CONSERVATION STRATEGY FOR COLORADO RIVER CUTTHROAT TROUT (*Oncorhynchus clarkii pleuriticus*)

in the States of
Colorado, Utah, and Wyoming

June 2006

TABLE OF CONTENTS

Acknowledgments

Preparation of the original 2001 Conservation Agreement and Strategy was coordinated by Mary McAfee, Colorado Division of Wildlife (CDOW), with assistance from Tom Nesler (CDOW), Ron Remmick, Wyoming Game and Fish Department (WGFD), and Tom Pettengill, Utah Division of Wildlife Resources (UDWR). This Conservation Strategy was revised by Kevin Rogers (CDOW), with assistance from writing team members Dirk Miller (WGFD), Paul Birdsey (UDWR), Jay Thompson, Bureau of Land Management (BLM), and Dirk Renner, United States Forest Service (USFS). Biologists, researchers and administrators from all signatory agencies provided significant input to this document.

Citation:

CRCT Coordination Team. 2006. Conservation strategy for Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*) in the States of Colorado, Utah, and Wyoming. Colorado Division of Wildlife, Fort Collins. 24p.

CONSERVATION STRATEGY

COLORADO RIVER CUTTHROAT TROUT (*Oncorhynchus clarkii pleuriticus*)

This Conservation Strategy (Strategy) has been developed to direct implementation of conservation measures for Colorado River cutthroat trout (CRCT) in Colorado, Utah, and Wyoming as a collaborative and cooperative effort among resource agencies. Threats that warrant CRCT listing as a special status species by state and federal agencies and might lead to listing under the Endangered Species Act of 1973, as amended, will be eliminated or reduced through implementation of this Strategy.

INTRODUCTION AND BACKGROUND

This Conservation Strategy has been initiated by the wildlife agencies in Colorado, Utah and Wyoming to reduce threats to Colorado River cutthroat trout (CRCT), to stabilize or enhance its populations, and to maintain its ecosystems. The Strategy is designed to provide a framework for the long-term conservation of CRCT, and to reduce or eliminate the threats that warrant its status as a sensitive species or species of special concern by federal and state resource agencies. To address these threats, there must be a strong effort towards restoration and a clear allocation of resources for that purpose.

The 2001 Strategy was based on work plans and programs developed by state wildlife management field units and cooperating federal, state, local and nongovernmental agencies in each of the three states. Five conservation plans for CRCT in the three states (Sealing et al. 1992, Interagency Plan 1993 and 1994, Langlois et al.1994, UDWR 1997) were being implemented independently prior to the initiation of the 2001 Strategy (CRCT Task Force 2001). In 1994, member states of the Colorado River Fish and Wildlife Council (a consortium of State Fish and Wildlife agency directors) recognized the need for state wildlife agencies to coordinate conservation actions for CRCT and other native species, and directed Colorado, Utah, and Wyoming to develop a coordinated approach. This Strategy is the product of that decision. The first draft of the Strategy (CRCT Conservation Task Group 1996) identified several issues and technical questions needing resolution. A second draft was implemented in 2001 (CRCT Task Force 2001) and recommended 5-year updates to the Agreement and Strategy.

In April 1997, the Colorado River Fish and Wildlife Council (CRFWC), acting on the advice of the CRCT Conservation Task Group, established a two-level committee structure to resolve these items. A Coordination Committee was assigned to facilitate inter-agency communication and a Biology Committee was assigned to provide technical input on the identified questions. The Strategy was finalized in March 1999 and signed by the Fish and Wildlife Service and the Directors of the wildlife agencies in Colorado, Utah and Wyoming. A revised Agreement and Strategy was completed in 2001. The Biology Committee has been removed from this 2006 revision, the geographic management unit (GMU) boundaries have been revised, and GMU teams have been established (Figure 1). The appendices associated with the previous 2001 Agreement and Strategy have also been removed as that information now resides in spatially referenced form and is summarized in the Status Assessment (Hirsch et al. 2005).

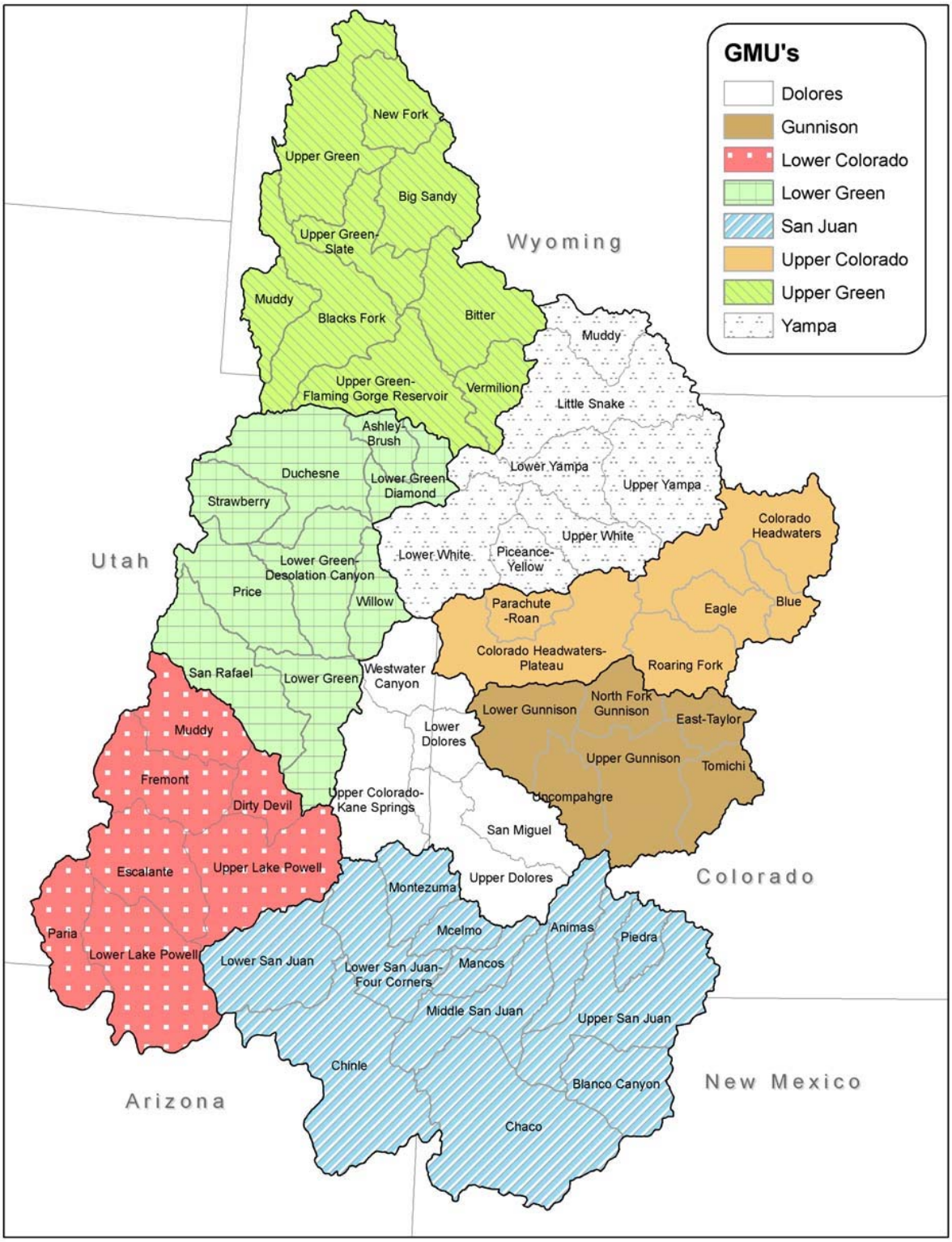

Figure 1: Range of CRCT delineated by geographic management unit (GMU) boundaries. Second level hydrologic units (HUC) define the GMU boundaries, while conservation populations are further grouped by fourth level HUCs to assist with information tracking.

STATUS AND DISTRIBUTION OF COLORADO RIVER CUTTHROAT TROUT

Colorado River cutthroat trout historically occupied portions of the Colorado River drainage in Wyoming, Colorado, Utah, Arizona, and New Mexico (Behnke 1992; Behnke 2002), probably including portions of larger streams, such as the Green (Simon 1935), Yampa, White, Colorado, and San Juan rivers. Widespread introductions of non-native salmonids over the last century however, have served to limit current distributions of CRCT primarily to isolated headwater streams and lakes. Declines in CRCT distribution have been documented in a number of reports (Behnke and Zarn 1976, Binns 1977, Martinez 1988, Young 1995). Young (1995) determined most lotic populations reside in streams with average daily flows less than 0.85 m^3/s (30 cfs). Stream gradients usually exceeded 4%, and all populations were found above 2,290 m (7,500 ft). Behnke (1979) stated that CRCT occupy less than 1% of its historical range, though a more rigorous assessment indicates that the true number lies closer to 14% (Hirsch et al. 2005). Early reviews were based on summaries of information contained in various agency reports. Their authors, however, did not conduct range-wide population or field surveys to generate the reports. The information contained in them, therefore only gives a general overview of the decline of the subspecies but not specific information on the subspecies status throughout its range. To quantify the decline in a more rigorous fashion, the CRCT Conservation Team worked with agency experts to develop a spatially referenced Geographic Information System (CRCT GIS) that contains all available information on the abundance, genetic integrity, and distribution of the subspecies relative to its historic range (Hirsch et al. 2005). The status assessment (Hirsch et al. 2005) used the best scientific information available, along with a strict decision making protocol to develop the most rigorous estimate of current and historic range available. This recent assessment identified 3,022 miles of occupied stream habitat (14% of historically occupied habitat).

Colorado River cutthroat trout have hybridized with non-native salmonids in many areas, reducing the genetic integrity of this subspecies. As such, hybridization is clearly recognized as a major influence upon CRCT status. There is still some disagreement about the role that hybridized populations should play in status determinations and conservation strategies. In 1996, the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration proposed and adopted the Policy on the Treatment of Intercrosses and Intercross Progeny (the issue of hybridization) (50 CFR Part 424, 61 FR 26). The proposed policy was never finalized. In the absence of that decision, the states developed their own guidelines that are consistent with the proposal. Those are guidelines are reflected in a position paper on genetic considerations associated with cutthroat trout management (UDWR 2000). The CRCT Coordination Team has chosen to adopt that paper to guide establishing genetic purity definitions for CRCT. This position paper describes a hierarchical classification for conserving cutthroat trout that includes: 1) a core component of genetically unaltered populations; 2) designated conservation populations that may be either genetically unaltered or slightly introgressed but have attributes worthy of conservation; and 3) populations that are managed primarily for their recreational fishery value. Core conservation populations are recognized as having important genetic value and would serve as donor sources for developing either captive broodstock or for re-founding additional populations. Populations displaying less than 10% introgression are defined as conservation populations for this Strategy. Two hundred eighty five conservation populations are identified in the CRCT GIS, including 153 “core” conservation

populations based on genetic testing and information indicating no record of non-native stocking and no contaminating species being present (Hirsch et al. 2005). Numbers of CRCT conservation populations, and the stream mileage or lake acreage they occupy by GMU are presented in Table 1. These results show pure and essentially pure populations of CRCT are still represented in many stream drainages across the three states.

The CRCT is designated as a species of special concern by Colorado and Wyoming, and a Tier I species in Utah (those species that are either federally listed or for which a conservation agreement has been implemented). Prior to 1995, this fish was a Federal Category 2 candidate species, but does not occur in the candidate list proposed by the U.S. Fish and Wildlife Service in 1996 (50 CFR Part 17, 61 FR 7600), as use of categories 1, 2, etc. was eliminated in this proposed rule. The CRCT is classified as a sensitive species by Regions 2 and 4 of the USFS and by the BLM in Colorado, Wyoming, and Utah.

Table 1. Numbers and miles/acres of CRCT conservation populations known to exist on June 30, 2005 by basin GMU.

Geographic Management Unit	Existing CRCT Populations (Distinct Populations)			
	In Streams		In Lakes	
	Number	Miles	Number	Acres
Lower Colorado	14	50	5	21
Upper Colorado	75	302	19	234
Dolores	4	14	0	0
Lower Green	26	307	1	36
Upper Green	76	650	8	699
Gunnison	25	92	2	75
San Juan	12	42	0	0
Yampa	53	339	6	58
Grand Total	285	1796	41	1123

DEFINITIONS AND ISSUES

A. Geographic Management Unit:

The range of the Colorado River cutthroat has been divided into eight GMUs to bring a finer level of resolution to population descriptions and habitat distribution, as well as related maintenance and restoration work. These GMUs reflect four digit Hydrologic Unit Codes. They do not necessarily reflect important differences in genetic variability in the fish based on adaptations to specific environments. As knowledge of genetic traits increases, planning and management may emphasize conservation of distinct genomes across the range of the subspecies

(Monroe and Nielsen 1994). It should be noted that in the original 2001 version of this document, that 14 GMUs were presented. Eliminating state boundaries that mean little to CRCT precipitated the reduction in GMU numbers. Experience gained over the last 5 years indicates that the new GMUs represent a more practical and meaningful approach to delineate the distribution of CRCT.

B. Conservation and Core Conservation Populations:

A conservation population is a naturally reproducing and recruiting population of native cutthroat trout that is managed to preserve the historical genome and/or unique genetic, ecological, and/or behavioral characteristics. Populations are further defined by quantifying introgression (for details, see Item D, below). In general, a conservation population is at least 90% cutthroat trout ($\leq$10% introgression), but may be lower depending on circumstances. These populations retain all of the phenotypic attributes associated with the subspecies. This definition includes situations where genetically pure individuals coexist with introgressed individuals or they occur as hybrid swarms.

Protection of introgressed populations is consistent with the U.S. Fish and Wildlife Service proposed policy on the Treatment of Intercrosses and Intercross Progeny (Federal Register 61(26), 02/07/96). Since one of the goals of the CRCT Conservation Strategy is to preserve as much CRCT genetic diversity as possible, it may be necessary to accept a small amount of hybrid influence in order to preserve a larger amount of CRCT diversity. This definition addresses these policy guidelines and strategy goals while honoring the overall intent of species restoration efforts.

A body of water contains a CRCT conservation population if it is reproducing and recruiting as a geographically distinct group, or is being managed through periodic stocking for the purpose of maintaining a genetic refugia. These populations should not receive genetic material from other populations unless there is evidence that unique population attributes can be maintained. These populations should not be used to develop broodstock for subspecies preservation purposes, but may be considered as sources for introductions or reintroductions when the objective is to duplicate unique ecological, genetic or behavioral attributes.

A core conservation population is a conservation population that is greater than 99% pure, and representative of the historic genome of the native cutthroat trout. Core populations contain cutthroat trout that have not been influenced by genetic alteration linked to human intervention. These populations serve as the primary source of gametes for introductions and re-introductions through transplants, and for broodstock development. These populations should not receive genetic material from other population sources unless there is evidence that loss of fitness, reduced reproduction, or reduced survival has put the population in jeopardy.

C. Viability or Stability:

The Coordination Team adopted a definition of population viability based on criteria from Rieman and McIntyre (1993). More recently, McElhany et al. (2000) have provided additional discussion on guidelines for viability. Some of these criteria may not be directly

applicable to the CRCT conservation program as some small, isolated populations of CRCT have been stable for many years. It is clear that there are significant uncertainties surrounding ecological requirements for persistence of this subspecies. The Conservation Team agrees on the need for a consistent way to describe the condition of the different populations across the range of CRCT so that it is clear which populations are stable and which are at risk of decline. As such, some measures of population health have been incorporated in the Status Assessment (Hirsch et al. 2005) and the CRCT GIS.

D. Introgression:

Introgression is reproduction between a native cutthroat trout subspecies and other cutthroat subspecies (intraspecific) or other salmonid species (interspecific), and occurs in varying degrees among populations. Some introgressed populations may offer genetic, ecological, or behavioral attributes valuable to conservation efforts for the subspecies. Measures of introgression are varied among research entities and governmental management agencies. The Coordination Team has adopted a genetics position paper (UDWR 2000) to provide a unified approach to quantifying introgression.

The use of both allozymes and nuclear DNA analyses (e.g., AFLPs, microsatellites, RAPDS, PINES) are acceptable analytical techniques. All markers used must be diagnostic for the nonnative species and CRCT. In situations where allozyme analysis is used (requiring lethal sampling), collection of a full sample to achieve desired 90-99% confidence of estimates ($\pm$1%) of percent introgression levels recommended for conservation and core conservation populations may jeopardize long term health of the population. For these populations, collection of a full sample may be accomplished over two or more years.

Earlier categorizations of CRCT populations based on genetic purity relied on an A-D purity rating. During the transition between that system and the one outlined above, populations that were rated B or better under the old system will be considered conservation populations, and those that were rated A+, A, and A- under the old system will be considered core conservation populations. The overriding intent of this genetic strategy is to preserve, protect and enhance the purity and diversity of the genome of Colorado River cutthroat trout across its range as circumstances permit.

E. Metapopulation

A collection of localized populations that are geographically distinct yet are genetically interconnected through natural movement of individual fish between populations. If individual localized populations go extinct, they can be refounded by surrounding populations.

F. Phenotype

The physical manifestation of the interaction of an organism's genetic information with its environment that results in a unique physical, physiological or behavioral trait.

PROBLEMS CONTRIBUTING TO THE DECLINE OF THE SPECIES

In the 2001 CRCT Agreement and Strategy (CRCT Task Force 2001), the authors elected to use the ESA listing criteria as the basis for discussing problems contributing to the decline of the species. Those criteria are discussed here as well, even if they do not play a prominent role in either the decline or subsequent conservation of CRCT.

A. Present or threatened destruction, modification or curtailment of the species' habitat or range

Young (1995) determined that introductions of non-native salmonids may have had the greatest effect on CRCT. Stocking of non-native salmonids has been widespread since the 1880s. Non-native salmonids affect populations of Colorado River cutthroat trout in different ways. Brook trout are known to replace most subspecies of inland cutthroat trout when in sympatry, especially at lower elevations and in low-gradient streams (Eiserman 1958, Behnke and Zarn 1976, Fausch 1989, Oberholtzer 1990). Competition is often cited as the mechanism leading to replacement (Fausch 1988; Griffith 1988, DeStaso and Rahel 1994), particularly at early life stages (Peterson and Fausch 2003, Peterson et al. 2004).

Rainbow trout and non-native subspecies of cutthroat trout readily hybridize with Colorado River cutthroat trout and produce fertile offspring (Snyder and Tanner 1960, Behnke and Zarn 1976, Martinez 1988). Introductions of non-native salmonids into existing populations of native trout by State and Federal fish and wildlife agencies have ceased, and do not represent an ongoing practice or expanding threat. However, private organizations and individuals may be illegally stocking waters with fish that can hybridize or compete with CRCT. Wildlife laws are in place to restrict this activity and enforcement on illegal fish stocking has increased.

A wide variety of land management practices affect populations of CRCT, including overgrazing (Binns 1977), heavy metal pollution (Quinlan 1980, Jespersen 1981, Oberholtzer 1987), and water depletion and diversion (Jespersen 1981). Some of these practices have served to isolate upstream populations of CRCT, thereby protecting them from invasion by non-native salmonids and disease. Fragmented streams however, restrict movement between formerly connected populations, leaving small isolated populations that may be more vulnerable to stochastic events that can lead to extinction.

Even when the effects of land management are discernable in aquatic ecosystems, the consequences for fish may be unknown. Young (1995) describes an example of differential habitat effects where production of juvenile trout benefited at the expense of adult habitat. Behnke and Benson (1980) have described the CRCT as the "canary in the mine" with regard to habitat degradation, but mention that some have persevered in suboptimal habitats. Binns (1977) found that CRCT sometimes persisted in marginal or degraded habitats, often as the only fish species present. Behnke and Zarn (1976) reported that CRCT persisted in such habitats despite introductions of rainbow trout.

Habitat problems are viewed as site specific and not an overall threat throughout the range of CRCT. Wyoming has implemented a number of ongoing watershed projects that focus on entire systems and permit reconnection of stream populations. In addition, they have bought out grazing allotments that will benefit CRCT. Existing headwater habitats that support wild

trout populations are being converted to native trout habitat. Colorado River cutthroat trout reclamation projects were initiated within Rocky Mountain National Park in 1979, and have since spread across the range of the sub-species, forming the foundation of restoration efforts. The continued use of rotenone and antimycin will be critical in restoring native cutthroat trout to historic habitats. Both treatments have proven extremely effective in the hands of certified and trained applicators. Use conforms to that described on the piscicide product labels, and careful monitoring to ensure the persistence of non-target organisms is implemented. Specific activities in the last five years are detailed in the Conservation Accomplishments 1999-2003 report (http://wildlife.state.co.us/research/aquatic/CutthroatTrout).

B. Overuse of the species for commercial, recreational, scientific or educational purposes:

Quinlan (1980) and Eiserman (1958) report instances wherein CRCT demonstrated an ease of capture by anglers that could be translated into vulnerability to excessive harvest. However, overharvest is not considered a problem to CRCT at this time. Special regulations requiring catch-and-release, limited harvest, and terminal tackle restrictions have demonstrated effectiveness in maintaining trout populations in the face of a wide range of fishing pressure, and have been applied to native cutthroat trout waters in all three states. Many CRCT populations tend to lie in remote headwater drainages with difficult access, which has served to minimize angling pressure. The tendency for these populations to be composed largely of small-sized fish may also reduce interest by anglers wishing to harvest fish. Wyoming has closed some cutthroat waters to fishing where angler harvest was thought to be a concern. In addition, the National Park Service has closed four CRCT waters to fishing to protect broodstocks, small populations, and spawning fish.

Monitoring wild native cutthroat trout populations is a continuous process in all three states. A carefully scrutinized permitting system is in place governing scientific collections to ensure that excessive sampling for scientific or educational purposes does not adversely effect CRCT populations. Commercial harvest is not allowed anywhere across the range of CRCT. Based on ongoing monitoring programs, overuse does not appear to have contributed to the decline of the species.

C. Disease or predation:

Cutthroat trout are susceptible to common salmonid diseases, including whirling disease, which is caused by the myxosporean *Myxobolus cerebralis* (Markiw 1992). Colorado River cutthroat trout exposed to *M. cerebralis* (MC) in sentinel fish experiments suffered significantly greater mortality from the infection than most other non-native salmonids (Nehring 1998). In an effort to evaluate the presence and effect of whirling disease in native cutthroat trout populations, Colorado has surveyed for MC in over 100 conservation populations to date. While whirling disease has shown up in a number of them, only two show signs of year-class failure (R. B. Nehring, Colorado Division of Wildlife, personal communication). These populations will be monitored closely to determine if population collapse results. Very little is known about other diseases and parasites of this subspecies.

Transmission of diseases to wild cutthroat trout populations through hatchery-based fish stocking is recognized as a significant potential threat. In Wyoming and Utah, statewide policies and regulations address fish health status, disease certification of stocked and imported fish, and stocking protocols, which are designed to reduce disease threats. Fish testing positive for MC in Wyoming and Utah hatcheries will not be stocked. In addition, fish are not stocked into established wild populations. In Colorado, Wildlife Commission policy D-9 on MC clearly prohibits stocking of MC positive salmonid fish in protected habitats, which include native cutthroat trout waters and most salmonid habitats as defined by regulation. For stocking of native cutthroat trout into existing or restored habitats by the Division of Wildlife, only fish that have tested negative for MC using polymerase chain reaction (PCR) protocol are eligible for release, and the PCR test must be performed within 60 days of the desired stocking date. By policy and regulation (CDOW Regulations, Chapter 0, #008.H; #009.G), the Division of Wildlife has been directed to eliminate the stocking of WD positive fish in habitats that are capable of supporting self-reproducing salmonid populations, including standing waters above such habitat by 2003. These salmonid habitats and native cutthroat trout habitats are identified in regulation (CDOW Regulations, Chapter 0, Appendices D, E, and F), and include most coldwater stream drainages in the state. Colorado also has regulations for disease-free certification for seven salmonid pathogens for imported fish and a policy requiring use of isolation/quarantine units while propagating native cutthroat trout stocks to decrease risk of transmitting salmonid pathogens.

D. Absence of regulating mechanisms adequate to prevent decline of the species or degradation of its habitat:

Colorado River cutthroat trout is designated as a special status species by Colorado, Utah and Wyoming. The fish is classified as a sensitive species by Regions 2 and 4 of the USFS and by the BLM in Colorado and Utah. As such, native cutthroat trout populations are protected by state regulations concerning stocking restrictions, fishing closures, harvest and gear restrictions, stream barriers to fish passage, and disease control. These approaches are considered to be effective in reducing the threats of hybridization with other salmonids, overharvest by angling, and disease (Bennett et al. 1996).

Further federal protection for CRCT habitat is found in the Clean Water Act, National Environmental Policy Act (NEPA), and other federal mandates such as the U.S. Forest Service Sensitive Species and Wilderness Areas programs. In conjunction with state species management objectives for native cutthroat trout, these federal mandates make protection and enhancement of their habitat both high profile and high priority within these federal agencies. For example, goals and objectives in the Arapaho and Roosevelt National Forest Land and Resource Management Plan (USDA-FS 1997) outline protections and habitat improvement projects specifically to benefit CRCT. In addition, these Forests and numerous others currently use CRCT as a management indicator species. This translates into extreme care for riparian habitats where CRCT are present on both BLM and FS managed lands.

In Colorado, the CDOW and National Park Service have placed the highest priority on protection of native cutthroat trout populations. The CDOW has implemented regulations consistent with its Statewide Fish Management Policy and Whirling Disease Policy. These regulations prevent the stocking of non-native salmonids in areas with CRCT populations, and

minimize their exposure to MC and other diseases through stocking restrictions and rigorous disease testing of hatchery and wild salmonid populations.

Threats to depletion of stream flow regimes are reduced through filing for minimum instream flow rights with the Colorado Water Conservation Board. As of 1996, 7,255 stream miles in 1,222 stream segments are protected by decree, including waters within the Colorado, Gunnison, San Miguel, Yampa, White, San Juan and Dolores rivers (CWCB 1996). The Colorado Water Quality Control Division and Commission implements regulatory controls of water quality in Colorado. Water quality standards are already in place to protect the maintenance of aquatic life in coldwater environments, and special resource restrictions are also available to provide further site-specific protection to water quality.

In Wyoming, the State Division of Environmental Quality implements water quality regulations and controls. The WGFD has submitted instream flow filings for 29 stream segments (103 miles) to protect stream flows for CRCT. In Utah, threats to CRCT populations are being addressed through an existing conservation agreement and strategy approved by the state's Division of Wildlife Resources and Reclamation Mitigation and Conservation Commission, and the U.S. Fish and Wildlife Service, Bureau of Land Management, Forest Service, and Bureau of Reclamation (UDWR 1997). Therefore, lack of regulating mechanisms to prevent species decline or habitat degradation does not constrain this conservation effort.

E. Other natural or manmade factors affecting continued existence of the species:

The impacts of stocking non-native trout species on native cutthroat trout populations, and the use of hatchery-raised fish to augment wild populations are two significant areas of concern. The first of these issues has been addressed in all three states as evidenced above in the description of management policy and priorities for native cutthroat trout populations and habitat, disease control, and fishing restrictions.

Stocking of non-native trout by private interests is regulated in Colorado, Utah, and Wyoming to protect native cutthroat populations. Stocking of native cutthroat trout is used to restore naturally functioning populations within historic range. Protocols are described for the appropriate use of native fish from wild populations for captive broodstock development, reclamation projects resulting in new populations, and translocations based on genetic purity rating. These activities are also guided by genetic protocols and quantifiable population objectives.

The intent of this tri-state strategy is to make these protocols and objectives consistent among the natural resource agencies charged with management responsibilities over CRCT and their habitat. In Wyoming, policy has been developed that enables CRCT to be provided to private landowners if such action will benefit cutthroat management objectives. Colorado has developed a conservation agreement process to promote the expansion of native cutthroat trout populations in privately owned waters.

CONSERVATION STRATEGY

The goal of the Conservation Strategy for Colorado River cutthroat trout is:

To assure the long-term viability of CRCT throughout their historic range. Areas that currently support CRCT will be maintained, while other areas will be managed for increased abundance. New populations will be established where ecologically and economically feasible, while the genetic diversity of the species is maintained. The cooperators envision a future where threats to wild CRCT are either eliminated or reduced to the greatest extent possible.

The Objectives of the Conservation Strategy for Colorado River cutthroat trout are:

Objective 1: Identify and characterize all CRCT core and conservation populations

Identify all waters with CRCT populations and monitor known populations to detect changes. Complete genetic analyses on known or potential CRCT populations.

Objective 2: Secure and enhance conservation populations

Secure and if necessary enhance all known and suspected genetically pure CRCT populations. These efforts might include, but are not limited to:

- Restricting introduction of non-native fish species
- Restricting spread of disease and invasive species
- Removing non-native fish species
- Regulating angling and enforcing regulations
- Constructing in-channel barriers
- Maintaining sources of genetically pure CRCT

Objective 3: Restore populations

Increase the number of populations by restoring CRCT within their native range. Local restoration goals and approaches will be developed to meet this objective.

Objective 4: Secure and enhance watershed conditions

Strive to improve watershed conditions for CRCT, including development of protocols for monitoring

Objective 5: Public outreach

Develop and implement a public outreach effort specifically addressing CRCT conservation.

Objective 6: Data sharing

Continue to build and maintain the CRCT GIS so that information can readily be shared between and among jurisdictions.

Objective 7: Coordination

Maximize effectiveness of CRCT conservation efforts by coordinating signatory agency efforts toward achieving a common goal.

These goals and objectives will be reached by implementing specific management actions detailed in this Conservation Strategy and in existing and future conservation agreements/ strategies and management plans developed between the signatory agencies and other federal, state, local and nongovernmental agencies. The Strategy will be evaluated annually, and modified as necessary to address newly identified conservation issues and to ensure program effectiveness. Strategy setting for CRCT conservation will necessarily be a fluid and adaptive process.

The 2001 Conservation Strategy (CRCT Task Force 2001) included three primary activities: protecting existing and restored ecosystems, restore degraded ecosystems, and coordination and planning. Because there was redundancy in the strategies when divided in such a fashion, this revision now only has two broad categories: physical conservation activities and administrative conservation activities. Signatories are responsible for implementing the strategies that fit their mission. All of the 2001 strategies are still addressed in this revision; they are now simply consolidated into the following strategies:

Physical conservation activities:

Strategy 1: Characterize CRCT populations

Monitor CRCT populations to detect changes

Continue monitoring CRCT populations, with emphasis on accurate assessment of total adult cutthroat population size and relative abundance of native non-game species. A minimum of two-pass removal type estimators (Seber and LeCren 1967, Bagenal 1978) will be used to facilitate comparisons of CRCT population size over the range of the subspecies. Assessments should be conducted at least once over the life of this revised strategy (five years) for each core population.

Survey waters with potential CRCT populations

Seek out undiscovered waters that have the potential to support CRCT populations until all remnant populations and potential habitats have been identified.

Complete genetic analyses on known or potential populations of CRCT

The genetic status of all known or potential CRCT populations will be assessed using the most effective genetic identification techniques. Large-scale restoration plans should be guided by results of a uniformly interpreted standard analysis. Implicit in

this guideline is the need for research that examines populations with all available genetic diagnostic approaches so these can be calibrated with one another. In addition, a reference collection of fish or DNA from the entire tri-state area should be developed and maintained.

Strategy 2: Secure CRCT conservation populations

Restrict introduction of non-native fish species

Regulations concerning stocking of hatchery reared fish and human movement of resident fish will be enforced to ensure that populations of CRCT are not jeopardized by introduced non-native species. Education and information activities explaining the reasons for prohibitions against non-native stocking in cutthroat waters will also be used.

Restrict spread of disease and invasive species

Continue to implement guidelines to restrict spread of disease (e.g., testing procedures for *Myxobolus cerebralis* prior to stocking, agency field protocols to reduce spread, education efforts).

Construct in-channel barriers

If natural barriers cannot be used, in-channel barriers will be constructed downstream of the populations at risk from invasion by non-native fish species or hybridized cutthroat populations. Maintenance schedules appropriate to each type of barrier will be developed, and maintenance work funded and completed.

Regulate angling and enforce regulations

Use special regulations to promote persistence of CRCT populations, and provide a concerted law enforcement presence to ensure compliance.

Strategy 3: Restore or enhance CRCT populations

Remove non-native fish species

Non-native fish in the ecosystems selected for restoration of CRCT will be removed using standard operating procedures for electrofishing or chemical (primarily rotenone or antimycin) treatment. Precautions will be taken to minimize any detrimental effects on native non-game fish species, amphibians, or unique macroinvertebrate populations. Reclamation plans for the next five-year cycle split by GMU are illustrated in Table 2.

Table 2. Numbers and miles/acres of additional CRCT conservation populations to be added by 2010, through traditional reclamation efforts using rotenone or antimycin.

Geographic Management Unit	Anticipated Additional CRCT Populations			
	In Streams		In Lakes	
	Number	Miles	Number	Acres
Lower Colorado	2	12	1	5
Upper Colorado	8	16	1	10
Dolores	2	6.5	1	20
Lower Green	9	83	0	0
Upper Green	4	149	0	0
Gunnison	2	8	0	0
San Juan	1	2.5	0	0
Yampa	8	33.5	1	30
Total	36	310.5	4	65

Secure reintroduction sites

Ecosystems selected for restoration of CRCT will be secured from watershed habitat degradation. Cooperative management agreements with public agencies and private organizations or individuals that have an interest in CRCT will may be developed where appropriate, in order to ensure the long-term safety of the restored ecosystems.

Protect distinct life-history traits

Redundant populations should be created from CRCT conservation populations that possess unique life-history attributes (e.g. extreme temperature tolerance).

Create metapopulations where possible

Where it is possible to protect larger drainages from invasion by non-native species, barriers should be removed to allow the reconnection of habitat within a metapopulations framework. This will ensure persistent gene exchange, as well as allow for the recolonization of habitats following local extinction

Strategy 4: Maintain sources of genetically pure Colorado River cutthroat trout

Sources of the various genetic stocks identified throughout the range of the CRCT will be maintained in hatcheries or in designated lake and stream refugia. Wild brood recruitment should be included in the captive broodstock management program and wild genes infused no less than once every three years to maintain genetic integrity. Distinct genomes will be preserved with local conservation and management planning efforts. A minimum of one genetically pure broodstock will be identified or developed for each GMU.

Strategy 5: Stock selected sites with progeny developed from core or conservation populations of genetically pure Colorado River cutthroat trout

Protocols for introduction, re-introduction and transplanting can be found in the genetics position paper (UDWR 2000) and have been adopted by the CRCT Conservation Coordination Team. These protocols strive to maximize genetic variability within populations, but minimize mixing of genetic types. Ecosystems selected for restoration will be stocked with an appropriate strain of CRCT determined to be genetically pure using a suite of assessment techniques. Fish will be stocked either by natural dispersal from a connected body of water, transplant of juvenile and/or adult fish from a donor water, or stocking from a hatchery source. Indigenous populations will always be considered more valuable than stocked populations as sources for restocking. Stocked populations will be considered restored when natural recruitment has sustained them for ten years.

Strategy 6: Monitor watershed conditions to detect changes

Develop meaningful standards and guidelines

Standards and guidelines for monitoring watershed management in CRCT ecosystems will be developed in concert with responsible land management agencies and followed over the long term. Develop monitoring processes designed to accurately detect changes in lake and stream habitats and watershed conditions, and consider their effects on CRCT.

Monitor lake and stream habitats to detect changes

Apply watershed-monitoring guidelines developed above consistently across the historic range of CRCT. Look for solutions to degradation by expanding management to the watershed level.

Identify instream flows, lake levels, and water quality to detect changes

Minimum instream flows and lake levels, and water quality standards will be monitored so that conditions necessary for the long term persistence of the population are maintained over the long term.

Strategy 7: Improve habitat conditions for CRCT

Manage the entire watershed

Impacts outside the riparian zone should be considered as part of CRCT management. Land management agencies should work to mitigate adverse impacts of watershed activities on water quality, instream habitat, channel morphology, riparian areas, and population stability.

Improve lake and stream habitat

Habitat improvement techniques will be used where appropriate to provide missing habitat components or improve existing ones. Examples of these techniques include building instream structures to improve pool to riffle ratios, stream bank stabilization, riparian management, instream cover, pool or spawning gravel enhancement, and provision of fish passageways.

Acquire adequate instream flows and lake levels, and meet water quality standards

All reasonable alternatives for maintaining adequate flows, pools and water quality will be used, along with purchase of private water rights and negotiations on timing, duration and volume of flows and drawdowns.

Administrative conservation activities:

Strategy 8: Implement interpretive and educational programs

Public education and awareness is critical to the conservation and restoration of CRCT. Programs designed to educate various angling and non-angling publics about the unique qualities of the species, to increase understanding and support for management activities, and to promote cooperation and communication will be established. Enlisting the help of these publics toward combating the introduction of invasive species, diseases, and illegal fish stocking is essential. Central to this strategy will be the maintenance of a dedicated web page detailing the conservation activities of the group as well as providing information on proper sanitation to help reduce the spread of whirling disease and New Zealand mud snails. In addition, linkages with local programs that allow students, anglers and others to participate in

conservation of local CRCT ecosystems will be explored.

Strategy 9: Continue to build and maintain CRCT GIS

Fish community and baseline population distribution information has been collected for watersheds where CRCT populations occur. This spatially referenced database will continue to grow and act as a repository for information regarding each population (Hirsch et al. 2005). The Conservation Team recognizes the importance of identifying entire populations of CRCT rather than individual waters that contain them as has been the case in the past. This database makes basic descriptive information, including criteria for the selection of potential restoration sites, available to the organizations involved in resource management decisions. The Conservation Team will work toward linking diverse existing habitat databases to this system as well.

Strategy 10: Continue fostering cooperative interagency work environment

Maintain effectiveness of CRCT Conservation Coordination Team

Coordination on a multi-state, multi-jurisdictional level is needed to develop and support the Conservation Strategy. The Coordination Team has fostered a team approach to CRCT management issues among the agencies signatory to the Conservation Agreement. This will be maintained by each signatory to the Conservation Agreement, with participation open to any interested person, conservation organization, tribe, or government agency not currently a signatory. Annual or bi-annual interagency Coordination Team meetings will be held to discuss plans and progress, researching findings and other issues.

Develop management teams to oversee conservation activities in each GMU

Each GMU will have a management team comprised of individuals working on CRCT issues within the drainage. Each will have representatives from the appropriate state wildlife agency, the USFS and the BLM. Other signatory agencies are encouraged to sent representatives where appropriate. Each team will have a coordinator responsible for ensuring that current information is updated annually in the CRCT GIS. Teams will meet as needed to discuss, plan and coordinate activities affecting CRCT within the GMU, as well as provide annual updates for entry the CRCT GIS. The GMU coordinators will report to the Coordination Team annually.

Communication on decisions likely to affect Colorado River cutthroat trout

A process that encourages communication between wildlife agencies and land management agencies on decisions likely to affect CRCT or their habitat will be

developed. Land management agencies agree to protect existing and potential cutthroat waters from adverse effects of other land uses and to consult with wildlife agency biologists on forest plans, permit processes, and other proposed activities to avoid or minimize potential negative impacts. Signatory agencies will ensure that their planning documents are consistent with this Strategy. Local interagency cooperation will be facilitated through CRCT Coordination Team meetings and GMU meetings. Formal comments will be undertaken through existing NEPA and forest management plan processes.

Monitor results of the Conservation Strategy

The CRCT Coordination Team will meet at least annually to report on progress toward Strategy goals and to discuss future plans. Progress will be summarized in a status assessment every five years.

Coordinate with other cutthroat conservation efforts

Many issues faced by the CRCT are common to other subspecies of cutthroat trout. Coordination Team members and the team leader should actively participate in developing efforts to coordinate on common management concerns. The Western Native Trout Initiative and National Fish Habitat Initiative are examples of developing programs that have the potential to further CRCT conservation and would benefit from the support and involvement of the CRCT Conservation Coordination Team.

Strategy 11: Evaluate and monitor land management actions

Land management decisions likely to affect CRCT populations will include both pre- and post-project evaluation and monitoring to ensure that the habitat elements for CRCT are protected. Timber management, road construction, mineral development, and their associated impacts should be analyzed and mitigated prior to implementation. In addition, impacts to CRCT populations should be evaluated in livestock grazing management planning, with a specific focus on riparian areas. Water diversions should also be closely evaluated and monitored if adverse impacts to CRCT could occur. This amounts to administrative restoration, where adverse impacts are mitigated at the plan level.

LITERATURE CITED

Bagenal, T. 1978. Methods for assessment of fish production in fresh water, 3rd edition. IBP Handbook #3, Blackwell Scientific Publications, Oxford, U.K.

Behnke, R. J. 1979. Monograph of the native trouts of the genus *Salmo* of western North America. USDA Forest Service, Rocky Mountain Region, Denver, Colorado.

Behnke, R. J. 1992. Native trout of western North America. American Fisheries Society Monograph 6.

Behnke, R. J. 2002 Trout and salmon of North America. Free Press, New York.

Behnke, R. J., and D. E. Benson. 1980. Endangered and threatened fishes of the upper Colorado River basin. Cooperative Extension Service, Colorado State University, Fort Collins. Bulletin 503A.

Behnke, R. J., and M. Zarn. 1976. Biology and management of threatened and endangered western trouts. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado. General Technical Report RM-28.

Bennett, J. R., D. A. Krieger, T. P. Nesler, L. E. Harris, and R. B. Nehring. 1996. An assessment of fishery management and fish production alternatives to reduce the impact of whirling disease in Colorado. Task Group Report. Colorado Division of Wildlife, Denver. 96pp.

Binns, N. A. 1977. Present status of indigenous populations of cutthroat trout, *Salmo clarki,* in southwest Wyoming. Wyoming Game and Fish Department, Cheyenne. Fisheries Technical Bulletin 2.

Colorado River Cutthroat Trout Conservation Task Group. 1996. Joint conservation strategy for Colorado River cutthroat for Colorado, Utah, and Wyoming. Colorado Division of Wildlife, Fort Collins, Colorado.

CRCT Task Force. 2001. Conservation agreement and strategy for Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) in the states of Colorado, Utah, and Wyoming. Colorado Division of Wildlife, Fort Collins, Colorado.

CWCB. 1996. Tabulation of instream flow water rights, January 1996. Denver, Colorado. 1p.

DeStaso, J., and F. J. Rahel. 1994. Influence of water temperature on interactions between juvenile Colorado River cutthroat trout and brook trout in a laboratory stream. Transactions of the American Fisheries Society 123:289-297.

Eiserman, F. 1958. A fisheries survey of the Little Snake River drainage. Wyoming Game and Fish Commission, Cheyenne. Fisheries Technical Report 6.

Fausch, K. D. 1988. Tests of competition between native and introduced salmonids in streams: what have we learned? Canadian Journal of Fisheries and Aquatic Sciences 45:2238-2246.

Fausch, K. D. 1989. Do gradient and temperature affect distributions of, and interactions between, brook charr (*Salvelinus fontinalis*) and other resident salmonids in streams? Physiology and Ecology Japan, Special Volume 1:303-322.

Griffith, J. S. 1988. Review of competition between cutthroat trout and other salmonids. American Fisheries Society Symposium 4:134-140.

Hirsch, C. L., T. P. Nesler, and S. Q. Albeke. 2005. Range-wide status of Colorado River cutthroat trout. (*Oncorhynchus clarkii pleuriticus*) Colorado River cutthroat trout Conservation Coordination Team Report. Craig, Colorado.

Interagency Plan. 1993. Colorado River cutthroat trout inter-agency five year management plan (1993-1997) Green River westside tributary enclave. Wyoming Game and Fish Department, Bridger-Teton National Forest, and Pinedale BLM Resource Area plan, Pinedale Wyoming.

Interagency Plan. 1994. Conservation plan for the Colorado River cutthroat trout, Little Snake River drainage, southwestern Wyoming. Medicine Bow National forest, Wyoming Game and Fish Department, and Great Divide BLM Resource Area final report, Green River, Wyoming.

Jespersen, D. M. 1981. A study of the effects of water diversion on the Colorado River cutthroat trout (*Salmo clarki pleuriticus*) in the drainage of the North Fork of the Little Snake River in Wyoming. Master's thesis, University of Wyoming, Laramie.

Langlois, D., J. Cameron, C. S. Hutchinson, M. Japhet, D. Smith, and J. Castellano. 1994. Colorado River cutthroat trout conservation strategy for southwestern Colorado. Colo. Div. of Wildl., Montrose, CO and U.S. For. Serv., Delta, CO. 42pp.

Markiw, M. E. 1992. Salmonid whirling disease. Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service, Fish and Wildlife Leaflet 17. 11pp.

Martinez, A. M. 1988. Identification and status of Colorado River cutthroat trout in Colorado. American Fisheries Society Symposium 4:81-89.

McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorksstedt. 2000. Viable salmonid populations and the recovery of Evolutionary Significant Units. U. S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-42.

Monroe, J. and J. L. Nielsen. 1994. Symposium on evolution and the aquatic ecosystem: Defining unique units in population conservation. Executive summary. American Fisheries Society, Bethesda, MD. 17 pp.

Nehring, B. 1998. Stream fisheries investigations. Special regulations evaluations. Colorado Division of Wildlife Job 2 Final Report, Fed. Aid Proj. F-237. 138 pp.

Oberholtzer, M. 1987. A fisheries survey of the Little Snake River drainage, Carbon County, Wyoming. Fish Division, Wyoming Game and Fish Department, Cheyenne. Project 5086-01-8501.

Oberholtzer, M. 1990. Current status of Colorado River cutthroat trout in the Little Snake River enclave. Fish Division, Wyoming Game and Fish Department, Cheyenne. Project 5090-28-8501.

Peterson, D. P., and K. D. Fausch. 2003. Dispersal of brook trout promotes invasion success and replacement of native cutthroat trout. Canadian Journal of Fisheries and Aquatic Sciences 60:1502-1516.

Peterson, D. P., K. D. Fausch, and G. C. White. 2004. Population ecology of an invasion: effects of brook trout on native cutthroat trout. *Ecological Applications* 14:754–772.

Quinlan, R. E. 1980. A study of the biology of the Colorado River cutthroat trout (*Salmo clarki pleuriticus*) population in the North Fork of the Little Snake River drainage in Wyoming. Master's thesis, University of Wyoming, Laramie.

Rieman, B. E. and J. D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. General Technical Report INT-302. U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 34 pp.

Simon, J. R. 1935. A survey of the waters of the Wyoming National Forest. U.S. Department of Commerce, Bureau of Fisheries, Washington, D.C.

Sealing, C., L. Ulmer, C. Cesar, J. Thompson, D. Gerhardt, and T. Fratt. 1992. Conservation plan for Colorado River cutthroat trout in northwest Colorado. Colorado Division of Wildlife-Grand Junction, White River National Forest, Routt National Forest, Roosevelt-Arapahoe National Forest, BLM Grand Junction Resource Area, BLM Craig Resource Area.

Seber, G. A. F., and LeCren, E. D. 1967. Estimating population parameters from catches large relative to the population. Journal of Animal Ecology 36:631-643.

Snyder, G. R., and H. A. Tanner. 1960. Cutthroat trout reproduction in the inlets to Trappers Lake. Colorado Department of Game and Fish, Denver. Technical Bulletin 7.

UDWR. 1997. Conservation agreement and strategy for Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) in the State of Utah. Publication No. 97-20. Utah Division of Wildlife Resources, Salt Lake City, UT. 61pp.

UDWR. 2000. Genetic considerations associated with cutthroat trout management. Publication Number 00-26. Utah Division of Wildlife Resources. Salt Lake City, Utah. 9 pp.

USDA-FS. 1997. Revised Land and Resource Management Plan, Arapaho and Roosevelt National Forests and Pawnee National Grassland. Fort Collins, CO. USDA-Forest Service, Rocky Mountain Region.

Young, M. K., tech. ed. 1995. Conservation assessment for inland cutthroat trout. General Technical Report RM-256. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61pp.