and additional populations on the east side of Great Basin National Park.

Southern Bonneville GMU

The Southern Bonneville GMU contains remnant populations from the Sevier River system. There are currently 42 populations occupying 308 km of habitat within the GMU (Table 2). The occupied habitat in some sub-basins is limited. For example, the Upper Sevier sub-basin has three populations that occupy a total of 4 km of habitat. Within the GMU, 35 populations (83%) had less than 10% introgression. Only the resident life history form currently occurs within the GMU and there is one stronghold population and one metapopulation. Of the current populations, 12 have been identified as disjunct. There are 11 HUCs (8 digit) within the Southern Bonneville GMU and BCT

Table 7: Projected timeline for meeting goals in the West Desert GMU. GMU goals refers to the numbered goal as described in the text. Grey shaded cells represent years where work towards a goal is projected to occur.

GMU Goal	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
2										
4										
5										
6										
7										

currently occupy 7 of those HUCs. The GMU does not currently meet the disjunct population and stronghold population goals identified in Table 2.

A low percentage of historic habitat within the Southern Bonneville GMU is currently occupied (14%). Fortunately, thanks to successful restoration efforts, many of the populations that occur have relatively high CSI scores. The mean CSI score within the GMU is 71 (range: 57-78). The lowest CSI score is in the San Pitch HUC (16090004) and the highest is the Upper Virgin HUC (15010008). The small average patch size (7.3 km) and limited number of populations within the Southern Bonneville GMU makes BCT in the GMU susceptible to stochastic events. Current restoration efforts are geared towards creating strongholds or metapopulations that will be robust to these events. In general, the Conservation Portfolio within the GMU is lacking disjunct peripheral populations and resiliency. Opportunities to create disjunct peripheral populations is limited within the GMU. Thus improving resiliency by creating metapopulations and stronghold populations is the best way to improve the Conservation Portfolio of BCT within the GMU. The restoration projects that are currently planned will increase the number of metapopulations within the GMU from 1 to 3. The primary conservation strategies identified in Trout Unlimited's CSI are reintroduce (48% of historic habitat) and restore habitat then reintroduce fish (42% of historic habitat).

GMU Goal 1: Maintain all populations within GMU

GMU Goal 2: Complete restoration of Mammoth Creek by end of 2022 (Table 8)

Table 8: Projected timeline for meeting goals in the Southern Bonneville GMU. GMU goals refers to the numbered goal as described in the text. Grey shaded cells represent years where work towards a goal is projected to occur.

GMU Goal	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
2										
3										

GMU Goal 3: Complete restoration of the Upper East Fork of the Sevier River above Tropic Reservoir by 2027 (Table 8).

Objective 1: Develop and execute a treatment plan and create necessary barriers in East Fork Sevier and tributaries. Repopulate after treatment by transferring fish from whirling disease negative populations in the headwaters of Deep Creek and allow the transferred fish to reproduce naturally.

Completion of the restoration efforts identified should secure BCT in perpetuity. Table 9 summarizes the recommended actions for each GMU

Bonneville Cutthroat Trout Monitoring Plan

Significant investment into BCT restoration has occurred and these efforts and their associated costs are wasted if restored populations are not appropriately monitored. In addition, effective monitoring provides the data required to proactively manage for the future persistence of BCT. A monitoring plan will be collaboratively developed and released within one year of enacting an updated BCT Conservation Agreement and Strategy. This monitoring plan will encourage standardized data collection and reporting, which will assist in the assessing changes in BCT populations and will help ensure that BCT are conserved in perpetuity. This monitoring plan will also encourage adaptive management of BCT. Plan components will likely include:

1. A proposed sampling rotation that will allow for monitoring temporal trends in BCT across the spatial extent of the subspecies
2. The ability to monitor the effects of climate and habitat change on BCT
3. A standardized approach to fish and habitat sampling
4. Guidelines for adaptively managing BCT

Table 9: Conservation portfolio deficiencies and recommended actions for each GMU.

GMU	Conservation Portfolio Deficiency	Projected Year of Completion	Recommended Actions
Northern	None	2027	Complete planned restoration efforts
Bear River	None	2022	Complete planned restoration efforts
West Desert	Redundancy lacking	2027	Increase number of replicate populations by at least 2; ideally these populations should also meet persistence criteria
Southern	Resiliency lacking	2027	Completion of planned restoration efforts should provide necessary resiliency

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Appendix 1: List of Bonneville Populations

The following is a list of known BCT populations from the 2015 Rangewide Assessment (P. Burnett, un-published data). The population origin, current population status, and genetic status of each population is provided. Data is sorted by GMU. Water identification numbers are provided for Utah populations. Abbreviations used in the table are as follows: A=aboriginal population, R = restored population, CP= current population, NLP = population no longer present, RP = recreational population, and OR=out of range.

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
BR	Bailey Creek	ID		A	CP	Not Tested - Unaltered
BR	Bald Head Creek	UT	IVAQ040E01B-01	A	CP	Not Tested - Unaltered
BR	Bear Hollow	UT	IVAQ040A08D-01	A	CP	Unaltered
BR	Bear River	ID/UT/WY		A	CP	Not Tested - Hybridized
BR	Beaver Creek	UT	IVAQ040A16-01	A	CP	Unaltered
BR	Beaver Creek	ID		A	CP	Unaltered
BR	Big Creek	UT	IVAQ190-02	A	CP	Not Tested - Hybridized
BR	Big Creek	ID		A	CP	90% - 99%
BR	Big Mahogany Creek	UT	IVAQ200AA03-01	A	CP	Not Tested - Unaltered
BR	Big Spring Creek	UT	IVAQ120C-01	A	CP	Unaltered
BR	Big Spring Fork	UT	IVAQ200D-01	A	CP	Not Tested - Unaltered
BR	Birch Creek	UT	IVAQ200A-02	A	CP	Not Tested - Unaltered
BR	Birch Creek	ID		A	CP	Unaltered
BR	Blacksmith Fork	UT	IVAQ040A03	A	CP	Not Tested - Hybridized
BR	Blue Creek	ID		A	CP	Not Applicable
BR	Blue Pond Spring	ID		A	CP	< 80%
BR	Boundary Creek	UT	IVAQ250A-01	A	CP	Not Tested - Unaltered
BR	Bourne Creek	WY		A	CP	Not Tested - Unaltered
BR	Bruner Creek	WY		A	CP	Not Tested - Hybridized
BR	Bull Creek	WY		A	CP	Not Tested - Hybridized

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
BR	Bull Gulch	WY		A	CP	Not Tested - Hybridized
BR	Bullwhacker Canyon	ID		A	CP	Not Applicable
BR	Bunchgrass Creek	UT	IVAQ040A14-01	A	CP	Unaltered
BR	Carter Creek	UT	IVAQ230C-01	A	CP	Not Tested - Unaltered
BR	Cinnamon Creek	UT	IVAQ040D04-02	A	CP	Not Tested - Unaltered
BR	Cinnamon Creek	UT	IVAQ040D04-01	A	CP	Not Tested - Hybridized
BR	Claudia Creek	WY		A	CP	Not Tested - Unaltered
BR	Coal Creek	WY		A	CP	Not Tested - Hybridized
BR	Coantag Creek	WY		A	CP	Not Tested - Unaltered
BR	Co-Op Creek	ID		A	CP	Unaltered
BR	Corral Hollow	ID		A	CP	Unaltered
BR	Cottonwood Canyon	UT	IVAQ040A07D-01	A	CP	Unaltered
BR	Cottonwood Creek	ID		A	CP	Co-existence
BR	Cottonwood Creek	WY		A	CP	Not Tested - Hybridized
BR	Coyote Hollow	UT	IVAQ240B03-01	A	CP	Not Tested - Unaltered
BR	Cub River	ID/UT	IVAQ110-01	A	CP	Unaltered
BR	Curtis Creek	UT	IVAQ040A03C-01	A	CP	Not Tested - Hybridized
BR	Dairy Creek	ID		A	CP	Not Tested - Hybridized
BR	Davenport Creek	UT	IVAQ040E01-01	A	CP	Not Tested - Unaltered
BR	Deadman Creek	NV/UT	IVAQ230B-01	A	CP	Unaltered
BR	Deep Creek	ID		A	CP	Not Tested - Hybridized
BR	Deer Creek	UT	IVAQ240A-01	A	CP	Not Tested - Unaltered
BR	Devil Creek	ID		A	CP	Not Tested - Hybridized
BR	Dipper Creek	WY		A	CP	Not Tested - Unaltered
BR	Dry Creek	ID		A	CP	Unaltered
BR	Dry Fork Smiths Fork	WY		A	CP	Not Tested - Hybridized
BR	East Fork Bear River	UT	IVAQ250-01	A	CP	Not Tested - Hybridized
BR	East Fork Little Bear River	UT	IVAQ040D-01	A	CP	Not Tested - Hybridized

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
BR	East Fork Little Bear River	UT	IVAQ040D-02	A	CP	Not Tested - Unaltered
BR	East Fork Salt Creek	WY		A	CP	Not Tested - Unaltered
BR	East Pole Creek	UT	IVAQ040D01-01	A	CP	Not Tested - Hybridized
BR	Eightmile Creek	ID		A	CP	Not Tested - Unaltered
BR	Emigration Creek	ID		A	CP	Not Tested - Unaltered
BR	Fence Creek	UT	IVAQ200E-01	A	CP	Not Tested - Unaltered
BR	First Creek	ID		A	CP	Not Tested - Unaltered
BR	Fish Creek	UT	IVAQ040E01D-01	A	CP	Not Tested - Unaltered
BR	Fish Haven Creek	ID		A	CP	90% - 99%
BR	Foster Creek	ID		A	CP	Unaltered
BR	Georgetown Creek	ID		A	CP	Not Tested - Unaltered
BR	Giraffe Creek	ID		A	CP	Not Tested - Unaltered
BR	Giraffe Creek	WY		A	CP	Unaltered
BR	Girl Hollow	UT	IVAQ200G-01	A	CP	Not Tested - Unaltered
BR	Grade Canyon Creek	WY		A	CP	Unaltered
BR	Hayden Fork	UT	IVAQ270-01	A	CP	Not Tested - Hybridized
BR	Hobble Creek	WY		A	CP	Not Tested - Unaltered
BR	Hodge Nibley Creek	ID		A	CP	Unaltered
BR	Home Canyon	ID		A	CP	Not Tested - Hybridized
BR	Hoopes Creek	ID		A	CP	Not Applicable
BR	Huff Creek	WY		A	CP	Not Tested - Unaltered
BR	Humpy Creek	UT	IVAQ240C-01	A	CP	Not Tested - Unaltered
BR	Kackley Spring	ID		R	CP	Not Tested - Unaltered
BR	Kermsuh Lake outlet	UT	IVAQ260E02-01	A	CP	Not Tested - Unaltered
BR	LaChapelle Creek	WY		A	CP	Not Tested - Hybridized
BR	Laketown Canyon	UT	IVAQ120D-01	A	CP	Unaltered
BR	Lander Creek	WY		A	CP	Not Tested - Hybridized
BR	Left Hand Fork Blacksmith Fork	UT	IVAQ040A03A	A	CP	Not Tested - Hybridized

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
BR	Left Hand Fork East Fork Bear River	UT	IVAQ250Q-01	A	CP	Not Tested - Unaltered
BR	Little Bear Creek	UT	IVAQ040A12-01	A	CP	Unaltered
BR	Little Bear River	UT	IVAQ040-05	A	NLP	Not Tested - Hybridized
BR	Little Creek	ID	IVAQ120A-01	A	CP	90% - 99%
BR	Little Malad River	ID		A	CP	Not Tested - Hybridized
BR	Little Muddy Creek	WY		A	CP	Not Tested - Unaltered
BR	Little White Creek	WY		A	CP	Not Tested - Unaltered
BR	Logan River	UT	IVAQ040A	A	CP	Unaltered
BR	Logan River	ID		A	CP	Not Tested - Hybridized
BR	Lost Creek	WY		A	CP	Not Tested - Unaltered
BR	Lost Dog Creek	UT	IVAQ230D-01	A	CP	Not Tested - Unaltered
BR	Main Fork	UT	IVAQ260A-01	A	CP	Not Tested - Unaltered
BR	Maple Creek	ID		A	CP	90% - 99%
BR	McKenzie Creek	UT	IVAQ230E-01	A	CP	Not Tested - Unaltered
BR	McPheter Lake outlet	UT	IVAQ260F02-01	A	CP	Not Tested - Unaltered
BR	Meachum Canyon	UT	IVAQ210A01-01	R	CP	Unaltered
BR	Meadow Creek	UT	IVAQ240D-01	A	CP	Not Tested - Unaltered
BR	Middle Basin	UT	IVAQ260F-01	A	CP	Not Tested - Unaltered
BR	Middle Fork Saint Charles Creek	ID		A	CP	< 80%
BR	Mill Canyon	ID		A	CP	Not Tested - Hybridized
BR	Mill City Creek	UT	IVAQ240B-01	A	CP	Not Tested - Unaltered
BR	Mill Creek	UT	IVAQ230-01	A	CP	90% - 99%
BR	Mill Creek	UT	IVAQ040A03D-01	A	CP	Not Tested - Unaltered
BR	Mill Creek	ID		A	CP	Not Tested - Unaltered
BR	Mill Creek	WY		A	CP	Not Tested - Hybridized
BR	Mink Creek	ID		A	CP	Not Tested - Hybridized
BR	Montpelier Creek	ID		A	CP	Not Tested - Hybridized

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
BR	Muddy Creek	WY		A	CP	Not Tested - Unaltered
BR	Murdock Creek	WY		A	CP	Not Tested - Hybridized
BR	North Creek	ID		A	CP	Not Tested - Unaltered
BR	North Eden Creek	UT	IVAQ120F	A	CP	Unaltered
BR	North Fork Lander Creek	WY		A	CP	Not Tested - Unaltered
BR	North Fork Mill Creek	UT	IVAQ230F-01	A	CP	Not Tested - Unaltered
BR	North Fork Saint Charles Creek	ID		A	CP	< 80%
BR	North Fork Smiths Fork	WY		A	CP	Not Tested - Unaltered
BR	North Fork Stoner Creek	WY		A	CP	Not Tested - Unaltered
BR	North Hoopes Creek	ID		A	CP	Not Applicable
BR	North Pearl Creek	ID		A	CP	Unaltered
BR	North Skinner Creek	ID		A	CP	Unaltered
BR	North Stauffer Creek	ID		A	CP	Unaltered
BR	Nounan Canal	ID		A	CP	Not Tested - Unaltered
BR	Ovid Creek	ID		A	CP	Not Tested - Unaltered
BR	Packstring Creek	WY		A	CP	Not Tested - Unaltered
BR	Paris Creek	ID		A	CP	Not Tested - Hybridized
BR	Pearl Creek	ID		A	CP	Unaltered
BR	Pegram Creek	ID		A	CP	Not Tested - Hybridized
BR	Peterson Hollow	UT	IVAQ040A21-01	A	CP	Unaltered
BR	Poker Creek	WY		A	CP	Not Tested - Hybridized
BR	Poker Hollow	WY		A	CP	Not Tested - Hybridized
BR	Pole Creek	UT	IVAQ040E01A-01	A	CP	Not Tested - Unaltered
BR	Porcupine Creek	WY		A	CP	Not Tested - Hybridized
BR	Preuss Creek	ID		A	CP	Unaltered
BR	Raymond Creek	WY		A	CP	Not Tested - Unaltered
BR	Red Rock Creek	UT	IVAQ040D04A-02	A	CP	Not Tested - Unaltered
BR	Right Fork Cottonwood Creek	ID		A	CP	Not Tested - Hybridized

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
BR	Right Fork Logan River	UT	IVAQ040A07-01	R	CP	Unaltered
BR	Right Hand Fork East Fork Bear River	UT	IVAQ250P-01	A	CP	Not Tested - Hybridized
BR	Robinson Creek	ID		A	CP	Not Tested - Unaltered
BR	Robinson Creek	WY		A	CP	Not Tested - Unaltered
BR	Rock Creek	UT	IVAQ040A03B-01	A	CP	Not Tested - Hybridized
BR	Rock Creek	WY		A	CP	Unaltered
BR	Ryan Creek	WY		A	CP	Not Tested - Hybridized
BR	Ryder Lake outlet	UT	IVAQ260F01-01	A	CP	Not Tested - Unaltered
BR	Saddle Creek	UT	IVAQ040A03A1-01	A	CP	Not Tested - Hybridized
BR	Saint Charles Creek	ID	IVAQ120A-01	A	CP	< 80%
BR	Salt Basin Creek	WY		A	CP	Not Tested - Unaltered
BR	Salt Creek	WY		A	CP	Not Tested - Unaltered
BR	Sams Creek	WY		A	CP	Not Tested - Hybridized
BR	Sawmill Creek	WY		A	CP	Not Tested - Hybridized
BR	Second Creek	ID		A	CP	Not Tested - Unaltered
BR	Sheep Creek	ID		A	CP	Not Tested - Hybridized
BR	Sheeppen Creek	UT	IVAQ120F02-01	A	CP	Unaltered
BR	Shingle Creek	ID		A	CP	Not Tested - Hybridized
BR	Skinner Creek	ID		A	CP	Unaltered
BR	Smiths Fork	WY		A	CP	Not Tested - Unaltered
BR	Snowslide Canyon	ID		A	CP	Not Tested - Unaltered
BR	South Fork Little Bear River	UT	IVAQ040E-01	A	CP	Not Tested - Hybridized
BR	South Fork Raymond Creek	WY		A	CP	Not Tested - Unaltered
BR	South Fork Saint Charles Creek	ID		A	CP	< 80%
BR	South Fork Smiths Fork	WY		A	CP	Not Tested - Hybridized
BR	South Fork Stoner Creek	WY		A	CP	Not Tested - Unaltered

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
BR	South Fork Twin Creek	WY		A	CP	Not Tested - Hybridized
BR	South Skinner Creek	ID		A	CP	Not Tested - Unaltered
BR	South Stauffer Creek	ID		A	CP	Not Tested - Unaltered
BR	Spawn Creek	UT	IVAQ040A08A-01	A	CP	Unaltered
BR	Spring Creek	ID		A	CP	90% - 99%
BR	Spring Creek	WY		A	CP	Not Tested - Hybridized
BR	Spring Hollow	UT	IVAQ040A05-01	A	CP	Unaltered
BR	Spring Lake Creek	WY		A	CP	Not Tested - Unaltered
BR	Stauffer Creek	ID		A	CP	Not Tested - Unaltered
BR	Stillwater Fork	UT	IVAQ260	A	CP	Not Tested - Unaltered
BR	Stockton Creek	ID		A	CP	Not Applicable
BR	Stoner Creek	WY		A	CP	Not Tested - Unaltered
BR	Sublette Creek	WY		A	CP	Not Tested - Unaltered
BR	Sugar Creek	ID		A	CP	90% - 99%
BR	Sugar Pine Canyon	UT	IVAQ200B-01	A	CP	Unaltered
BR	Sulphur Creek	WY		A	CP	Not Tested - Hybridized
BR	Swan Creek	UT	IVAQ120B-01	A	CP	Not Tested - Hybridized
BR	Sylvia Hollow	UT	IVAQ200C01-01	A	NLP	Not Tested - Unaltered
BR	Teal Lake Creek	UT	IVAQ270I-01	A	CP	Not Tested - Unaltered
BR	Temple Fork	UT	IVAQ040A08	A	CP	Unaltered
BR	Theurer Hollow	UT	IVAQ040A11-01	A	CP	Unaltered
BR	Third Creek	ID		A	CP	Not Tested - Unaltered
BR	Thomas Fork	ID		A	CP	Not Tested - Unaltered
BR	Tony Grove Creek	UT	IVAQ040A13-01	A	CP	Unaltered
BR	Travis Creek	WY		A	CP	Not Tested - Hybridized
BR	Trespass Creek	WY		A	CP	Not Tested - Hybridized
BR	Trout Creek	ID		R	CP	Unaltered
BR	Twin Creek	UT	IVAQ040A09-01	A	CP	Unaltered

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
BR	Twin Creek	WY		A	CP	Not Tested - Hybridized
BR	Unnamed 139	ID		A	CP	Unaltered
BR	Unnamed 18	WY		A	CP	Not Tested - Hybridized
BR	Unnamed 20	WY		A	CP	Not Tested - Unaltered
BR	Unnamed 23	WY		A	CP	Not Tested - Unaltered
BR	Unnamed 24	WY		A	CP	Not Tested - Unaltered
BR	Unnamed 270	WY		A	CP	Not Tested - Unaltered
BR	Unnamed 271	WY		A	CP	Not Tested - Unaltered
BR	Unnamed 3	UT		A	CP	Not Tested - Unaltered
BR	Unnamed 31	ID		A	CP	Not Tested - Unaltered
BR	Unnamed 60	ID		A	CP	Not Tested - Unaltered
BR	Unnamed 65	ID		A	CP	Not Tested - Hybridized
BR	Walker Gulch	ID		A	CP	Not Tested - Hybridized
BR	Water Canyon	WY		A	CP	Unaltered
BR	Watercress Canyon	WY		A	CP	Not Tested - Hybridized
BR	Wellsville Creek	UT	IVAQ040E01E-01	A	CP	Not Tested - Unaltered
BR	West Basin Creek	UT	IVAQ260E-01	A	CP	Not Tested - Unaltered
BR	West Fork Bear River	UT	IVAQ240-01	A	CP	Not Tested - Unaltered
BR	West Fork Bear River	UT	IVAQ240-02	A	CP	Not Tested - Hybridized
BR	West Fork Smiths Fork	WY		A	CP	Not Tested - Unaltered
BR	West Hodges Creek	UT	IVAQ040A10-01	A	CP	Unaltered
BR	Wheeler Creek	UT	IVAQ200C-01	A	CP	Not Tested - Unaltered
BR	Whiskey Creek	UT	IVAQ270G-01	A	CP	Not Tested - Unaltered
BR	Whiskey Creek	ID		A	CP	Not Tested - Hybridized
BR	White Canyon	ID		A	CP	Unaltered
BR	White Pine Creek	UT	IVAQ040A15-01	A	CP	Unaltered
BR	Wind Cave Spring	UT	IVAQ040A05A-01	A	CP	Unaltered
BR	Wood Camp Hollow	UT	IVAQ040A07A-01	A	CP	Unaltered

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
BR	Woodruff Creek	UT	IVAQ200-02	A	CP	Not Tested - Hybridized
BR	Woodruff Creek	UT	IVAQ200-03	A	CP	Not Tested - Unaltered
BR	Wright Creek	ID		A	CP	Not Tested - Hybridized
BR	Yellow Creek	UT	IVAQ220-02	A	CP	Unaltered
BR	Zeke Hollow	UT	IVAQ200B01-01	A	CP	Not Tested - Unaltered
NB	Alexander Creek	UT	IVAP280A-01	A	CP	Not Tested - Unaltered
NB	Arbuckle Creek	UT	IVAP080A-01	A	CP	Not Tested - Unaltered
NB	Arthurs Fork	UT	IVAP150A02-01	A	CP	Not Tested - Hybridized
NB	Bear Canyon	UT	IVAP030B05D-01	A	CP	< 80%
NB	Beaver Creek	UT	IVAP330-03	A	CP	Not Tested - Hybridized
NB	Beaver Creek	UT	IVAP030B02-02	A	CP	Not Tested - Unaltered
NB	Beaver Creek	UT	IVAP030B02-01	A	CP	Not Tested - Hybridized
NB	Beaver Creek	UT	IVAP330-02	A	CP	Unaltered
NB	Bell Creek	UT	IVAA090-01	A	CP	Not Tested - Hybridized
NB	Bench Creek	UT	VAF170-01	A	CP	Not Tested - Unaltered
NB	Bennett Creek	UT	IVAP030B01-01	A	CP	Not Tested - Hybridized
NB	Bennie Creek	UT	VAK030C	A	CP	Not Tested - Hybridized
NB	Big Bear Creek	UT	IVAP150L-01	A	CP	Not Tested - Hybridized
NB	Big Dutch Creek	UT	IVAP150H-01	A	CP	Unaltered
NB	Blue Fork Creek	UT	IVAP180G-01	A	CP	Not Tested - Unaltered
NB	Bob Young Creek	UT	IVAP380-01	A	CP	Not Tested - Unaltered
NB	Boulder Creek	UT	VAF200A-01	A	CP	Not Tested - Unaltered
NB	Box Canyon	UT	IVAP400D01-01	A	CP	Not Tested - Unaltered
NB	Broadhead Meadows Creek	UT	VAF260-01	A	CP	Not Tested - Unaltered
NB	Cache Valley Creek	UT	IVAP030D03C-01	A	CP	Not Tested - Unaltered
NB	Cataract Canyon	UT	IVAP150A07-01	A	CP	90% - 99%
NB	Chalk Creek	UT	IVAP230-02	A	CP	Not Tested - Unaltered
NB	Chalk Creek	UT	IVAP230-01	A	CP	Not Tested - Hybridized

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
NB	Chalk Creek	UT	IVAP230-03	A	CP	Not Tested - Unaltered
NB	Chase Creek	UT	VAK020J01-01	R	CP	Unaltered
NB	City Creek	UT	IVAA010-02	A	CP	90% - 99%
NB	Clear Creek	UT	VAK040H-01	A	CP	Not Tested - Unaltered
NB	Cold Canyon	UT	IVAP030D03C-02	A	CP	Not Tested - Unaltered
NB	Coop Creek	UT	IVAP330D-01	A	CP	Not Tested - Hybridized
NB	Cottonwood Creek	UT	IVAP080-01	A	CP	Unaltered
NB	Cottonwood Creek	UT	VAK020G-01	A	CP	Not Tested - Unaltered
NB	Cutler Creek	UT	IVAP030D06-01	A	CP	90% - 99%
NB	Dalton Creek	UT	IVAP100-01	A	CP	Not Tested - Unaltered
NB	Daniels Creek	UT	VAF060	A	CP	Not Tested - Hybridized
NB	Deep Creek	UT	IVAP140-02	A	CP	Not Tested - Hybridized
NB	Deer Hollow	UT	IVAP150K-01	A	CP	Not Tested - Unaltered
NB	Diamond Fork	UT	VAK020-01	A	CP	Not Tested - Hybridized
NB	Diamond Fork	UT	VAK020-02	R	CP	Unaltered
NB	Dip Vat Creek	UT	VAK020H08-01	A	CP	Unaltered
NB	Dry Fork	UT	IVAP440-01	A	CP	Unaltered
NB	Durfee Creek	UT	IVAP030D05-01	A	CP	Not Tested - Unaltered
NB	East Canyon Creek	UT	IVAP150	A	CP	Not Tested - Hybridized
NB	East Fork Chalk Creek	UT	IVAP230M-01	A	CP	Unaltered
NB	Echo Creek	UT	IVAP210-01	A	CP	Not Tested - Hybridized
NB	Elkhorn Canyon	UT	IVAP230D01-01	A	CP	Not Tested - Unaltered
NB	Emigration Creek	UT	IVAA030	A	CP	Unaltered
NB	Farrells Creek	UT	IVAP150A06-01	A	CP	Not Tested - Unaltered
NB	Fifth Water Creek	UT	VAK020H01-01	A	CP	Not Tested - Unaltered
NB	Fish Creek	UT	IVAP230D05-01	A	CP	Not Tested - Unaltered
NB	Florence Creek	UT	IVAP230T-01	A	CP	Not Tested - Unaltered
NB	Frost Canyon	UT	IVAP030B05D2-01	A	CP	Not Tested - Unaltered

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
NB	Gardners Fork	UT	IVAP450A-01	A	NLP	Not Tested - Unaltered
NB	Gertsen Creek	UT	IVAP030C02-02	A	CP	Not Tested - Unaltered
NB	Gordon Creek	UT	IVAP070A-01	A	CP	Unaltered
NB	Guildersleeve Creek	UT	IVAP180C-01	A	CP	Not Tested - Unaltered
NB	Halls Fork	UT	VAK020J-01	R	CP	Unaltered
NB	Hardscrabble Creek	UT	IVAP150A-01	A	CP	90% - 99%
NB	Heiners Creek	UT	IVAP210B-01	A	CP	Not Tested - Unaltered
NB	Hell Canyon	UT	IVAP180D-01	A	CP	Not Tested - Unaltered
NB	Herd Hollow	UT	VAF170A-01	A	CP	Not Tested - Unaltered
NB	Hobble Creek	UT	VAJ-05	A	CP	Not Tested - Hybridized
NB	Hobble Creek	UT	VAJ-04	A	CP	Not Tested - Hybridized
NB	Hobble Creek, Right Fork	UT	VAJ020-01	A	CP	Not Tested - Hybridized
NB	Holman Creek	UT	VAK030E04-01	A	CP	Not Tested - Unaltered
NB	Holmes Creek	UT	IVAN-02	R	CP	Unaltered
NB	Howard Hollow	UT	IVAP180G06-01	A	CP	< 80%
NB	Huff Creek	UT	IVAP230H-01	A	CP	Not Tested - Unaltered
NB	Killfoil Creek	UT	IVAP180F-01	A	CP	Not Tested - Unaltered
NB	Lake Creek	UT	VAF090A-03	A	CP	Not Tested - Unaltered
NB	Lake Fork	UT	VAK040A-01	A	CP	Not Tested - Unaltered
NB	Lambs Canyon	UT	IVAA040B-01	A	CP	Unaltered
NB	Lambs Canyon	UT	IVAA040B-02	A	CP	Unaltered
NB	Larrabee Creek	UT	IVAP420-01	A	CP	Not Tested - Unaltered
NB	Left Fork Beaver Creek	UT	IVAP330C-01	A	CP	Not Tested - Unaltered
NB	Left Fork Hobble Creek	UT	VAJ010-01	A	CP	Not Tested - Hybridized
NB	Left Fork South Fork Ogden River	UT	IVAP030B05-01	A	CP	Not Tested - Hybridized
NB	Line Creek	UT	IVAP130	A	CP	Not Tested - Unaltered
NB	Little Cottonwood Creek	UT	IVAA080-03	A	CP	Not Tested - Hybridized
NB	Little Deer Creek	UT	VAF040-01	A	CP	Not Tested - Hybridized

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
NB	Little Deer Creek, South Fork	UT	VAF040A-01	A	CP	Not Tested - Unaltered
NB	Little Diamond Creek	UT	VAK020B-01	A	CP	Unaltered
NB	Little Dutch Hollow	UT	IVAP150G-01	A	CP	Not Tested - Unaltered
NB	Little Hobble Creek	UT	VAF050B01-01	A	CP	Not Tested - Hybridized
NB	Little South Fork Provo River	UT	VAF180-01	A	CP	Not Tested - Unaltered
NB	Lodgepole Creek	UT	IVAP230D02-01	A	CP	Not Tested - Unaltered
NB	Lost Creek	UT	IVAP180-01	A	CP	Not Tested - Hybridized
NB	Lost Creek	UT	IVAP180-02	A	CP	Not Tested - Unaltered
NB	Main Creek	UT	VAF050B-01	A	CP	Not Tested - Hybridized
NB	Main Creek	UT	VAF050B-02	A	CP	Not Tested - Unaltered
NB	Middle Fork East Fork Chalk Creek	UT	IVAP230M01-01	A	CP	Unaltered
NB	Middle Fork Ogden River	UT	IVAP030C	A	CP	Not Tested - Hybridized
NB	Middle Fork Weber River	UT	IVAP450-01	A	CP	Unaltered
NB	Mill Creek	UT	IVAA050	A	CP	Not Tested - Hybridized
NB	Mill Fork	UT	IVAP230M01B-01	A	CP	Unaltered
NB	Mill Fork Tributary #2	UT	IVAP230M01B02-01	A	CP	Unaltered
NB	Mill Hollow Creek	UT	VAF190B-01	A	CP	Not Tested - Unaltered
NB	Mine Hollow Creek	UT	VAK040F05-01	A	CP	Not Tested - Unaltered
NB	Moffit Creek	UT	IVAP430-01	A	CP	Not Tested - Unaltered
NB	Mountain Dell Creek	UT	IVAA040A-01	A	CP	Unaltered
NB	Nebo Creek	UT	VAK030E-01	A	CP	Not Tested - Hybridized
NB	Neil Creek	UT	IVAP370-01	A	CP	Not Tested - Unaltered
NB	North Fork American Fork Creek	UT	VAB020	A	CP	Not Tested - Hybridized
NB	North Fork Deep Creek	UT	IVAP140A-01	A	CP	Not Tested - Unaltered
NB	North Fork Ogden River	UT	IVAP030D-02	A	CP	Not Tested - Hybridized
NB	North Fork Ogden River	UT	IVAP030D-03	A	CP	90% - 99%
NB	North Fork Provo River	UT	VAF200-01	A	CP	Not Tested - Hybridized

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
NB	Parleys Creek	UT	IVAA040	A	CP	Unaltered
NB	Peteetneet Creek	UT	VAM	A	CP	Not Tested - Hybridized
NB	Peterson Creek	UT	IVAP090-02	A	CP	Not Tested - Unaltered
NB	Provo River	UT	VAF-06	A	CP	Unaltered
NB	Provo River	UT	VAF-11	A	CP	Not Tested - Hybridized
NB	Provo River	UT	VAF-10	A	CP	Not Tested - Hybridized
NB	Provo River	UT	VAF-05	A	CP	Unaltered
NB	Provo River	UT	VAF-04	A	CP	Not Tested - Hybridized
NB	Provo River	UT	VAF-09	A	CP	Not Tested - Hybridized
NB	Provo River	UT	VAF-07	A	CP	Unaltered
NB	Provo River	UT	VAF-08	A	CP	Unaltered
NB	Red Butte Creek	UT	IVAA020	A	CP	Unaltered
NB	Red Creek	UT	IVAP410-01	A	CP	Not Tested - Unaltered
NB	Red Pine Creek	UT	IVAP400D-01	A	CP	Not Tested - Unaltered
NB	Red Pine Lake Creek	UT	IVAA080F-01	R	CP	Unaltered
NB	Right Fork Middle Fork Ogden River	UT	IVAP030C04-01	A	CP	Unaltered
NB	Right Fork Peteeneet Creek	UT	VAM030-01	A	CP	Not Tested - Hybridized
NB	Right Fork Silver Creek	UT	VAB020B01-01	A	CP	Not Tested - Hybridized
NB	Right Hand Fork Dalton Creek	UT	IVAP100-02	A	CP	Not Tested - Unaltered
NB	Right Hand Fork Sheep Canyon	UT	IVAP150B01-01	A	CP	Not Tested - Unaltered
NB	Rock Creek	UT	VAF210-01	A	CP	Not Tested - Unaltered
NB	Rock Creek	UT	IVAP030B02C-01	A	CP	Not Tested - Unaltered
NB	Sawmill Canyon	UT	IVAP210A-01	A	CP	Not Tested - Unaltered
NB	Schuster Creek	UT	IVAP150J-01	A	CP	Not Tested - Unaltered
NB	Sheep Canyon	UT	IVAP150B	A	CP	Not Tested - Unaltered
NB	Sheep Creek	UT	IVAP030D03-01	A	CP	Co-existence
NB	Shingle Creek	UT	IVAP330E-01	A	CP	Not Tested - Unaltered

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
NB	Shingle Mill Creek	UT	IVAP150A05-01	A	CP	Not Tested - Unaltered
NB	Shingle Mill Fork	UT	VAK020J01A-01	R	CP	Unaltered
NB	Silver Creek	UT	IVAP280-01	A	CP	Not Tested - Unaltered
NB	Silver Creek	UT	VAB020B-01	A	CP	Not Tested - Hybridized
NB	Sixth Water Creek	UT	VAK020H-01	A	CP	Unaltered
NB	Slab Creek	UT	VAK030E06-01	A	CP	Not Tested - Unaltered
NB	Slate Creek	UT	IVAP330CA-01	A	CP	Not Tested - Hybridized
NB	Smith and Morehouse Creek	UT	IVAP400-01	A	CP	Co-existence
NB	Smith and Morehouse Creek	UT	IVAP400-02	A	CP	Not Tested - Unaltered
NB	Soapstone Creek	UT	VAF220-01	A	CP	Not Tested - Hybridized
NB	Soldier Creek	UT	VAK040	A	CP	Not Tested - Hybridized
NB	South Fork Chalk Creek	UT	IVAP230D-01	A	CP	Not Tested - Unaltered
NB	South Fork Ogden River	UT	IVAP030B	A	CP	Not Tested - Hybridized
NB	South Fork Provo River	UT	VAF190-01	A	CP	Not Tested - Hybridized
NB	South Fork Weber River	UT	IVAP350-01	A	NLP	Not Tested - Hybridized
NB	South Fork Wolf Creek	UT	IVAP030D01A-01	A	CP	Not Tested - Unaltered
NB	Spanish Fork	UT	VAK	A	CP	Not Tested - Hybridized
NB	Spanish Fork River	UT	VAK-02	A	CP	Not Tested - Hybridized
NB	Spring Creek	UT	VAF090-01	A	CP	Not Tested - Hybridized
NB	Spring Creek	UT	VAF050A-01	A	CP	Not Tested - Hybridized
NB	Stillman Creek	UT	IVAP390-01	A	CP	Not Tested - Unaltered
NB	Strawberry Creek	UT	IVAP060-01	A	CP	Not Tested - Unaltered
NB	Taylor Hollow	UT	IVAP150D-01	A	CP	Not Tested - Unaltered
NB	Thistle Creek	UT	VAK030	A	CP	Not Tested - Hybridized
NB	Three Mile Canyon	UT	IVAP150Q-01	A	CP	Not Tested - Unaltered
NB	Tie Fork	UT	VAK040F	A	CP	Not Tested - Unaltered
NB	Toll Canyon	UT	IVAP150O-01	A	CP	Not Tested - Unaltered
NB	Tom Condies Creek	UT	IVAP180A-01	A	CP	Not Tested - Unaltered

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
NB	Unnamed 149	UT	IVAP230D09-01	A	CP	Not Tested - Unaltered
NB	Unnamed 151	UT	IVAP230D06-01	A	CP	Not Tested - Unaltered
NB	Unnamed 266	UT	IVAP230M02-01	A	CP	Unaltered
NB	Unnamed 267	UT	IVAP230S-01	A	CP	Not Tested - Unaltered
NB	Unnamed 269	UT	IVAP230S01-01	A	CP	Not Tested - Unaltered
NB	Wallsburg Creek	UT	VAF050-01	A	CP	Not Tested - Hybridized
NB	Walton Creek	UT	IVAP150A04-01	A	CP	Not Tested - Unaltered
NB	Wanrhodes Creek	UT	VAK020C-01	A	CP	Not Tested - Hybridized
NB	Wardsworth Creek	UT	VAJ020E-01	A	CP	Not Tested - Hybridized
NB	Weber River	UT	IVAP-06	A	CP	Not Tested - Hybridized
NB	Weber River	UT	IVAP-07	A	RP	Not Tested - Hybridized
NB	Weber River	UT	IVAP-11	A	CP	Not Tested - Hybridized
NB	Weber River	UT	IVAP-04	A	CP	< 80%
NB	Weber River	UT	IVAP-10	A	CP	Not Tested - Hybridized
NB	Weber River	UT	IVAP-12	A	CP	80% - 89%
NB	Weber River	UT	IVAP-05	A	CP	Not Tested - Hybridized
NB	Weber River	UT	IVAP-09	A	RP	Not Tested - Hybridized
NB	Weber River	UT	IVAP-03	A	CP	Not Tested - Hybridized
NB	Weber River	UT	IVAP-02	A	CP	Not Tested - Hybridized
NB	Wheatgrass Creek	UT	IVAP030B03-01	A	CP	Not Tested - Hybridized
NB	Wheeler Creek	UT	IVAP030A-01	A	CP	Not Tested - Unaltered
NB	Whites Creek	UT	IVAP340-01	A	CP	Not Tested - Unaltered
NB	Willard Creek	UT	IVAR123-02	R	CP	Unaltered
NB	Wolf Creek	UT	IVAP030D01-02	A	CP	Not Tested - Unaltered
NB	Yellow Pine Creek	UT	IVAP330CB-01	A	CP	Not Tested - Hybridized
SB	Beaver Creek	UT	VIAA200G-01	A	CP	Unaltered
SB	Birch Creek	UT	VIAA550-01	R	CP	Unaltered
SB	Birch Creek	UT	VIAB050A02	A	CP	Unaltered

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
SB	Briggs Creek	UT	VIAB070B02-01	R	CP	Unaltered
SB	Center Creek	UT	VIAA510I-01	R	CP	Unaltered
SB	Clear Creek	UT	VIAA360	R	CP	Unaltered
SB	Deep Creek	UT	VIAA510G01	A	CP	Unaltered
SB	Deer Creek	UT	VIAA510J-01	R	CP	Unaltered
SB	Dry Creek	UT	VIAA180R-01	R	CP	Unaltered
SB	East Fork Hunt Creek	UT	VIAA510S02-01	R	CP	Unaltered
SB	East Fork Sevier River	UT	VIAA510	R	RP	Not Tested - Hybridized
SB	Fish Creek	UT	VIAA360E	R	CP	Unaltered
SB	Harmon Creek	UT	IAA060A01-01	R	CP	Unaltered
SB	Horse Creek	UT	IAA040C01-01	R	CP	Unaltered
SB	Leap Creek	UT	IAA060B-01	R	CP	Unaltered
SB	Leeds Creek	UT	IAA040-03	R	CP	Unaltered
SB	Mammoth Creek	UT	VIAA780	A	CP	90% - 99%
SB	Manning Creek	UT	VIAA430-01	R	CP	Unaltered
SB	Mill Creek	UT	IAA060A02-01	R	CP	Unaltered
SB	Mill Creek	UT	VIAA360C-01	R	CP	Unaltered
SB	North Fork Corn Creek	UT	VIAA070A-01	R	CP	90% - 99%
SB	North Fork North Creek	UT	VIAB070A-01	A	CP	90% - 99%
SB	Oak Creek	UT	VIAA180H-04	R	CP	Unaltered
SB	Panguitch Creek	UT	VIAA690	R	RP	Unaltered
SB	Picnic Creek	UT	VIAA360E02-01	R	CP	90% - 99%
SB	Pig Creek	UT	IAA040D-01	R	CP	Unaltered
SB	Pine Creek	UT	VIAB010-01	R	CP	Unaltered
SB	Pole Creek	UT	VIAA360D01-01	A	CP	Unaltered
SB	Pole Creek	UT	VIAB070A01-01	R	CP	90% - 99%
SB	Ranch Creek	UT	VIAA510M01-01	A	CP	Unaltered
SB	Salina Creek	UT	VIAA200	A	CP	Unaltered

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
SB	Sam Stowe Creek	UT	VIAA360A-01	R	CP	Unaltered
SB	Sevier River	UT	VIAA-17	R	RP	Not Tested - Hybridized
SB	Shingle Creek	UT	VIAA360F-01	R	CP	Unaltered
SB	Skunk Creek	UT	VIAA360D01B-01	A	CP	90% - 99%
SB	South Ash Creek	UT	IAA060A-01	R	CP	Unaltered
SB	Spirit Creek	UT	IAA040C-01	R	CP	Unaltered
SB	Tenmile Creek	UT	VIAA440-01	R	CP	Unaltered
SB	Threemile Creek	UT	VIAA680-01	R	CP	Unaltered
SB	Vale Creek	UT	VIAA430B-01	R	CP	Unaltered
SB	Water Canyon	UT	IAA020C01-01	A	CP	Unaltered
SB	West Fork Beaver Creek	UT	VIAA200G01-01	A	CP	Unaltered
SB	West Fork Hunt Creek	UT	VIAA510S03-01	R	CP	Unaltered
WD	Basin Creek	UT	IVAR420-01	R	CP	Unaltered
WD	Big Wash	NV		R	CP	Unaltered
WD	Birch Creek	UT	IVAR360-01	A	CP	Unaltered
WD	Deep Canyon	NV		A	Unknown	Unaltered
WD	Deep Creek	NV		R	CP	Unaltered
WD	Goshute Creek	NV		R	CP	Unaltered
WD	Granite Creek	UT	IVAR380-01	R	CP	Unaltered
WD	Hampton Creek	NV		R	NLP	Unaltered
WD	Hendrys Creek	NV		A	CP	Unaltered
WD	Indian Farm Creek	UT	IVAR400-01	A	CP	Unaltered
WD	Mill Creek	NV		A	CP	Unaltered
WD	Pine Creek	NV		OR	CP	Unaltered
WD	Red Cedar Creek	UT	IVAR390-01	A	CP	Unaltered
WD	Ridge Creek	NV		OR	CP	Unaltered
WD	Smith Creek	NV		R	CP	Unaltered
WD	Snake Creek	NV		R	CP	Unaltered

GMU	Water Name	State	Utah Water ID	Population Origin	Population Status	Genetic Status
WD	South Fork Baker Creek	NV		R	CP	Unaltered
WD	South Fork Big Wash	NV		R	CP	Unaltered
WD	Spring Creek	NV		A	CP	Unaltered
WD	Strawberry Creek	NV		R	CP	Unaltered
WD	Toms Creek	UT	IVAR410-01	A	CP	Unaltered
WD	Trout Creek	UT	IVAR370-01	A	CP	Unaltered
WD	Unnamed 212	NV		R	CP	Unaltered