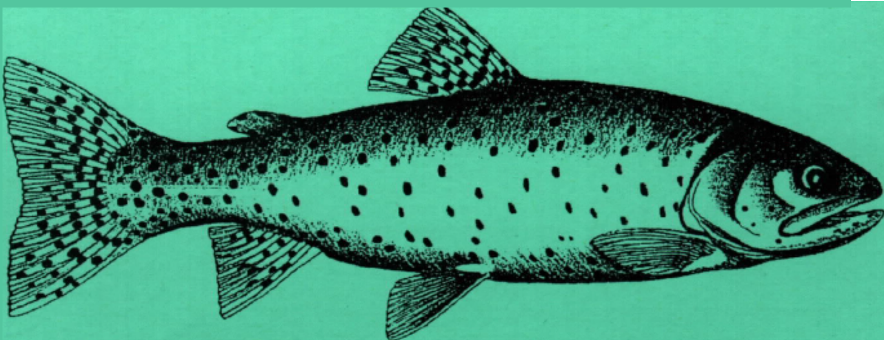
Recovery Plan

for the

Lahontan Cutthroat Trout

January 1995



U.S. Fish and Wildlife Service
Region 1
Portland, Oregon

LAHONTAN CUTTHROAT TROUT
(Oncorhynchus clarki henshawi)
RECOVERY PLAN

Prepared by
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for
Region 1
U.S. Fish and Wildlife Service
Portland, Oregon

Approved: ______________________________
Regional Director, U.S. Fish and Wildlife Service

Date: 1/30/95

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EXECUTIVE SUMMARY OF THE LAHONTAN CUTTHROAT TROUT RECOVERY PLAN

Current Status: Lahontan cutthroat trout (LCT) are listed as threatened. This subspecies is native to lakes and streams throughout the physiographic Lahontan basin of northern Nevada, eastern California, and southern Oregon. Prior to this century, eleven lacustrine populations occupied about 334,000 acres of lakes and an estimated 400 to 600 fluvial populations inhabited more than 3,600 miles of streams. Lahontan cutthroat trout currently exist in about 155 streams and 6 lakes and reservoirs in Nevada, California, Oregon, and Utah. The species has been introduced outside its native range, primarily for recreational fishing purposes. Currently LCT occupy approximately 0.4 percent of former lake habitat and 10.7 percent of former stream habitat within native range. Independence and Summit lakes support the only remaining reproducing lacustrine form of LCT within native range. Many of the fluvial LCT populations occupy isolated stream segments of larger river systems with no opportunity for natural recolonization. Both lacustrine and fluvial forms are subject to unique high risk extinction factors.

Habitat Requirements and Limiting Factors: Lahontan cutthroat trout inhabit lakes and streams and require spawning and nursery habitat characterized by cool water, pools in close proximity to cover and velocity breaks, well vegetated and stable stream banks, and relatively silt free rocky substrate in riffle-run areas. Principal threats to LCT include: Habitat loss associated with livestock grazing practices, urban and mining development; water diversions; poor water quality; hybridization with non-native trout; and, competition with introduced species of fish.

Recovery Objectives: Delisting

Recovery Criteria: Lahontan cutthroat trout will be considered for delisting when management has been instituted to enhance and protect habitat required to sustain appropriate numbers of viable self-sustaining populations. Recovery objectives protect all existing populations of LCT until research and analysis can validate population requirements by basin.

Three distinct vertebrate population segments of LCT exist: 1) Western Lahontan basin comprised of Truckee, Carson, and Walker river basins; 2) Northwestern Lahontan basin comprised of Quinn River, Black Rock Desert, and Coyote Lake basins; and 3) Humboldt River basin. These distinct vertebrate population segments may be delisted separately.

Fluvial and lacustrine adapted forms of LCT have different behavior, ecology, and habitat use. Lacustrine LCT populations occur in the Truckee, Walker, and Black Rock Desert basins. Recovery criteria necessary to delist LCT may be modified after population viability analysis has been conducted. The ecological and genetic importance of Pyramid and Walker Lakes in recovery of lacustrine LCT will be determined after research has been conducted.

Interagency cooperation will be necessary to revise, develop and implement LCT fisheries management activities. Reintroduction plans will be developed for the following basins: Truckee, Carson, Walker, Quinn, Black Rock Desert and subbasins within the Humboldt River. New populations will be considered viable when multiple age classes are present for 5 years and the population exhibits a statistically significant upward trend toward target density.

Actions Needed:

1. Identify and coordinate interagency activities to secure, manage, and improve habitat for all existing populations.
2. Revise the LCT recovery plan based on genetic, population viability, and other research.
3. Develop and implement LCT reintroduction plans.
4. Regulate LCT harvest to maintain viable populations.
5. Manage self-sustaining LCT populations existing out of native range until their need is completed.

Costs: ($1000)

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Total
1995	162	0	0	Unknown	120	282
1996	278	287	0	Unknown	181	746
1997	166	229	0	Unknown	155	550
1998	152	209	0	Unknown	90	451
1998	152	209	0	Unknown	110	471
2000	152	209	0	Unknown	90	451
2001	152	159	155	Unknown	110	576
2002	152	159	150	Unknown	90	551
2003	152	159	35	Unknown	110	456
2004	152	159	540	Unknown	90	941
2005	152	159	505	Unknown	110	926
2006	152	30	505	Unknown	90	777
2007	152	0	505	Unknown	110	767
2008	152	0	505	Unknown	90	747
2009	152	0	505	Unknown	110	767
2010	152	0	505	Unknown	90	747
2011	152	0	505	Unknown	110	767
2012	152	0	505	Unknown	90	747
2013	152	0	505	Unknown	110	767
2014	152	0	505	Unknown	90	747
2015	152	0	505	Unknown	110	767
2016	152	0	505	Unknown	90	747
2017	152	0	505	Unknown	110	767
2018	152	0	505	Unknown	90	747
Recovery Cost	3,798	1,968	7,950	Unknown	2,546	16,262

Date of Recovery: The plan should be revised by 2007 to incorperate genetic, population viability analysis, and other research. As actions described in this plan are accomplished population segments can be delisted.

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LAHONTAN CUTTHROAT TROUT
(*Oncorhynchus clarki henshawi*)

RECOVERY PLAN

PART I. INTRODUCTION

The Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) is an inland subspecies of cutthroat trout endemic to the physiographic Lahontan basin of northern Nevada, eastern California, and southern Oregon (Figure 1). It was listed by the U.S. Fish and Wildlife Service as endangered in 1970 (Federal Register Vol. 35, p. 13520) and subsequently reclassified as threatened in 1975 to facilitate management and allow regulated angling (Federal Register Vol. 40, p. 29864). There is no designated critical habitat. The species has been introduced into habitats outside its native range, primarily for recreational fishing purposes.

A. Distinct Vertebrate Population Segments

The Endangered Species Act defines "species" to include distinct vertebrate population segments. The Service, therefore, list or delist distinct vertebrate population segments of a species separately. Generally, the Service treats a population segment as a listable entity when it is isolated and separable by physiological, ecological, behavioral, or genetic factors. If a population segment is discreet, then the Service evaluates whether it is significant to the species, and whether segments are endangered or threatened.

Based on geographical, ecological, behavioral, and genetic factors presented in subsequent sections of this plan, the Service has determined that three vertebrate population segments of LCT exist: 1) Western Lahontan basin comprised of Truckee, Carson, and Walker river basins; 2) Northwestern Lahontan basin comprised of Quinn River, Black Rock Desert, and Coyote Lake basins; and 3) Humboldt River basin (Figure 1). Lake level variation in the Lahontan basin

(Benson and Thompson 1987) indicate that hydrologic connections among the three population segments were likely separated for about 10,000 years. Genetic and morphometric differentiation of LCT suggest that cutthroat trout native to the Humboldt River basin warrants formal recognition and classification as a unique subspecies of cutthroat trout. Lahontan cutthroat trout native to the Western Lahontan basin population segment adapted unique behavioral and physiological traits to inhabit lacustrine and fluvial environments. The Northwestern Lahontan basin population segment, like the Humboldt River basin population segment are primarily comprised of fluvial LCT, although one lacustrine population exists in Summit Lake. Geologic evidence also suggests that LCT may have had access between the Quinn River of the Northwest Lahontan basin population segment and the Humboldt River (Behnke 1992).

B. Description

Behnke (1979, 1992) identified three characters which separate Lahontan cutthroat trout (LCT) from other subspecies of cutthroat trout: 1) The pattern of medium-large, rounded spots, somewhat evenly distributed over the sides of the body, on the head, and often on the abdomen; 2) the highest number of gillrakers found in any trout, 21 to 28, with mean values ranging from 23 to 26; and 3) a high number of pyloric caeca, 40 to 75 or more, with mean values of more than 50. Variability in these characters forms a basis for designation of different subspecies of cutthroat trout within basins of the western United States (Behnke 1981, 1992; Trotter 1987).

Lahontan cutthroat trout typically exhibits spots on the top and sides of the head extending to the tip of the snout. Other subspecies of interior cutthroat trout usually lack spots on the head and ventral region and exhibit spots more concentrated posteriorly in the caudal peduncle area. Lahontan cutthroat trout exhibits variable spotting and

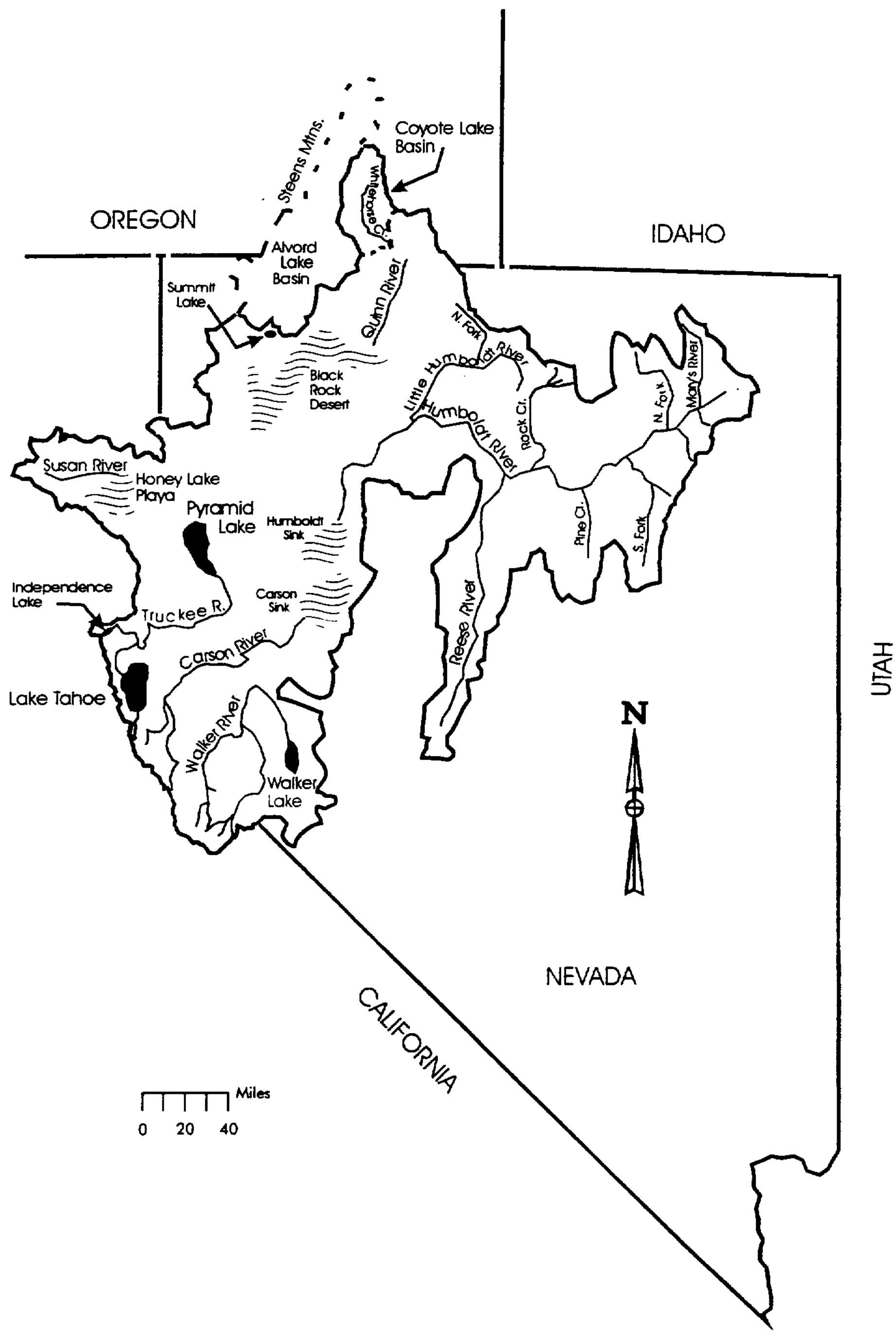

Figure 1. Lahontan cutthroat trout distribution in Lahontan and associated basins of Nevada, California, and Oregon.

color combinations within and among populations (Figure 2). The coloration is generally dull, but reddish hues may appear on the sides and cheeks. Larger stream specimens tend toward an olive-colored back with reddish sides and a silver belly. Smaller specimens do not show the distinct color change and tend to be olive and yellowish on the back and sides. Larger lake-dwelling LCT tend to have copper colored sides. The orange cutthroat slash is usually present to some degree, but yellow variations occur. The diversity in color has been suggested as another characteristic of the subspecies (La Rivers 1962). Lacustrine forms historically grew to 2 to 4 feet in length in Pyramid and Walker Lakes and had a long co-evolution with fish prey species (Behnke 1992).

Comparative meristic characters of Great Basin cutthroat trout are presented in Appendix A. Lahontan cutthroat trout typically have 60 to 63 vertebrae and 150 to 180 lateral series scales. Basibranchial teeth are generally well-developed and numerous. In Humboldt River populations, individuals typically have fewer scales on the lateral series (125 to 150 vs. 150 to 180) and fewer gillrakers (19 to 23 vs. 21 to 28) than LCT found in Carson, Truckee, and Walker River populations (Behnke and Zarn 1976; Behnke 1981, 1992; Trotter 1987). Electrophoretic and mitochondrial DNA studies support meristic and morphometric data suggesting that Humboldt River populations are divergent from those found in other basins and may be suitable for a separate subspecific designation (Williams 1991; Williams et al. 1992).

C. Distribution

Lahontan cutthroat trout were once widespread throughout the basins of Pleistocene Lake Lahontan (Figure 1). At its peak, about 14,000 years ago (Thompson et al. 1986), Lake Lahontan covered approximately 8,500 square miles and had a drainage basin of about 45,000 square miles (La Rivers 1962). Lake Lahontan fluctuated

Figure 2. Variable spotting patterns of lacustrine (top) and fluvial (bottom) Lahontan cutthroat trout (*O. c. henshawi*).

widely from about 75,000 years before present to about 8,000 years before present, but dropped rapidly about 12,000 years ago in response to climatic changes (Russell 1895; Benson 1978; Thompson et al. 1986; Benson and Thompson 1987).

Fluctuating water depths and the last desiccation of Pleistocene lakes within the Great Basin created a series of unique evolutionary characteristics in the indigenous fish fauna. Desiccation of Lake Lahontan may have effectively isolated various drainage basins. Before the last major desiccation Humboldt River fish fauna may have isolated from other major basins, causing the Humboldt cutthroat trout to adapt to fluvial conditions and differentiate morphologically (Behnke 1972, 1979, 1981, 1992; Behnke and Zarn 1976).

Gerstung (1986) indicates that in 1844 there were 11 lacustrine populations of LCT occupying about 334,000 acres of lakes, and 400 to 600 fluvial populations in over 3,600 miles of streams within the major basins of Pleistocene Lake Lahontan. With settlement of the Great Basin by non-Indians in the late 19th century, significant changes started to occur in the distribution of LCT. Diversion of water for irrigation, pollution from mining and milling operations, and long-term livestock overgrazing were some of the first impacts upon LCT. Commercial fishing on the larger lakes (Pyramid, Walker, and Tahoe) and rivers (Humboldt, Truckee, Carson, and Walker) was common. Large numbers of trout were taken for food and sometimes transported by train to markets out of the basin.

As early as the 1880s, nonindigenous salmonids were stocked in Nevada, California, and Oregon streams and lakes occupied by LCT. Townley (1980) provided an accounting of the loss of LCT from the Truckee River basin between 1844 and 1944. Similar patterns occurred in most of the major basins within the Lahontan basin. The decline of LCT and its causes have been described in the literature (Juday 1907; Snyder 1917; Sumner 1940; Wheeler 1974; Behnke 1979, 1992; Townley 1980; Coffin 1983; Knack and Stewart 1984).

Lahontan cutthroat trout currently occupy between 155 and 160 streams; 123 to 129 streams within the Lahontan basin and 32 to 34 streams outside the basin, with approximately 482 miles of occupied habitat. In addition, LCT are found in six lakes and reservoirs, including two small, wild, indigenous populations in Summit and Independence Lakes. Most LCT populations currently in the Carson, Walker, and Truckee River basins have been established in headwater reaches presumed to be upstream of historic range. Currently, self-sustaining LCT populations occur in 10.7 percent of the historic fluvial and 0.4 percent of the historic lacustrine habitats (Appendix B).

Many LCT populations are at risk of extinction within the foreseeable future. Lahontan cutthroat trout populations are impacted by: 1) degraded and/or limited habitat; 2) displacement and/or hybridization with non-native trout; 3) competition with non-native fishes; and 4) decreased viability. Evaluation of 92 fluvial populations indicate that at the time of survey, 26.1 percent (N=24) had less than 100 LCT, 30.4 percent (N=28) had 100 to 500 LCT, 14.1 percent (N=13) had 500 to 1000 LCT, 13.0 percent (N=12) had 1000 to 2000 LCT, 12.0 percent (N=11) had 2000 to 5000 LCT, 3.3 percent (N=3) had 5000 to 10000 LCT, and only 1.1 percent (N=1) had greater than 10000 LCT (Appendix C). Appendix D identifies status of LCT and associated management problems by basin.

1. Western Lahontan basin population segment

a. Truckee River basin

Lahontan cutthroat trout occurred throughout the Truckee River basin. Gerstung (1986) estimated 360 miles of stream habitat and 284,000 acres of lake habitat existed before non-Indian settlement within the basin. The largest populations of LCT occurred in Pyramid Lake and Lake Tahoe, where the fish served as a major food source for local Paiute Indians and supported important commercial fisheries for several decades (Juday 1907; Sumner 1940; Townley 1980; Knack and Stewart 1984). Before extirpation, two distinct Pyramid Lake cutthroat trout spawning migrations existed in the Truckee River, spring run "Tommies" and fall run "redfish" (Snyder 1917). Whether more than one variety of LCT was native to Pyramid Lake and Lake Tahoe has never been determined. Behnke (1979) suggested that the history of the Lahontan Basin is such that an opportunity for isolation and incipient speciation between populations in Pyramid Lake and Lake Tahoe must be recognized. Lacustrine populations also occurred in Fallen Leaf, Cascade, Donner, Independence, and Winnemucca Lakes (Gerstung 1986).

Three primary threats to LCT in the Truckee River basin developed during the 19th century -- pollution, dams, and commercial marketing. Degradation of habitat commenced in the early 1860's with logging activities (Townley 1980). Significant quantities of sawdust and wood-chips discharged from sawmills contaminated the Truckee River until the late 1890's. Until about 1930, industrial and sewage waste were dumped into the Truckee River (Sumner 1940). Regulated water discharge from dams to drive logs to sawmills, supply irrigation water for agriculture, and generate power effectively disrupted spawner migrations by creating torrential floods and abruptly drying the river. Many dams served as barriers and often great numbers of spawners were harvested in pools downstream from impassable dams. Between 1873 and 1922 approximately 100,000 to 200,000 pounds of LCT were harvested annually from Pyramid Lake and the Truckee River for commercial purposes (Townley 1980).

The Lake Tahoe LCT fishery disappeared in 1939 as a result of the combined effects of overfishing, introductions of exotic species, and damage to spawning habitat caused by pollution, logging, diversions, and barriers (Gerstung 1988). By 1944, the original Pyramid Lake LCT population was extinct (Townley 1980) as a result of Truckee River water diversion at Derby Dam for the Newlands Project, pollution, commercial harvest, and introductions of exotic species (Sumner 1940; Knack and Stewart 1984).

For several decades prior to extinction, Pyramid Lake fish were used as a primary egg source for hatchery production of LCT or "black spotted trout". Because transplants of hatchery-reared Pyramid Lake LCT were common, remnant populations may exist in a number of localities in the western United States (Trotter 1987). Recent data compiled by Nevada Division of Wildlife (NDOW) indicate that more than 11.5 million Pyramid Lake LCT were planted in Nevada from 1905 - 1925. Sixty percent of these fry-fingerling LCT were stocked back into the Truckee River and may have contributed to continuation of the LCT runs from Pyramid Lake for three decades after completion of Derby Dam in 1905. Nearly 1.75 million of these LCT were stocked in the Humboldt River and its tributaries, and 1.3 million were stocked in the Carson River system in Nevada (Jim Curran, 1992, NDOW, personal communication).

In 1960, LCT populations in the Truckee River basin were limited to Pole Creek, Pyramid Lake, Independence Lake, and its tributary Independence Creek. Stream populations existing in West Fork Gray, Hill, Deep Canyon, and Bronco Creeks, and a reintroduction into Pole Creek were started through stocking in the 1980's, while the Upper Truckee River, an upstream tributary to Lake Tahoe, was established in the early 1990's. Except for the Upper Truckee River, LCT reintroduced into streams of the Truckee River basin are of Macklin Creek origin, a population situated outside the Lahontan basin, which presumably was derived from the Lake Tahoe LCT strain (Gerstung 1986). Lahontan cutthroat trout reintroduced into the Upper Truckee River were derived from the Independence Lake strain reared in Heenan Lake, Alpine County, California (Eric Gerstung, 1993, California Department of Fish and Game, personal communication). Currently, seven stream populations occupy about 8 miles of habitat comprising approximately 2.2 percent of the historic stream distribution (Appendix B).

Independence Lake in Sierra County, California, has the only self-sustaining lacustrine LCT Truckee River population. This 700 surface-acre lake located in the Little Truckee River basin supports a small catch-and-release fishery and represents approximately 0.2 percent of the historic lake habitat (Appendix B). Independence Lake once supported spawning runs of 2,000 to 3,000 fish (Welch 1929). Numbers declined to less than 100 spawners per year by 1960 (Gerstung 1988), even though there were numerous attempts to augment this population with hatchery-reared native Independence Lake LCT stock. Competition with non-native salmonids, particularly kokanee salmon (*O. nerka kennerly*) in the lake and brook trout (*Salvelinus fontinalis*) in the stream are believed to be responsible for the decline.

Following extinction of Pyramid Lake LCT in the 1940's, hatchery stocking developed a popular sport fishery at the lake. Until the 1980's four strains of LCT (e.g. Heenan, Walker, Summit, and Independence Lakes) were used for stocking into Pyramid Lake (Coleman and Johnson 1988). Since the early 1980s LCT eggs have been taken almost exclusively from Pyramid Lake spawners and reared for release.

Buchanan (1987) indicated that limited water resources, resulting in poor spawning and rearing habitat in the lower Truckee River, currently preclude even occasional achievement of the minimum flow required for LCT to reproduce and rear in the lower reaches of the river. Riverine conditions that could be provided would cause high egg mortality in May, and fry would be forced out of the river in July. He estimated it would take 478,500 acre-feet of water annually to provide suitable spring spawning habitat in the lower Truckee River for LCT. Some of these flows could be provided concurrently with cui-ui (*Chasmistes cujus*) spawning flows in the lower Truckee River, but LCT would need these flows on nearly an annual basis to maintain population abundance, while cui-ui survive with flows on an irregular basis over a period of years. It would also take much larger flows during May, June, and July to meet LCT spawning needs than are required for cui-ui spawning.

A fish ladder around Derby Dam would improve fish passage and provide access to upstream spawning habitat. Passage flows to the upper river reaches during the spring would not require as much water; however, screens on diversions and adequate river flows would be necessary in the summer for successful return of newly-hatched trout to Pyramid Lake. Passage past Derby Dam does not resolve all spawning problems for LCT in the Truckee River system. Truckee River tributaries where LCT historically spawned now have dams and introduced species of salmonids which reduces the potential for reestablishment of LCT in the entire river basin.

Water in Stampede Reservoir was dedicated to cui-ui and LCT in 1976. In 1982 the U.S. District Court for the District of Nevada affirmed a U.S. Fish and Wildlife Service (FWS) management strategy to prioritize the water for the benefit of the Pyramid Lake fishery until such time as the cui-ui and LCT are no longer classified as endangered or threatened, or until sufficient water becomes available from other sources to conserve the cui-ui and LCT (USFWS 1992). An ecosystem management plan should be completed for the Truckee River basin to evaluate water availability and use for all species in the basin, and Pyramid Lake resources should be an important component of that plan.

b. Carson River basin

Historic LCT distribution in the Carson River basin included most of the drainage downstream from Carson Falls, California, on the East Fork, and Faith Valley, California, on the West Fork. Gerstung (1986) estimated that at least 300 miles of cold water stream habitat within the Carson River subbasin was used by LCT. No long-term lacustrine population existed except during extremely wet cycles when Carson Sink was inundated. West Fork Carson River LCT were stocked into Blue Lakes in 1864 and later into Heenan Lake (Gerstung 1988). Dams and diversions, introductions of exotic salmonids, channelization, and other uses of water within this basin have significantly changed the habitat available for LCT this century.

Native, self-sustaining LCT populations no longer occupy historic habitat within the Carson River basin (Gerstung 1986, 1988). Currently, small populations have been introduced into six formerly unoccupied headwater streams of the Carson River: East Fork Carson River, Murray Canyon, Poison Flat, Raymond Meadows, Golden Canyon, and Heenan creeks. These small populations were derived by transplanting endemic LCT beyond barriers or by stocking hatchery-reared LCT predominately of Carson River origin (Gerstung 1988). Extrapolated data from Gerstung (1986) indicate LCT occupy about 9 miles of habitat comprising 3.0 percent of historic range in the Carson River basin (Appendix B).

c. Walker River basin

Within the Walker River basin, LCT occurred in Walker Lake and its tributaries upstream to Pickle Meadows, California, in West Fork Walker River, and upstream to Bridgeport Valley, California in East Fork Walker River. About 360 miles of stream habitat and 49,400 acres of lake habitat were occupied, with Walker, Upper-, and Lower-Twin Lakes supporting the only lacustrine populations (Gerstung 1986). Walker Lake was commercially fished and provided subsistence fishing for local Paiute Indians (Sevon 1988). Spawning runs of LCT began to diminish as early as 1860 with the development of agriculture in Smith and Mason valleys. The construction of Weber Dam in 1933 blocked runs from Walker Lake, although some limited natural reproduction may have occurred downstream from Weber Reservoir until 1948 when the last large LCT were seined from the river and used as broodstock (Sevon 1988). Water diversions for irrigation also caused a concurrent decline in lake elevations and an increase in alkalinity and total dissolved solids. This change in water quality has reduced species diversity in the lake. Currently, LCT is the only salmonid capable of surviving in Walker Lake, and its future is uncertain if water quality continues to deteriorate (Sevon 1988).

The Walker River basin supports five populations of LCT. The only endemic population occurs in By-Day Creek, a small tributary to the

East Walker River in California. The other four populations were introduced in Murphy, Mill, Slinkard, and Bodie Creeks (Eric Gerstung, 1992, California Department of Fish and Game, personal communication). Extrapolated data from Gerstung (1986) indicate LCT occupy 11 miles of suitable habitat in these five streams comprising 3.1 percent of historic range within the subbasin (Appendix B).

A sport fishery has been maintained in Walker Lake since the early 1950's with progeny of LCT broodstock raised in state and Federal hatchery programs. The fishery faces an uncertain future due to the general decline in lake level and associated increase in total dissolved solids and other water quality problems (Koch et al. 1979; Sevon 1988). Walker Lake's current average annual water deficit is about 60,000 acre-feet, with an evaporation loss of about 148,000 acre-feet per year. Nevada Division of Wildlife has acquired state water rights for flows to support Walker Lake levels. The water right has a 1970 priority date which is junior to most other water rights on the river system, therefore, water is not available to the lake during many years. Furthermore, Weber Reservoir precludes the migration of any LCT up the river to suitable trout spawning habitat when water does reach the lake. Lahontan cutthroat trout are the only salmonid capable of surviving the high water temperatures, alkalinity, salinity, and other chemical constituents of the lake water (Sevon 1988). Walker Lake will continue to recede unless water management practices are changed upstream. An ecosystem management plan should be completed for the Walker River basin to evaluate water availability and use for all species, and Walker Lake resources should be an important component of that plan.

d. Honey Lake basin

Honey Lake basin lies about 35 miles northwest of Pyramid Lake in Lassen County, California. The basin is isolated with no recent connection to the Lahontan basin (La Rivers 1962). Lahontan cutthroat trout probably occurred in the Honey Lake drainage before settlement during the mid-1800's. An account by a settler (John A. Dreibelbis) in 1853 reported that "mountain trout" were abundant in Susan River (Hutchings 1857) upstream from Honey Lake before any recorded introduction or transplant (Gerstung 1988). Lahontan cutthroat trout were collected from Susan River in 1915 (Snyder 1917); however, Gerstung (1988) noted that these fish possibly originated from introductions commencing in 1904. No LCT currently occur within the Honey Lake basin, although the basin does have other Lahontan basin fish fauna. The origin and history of Lahontan basin fish fauna present in Honey Lake basin is unknown. Gerstung (1986) estimated that about 150 miles of suitable cold water stream habitat formerly existed in the Honey Lake drainage.

There are no known populations of LCT remaining in this basin, nor is there any suitable transplant habitat available.

2. Northwestern Lahontan basin population segment

a. Quinn River/Black Rock Desert basin

Lahontan cutthroat trout may have occupied many cold water stream habitats associated with the Black Rock and Smoke Creek Deserts of north-central Nevada, including the Quinn River. This major drainage for the Black Rock Desert had a connection with the Pyramid Lake basin during the period of Pleistocene Lake Lahontan and possibly also through the Humboldt River basin (Russell 1895). The historic range of LCT in Quinn River is unclear because of undocumented trout introductions and transfers throughout the basin starting as early as 1873 (French and Curran 1991). There may have been as many as 46 streams occupied by LCT (French and Curran 1991) with 386 miles (includes Summit Lake drainage) of cold water stream habitat within this area of Nevada and Oregon (Gerstung 1986, 1988).

One isolated lacustrine population remains in Summit Lake immediately north of the Black Rock Desert. Summit Lake has a complex hydrologic history (Mifflin and Wheat 1979; Curry and Melhorn 1990), and may support a remnant LCT population derived from founders that transmigrated from Alvord and/or Lahontan basins. Lahontan cutthroat trout from the Summit Lake basin electrophoretically resembles LCT living in the subbasins of former Lake Lahontan (Loudenslager and Gall 1980; Cowan 1988). Curry and Melhorn (1990) suggested that geologic mechanisms forming the Summit Lake basin coupled with pluvial conditions could allow fish transfer between the Alvord and Lahontan basins before hydrologic connections to the Lahontan basin were severed by a landslide. The Summit Lake landslide is estimated to have occurred between 7,840 and 19,000 years ago and may have occurred during a high stage of Lake Lahontan about 12,500 years ago (Curry and Melhorn 1990).

Lahontan cutthroat trout may occur in 15 streams occupying about 58.0 miles of habitat in Nevada and Oregon (Appendix E). This includes 4 streams in the Black Rock Desert portion of the system and 11 small streams in the Quinn River portion. The streams in the Quinn River portion contain small remnant populations isolated in headwater reaches (French and Curran 1991). Some of these populations may have gone extinct from the recent drought in 1987 - 1994 (Jim French, 1992, NDOW, personal communication). Data extrapolated from Gerstung (1986) and files maintained by NDOW and Oregon Department of Fish and Wildlife (ODFW) indicate LCT may occupy 15 percent of historic stream habitat and 100 percent of existing historic lake habitat within the subbasin (Appendix B). Indiscriminate introductions of non-native trout (rainbow, brown, and brook) and excessive livestock and feral horse grazing on riparian habitat appear to be the primary causes for decline in the distribution and abundance of LCT within the Quinn River/Black Rock Desert basin (French and Curran 1991).

The largest self-sustaining lacustrine population of LCT in the Lahontan Basin occurs in Summit Lake and its tributary streams, located on the Summit Lake Indian Reservation. This population has declined since 1981 (Cowan 1990), attributed in part to interactions between LCT and non-native Lahontan redside shiners (*Richardsonius* *egregius*) that became established in the early 1970s (USFWS 1977; Cowan 1983; Cowan and Blake 1989), lake water quality (Hilton 1983; Vigg 1983; Cowan 1984), and access up and down Mahogany Creek for spawning and return of migrants to the lake (USFWS 1977; Cowan 1982).

b. Coyote Lake basin

Coyote Lake basin, a small arid drainage north of and adjacent to the Quinn River subbasin, may have had more than 60 miles of cold water stream habitat for trout. One small ephemeral lake, Coyote Lake, provided lacustrine habitat during wet cycles (Trotter 1987). Hydrologic linkage between pluvial basins in the region have yet to be sufficiently examined to confirm access routes by founding LCT populations. Hubbs and Miller (1948) believed that this basin was connected to the Alvord basin during pluvial times and in recent times during floods.

The only native trout found in the Coyote Lake basin is the cutthroat trout (Behnke 1992). Recent electrophoretic and mitochondrial DNA (mtDNA) analysis confirm that Coyote Lake basin cutthroat trout are genetically indistinguishable from LCT (Williams 1991; Williams et al. 1992). Several theories have been proposed to explain the origin of LCT in the Coyote Lake basin. A preliminary theory by Behnke and Zarn (1976) suggested that the Coyote Lake basin cutthroat trout originated by a headwater stream capture from the Humboldt River system. In a subsequent theory, Behnke (1979, 1981) proposed an origin from headwater transfer from the Trout Creek drainage of the Alvord basin. Trotter (1987) discussed two other ways LCT may have entered the basin: 1) By an ancestral cutthroat trout transmigration directly into the Coyote Lake basin via Crooked Creek, the Owyhee River, and the Snake River; or 2) by headwater stream transfer from the Quinn River drainage. In light of new information, Behnke (1992) has refined his earlier theory and now favors an origin from a Quinn River headwater stream transfer that occurred before the unique Humboldt cutthroat trout evolved. During this period it is speculated that the Humboldt River may have flowed to the Quinn River before changing course to its present terminus in the Humboldt sink. Others have speculated that LCT were introduced by humans into the Coyote Lake basin from the Quinn River basin.

Small populations of LCT occur in 10 streams and headwater tributaries in this basin: Willow, Whitehorse, Doolittle, Fifteen Mile, Twelve Mile, Antelope, Cottonwood, and Little Whitehorse Creeks, and one unnamed tributary to both Whitehorse and Willow Creeks (Perkins et al. 1991; Hanson et al. 1993). Total occupied habitat is approximately 57 miles which represents most of the available habitat.

3. Humboldt River Basin Population Segment

a. Humboldt River basin

Cutthroat trout historically occurred in the Humboldt River and at least 10 of its major subbasins. Coffin (1983) estimated 2,210 miles of cold water stream habitat occurred within the Humboldt River basin prior to settlement during the mid-1800's. Lahontan cutthroat trout are known to have occurred in the following subbasins or areas: Marys River; East Humboldt River area; South Fork Humboldt River; North Fork Humboldt River; Maggie Creek; Pine Creek; Rock Creek; Reese River; and Little Humboldt River. There were no lacustrine populations in this basin after the desiccation of Lake Lahontan.

Several subbasins downstream from Carlin, Nevada may have been disjunct from the Humboldt River during drier cycles causing some LCT populations to be isolated. The Humboldt River basin upstream of Carlin probably provided continuous LCT habitat which allowed population intermixing throughout the system during cool, wet cycles. Behnke (1981, 1992), Williams (1991), and Williams et al. (1992) believed that the Humboldt River race of LCT is a distinct subspecies.

The Humboldt River basin supports the greatest number of fluvial LCT populations native to the Lahontan Basin. Within the Humboldt River basin, LCT occur in 83 to 93 streams and approximately 318 miles of riverine habitat (Appendix B), or about 14 percent of the historic habitat. Most populations occur within eight subbasins of the Humboldt River basin. The Marys River subbasin has the most potential for a metapopulation structure where the presence of several interconnected subpopulations increases the probability of survival during periods of restriction and hardship. North Fork Humboldt River, Maggie Creek, Rock Creek, and the South Fork Little Humboldt River provide limited metapopulation habitat because of seasonal flow and water quality problems. The East Fork Humboldt River area, South Fork Humboldt River, North Fork Little Humboldt River, and Reese River have isolated populations which are subject to local extinctions caused by hybridization with non-native salmonids and loss of habitat from land-use problems.

Decline in LCT populations within the Humboldt River basin is attributed to stream diversions, degradation of water quality, grazing, and displacement by and hybridization with introduced salmonids. Lahontan cutthroat trout have been displaced by other trout species in more than 95 percent of the streams on the west side of the Ruby Mountains, which encompasses the best salmonid habitat within the Humboldt River basin (Coffin 1983). Many populations in subbasins where only LCT occur are depressed because of other causes listed above.

4. Populations outside Lahontan basin

Lahontan cutthroat trout, like many other fish species, were widely stocked outside their native range. A number of lake-dwelling LCT populations occur in western states that were introduced for recreational fishing purposes and are supported by hatchery stocking programs. Eleven waters in Nevada, nine in Oregon, four in Utah, and nine in California currently support introduced LCT populations. All are small streams and/or headwater tributaries except for one small pond in Utah. Most of the California populations were established between 1893 and 1938 when millions of fry derived from LCT spawners trapped in Lake Tahoe tributaries were planted in waters throughout California (Behnke 1979). The small population in O'Harrel Creek, California is one of only a few genetically pure Walker Lake basin stocks. Many populations in Nevada and Utah probably were started by early plants of Pyramid Lake cutthroat trout that were sent throughout Nevada until the diminishing populations in Pyramid Lake ended this activity (La Rivers 1962; Gerstung 1988). In addition, Miller and Alcorn (1946) reported that early ranchers transplanted LCT from the Reese River drainage to streams in the nearby Toquima Range and on the east slope of the Toiyabe Range. Many other waters were stocked in the same manner. Oregon populations in the Pueblo Mountains and the east side of the Steens Mountains in the Alvord basin were introduced from the Coyote Lake basin and could be considered reintroductions back into historic species range, although they do not represent the original Alvord basin strain of LCT.

D. Life History

1. Habitat

Historically, LCT were found in a wide variety of cold-water habitats: Large terminal alkaline lakes (e.g., Pyramid and Walker Lakes); oligotrophic alpine lakes (e.g., Lake Tahoe and Independence Lake); slow meandering low-gradient rivers (e.g., Humboldt River); moderate-gradient montane rivers (e.g., Carson, Truckee, Walker, and Marys Rivers); and small headwater tributary streams (e.g., Donner and Prosser Creeks).

Generally riverine LCT inhabit small streams characterized by cool water, pools in close proximity to cover and velocity breaks, well vegetated and stable stream banks, and relatively silt free, rocky substrate in riffle-run areas. Fluvial LCT generally prefer rocky areas, riffles, deep pools, and habitats near overhanging logs, shrubs, or banks (McAfee 1966; Sigler and Sigler 1987).

Lahontan cutthroat trout inhabiting small tributary streams within the Humboldt River basin can tolerate temperatures exceeding 27°C (80°F) for short periods of time and daily fluctuations of 14 to 20°C (25 to 35°F) (Coffin 1983; French and Curran 1991). Intermittent tributary streams are occasionally utilized as spawning sites by LCT, and in good water cycles fry develop until flushed into the main stream during higher runoff (Coffin 1981; Trotter 1987).

Lacustrine LCT populations have adapted to a wide variety of lake habitats from small alpine lakes to large desert waters. Unlike most freshwater fish species, some LCT tolerate alkalinity and total dissolved solid levels as high as 3,000 mg/L and 10,000 mg/L, respectively (Koch et al. 1979). Galat et al. (1983) indicated that LCT will develop slight to moderate hyalin degeneration in kidney tubules in lakes where total dissolved solids and sulfates equal or exceed 5,000 mg/L and 2,000 mg/L, respectively. This ability to tolerate high alkalinity prompted introductions of LCT into saline-alkaline lakes in Nevada, Oregon, and Washington for recreational purposes (Trotter 1987). Walker Lake, Nevada is the most saline-alkaline water maintaining a LCT sport fishery. In Walker Lake, total alkalinity exceeded 2,800 mg/L HCO_3 in 1975 and total dissolved solids exceeded 11,000 mg/L in 1982 (Sevon 1988).

2. Reproduction

Typical of cutthroat trout subspecies, LCT is an obligatory stream spawner. Spawning occurs from April through July, depending on stream flow, elevation, and water temperature (Calhoun 1942; La Rivers 1962; McAfee 1966; Lea 1968; Moyle 1976). Females mature at 3 to 4 years of age, and males at 2 to 3 years of age. Consecutive-year spawning by individuals is uncommon. King (1982) noted repeat rates of 3.2 and 1.6 percent for LCT spawners returning in subsequent migrations 1 and 2 years later. Cowan (1982) noted post-spawning mortality of 60 to 70 percent for females and 85 to 90 percent for males, and spawner repeat rates of 50 and 25 percent for surviving females and male spawners, respectively. Others (Calhoun

1942; Lea 1968; Sigler et al. 1983) observed that most repeat spawners return after 2 or more years.

Fecundity of 600 to 8,000 eggs per female has been reported for lacustrine populations (Calhoun 1942; Lea 1968; Cowan 1983; Sigler et al. 1983). By contrast, only 100 to 300 eggs were found in females collected from small Nevada streams (Coffin 1981). Fecundity and egg size are positively correlated with length, weight, and age (Sigler et al. 1983).

Lake residents migrate up tributaries to spawn in riffles or tail ends of pools. Distance traveled varies with stream size and race of cutthroat trout. Populations in Pyramid and Winnemucca Lakes reportedly migrated over 100 miles up the Truckee River into Lake Tahoe (Sumner 1940; La Rivers 1962).

Spawning behavior of LCT is similar to other stream-spawning trout. They pair up, display courtship, lay eggs in redds dug by females, and chase intruders away from the nest. Lahontan cutthroat trout generally spawn in riffle areas over gravel substrate.

Lahontan cutthroat trout spawning migrations have been observed in water temperature ranging from 5 to 16°C (41 to 61°F) (Lea 1968; USFWS 1977; Sigler et al. 1983; Cowan 1983). Lahontan cutthroat trout eggs generally hatch in 4 to 6 weeks, depending on water temperature, and fry emerge 13 to 23 days later (Calhoun 1942; Lea 1968; Rankel 1976). Progeny of Summit Lake LCT spawners generally begin moving out of spawning tributaries shortly after emergence (Cowan 1991). Fry movement is density-dependent and correlated with fall and winter freshets (Johnson et al. 1983). Some fluvial-adapted fish remain for 1 or 2 years in nursery streams before emigrating in the spring (Rankel 1976; Johnson et al. 1983; Coffin 1983).

3. Food habits

Stream resident LCT are opportunistic feeders, with diets consisting of drift organisms, typically terrestrial and aquatic insects (Moyle 1976; Coffin 1983). In lakes, small LCT feed largely on insects and zooplankton (Calhoun 1942; McAfee 1966; Lea 1968), and larger LCT feed on fish. In Pyramid Lake fish enter the diet when LCT reach 200 millimeters (mm) in length, comprise over 50 percent of the diet at 300 mm, and fish represent almost 100 percent of the diet when LCT are over 500 mm (Sigler et al. 1983). Invertebrates are the major food source for all sizes of LCT in a few lakes, presumably because potential prey fishes never existed, or inhabit different areas than trout (Calhoun 1942; Rankel 1976).

4. Growth and longevity

Lahontan cutthroat trout growth rate is variable, with faster growth occurring in larger, warmer waters, and particularly where forage fish are utilized. Mean fork lengths for Pyramid Lake LCT were 217, 291, 362, and 431 mm at ages 1, 2, 3, and 4 years, respectively (Sigler et al. 1983). By contrast, LCT mean fork lengths from the small oligotrophic Blue Lake in California, were 66, 180, 307, and 378 mm for ages 1, 2, 3, and 4 years, respectively (Calhoun 1942).

Growth rates for stream dwelling LCT are fairly slow. Mean fork lengths of LCT from six Sierra Nevada streams averaged 89, 114, 203, and 267 mm at ages 1, 2, 3, and 4 years, respectively (Gerstung 1986). Stream-dwelling LCT are generally less than 5 years of age. In lakes, LCT may live 5 to 9 years (Sumner 1940; Lea 1968; Rankel 1976; Coleman and Johnson 1988).

5. Taxonomic Status

The cutthroat trout is a native polytypic species which is distributed widely throughout the basins and drainage systems of western North America (Behnke 1979, 1992; Trotter 1987). The distribution and differentiation of cutthroat trout is believed to have been influenced by Pleistocene volcanism and glaciation (Loudenslager and Thorgaard 1979).

Systematics of all inland cutthroat trout subspecies are based principally on morphologic and zoogeographic studies (Behnke 1972, 1992; Smith 1978). These studies documented approximately 14 geographic forms of cutthroat trout, but failed to clearly resolve taxonomic relationships, since variation within groups frequently was as high as variation among groups.

Chromosome karyotyping (Loudenslager and Thorgaard 1979) and protein electrophoresis (Loudenslager and Gall 1980; Gall and Loudenslager 1981; Leary et al. 1987; Bartley and Gall 1989) have been applied to the taxonomy of the cutthroat trout complex. Electrophoretic analysis not only increases discrimination between populations over that provided by morphology, but also provides a definitive means of identifying rainbow-cutthroat trout hybridization not always possible using morphological characters that can be influenced by environmental effects (Busack and Gall 1981; Leary et al. 1984; Campton and Utter 1985). Recently, mtDNA haplotypes have been used to help clarify taxonomic relationships (Williams 1991; Williams et al. 1992).

While morphological studies have identified as many as 14 subspecies of cutthroat trout (Behnke 1979, 1992; Trotter 1987), electrophoretic work distinguishes only four major groups; coastal, Lahontan, Yellowstone, and west-slope (Leary et al. 1987; Allendorf and Leary 1988; Williams 1991; Williams et al. 1992). Trout that make up the Lahontan subgroup consist of: Lahontan, Humboldt, Paiute, Coyote Lake, and Alvord.

Ongoing genetic studies contracted by NDOW since 1976 on cutthroat trout populations within the Lahontan Basin including the Humboldt River, Quinn River, Coyote Lake, Carson River, Walker River, and Truckee River subbasins exhibit low genetic divergence and support a common origin (Loudenslager and Gall 1980; Bartley and Gall 1989; Williams 1991; Williams et al. 1992). The genetic divergence within the Lahontan group appears to be approximately an order of magnitude less than divergence among subspecies within the Yellowstone group (Williams 1991). Of the Lahontan basin groups, the Humboldt cutthroat trout was the most divergent based on morphology, mtDNA, and allozyme analyses (Hickman 1978; Behnke 1979, 1992; Loudenslager and Gall 1980; Busack and Gall 1981; Bartley and Gall 1989; Williams 1991; Williams et al. 1992). Behnke (1979, 1992) suggested that the Humboldt River basin cutthroat trout probably became isolated before the final desiccation of Lake Lahontan, and became better adapted to living in a fluvial environment than lacustrine cutthroat trout in the western Lahontan basin.

Origin of LCT in the Quinn River, Black Rock Desert, Alvord and Coyote Lake subbasin LCT is unanswered. With the exception of Summit Lake, the Northwestern Lahontan basin population segment represents an assemblage of fluvial adapted LCT populations that could have originated from any of several sources as discussed earlier. The ecology of the Northwestern Lahontan basin population segment is more similar to the Humboldt River basin than the Western Lahontan basin. Genetic data are needed to determine if existing lacustrine populations represent distinct population segments.

Although the Lahontan basin cutthroat trout populations are genetically similar, subtle differences among populations in different subbasins have been detected (Bartley and Gall 1989; Williams 1991; Williams et al. 1992). Electrophoretic and mtDNA techniques detect only a small percentage of the genetic material in individuals and populations. A comparison of meristic data illustrates the variability of LCT within their native range (Appendix A).

E. Reasons for Decline

Settlement of the west in the mid-1800's has dramatically changed the water-flow patterns of all major western river systems including those in the Lahontan basin. It is doubtful that there are any streams in the Lahontan basin that have not been significantly altered directly or indirectly by human activities (Walstrom 1973). This has resulted in degradation of virtually all habitats occupied by native trout species.

Major impacts to LCT habitat and abundance include: 1) Reduction and alteration of stream discharge; 2) alteration of stream channels and morphology; 3) degradation of water quality; 4) reduction of lake levels and concentrated chemical components in natural lakes; and 5) introductions of non-native fish species. These alterations are typically associated with agricultural use, livestock and feral horse grazing, mining, and urban development. Alteration and degradation of LCT habitat have also resulted from logging, highway and road construction, dam building, and the discharge of effluent from wastewater treatment facilities. All these factors reduce the suitability of streams for trout (Chapman and Knudsen 1980; Van Hassel et al. 1980).

The physical characteristics of many streams in the Lahontan basin have been affected by grazing activities. Concentrations of livestock in the riparian area causes alteration of riparian areas, loss of undercut banks and other cover, exposed stream channels, increased silt loads, wider and shallower streams which ultimately causes elevated water temperatures during the summer, and colder temperatures during the winter. Lacustrine habitat has been altered by construction of dams and diversions, pollution, reduced spawning flows, desiccation of lakes, and introduction of exotic fish species.

Prior to the middle of the nineteenth century only native fish species inhabited waters within the Lahontan basin. Lahontan cutthroat trout are well-adapted to the harsh physical environment of its diverse natural habitats, but less able to cope with the impacts discussed above. Non-native rainbow, brook, and brown trout have become established in all the basins inhabited by LCT (Miller and Alcorn 1946), causing the loss of many LCT populations. A survey of Humboldt National Forest indicate that many LCT streams were stocked with non-native trout before 1934 (Durrant 1935). Within the Ruby Mountains in the upper Humboldt River basin, more than 95 percent of the LCT populations have been lost because of displacement by other trout species (Coffin 1983). Introduced fall spawning salmonids may have an advantage over spring spawning LCT because altered watersheds provide poor habitat with such conditions as excessive turbidity, limited spawning gravel, and high flows. Furthermore, nursery habitat during the summer may be impacted by rapidly increasing water temperatures, and drying of stream segments important for fry survival. As pointed out by Garcia (1990), habitat improvement without the removal of non-native salmonids could impact LCT populations through hybridization and displacement. Removal of these introduced trout and reintroduction of LCT is a recovery task identified for several basins.

Lahontan cutthroat trout in the Humboldt River appears to be more resistant to hybridization with rainbow trout, possibly due to distinct spawning requirements. Mixed populations of LCT and non-native salmonids occur in over 23 tributaries to the Humboldt River (Coffin 1983). Ten of these streams support rainbow trout with introgression documented in only three (Loudenslager and Gall 1980). The magnitude of hybridization within the Humboldt River subbasins has not been fully evaluated. Lahontan cutthroat trout populations in the North Fork Little Humboldt River subbasin and the Quinn River system are more frequently impacted by hybridization with rainbow trout than other basins.

A significant portion of LCT habitat occurs on public lands administered by the U.S. Forest Service (USFS) and U.S. Bureau of Land Management (BLM). Within the Humboldt River basin, 67 percent of LCT streams flow through some USFS lands and 49 percent flow through BLM lands. Private land also exists on approximately 77 percent of LCT streams within the Humboldt River basin, mostly below USFS lands, but sometimes within USFS administered lands. In many areas all three types of land ownership traverse a single stream (Coffin 1983). Livestock grazing is the primary land use on these public lands, although mining is increasing as a land use within some subbasins. Stream habitat surveys conducted by NDOW between 1977 and 1991 of all LCT streams in Nevada indicated that most of these waters had been significantly impacted by livestock grazing and in some areas by feral horse use.

Unrestricted livestock grazing often exceeded the carrying capacity of the range, especially in fragile riparian areas (Chaney et al. 1990). During summer and early fall months, riparian areas are often heavily grazed because of lush plant growth, a cooler microclimate, cover, and proximity to water. Numerous studies have shown that, in stream sections where grazing use is reduced, production of trout numbers and biomass increase substantially (Gunderson 1968; Bowers et al. 1979; Chapman and Knudsen 1980; Stuber 1985; Crispin 1981; Chaney et al. 1990). Five study areas showed an average increase of 184 percent in fish production when livestock were removed or use decreased (Bowers et al. 1979).

E. Recent Conservation Measures

Four acts of Congress offer authority to implement conservation measures for LCT. Conservation and protection of LCT are mandated by the Endangered Species Act (ESA) of 1973, as amended in 1988. Section 2 of the ESA declares it the policy of Congress that all Federal departments and agencies shall seek to conserve endangered and threatened species and shall utilize their authorities in furtherance of the purposes of the ESA. Section 7 of the ESA requires Federal agencies to insure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or modify their critical habitat. Cooperation with the States to conserve, manage, and regulate take of LCT, is authorized by section 6 of the ESA, which allows regulated fishing for LCT. Public Law 101-618 (Title II. Truckee-Carson-Pyramid Lake Water Settlement Act), section 207 (a), directs the Secretary of Interior to expeditiously revise, update, and implement plans for the conservation and recovery of cui-ui and LCT. The National Forest Management Act of 1976 and the Federal Land Policy and Management Act of 1976 are respective organic acts of the USFS and BLM which afford conservation of LCT through multiple resource management.

Conservation measures implemented to improve the status of LCT include: 1) Transplants; 2) extensive population survey and habitat inventory; 3) genetic evaluation; 4) habitat improvement activities; 5) changes in grazing practices; 6) riparian fencing and exclosures; 7) land exchanges to secure important habitat; 8) fishing regulation and season closures; and 9) fishery management plans for several basins and subbasins. Some of these conservation measures were initiated to enhance LCT status before the species was listed under the authority of the ESA.

Since 1963 LCT have been transplanted to 56 streams, including 32 reintroductions within native range. Fifteen of these are now established populations. Outside the native range 24 introductions were made, of which 14 are self-sustaining. Introduction of LCT outside its native range may exacerbate problems with native species in those basins and should only be considered after full evaluation of impacts on other species.

In 1977 a cooperative interagency stream survey project was initiated by NDOW and BLM. In 1978 USFS joined the stream survey project. This cooperative project centered around evaluation of LCT distribution, status, and habitat condition (Coffin 1988). Through 1989 surveys have been completed on more than 625 waters in the state of Nevada, both in and out of the Lahontan basin. Individual stream survey reports are in databases maintained by NDOW, ODFW, California Department of Fish and Game (CDFG), and Utah Division of Wildlife Resource (UDWR).

Investigation of the biochemical genetics and systematics of Nevada trout populations by NDOW and the Department of Animal Science, University of California, Davis, was initiated in 1976 with samples of Walker Lake LCT. Primary objectives were to identify whether populations of LCT were pure or hybridized with introduced species (Coffin 1988). Additional objectives of these genetic studies were to: 1) Determine if different subspecies and stocks of cutthroat trout could be distinguished by biochemical genetic methods; 2) quantify the genetic divergence among the subspecies; and 3) evaluate the evolutionary relationships among inland subspecies of cutthroat trout (Loudenslager and Gall 1980; Bartley and Gall 1989, 1993). Seventy-eight groups of trout from Nevada, southern Oregon, northeastern California, and western Utah were sampled over a 12 year period. Fifteen of the groups were rainbow trout, 57 were cutthroat trout, and 6 showed evidence of cutthroat-rainbow trout hybridization (Bartley and Gall 1989). Oregon and California have also conducted genetic evaluations of specific LCT populations within their states.

In 1988 NDOW and researchers from Boise State and Brigham Young universities initiated further genetic studies using protein electrophoresis and mtDNA analyses to assess variation within and among various Lahontan Basin cutthroat trout populations. Through 1991 mtDNA analyses were completed on 22 trout populations, 13 of which were from Nevada. Results suggest that the undescribed Willow Creek and Whitehorse Creek cutthroat trout populations in southeastern Oregon are LCT rather than a unique subspecies (Williams 1991; Williams et al. 1992). Williams (1991) and Williams et al. (1992) also suggested that Humboldt River populations of LCT are distinct enough to be considered a separate subspecies.

Various LCT habitat improvement projects were initiated in 1969 in the North Fork Humboldt River on Humboldt National Forest lands. In the early 1970's the Elko District BLM improved LCT habitat in Sherman and Deer Creeks. The first livestock grazing exclosure in Nevada was built on Tabor Creek in 1968 by BLM, creating a 40-acre exclosure. Between 1968 and 1982 BLM built livestock grazing exclosures surrounding 580 acres on five LCT streams in Elko County, Nevada at a cost of about $3,000 per mile (Coffin 1982). In 1976, BLM constructed a livestock grazing exclosure encompassing most of the Mahogany Creek watershed in northwestern Humboldt County, Nevada (Dahlem 1979; Chaney et al. 1990). Exclosures have also been constructed on BLM lands in Oregon surrounding parcels of Willow, Whitehorse, and Little Whitehorse Creeks in the Coyote Lake basin (Jerry L. Taylor, Jordan Resource Area Manager, Vale District BLM, letter dated December 6, 1993). The effectiveness of these exclosures is limited by their size, trespass and other use, conditions within the watershed upstream from the exclosure, and the capabilities of the site to improve with rest.

As mitigation for mining activities, some mining companies are improving LCT streams by building and maintaining exclosures, planting trees and shrubs, reshaping and revegetating streambanks, and providing funds for stream enhancement projects and land exchanges. As an example, Independence Mining Company, Incorporated (IMCI) has made considerable effort to enhance LCT habitat on seven streams within the Independence Mountain Range of the North Fork Humboldt River subbasin. These efforts include riparian enhancement planting projects, water quality and aquatic biology monitoring, installation of sediment control structures, and a commitment to reclaim exploration roads (John C. Bokich, Environmental Resources, IMCI, letter dated May 24, 1993).

Several land exchanges have been completed to improve the status of LCT. The BLM and Whitehorse Ranch completed a land exchange on Whitehorse and Willow Creeks in the Coyote Lake basin in April, 1983 (Jerry L. Taylor, Jordan Resource Area Manager, Vale District BLM, letter dated December 6, 1993). Two recent land exchanges were the Marys River land exchange (Brouha 1992; Geuser 1992), and the Soldier Meadows Conservation Project (Anonymous 1992; Swartzfager 1992). The Marys River land exchange added approximately 47,000 acres to BLM lands surrounding Marys River (Geuser 1992) and included 55 miles of LCT stream habitat. The Soldier Meadows Conservation Project will allow The Nature Conservancy to transfer private ownership of LCT habitat in Summer Camp and Mahogany Creeks to BLM (Swartzfager 1992). Summer Camp and Mahogany Creeks support stream resident LCT and provide spawning and nursery habitat for the Summit Lake LCT population in the Black Rock Desert basin.

Consideration of LCT is increasing in USFS and BLM land use, and site specific activity plans. Lahontan cutthroat trout occur on at least 103 livestock grazing allotments in Nevada and Oregon. Land management agencies are updating allotment management plans to improve stream, riparian, and watershed conditions which will, when implemented, enhance LCT long-term viability. Mangement strategies to improve LCT habitat include exclosure fencing, riparian pastures, changes in numbers of livestock, changes in season of use, herding, rest-rotation and other practices to enhance riparian vegetation status.

In addition to improving habitat for LCT, fish population management activities such as fishing regulations, reintroductions, and fisheries management plans have been initiated as described below. California, Oregon, and Nevada have closed some LCT streams to fishing for survival of the subspecies or because of special management purposes. Waters currently closed to fishing include: Mahogany, Sage, Line Canyon, Riser, Washburn, Eight-mile, and Crowley Creeks in Nevada; Pole, Golden Canyon, Murray Canyon, By-Day, and Macklin Creeks, Independence Lake tributaries, and Independence Lake within 300 feet of the mouth of all tributaries, Upper Truckee River within Meiss Meadow and Meiss Lake, and East Fork of the Carson River in California; and Whitehorse, Willow, and Sage Creeks in Oregon.

Eight fishery management plans have been completed or drafted by state and Federal wildlife agencies and/or tribal governments for LCT management activities:

1. Lahontan Cutthroat Trout Fishery Management Plan For The Humboldt River Drainage Basin (Coffin 1983).
2. Fishery Management Plan For Lahontan Cutthroat Trout (*Salmo clarki henshawi*) in California and Western Nevada Waters (Gerstung 1986).

3. Fisheries Management Plan - Summit Lake Indian Reservation (USFWS 1977).
4. Walker Lake Fisheries Management Plan (Sevon 1988).
5. DRAFT Lahontan Cutthroat Trout Fishery Management Plan For The Quinn River Drainage Basin (French and Curran 1991).
6. Pyramid Lake Fishery Conservation Plan (PLF 1992).
7. Final Draft Lahontan Subbasins Fish Management Plan (Hanson et al. 1993).
8. Draft Native Cutthroat Trout Management Plan (UDWR 1993).

These plans identify state or tribal management activities for each basin and are coordinated with FWS, BLM, and USFS. Plans drafted before 1991 are not current and should be revised. In addition, the Lahontan National Fish Hatchery Operational Plan will be reviewed and modified as necessary to meet the needs of the LCT Recovery Plan.

G. Strategies for Recovery

Lahontan cutthroat trout need to be maintained in all subbasins, while population viability research and modeling is being completed. Genetic analysis of lacustrine populations is needed to determine if they represent distinct population segments. Improvements in habitat condition could extend the range of the species within specific streams and may provide the opportunity to expand the number of small interconnected subpopulations to ultimately function as metapopulations. Removal of non-native trout species, and reintroduction of LCT is necessary in many locations to recover LCT. Lahontan cutthroat trout remain in only 10.7 percent of their native stream habitat and 0.4 percent of their native lake habitat (Appendix B). Recovery of LCT requires management of populations and habitat, research to determine and validate appropriate recovery criteria, and periodic revision of the LCT recovery plan.

1. Population Management

Management of LCT should consider genetic variation within and among LCT stocks; opportunities to maintain or develop metapopulations; distribution, abundance and maintenance of populations; and reintroductions.

a. Genetic variation

The diversity of remaining stocks of LCT poses a problem for recovery. Variable forms of lacustrine and fluvial LCT stocks occur within different Lahontan basins and subbasins. Any isolated population of fishes is a potentially unique gene pool with characteristics that may differ from all other populations (Meffe 1978). Whenever possible, genetic stocks should be maintained within their historic basin source. Recognition of the uniqueness of locally-adapted LCT populations is recommended by many taxonomists and conservation biologists for restoration and future utilization of the resource (Behnke 1972, 1992; Gall and Loudenslager 1981; Meffe 1987; Williams 1991; Williams et al. 1992).

Diversity among populations of LCT is one of the characteristics of the subspecies and the rationale for maintaining populations within each of the river basins and subbasins of the Lahontan basin. This diversity expressed in morphological and genetic differentiation is not fully understood, thus alleles should be conserved as an objective for recovery. Alleles are alternate forms of a particular gene (or locus). The number and relative abundance of alleles in a population is one measure of genetic variation. The loss of alleles and genetic variation reduces the ability of locally-adapted populations to respond adaptively to altered environmental conditions and also can reduce resistance to disease (Meffe 1987; Allendorf and Leary 1986, 1988). Lacustrine adapted LCT are extremely vulnerable to extinction because only two small naturally reproducing populations exist within native range. These two populations in Summit and Independence Lakes are genetically unique (Cowan 1988; Bartley and Gall 1993). Native LCT populations that previously occurred in Pyramid and Walker Lakes, and Lake Tahoe are now extinct. Remnants of these extinct lacustrine populations established from transplants into small streams may not have the full genetic makeup of the original lake populations because of founder effect and/or genetic drift. Some populations of LCT such as the Independence Lake strain have been established in broodstock sites and are hatchery reared for transplant purposes within the Truckee River basin. Summit Lake and its tributaries provide the same potential within the Quinn River/Black Rock Desert basin. Further research should be conducted to determine the magnitude of genetic divergence of transplanted stocks.

b. Metapopulations

Historically, networks of streams in major rivers of the Lahontan basin (e.g., Truckee, Carson, Walker, Quinn, Reese, and Humboldt Rivers) provided habitat for interconnected and interactive subpopulations of LCT, collectively referenced as metapopulations. Such metapopulations were less vulnerable to extinction from catastrophic events because the presence of several interconnected subpopulations increased the probability that at least one would survive during periods of restriction and hardship, and provide opportunities for recolonization after a disaster, and for genetic exchange on a periodic basis (Gilpin 1987). Rates of genetic exchange or recolonization depends on the degree of isolation between subpopulations, by physical distance, and character of the intervening habitat (Gilpin 1987). Isolated populations cannot be naturally recolonized after a local extinction from weather or other factors. As subpopulations become isolated migration rates decrease, local extinction becomes permanent, and an entire metapopulation can move incrementally toward extinction (Rieman and McIntyre, 1993).

Because of the existing environment within the Lahontan basin and the current status of LCT, there are limited opportunities to reestablish and maintain metapopulations. Consequently, reintroductions and maintenance of many isolated LCT populations within some subbasins where metapopulations cannot be developed will be included as part of a recovery strategy to serve as genetic repositories and to reduce the potential for extinction from catastrophic events. Research is being recommended to evaluate metapopulation contribution towards recovery of LCT.

c. Distribution and abundance

Lahontan cutthroat trout populations identified since 1976 are listed in Appendix E. Populations classified as best suited for recovery are denoted by shaded print in this appendix, and represent self-sustaining, genetically pure LCT populations, or streams that recently had LCT present, or have good potential for establishing LCT.

Long-term persistence of LCT requires maintenance of viable populations distributed throughout its native range. Viability of LCT may be limited by habitat, inbreeding depression, or presence of non-native salmonids capable of competing or hybridizing. Habitat degradation and fragmentation have isolated many LCT populations promoting inbreeding depression, the loss of fitness due to small population size or frequent matings between close relatives (FAO/UNEP 1981; Lande and Barrowclough 1987). The effective population size of breeding individuals is often much smaller than the actual population size and may be affected by such factors as breeding structure, sex ratios, fluctuations of population size, overlapping generations, and variance in progeny survival (Franklin 1980; Soulé 1980; FAO/UNEP 1981; Meffe 1987; Lande and Barrowclough 1987; Nelson and Soulé 1987). Isolated LCT populations are at greater risk of extinction through deterministic and stochastic processes than connected metapopulations. The appropriate number and size of populations per basin depend on genetic variation within and among populations, fluctuating size of individual populations, habitat integrity, and potential to support metapopulations.

Lacustrine adapted LCT within native range exist in Pyramid and Independence Lakes in the Truckee River basin, Walker Lake in the Walker River basin, and Summit Lake in the Black Rock Desert basin. Two other lacustrine populations exist in Bull and Heenan Lakes within the Carson River basin; however, these populations are considered out of native range since it is doubtful that the Carson River basin supported any lacustrine populations (Gerstung 1986). Bull Lake occupies an isolated subbasin with no hydrologic connection to Carson River, and Heenan Lake is a reservoir. Independence and Summit Lakes support the only self-sustaining lacustrine LCT populations within native range. Heenan Lake LCT were derived from the Independence Lake strain and serve as a broodstock for various California waters (Eric Gerstung, 1993, CDFG, personal communication). All other lakes occupied by LCT within Lahontan basin are sustained by hatcheries.

Three distinct vertebrate population segments of LCT exist:

1. **Western Lahontan basin population segment**
A total of 17 fluvial LCT populations are distributed among the Truckee River (N=7), Carson River (N=6), and Walker River (N=5) basins. This unit offers no potential for maintaining metapopulations. Lacustrine adapted LCT within native range in this segment occur in Pyramid, Independence and Walker Lakes. Introduced lacustrine LCT considered outside of native range exist in Bull and Heenan Lakes.

2. **Northwestern Lahontan basin population segment**
A total of 25 fluvial LCT populations are distributed among the Quinn River (N=11), Black Rock Desert (N=4), and Coyote Lake (N=10) basins. Very limited metapopulation potential exists in isolated areas within each basin comprising this unit. Lacustrine adapted fish exist in Summit Lake in the Black Rock Desert basin.

3. Humboldt River Population Segment

A total of 93 fluvial LCT populations are distributed among seven subbasins and two localized areas as follows: Marys River subbasin (N=17); North Fork Humboldt River subbasin (N=12); South Fork Humboldt River subbasin (N=20); Maggie Creek subbasin (N=7); Rock Creek Subbasin (N=6); Reese River subbasin (N=9); Little Humboldt River subbasin (N=15); East Humboldt River area (N=6); and the Lower Humboldt River area (N=1). Very limited metapopulation potential exists within the North Fork Humboldt River, Maggie Creek, Rock Creek and the Little Humboldt River subbasins of this unit. The Marys River subbasin of the Humboldt River population segment offers the most significant metapopulation potential since most tributaries are occupied by LCT.

A total of 33 LCT populations exist outside of the Lahontan basin. Out-of-basin LCT populations derived from stocks within the Western Lahontan basin population segment exist in California (N=9) and Utah (N=4); out-of-basin LCT populations derived from stocks within the Northwestern Lahontan basin population segment exist in Oregon (N=9); and out-of-basin LCT populations derived from Truckee (N=2) and Humboldt River (N=9) stocks exist in interior Nevada basins.

d. Reintroductions

Current data do not permit a statistically reliable population estimate for LCT. Annual year class production is highly variable, and the species has the capability of responding to improved environmental conditions with rapid increases in population abundance (Platts and Nelson 1983, 1988; Cowan 1991a). The recent drought from 1987 to 1992 has decreased abundance of many LCT populations, and possibly caused extinction of some isolated stream populations in degraded habitats (Jim French and Gene Weller, 1992, NDOW, personal communication). Reintroductions may be appropriate for some of these recent extinctions if they cannot be naturally recolonized.

Reintroductions proposed to meet LCT recovery requirements should be made from endemic donor stocks inhabiting the same geographic basin, or where endemic stocks are not available, from similar genetic stocks. Proper genetic matching increases the likelihood of successful reintroduction (Meffe 1987). Introductions from outside a basin should only be made where original genetic stocks are not available or where endemic populations are threatened by imminent loss should it be utilized as a donor stock. The following characteristics or factors should be considered when selecting LCT donor stocks: Conservation of alleles, genetic variation, demographics (e.g. sex ratios, abundance, and age-class structure), behavior, growth, fecundity, disease resistance, and ecology. After reintroduced populations are established they should be monitored.

2. Habitat Management

a. Habitat requirements

Cutthroat trout habitat suitability index models (Hickman and Raleigh 1982) may not directly apply to many small, diverse habitats occupied by LCT. Optimal habitat conditions described by Hickman and Raleigh (1982) might apply to LCT in the Truckee, Carson, and Walker River basins, but may be inaccurate for other populations within the Humboldt, Quinn River/Black Rock and other desert basins where LCT thrive under less than optimal conditions. As an example most small Nevada streams have a low pool to riffle ratio and small, poor quality pools. Humboldt River LCT demonstrated greater environmental tolerance by occupying habitats inhospitable to brook trout (Durrant 1935; Coffin 1983; Nelson et al. 1992). Humboldt River LCT can tolerate water temperatures as high as 27°C (80°F) for short periods of time (Coffin 1983). Lacustrine LCT exist in habitats ranging from small relatively infertile alpine lakes to large highly alkaline desert waters (McAfee 1966, Sigler and Sigler 1987). Lahontan cutthroat trout tolerate waters high in alkalinity and ion concentrations that are lethal to other species of fish (Koch et al. 1979; Behnke 1993).

Many factors must be considered in defining habitat condition thresholds that affect the distribution and abundance of LCT populations. Local habitat conditions are produced by an interaction of climatic, biologic, geomorphic, and hydrologic processes (Swanston 1991; Nelson 1992). Habitat requirements of LCT vary with seasons and life cycle stage. Fluvial adapted LCT are typically regarded as small-stream spawners, and may use intermittent streams as spawning and rearing habitat (Nelson et al. 1987). Migratory lacustrine LCT spawners returning to their natal streams require suitable stream discharges and water quality. Successful incubation of embryos and emergence of fry depend on many extragravel and intragravel chemical, physical, and hydraulic variables: Dissolved oxygen, water temperature, biochemical oxygen demand of material carried in the water and deposited in the redd, substrate size (including the amount of fine sediment), channel gradient, channel configuration, water depth over the redd, surface water discharge and velocity, permeability and porosity of gravel in the redd and surrounding streambed, and velocity of water through the redd (Bjornn and Reiser 1991). The development of habitat suitability models specific to landtypes, life cycle stage, and fluvial and lacustrine adapted LCT is an action needed to validate recovery.

Substrate composition, cover, water quality and quantity are important rearing habitat elements for fluvial and lacustrine adapted LCT. The following habitat parameters for fluvial and lacustrine cutthroat trout (Hickman and Raleigh 1982) are offered as general guidance. Optimal fluvial cutthroat trout habitat is characterized by: 1) Clear cold water with an average maximum summer temperature of $< 22°C$ ($72°F$), and relatively stable summer temperature regime averaging about $13°C$ ($55°F$) $\pm$ $4°C$ ($7°F$); 2) pools in close proximity to cover and velocity breaks to provide hiding cover and spawning areas; 3) well vegetated, stable stream banks; 4) 50 percent or more of stream area providing cover; and 5) a relatively silt free rocky substrate in riffle-run areas. Optimal lacustrine cutthroat trout habitat is characterized by: 1) Clear, cool/cold water with an average summer mid-epilimnion temperature of $< 22°C$ ($72°F$); 2) a mid-epilimnion pH of 6.5 to 8.5;

3) dissolved oxygen content $\geq$ 8 mg/L of epilimnion; and 4) access to riverine spawning tributaries.

b. Implementation

Successful implementation of any fish habitat management program depends on clearly defined goals and objectives. The overall goal for fisheries management should be to manage the physical and biological functions of watershed areas - uplands, floodplains, riparian zones, and channels - to assure that some dynamic equilibrium is maintained (Kershner et al. 1991).

Watersheds should be managed to achieve future desired condition, and preclude degradation of riparian, stream, and lake systems occupied by LCT. The regulated flow of water for irrigation and domestic water supply has affected floodplains, lake levels, water quality, aquatic and terrestrial wildlife and plant communities, and movements of LCT in and out of spawning and rearing tributaries. Other activities such as timber harvesting, mining, and grazing uplands require careful evaluation since they can alter functional links between terrestrial and aquatic ecosystems. The removal of upland vegetation can reduce water storage capacity of the watershed and promote erosion. Streamside riparian vegetation influences aquatic habitat structure, food or energy input into the aquatic environment (Meehan et al. 1977) which ultimately contributes to trout carrying capacity (Wesche et al. 1985, 1987). Projects such as stock watering developments of upland springs, could impact endemic aquatic and terrestrial wildlife and plant communities, and have late-summer season impacts on stream flows and water quality. Lahontan cutthroat trout habitat including spawning, rearing, feeding and hiding areas should be considered in planning and implementing watershed management projects.

An ecosystem approach to manage major watersheds should be implemented to maintain the full range of biological diversity, process, and function (FEMAT 1993). The major benefit of an ecosystem approach to manage LCT habitats is that all associated organisms, together with their environments, would be considered as opposed to managing for an individual species. Implementing an ecosystem approach to manage watersheds also fosters inter-ownership cooperation and improved efficiency in balancing ecological and economic objectives. Ecosystem management works with present conditions and an understanding of natural patterns and disturbance regimes to direct ecosystems to a potentially different future (FEMAT 1993). Based on these applications and benefits, ecosystem management plans should be developed to determine and manage for future desired conditions of at least the Truckee and Walker River basins, and perhaps also the Carson and Humboldt River basins. Through this process the feasibility of restoring and maintaining the unique lacustrine ecosystems of Pyramid and Walker Lakes could be determined, as well as wetland values in the Carson and Humboldt basins.

Existing LCT habitat management strategies on Federal lands are predicated by acts of Congress including the National Environmental Policy Act of 1969, the Endangered Species Act of 1973, the National Forest Management Act of 1976, and the Federal Land Policy and Management Act of 1976. From authority of these Congressional acts national policy initiatives have been established by BLM and USFS to: Restore and maintain riparian-wetland areas; promote cooperation among Federal, state and private interests; and, ensure that land use plans and activities are consistent with conservation and management of habitats occupied by species of special concern.

At the very least, designating and managing a Streamside Management Zone (SMZ) (Platts 1990) that includes the stream, riparian and streambank vegetation, and adjacent areas that might affect water quality, fish, and other aquatic resources is important for recovery of LCT on most small streams. A SMZ requires more intensive management and monitoring than an upland area, and is a broader area than the narrow riparian zone.

Proposed management actions for a watershed should be described in full, including site specific habitat objectives, monitoring, and evaluation procedures developed for the SMZ. Each SMZ should be managed to achieve and maintain proper functioning condition to: 1) Dissipate energy associated with high water flows, thereby reducing erosion and improving water quality; 2) filter sediment and nutrients and aid in floodplain development; 3) contribute to root mass development that stabilizes banks against erosion; 4) develop diverse ponding and channel characteristics to provide habitat with water depth, duration, and temperature necessary for fish production, and other uses; and 5) support greater biological diversity (BLM 1991).

Three types of monitoring information are needed for effective management; implementation, effectiveness, and validation (Kershner et al. 1991; USFS 1992). Implementation monitoring provides a permanent record of what management was actually applied. It should be conducted on an annual basis and provide details such as stream and range improvements implemented, natural events such as drought and fires, date and number of animals grazing a pasture, herding reports, sites where salt blocks were located, et cetera. Many land bases and associated streams do not get the exact management specified in plans. Knowledge of management actually implemented is crucial to interpret effectiveness and validate monitoring results.

Effectiveness monitoring records on a year-to-year basis the effects of applied management in relation to other important natural and anthropogenic events. It may include the effect of grazing on vegetation or streambanks as well as the effect of such things as growing conditions, and the occurrence of floods, fires, or anything that is likely to affect the attainment of objectives. For example, records of the vegetation remaining after grazing provides an important source of information needed for understanding plant community succession or streambank stability.

Validation monitoring determines if predictions and assumptions of applied management are appropriate to attain the desired objective.

Validation monitoring often requires long-term data collection to establish an adequate data base and would be conducted to validate results from effectiveness monitoring. It should be applied regardless of whether an objective was met or not met. For example, if desired instream habitat conditions are not achieved and a standard grazing utilization level was prescribed at 30 to 50 percent use for riparian areas during the hot season, validation monitoring could be applied to determine if it is appropriate to reduce forage consumption of the riparian complex, and/or change the season of use. In another situation, validation monitoring would verify the cause and effect of a management action implemented to achieve a goal or objective. This would assure that benefits of management are not wrongly attributed to a given action.

Interpretations for future management rely on implementation, effectiveness, and validation monitoring in combination. The task of management planning is cyclic and never ending. The combination of evolving societal values and economic opportunities as well as increased knowledge provided by research, inventory, and monitoring provides the context and substance for decision making at each step of monitoring.

All land-management agency activity plans involving LCT habitat should be monitored, validated, and revised on an as needed basis, at least every 10 years. Effectiveness monitoring should be completed annually until vegetation shows evidence of improving or attaining future desired condition. Monitoring can then be adjusted to evaluate achievement of long term goals and objectives (validation monitoring), and before the next update of the land management activity plan.

Effectiveness and validation monitoring should emphasize the following attributes related to streamside cover and streambank stability: 1) Amount of shading; 2) herbaceous and woody plant diversity, growth and development; 3) vegetation effectiveness to filter, absorb and improve floodplain stability; 4) streambank soil composition and cohesiveness; and 5) maintenance or development of streambank angles and undercuts (Platts 1990).

Land managers should recognize that the absence of unaltered or undisturbed riparian areas makes the determination of potential condition difficult, if not impossible (Leonard et al. 1992). In some cases (e.g., riparian plant community types) the designation of desired future condition rather than potential future condition would be a more appropriate objective. Riparian management objectives for LCT streams should assure that: 1) Desired key riparian plant community types or species (woody and herbaceous) are present, reproducing, and have high vigor; 2) cover of key species is 90 percent or greater of estimated potential; 3) soil productivity should not be significantly reduced by compaction from estimated potential; and 4) streambanks are restored to estimated potential condition.

3. Research

To validate LCT recovery objectives, deterministic and stochastic processes that could lead to extinction of populations need to be quantified. Extinctions caused by deterministic processes proceed in a predictable, systematic way, and can occur when something essential is removed (e.g., space, shelter, or food), or when something lethal is introduced (e.g., fishing mortality)(Gilpin and Soulé 1986). These processes affect birth or survival rates, either increasing or decreasing population growth rates. Negative population growth rates can cause populations to decline to the point that they cannot recover (Rieman and McIntyre 1993). As populations decline due to deterministic processes they become more vulnerable to stochastic processes.

Stochastic extinctions are unpredictable and result from normal, random changes or environmental perturbations (Gilpin and Soulé 1986). Stochastic processes have been classified as demographic, environmental, catastrophic, and genetic (Shaffer 1987, 1991). Demographic stochasticity includes the random variation in birth and death rates, sex ratios, or other demographic characteristics.

Environmental stochasticity includes unpredictable changes in weather, food supply, and other interactions (e.g., competition, predation, epidemics, etc.). Catastrophic stochasticity includes extreme events such as floods, debris torrents, drought, or fire. Genetic stochasticity includes random changes due to genetic drift, or inbreeding, which can alter the survival and reproductive probabilities of individuals. Population size, habitat complexity, and frequency and magnitude of stochastic events, are variables that influence the buffering capacity of a population from stochastic extinction (Rieman and McIntyre 1993). Demographic stochasticity is only an important hazard for relatively small populations (i.e., 10 to 100) (Shaffer 1987). Large or numerous interacting populations generally buffer environmental and genetic stochastic risks (Shaffer 1991). Complex habitat offers more refuge from environmental and catastrophic events than habitats of little diversity (Rieman and McIntyre 1993). The magnitude and frequency of catastrophes poses the greatest threat of extinction since population size offers no protection (Shaffer 1987, 1991). The only buffer against catastrophic stochasticity is the existence of many populations distributed throughout a species range which increases the probability that all populations are unlikely to be affected by the same catastrophe (Gilpin 1987).

Extinction processes do not operate independently. Many extinctions are the result of a deterministic event that reduces the population to a point where rather frequent or probable stochastic events can easily terminate it (Gilpin and Soulé 1986; Rieman and McIntyre 1993). Extinctions from deterministic and stochastic events are more likely to occur if the range of the species is restricted. Because interacting factors often influence extinction of populations and species, an approach called population viability analysis (PVA) was introduced as a process to develop minimum viable population criteria.

Population viability analysis is a comprehensive examination to quantify the risks of extinction through stochastic and deterministic processes (Gilpin and Soulé 1986; Shaffer 1990, 1991). A common PVA application is to predict population trends and probabilities of extinction under various scenarios over a specified time period (Marcot 1986; Murphy et al. 1990; Menges 1990; Shaffer 1990; Thomas et al. 1990; Dennis et al. 1991; USFWS 1992, 1993). As an example, a 95 percent probability of persisting for 100 years is one goal consistent with management and planning activities for bull trout, but more conservative goals (e.g., 99 percent for 150 years or 95 percent for 1000 years) have been proposed (Rieman and McIntyre 1993). There are no universal protocol or standards established for determining viability of populations or species (Shaffer 1987, 1990, 1991); however, Marcot et al. (1986) has offered guidelines to consider in planning a PVA.

Different applications of PVA may be required to validate recovery objectives because extinction risks differ for lacustrine and fluvial LCT, and by population segment. The primary purpose of applying PVA will be to determine the number of viable populations necessary for survival of LCT over a specified time period. Fluctuating population size and habitat integrity are important elements influencing a PVA applied to individual lacustrine and fluvial LCT populations. The spatial structure among LCT populations would be an important element influencing PVA for population segments and metapopulations. Continued research on LCT population dynamics, life history, genetics, and habitat are necessary to validate recovery objectives.

4. Update and Revise Recovery Plan

Because species recovery is a dynamic process and recovery plans are based on the best available biological information at the time, this recovery plan should be updated periodically. Thereafter, the plan should be reviewed, evaluated, and revised when appropriate tasks are completed, or as new information becomes available.

PART II. RECOVERY

A. Objective

The objective of the Lahontan Cutthroat Trout Recovery Plan is to delist LCT from the List of Threatened and Endangered Wildlife and Plants. Lahontan cutthroat trout will be considered for delisting by population segment when management has been instituted to enhance and protect habitat required to sustain appropriate numbers of viable self-sustaining populations. The number of viable populations necesary for survival of fluvial and lacustrine LCT will be validated by PVA and research. Recovery objectives should be targeted to allow for a 95 percent chance of persisting for 100 years.

Lacustrine and fluvial adapted LCT have different recovery needs based on variable behavior, ecology, and habitat use. The importance of Pyramid and Walker Lakes towards recovery of lacustrine LCT should be determined after genetic and ecologic research has been completed. Based upon the best biological information available at this time, a number of populations within each basin and subbasin have been identified as best suited for recovery of LCT within the current range of the subspecies. The establishment of additional populations are recommended in several basins and subbasins to reduce the risk of extinction.

The Service has determined that three distinct vertebrate population segments of LCT exist. Each distinct vertebrate population segment may be separately delisted, as recovery criteria are achieved.

Actions described in this plan to maintain and enhance existing populations, and making introductions within some basins and subbasins is described through 2018. To achieve this objective, management should be implemented to enhance and protect habitat necessary to sustain the following numbers of self-sustaining viable populations within the range of each distinct population segment as follows:

Western Lahontan basin population segment- maintain a total of 21 populations in the following native basins: Truckee River (N=7 fluvial and 2 lacustrine populations), Carson River (N=6 fluvial populations), and Walker River (N=5 fluvial and 1 lacustrine populations). Maintain 13 fluvial populations existing out of native range in California (N=9) and Utah (N=4) as remnant sources of Truckee, Carson, and Walker River strain LCT. Reintroduce populations as appropriate to establish a minimum distribution of 6 viable, self-sustaining fluvial populations each in the Truckee, Carson, and Walker River basins. Conduct research to validate recovery criteria for lacustrine adapted fish.

Northwestern Lahontan basin population segment- maintain a total of 26 populations in the following native basins: Quinn River (N=11 fluvial populations), Black Rock Desert (N=4 fluvial and 1 lacustrine populations), and Coyote Lake (N=10 fluvial populations). Maintain nine fluvial populations existing out of native range in the Alvord Lake basin as remnant sources of Coyote Lake strain LCT. Reintroduce a total of 12 fluvial populations distributed among the Quinn River (N=1) and Black Rock Desert basins (N=11). Conduct research to validate recovery criteria for lacustrine adapted fish.

Humboldt River basin population segment- maintain a total of 93 fluvial populations distributed among the Marys River subbasin (N=17), the North Fork Humboldt River subbasin (N=12), the East Humboldt River area (N=6), the South Fork Humboldt River subbasin (N=20), the Maggie Creek subbasin (N=7), the Rock Creek subbasin (N=6), the Reese River subbasin (N=9), the Little Humboldt River subbasin (N=15), and the Lower Humboldt River area (N=1).

A viable population is considered to be one that has been established for five or more years and has three or more age classes of self-sustaining trout as determined through monitoring described in the Narrative Outline for Recovery Actions Addressing Threats (Part II.B.

of this plan). Lahontan cutthroat trout population numbers fluctuate widely in response to a variety of stimuli including living space, food, cover, age class structure, predation, habitat conditions, and annual and long term weather patterns. Proper management of watersheds, riparian areas, and SMZs will provide good quality habitat for LCT and maintain populations where interspecific competition with other salmonids is not an influencing factor. Isolated populations have a higher extinction risk threat than interconnected metapopulations, but displacement can occur in any system where other salmonid species exist, and the potential is high that displacement will reduce the LCT population, maybe to the point of extinction.

B. Narrative Outline for Recovery Actions Addressing Threats

The primary objective of this recovery plan is to restore LCT to levels where population segments can be delisted. Specific objectives are to: 1) Manage and secure habitat to maintain all existing LCT populations; 2) establish 148 self-sustaining fluvial LCT populations within native range; 3) determine appropriate numbers of self-sustaining lacustrine LCT populations within native range to assure persistence for the next 100 years; 4) implement research and perform population viability analyses to validate recovery objectives; and 5) revise the recovery plan.

1 Secure habitat and manage LCT populations

The most immediate need in assuring recovery of LCT is securing habitat necessary to sustain viable lacustrine and fluvial populations within three distinct population segments: 1) Western Lahontan basin comprised of Truckee, Carson, and Walker River basin stocks; 2) Northwestern Lahontan basin comprised of Quinn River, Black Rock Desert, and Coyote Lake basin stocks; and 3) Humboldt River basin stocks.

To "secure" habitat is to ensure the benefits of management to allow LCT a 95 percent chance of persisting for 100 years. All existing LCT populations are considered essential for recovery until research is completed and PVAs are conducted to identify extinction risks and validate recovery objectives for lacustrine and fluvial populations.

Various types of ancillary plans and agreements are necessary to secure and manage LCT populations. These include basin-wide LCT Fisheries Management Plans (FMP), Cooperative Management Agreements (CMA), Habitat Management Plans (HMP), and reintroduction plans.

State and tribal FMPs can help direct LCT recovery objectives. Lahontan cutthroat trout fishery management plans should be completed and revised for each major basin or population segment to reflect recovery objectives. These plans should define specific state and tribal activities which relate to recovery objectives.

Cooperative Management Agreements between agencies should be developed for each major basin to identify activities and responsibilities of each management agency. Participants may include the FWS, USFS, BLM, BIA, four states (Nevada, California, Oregon, and Utah), tribal governments, county governments, and other interested organizations and individuals.

Habitat Management Plans should be developed with willing private land owners to foster voluntary cooperation to manage and improve LCT habitat on private lands.

Habitat proposed for LCT management should be selected by state wildlife and federal land management agencies dependent on the suitability or potential to maintain viable LCT populations over the long-term. Many LCT populations are found in restricted portions of streams not protected from invasion of non-native salmonids. These LCT populations are subject to displacement and/or hybridization.

Habitat proposed for LCT management should be protected from non-native salmonids. In specific stream systems within the Quinn, Little Humboldt, Truckee, and Carson River basins, non-native trout should be removed and streams restocked with LCT. Whenever practical, resident LCT should be returned to their original habitat if treated to remove non-native trout.

Streamside management zones including the green line and riparian areas associated with LCT streams should be in a good to excellent condition. This includes management to assure that: 1) Desired key riparian plant community types or species (woody and herbaceous) are present, reproducing, and have high vigor; 2) cover of key species is 90 percent or greater of estimated potential; 3) soil productivity should not be significantly reduced by compaction from estimated potential; and 4) streambank stability is restored to estimated potential condition. Grazing practices on federal lands within watersheds and the SMZ should be managed to achieve desired LCT habitat conditions. Watersheds should be managed to achieve desired future condition objectives and prevent degradation of SMZ, riparian areas, streambanks, and stream water quality. Strategies to achieve desired habitat conditions should be identified in land-use activity plans.

All land-management agency activity plans involving LCT habitat should be monitored, evaluated, and updated on an as needed basis. Land use activity plans should be evaluated and revised if watershed, SMZ and riparian objectives are not being achieved. Best management practices should be initiated to reduce non-point source pollution problems on LCT streams.

Reintroduction of LCT into additional waters within specific basins and subbasins is another management activity recommended to maintain LCT populations at recent levels. Additional populations are essential within the Truckee, Carson, Walker, Quinn, and Little Humboldt River basins to achieve viable population levels and maintain basin and subbasin integrity. Lahontan cutthroat trout used for reintroductions should come from genetically similar populations within the same basin, unless transplant stock is unavailable.

Reintroduced LCT populations will not be considered established until they reach and maintain viable population levels. A viable population is considered to be one that has been established for 5 or more years and has three or more self-sustaining age classes.

11 Manage, monitor, and reintroduce LCT populations in Humboldt River basin

Nevada Division of Wildlife, BLM, and Humboldt National Forest should continue implementing management for LCT populations as prescribed by the LCT FMP for the Humboldt River basin (Coffin 1983).

111 Manage LCT populations within Humboldt basin

Management should continue in an effort to maintain and enhance Humboldt River basin LCT populations.

1111 Update Humboldt River basin Fisheries Management Plan

Nevada Division of Wildlife should function as the lead agency to update the 1983 LCT FMP for the Humboldt River basin. This updated plan should include: Site-specific project descriptions and objectives identified by sub-basin; inventory schedules to monitor and report on LCT distribution, abundance, and habitat; reintroduction objectives and sites; and a schedule to evaluate and revise the FMP to accommodate management needs.

1112 Develop a Cooperative Management Agreement for the Humboldt River basin

A CMA for the Humboldt River basin should be developed to identify management activities and responsibilities among NDOW, USFS, and BLM, and other interested organizations or individuals, to assure recovery of LCT. Fish and Wildlife Service will be responsible for coordinating development of the CMA.

1113 Develop Habitat Management Plans with willing Humboldt River basin private landowners

A significant portion of LCT streams cross private lands for some portion of their length, including parcels within national forests and BLM districts. Habitat Management Plans should be developed for site specific projects with willing private landowners to promote voluntary partnerships to manage and improve LCT habitat. Habitat Management Plans may include technical assistance to the private landowner to implement cooperative LCT habitat improvement and maintenance projects identified in the appropriate LCT management plan.

11131 Identify Humboldt River basin private landowners with existing or potential LCT habitat

Land management agencies and other interested organizations or individuals should assist the FWS in identifying private landowners with existing or potential LCT habitat.

11132 Contact Humboldt River basin private landowners with existing or potential LCT habitat

Landowners with existing or potential LCT habitat should be contacted by the FWS or delegate to discuss the importance of LCT habitat, and explain benefits, incentives, and technical assistance, that could be offered to landowners through a HMP. The primary intent of contacting landowners is to determine who may be willing to enter into a voluntary partnership with managing agencies to enhance and maintain LCT habitat.

11133 Develop and implement HMPs with willing Humboldt River basin private landowners

Objectives, terms and conditions of HMPs between managing agencies and willing landowners should be developed and implemented to promote cooperative LCT habitat management.

1114 Implement revised Humboldt River basin Fisheries Management Plan

Management activities identified in the revised Humboldt River basin LCT FMP should be implemented after completion of public and governmental agency review, and compliance with applicable state and federal legislation.

112 Monitor LCT populations within Humboldt River basin

Monitoring of LCT distribution and abundance will be necessary to determine viability of populations, identify environmental conditions that may limit production, and evaluate success of management. Lahontan cutthroat trout population surveys should be completed at least once every 5 years to determine the status and trend of individual populations in response to land use practices and environmental changes. Entire stream segments should be surveyed to determine the status of LCT under all land ownership patterns and land use practices. Implementation monitoring of prescribed management and habitat conditions within the SMZ should be conducted annually to document if habitat condition objectives are being met or exceeded. Effectiveness monitoring of habitat conditions within the SMZ should be conducted at least once every 5 years to evaluate if trend and status of future desired habitat conditions were achieved by management activities undertaken. Validation monitoring should be conducted as appropriate to determine why future desired habitat conditions were met or not met, and to determine responses of LCT populations to management activities.

113 Reintroduce LCT within the Humboldt River basin to maintain viable stream populations

Reintroductions of LCT within the Humboldt River basin may be required to supplement small populations at risk of extinction, or to expand the range of the subspecies within certain subbasins or areas as a measure to counteract deterministic or stochastic extinction risks.

1131 Select streams for reintroductions within the Humboldt River basin

State wildlife and federal land management agencies should mutually select streams from Appendix E where reintroduction can be accomplished for each subbasin or area of the Humboldt River. Factors to be considered in selecting the reintroduction stream should include: The potential for establishing a metapopulation; current status and potential for improvement of riparian and SMZ habitat; the probability of being able to remove non-indigenous trout species present in the habitat; the need for fish barriers; and the development and implementation of land use activity plans to improve and maintain habitat.

1132 Prepare Humboldt River basin reintroduction plan

Appropriate state wildlife and federal land management agencies should develop a coordinated LCT reintroduction plan for Humboldt River subbasins to ensure that reintroductions of LCT are adequately planned and properly implemented. Conservation genetic issues, and introduction guidelines that should be addressed in fish reintroduction plans are summarized by Philipp et al. (1993), and Williams et al. (1988), respectively. Reintroduction plans should identify baseline genetic data characterizing the donor population for a reintroduction site, determine responsibilities of affiliated agencies, and describe contingent schedules, alternatives, and coordinated activities including: Post-introduction monitoring; removal of other salmonid species; improvement of riparian and SMZ habitats; and evaluation of the need for fish migration barriers.

1133 Implement Humboldt River basin reintroduction plan

Reintroduction plans for specific sites within subbasins of the Humboldt River should be implemented after completion of public and governmental agency review, and compliance with applicable state and federal legislation.

1134 Monitor Humboldt River basin reintroductions

Each reintroduced LCT population and their habitat should be monitored at least once every 3 years to validate the effectiveness of the reintroduction. Subsequent genetic analysis should also be monitored at appropriate intervals to evaluate potential loss of genetic variation by founder effect, genetic drift, or inbreeding depression. Habitat conditions in the SMZ should be monitored as applied in task 112.

12 Manage, monitor, and reintroduce LCT populations into Truckee River basin

California Department of Fish and Game, NDOW, Tahoe National Forest, Lake Tahoe Basin Management Unit, and Toiyabe National Forest should continue implementing management for LCT populations in the Truckee River basin as prescribed by Gerstung (1986).

121 Manage LCT populations within the Truckee River basin

Management agencies should continue to protect and enhance Truckee River basin LCT populations.

1211 Update the Truckee River portion of the California and western Nevada Fisheries Management Plan

California Department of Fish and Game should function as the lead agency to update the Truckee River portion of the Fishery Management Plan for Lahontan cutthroat trout in California and western Nevada waters (Gerstung 1986). The plan should be evaluated after 10 years and revised as necessary to continue management tasks.

1212 <u>Develop a Cooperative Management Agreement for the Truckee River basin</u>

A CMA for the Truckee River basin should be developed among CDFG, NDOW, USFWS, USFS, and other interested organizations or individuals, as applied under task 1112.

1213 <u>Develop Habitat Management Plans with Truckee River basin private landowners</u>

Habitat Management Plans should be developed for site specific projects with willing private landowners to promote voluntary partnerships to manage and improve LCT habitat as applied under task 1113.

12131 <u>Identify Truckee River basin private landowners with existing and potential LCT habitat</u>

Private landowners with existing and potential LCT habitat should be identified as applied under task 11131.

12132 <u>Contact Truckee River basin private landowners with existing and potential LCT habitat</u>

Private landowners with existing and potential LCT habitat should be contacted as applied under task 11132.

12133 <u>Develop and implement Habitat Management Plans with Truckee River private landowners</u>

Habitat Management Plans should be developed and implemented with cooperating private landowners to secure LCT habitat as applied under task 11133.

1214 <u>Implement Truckee River portion of the revised California and western Nevada Fisheries Management Plan</u>

Truckee River LCT management activities identified in the California and western Nevada LCT FMP should be implemented after completion of public and government agency review, and compliance with applicable state and federal legislation.

122 Monitor LCT populations within Truckee River basin

Monitoring described under task 112 should be applied to LCT populations within the Truckee River basin.

123 Reintroduce LCT within the Truckee River basin to establish six viable stream populations

Reintroduction of LCT to establish six viable stream populations may be sufficient for recovery of the fluvial adapted form within the Truckee River basin.

1231 Select streams for reintroductions within the Truckee River basin

California Department of Fish and Game, NDOW, and federal land management agencies should mutually select reintroduction streams from Appendix E where viable populations can be established to meet objectives for the Truckee River basin. Selection factors described under task 1131 should be applied.

1232 Prepare Truckee River basin reintroduction plan

California Department of Fish and Game, NDOW, and federal land management agencies should develop a coordinated LCT reintroduction plan for the Truckee River basin, as applied in task 1132.

1233 Implement Truckee River basin reintroduction plan

Reintroduction plans for specific sites within the Truckee River basin should be implemented after completion of public and agency review, and compliance with applicable state and federal legislation.

1234 Monitor Truckee River basin reintroductions

Monitoring as described in task 1134 should be applied to the Truckee River basin.

13 Manage, monitor, and reintroduce LCT populations into Carson River basin

California Department of Fish and Game, NDOW and Toiyabe National Forest should continue implementing management for LCT populations in the Carson River basin as prescribed by Gerstung (1986).

131 Manage LCT populations within the Carson River basin

Management agencies should protect and enhance Carson River basin LCT populations.

1311 Update the Carson River portion of the California and western Nevada Fisheries Management Plan

The Carson River portion of the FMP for Lahontan cutthroat trout in California and western Nevada waters (Gerstung 1986) should be updated. The plan should be evaluated after 10 years and revised as necessary to continue management tasks.

1312 Develop a Cooperative Management Agreement for the Carson River basin

A CMA for the Carson River basin should be developed among CDFG, NDOW, Toiyabe National Forest, and other interested organizations and individuals, as applied under task 1112.

1313 Develop Habitat Management Plans with Carson River basin private landowners

Habitat Management Plans should be developed for site specific projects with willing private landowners to promote voluntary partnerships to manage and improve LCT habitat as applied under task 1113.

13131 Identify Carson River basin private landowners with existing and potential LCT habitat

Private landowners with existing or potential LCT habitat should be identified as applied under task 11131.

13132 Contact Carson River basin private landowners with existing and potential LCT habitat

Private landowners with existing or potential LCT habitat should be contacted as applied under task 11132.

13133 Develop and implement Habitat Management Plans with Carson River basin private landowners

Habitat Management Plans should be developed and implemented with cooperating private landowners to secure LCT habitat as applied under task 11133.

1314 Implement the Carson River portion of the revised California and western Nevada Fisheries Management Plan

Carson River LCT management activities identified in the California and western Nevada LCT FMP should be implemented after completion of public and agency review, and compliance with applicable state and federal legislation.

132 Monitor LCT populations within Carson River basin

Monitoring described under task 112 should be applied to LCT populations within the Carson River basin.

133 Reintroduce LCT within the Carson River basin to establish six viable populations

Reintroduction of LCT to establish six viable stream populations is sufficient within the Carson River basin.

1331 Select streams for reintroductions within the Carson River basin

California Department of Fish and Game, NDOW and federal land management agencies should mutually select introduction or reintroduction streams from Appendix E to meet objectives for the Carson River basin. Selection factors described under task 1131 should be applied.

1332 Prepare Carson River basin reintroduction plan

California Department of Fish and Game, NDOW and federal land management agencies should develop a coordinated LCT reintroduction plan for the Carson River basin, as applied in task 1132.

1333 Implement Carson River basin reintroduction plan

Reintroduction plans for specific sites within the Carson River basin should be implemented after completion of public and governmental agency review, and compliance with applicable state and federal legislation.

1334 Monitor Carson River basin reintroductions

Monitoring as described under task 1134 should be applied to the Carson River basin.

14 Manage, monitor, and reintroduce LCT populations into Walker River basin

California Department of Fish and Game, NDOW and Toiyabe National Forest should continue implementing management for LCT populations in the Walker River basin as prescribed by Gerstung (1986).

141 Manage LCT populations within the Walker River basin

Management agencies should continue to protect and enhance Walker River basin LCT populations.

1411 Update the Walker River portion of the California and western Nevada Fisheries Management Plan

The Walker River portion of the 1986 FMP for LCT in California and western Nevada waters (Gerstung 1986) should be updated to address current management needs. The plan should be evaluated after 10 years and revised as necessary to continue management tasks.

1412 Develop a Cooperative Management Agreement for the Walker River basin

A CMA for the Walker River basin should be developed as applied under task 1112.

1413 Develop Habitat Management Plans with Walker River basin private landowners

Habitat Management Plans should be developed for site specific projects with willing private landowners to promote voluntary partnerships to manage and improve LCT habitat as applied under task 1113.

14131 Identify Walker River basin private landowners with existing and potential LCT habitat

Private landowners with existing and potential LCT habitat should be identified as applied under task 11131.

14132 Contact Walker River basin private landowners with existing and potential LCT habitat

Private landowners with existing and potential LCT habitat should be contacted as applied under task 11132.

14133 Develop and implement Habitat Management Plans with Walker River basin private landowners

Habitat Management Plans should be developed and implemented with cooperating private landowners to secure LCT habitat as applied under task 11133.

1414 Implement Walker River portion of the revised California and western Nevada Fisheries Management Plan

Walker River LCT management activities identified in the revised California and western Nevada LCT FMP should be implemented after completion of public and governmental agency review, and compliance with applicable state and federal legislation.

142 Monitor LCT populations within Walker River basin

Monitoring described under task 112 should be applied to LCT populations within the Walker River basin.

143 Reintroduce LCT within the Walker River basin to establish six viable populations

Reintroduction of LCT to establish six viable stream populations is sufficient within the Walker River basin.

1431 Select streams for reintroductions within the Walker River basin

California Department of Fish and Game, NDOW and federal land management agencies should mutually select reintroduction streams from Appendix E where reintroduction can be accomplished to meet objectives for the Walker River basin. Selection factors described under task 1131 should be applied.

1432 Prepare Walker River basin reintroduction plan

California Department of Fish and Game, NDOW and federal land management agencies should develop a coordinated LCT reintroduction plan for the Walker River basin, as applied in task 1132.

1433 Implement Walker River basin reintroduction plan

Reintroduction plans for specific sites within the Walker River basin should be implemented after completion of public and governmental agency review, and compliance with applicable state and federal legislation.

1434 Monitor Walker River basin reintroductions

Monitoring described under task 1134 should be applied to the Walker River basin.

15 Manage, monitor, and reintroduce LCT populations into Quinn River/Black Rock Desert basin

Nevada Division of Wildlife, ODFW, Humboldt National Forest, BLM and the Summit Lake Paiute Tribe (SLPT) should continue implementing management for LCT populations in sub-basins of the Quinn River/Black Rock Desert basin.

151 Manage LCT populations within the Quinn River/Black Rock Desert basin

Management agencies should continue to maintain and enhance Quinn River/Black Rock Desert basin LCT populations.

1511 Complete state Fisheries Management Plans for Nevada and Oregon parts of system

Reintroductions are necessary within the Quinn River basin to recover LCT. The draft Quinn River basin FMP (French and Curran 1991) should be completed to identify priority waters for management of LCT populations within the basin in Nevada. A schedule to evaluate and revise the FMP should be developed to accommodate management needs. The ODFW draft plan for the Lahontan subbasin should be finalized.

1512 Develop a Cooperative Management Agreement for the Quinn River/Black Rock Desert basin

A CMA for the Quinn River/Black Rock Desert basin should be developed among NDOW, ODFW, BLM, Humboldt National Forest, and other interested organizations and individuals as applied under task 1112.

1513 Develop Habitat Management Plans with Quinn River/Black Rock Desert basin private landowners

Habitat Management Plans should be developed for site specific projects with willing private landowners to promote voluntary partnerships to manage and improve LCT habitat as applied under task 1113.

15131 Identify Quinn River/Black Rock Desert basin private landowners with existing and potential LCT habitat

Private landowners with existing or potential LCT habitat should be identified as applied under task 11131.

15132 Contact Quinn River/Black Rock Desert basin landowners with existing or potential LCT habitat

Private landowners with existing or potential LCT habitat should be contacted as applied under task 11132.

15133 Develop and implement Habitat Management Plans with Quinn River/Black Rock Desert basin private landowners

Habitat Management Plans should be developed and implemented with cooperating private landowners to secure LCT habitat as applied under task 11133.

1514 Implement Quinn River/Black Rock Desert Fisheries Management Plans

Lahontan cutthroat trout management activities identified in NDOW and ODFW FMPs should be implemented after completion of public and agency review, and compliance with applicable state and federal legislation.

1515 Revise Summit Lake Fisheries Management Plan

The Summit Lake basin, composed of Summit Lake and its tributaries, Mahogany, Summer Camp and Snow Creeks, has an important role in recovery of LCT since it supports a metapopulation of sympatric lacustrine, adfluvial, and fluvial LCT. Because LCT within the Summit Lake basin occupy private, public, and Indian lands, coordinated management is required to resolve a number of problems, including: Declining LCT reproduction and recruitment; restricted access to spawning habitat in Mahogany Creek; instream flow to permit passage of migrants to and from the lake; livestock and wild horse use within the Summit Lake drainage basin; water quality and aquatic vegetation; and interactions with non-native minnows.

The Summit Lake FMP (USFWS 1977) needs to be updated and implemented in cooperation with other agencies. A schedule to evaluate and revise the FMP should be developed to accommodate management needs. Summit Lake Paiute Tribe should serve as the lead agency to revise the FMP.

1516 <u>Develop a Cooperative Management Agreement for the Summit Lake basin</u>

A CMA for the Summit Lake basin should be developed among NDOW, BLM, SLPT, BIA, and other interested organizations and individuals, as applied under task 1112.

1517 <u>Develop Habitat Management Plans with Summit Lake Indian Reservation private landowners</u>

Habitat Management Plans should be developed for site specific projects with willing private landowners to promote voluntary partnerships to manage and improve LCT habitat as applied under task 1113.

15171 <u>Identify Summit Lake Indian Reservation private landowners with LCT habitat</u>

Private landowners with LCT habitat within the Summit Lake Indian Reservation should be identified as applied under task 11131. The BIA should assist the FWS with identifying appropriate landowners. Summit Lake Indian Reservation private landowners are those individuals that have recognized interest in allotted trust lands within the exterior boundaries of the reservation.

15172 <u>Contact private landowners with LCT habitat within the Summit Lake Indian Reservation</u>

Private landowners with LCT habitat should be contacted as applied under task 11132.

15173 Develop and implement Habitat Management Plans with Summit Lake Indian Reservation private landowners

Habitat Management Plans may be developed and implemented with cooperating private landowners to secure LCT habitat as applied under task 11133.

1518 Implement revised Summit Lake Fisheries Management Plan

Lahontan cutthroat trout management activities identified in the Summit Lake basin FMP should be implemented after completion of public and governmental agency review, and compliance with applicable state, federal, and tribal legislation.

15181 Establish Interagency working group for Summit Lake basin

An interagency working group should be organized for the Summit Lake basin to coordinate LCT research and management activities.

15182 Maintain LCT spawner access up Mahogany Creek

The Mahogany Creek inflow channel into Summit Lake is unstable due to delta formation and should be maintained on an annual basis to provide access for LCT to migrate into Mahogany Creek during the spawning season.

15183 Maintain stream flow to Summit Lake for annual recruitment from Mahogany Creek

The SLPT should develop and implement a water use plan for the Summit Lake Indian Reservation to provide water flows sufficient for LCT spawning needs and return migrants to Summit Lake. Stream flows should be maintained in Summit Lake tributaries to allow access for annual recruitment to the Summit Lake population between August and November. Diversion of water for irrigation purposes, rapid changes in flow rates, and pollution of the streams and lake from irrigation return flows should also be addressed.

15184 Manage livestock use within the Summit Lake drainage basin

An interagency task force or working group including the SLPT, BIA, BLM, Soil Conservation Service (SCS), FWS, private permittees, and NDOW should be established to develop a plan for livestock use within the Summit Lake watershed basin. Intensive management of livestock in riparian and SMZ of Mahogany, Summer Camp, and Snow Creeks, and along the shoreline of Summit Lake is required to prevent degradation of the stream channels and non-point source pollution of the lake.

15185 Manage minnow populations in Summit Lake

An unauthorized introduction of Lahontan redside shiners (*Richardsonius egregius*) and speckled dace (*Rhinichthys osculus*) in the 1970s appears to have impacted the status of LCT in Summit Lake. Interactions between minnows and LCT need to be investigated to determine if minnows significantly reduce the viability of the LCT population. Management should be instituted to control minnow production if it is determined that LCT production is affected.

15186 Monitor water quality of the Summit Lake drainage basin

The water quality of Summit Lake may be influenced by return flows from irrigated pasture lands and livestock use along Mahogany Creek, Summer Camp Creek, and around the shoreline of the lake. Changes in water quality, levels of pollution, and abundance of aquatic vegetation should be monitored to determine potential effects on LCT production and to provide recommendations. The SLPT and BLM should be responsible for monitoring water quality within their respective jurisdiction.

152 Monitor LCT populations within Quinn River/Black Rock Desert basin

Monitoring as described under task 112 should be applied to LCT populations within the Quinn River/Black Rock Desert basin, except for the Summit Lake drainage system. Lahontan cutthroat trout in the Summit Lake drainage system should be monitored annually to determine viability of this population and to evaluate production and recruitment.

153 Reintroduce LCT within the Quinn River/Black Rock Desert basin

Reintroductions of LCT populations within the Quinn River/Black Rock Desert basin may be required as applied in task 113.

1531 Select streams for reintroductions within the Quinn River/Black Rock Desert basin

The NDOW, ODFW and federal land management agencies should mutually select reintroduction streams from Appendix E. Selection factors described under task 1131 should be applied.

1532 Prepare Quinn River/Black Rock Desert basin reintroduction plans for specific sites within the basin

The NDOW, ODFW and federal land management agencies should develop a coordinated LCT reintroduction plan for the Quinn River/Black Rock Desert basin, as applied in task 1132.

1533 Implement Quinn River/Black Rock Desert basin reintroduction plan

Reintroduction plans for specific sites within the Quinn River/Black Rock Desert basin should be implemented after completion of public and governmental agency review, and compliance with applicable state and federal legislation.

1534 Monitor Quinn River/Black Rock Desert basin reintroductions

Monitoring described under task 1134 should be applied to reintroduced LCT populations within the Quinn River/Black Rock Desert basin.

16 Manage and monitor LCT populations within Coyote Lake basin

Oregon Department of Fish and Wildlife, and BLM should continue implementing management for LCT populations in the Coyote Lake basin as prescribed by Hanson et al. (1993).

161 Manage LCT populations within the Coyote Lake basin

Management agencies should continue to maintain and enhance all Coyote Lake basin LCT populations.

1611 Complete the Lahontan Subbasins Fisheries Management Plan

The draft Lahontan Subbasins FMP (Hanson et al. 1993) identifying management priorities within the Coyote Lake basin in Oregon should be completed.

1612 Develop a Cooperative Management Agreement for the Coyote Lake basin

A CMA for the Coyote Lake basin should be developed among ODFW, BLM, and other interested organizations and individuals, as applied under task 1112.

1613 Develop Habitat Management Plans with willing Coyote Lake basin private landowners

Habitat Management Plans should be developed for site specific projects with willing private landowners to promote voluntary partnerships to manage and improve LCT habitat as applied under task 1113.

16131 Identify Coyote Lake basin private landowners with LCT habitat

Private landowners with LCT habitat should be identified as applied under task 11131.

16132 Contact Coyote Lake basin private landowners with LCT habitat

Private landowners with LCT habitat should be contacted as applied under task 11132.

16133 Develop and implement Habitat Management Plans with willing Coyote Lake basin private landowners

Habitat Management Plans should be developed and implemented with cooperating private landowners to secure LCT habitat as applied under task 11133.

1614 Implement the Lahontan Subbasin Fisheries Management Plan

Lahontan cutthroat trout management activities identified in the Lahontan Subbasin FMP should be implemented after compliance with applicable state and federal legislation.

162 Monitor LCT populations within Coyote Lake basin

Monitoring described under task 112 should be applied to LCT populations within the Coyote Lake basin.

17 Manage and monitor LCT populations in out-of-basin range

State wildlife agencies should continue implementing management for LCT populations in out-of-basin range that are cited in Appendix E. Some of these populations may be important stocks for reestablishing LCT within the Truckee, Carson, Walker, Humboldt River, and Coyote Lake basins.

171 Manage and monitor California LCT populations in out-of-basin range

California Department of Fish and Game and USFS should continue implementing management for LCT populations in the Yuba, Stanislaus, Mokelumne, San Joaquin, and Owens River systems of California. These populations may serve as donor stock for reintroductions within the Truckee, Carson, and Walker River basins.

1711 Update Fisheries Management Plan for LCT in California/western Nevada for populations in out-of-basin range

The FMP for LCT in California and western Nevada waters (Gerstung 1986) should be updated to address current management required to maintain and enhance LCT populations existing out-of-basin range in California that are cited in Appendix E. A schedule to evaluate and revise the FMP should be developed to accommodate management needs. Cooperative Management Agreements may be developed as applied under task 1112, if appropriate.

1712 Develop a Cooperative Management Agreement for out-of-basin LCT populations in California

A CMA for out-of-basin LCT populations in California should be developed among CDFG, USFS, and other interested organizations and individuals, as applied under task 1112.

1713 Develop Habitat Management Plans with willing California private landowners for LCT populations in out-of-basin range

Habitat Management Plans should be developed for site specific projects with willing private landowners to promote voluntary partnerships to manage and improve LCT habitat as applied under task 1113.

17131 Identify California private landowners with LCT habitat in out-of-basin range

Private landowners with LCT habitat should be identified as applied under task 11131.

17132 Contact private landowners with LCT habitat

Private landowners with LCT habitat should be contacted as applied under task 11132.

17133 Develop and implement Habitat Management Plans with willing California private landowners for out-of-basin LCT habitat

Habitat Management Plans should be developed and implemented with cooperating private landowners to secure LCT habitat as applied under task 11133.

1714 Implement revised Fisheries Management Plan for LCT in California/western Nevada for populations existing out-of-basin range

Management activities for LCT in out-of-basin range in California as identified in the revised FMP for LCT in California/western Nevada, should be implemented after completion of public and governmental agency review, and compliance with applicable state and federal legislation.

1715 Monitor LCT populations existing out-of-basin range in California

Monitoring described under task 112 should be applied to LCT populations in out-of-basin range within California basins identified in Appendix E.

172 Manage and monitor Nevada LCT populations in out-of-basin range

Management agencies should continue to protect and enhance LCT populations in out-of-basin range that are identified under Interior Nevada basins in Appendix E. These populations were derived from Humboldt and Truckee River basin stocks and may be considered as donor stock for reintroductions.

1721 Update Humboldt River basin Fisheries Management Plan for out-of-basin LCT populations in Nevada

The Humboldt River basin FMP should be updated as prescribed in task 1111 to address current management needs of LCT populations identified in Appendix E under Interior Nevada basins.

1722 Develop a Cooperative Management Agreement for out-of-basin LCT populations in Nevada

A CMA for out-of-basin LCT populations in Nevada should be developed among NDOW, BLM, USFS, and other interested organizations and individuals, as applied under task 1112.

1723 Develop Habitat Management Plans with willing Nevada private landowners for LCT populations in out-of-basin range

Habitat Management Plans should be developed for site specific projects with willing private landowners to promote voluntary partnerships to manage and improve LCT habitat as applied under task 1113.

17231 Identify Nevada private landowners with LCT habitat in out-of-basin range

Private landowners with LCT habitat should be identified as applied under task 11131.

17232 Contact private landowners with LCT habitat

Private landowners with LCT habitat should be contacted as applied under task 11132.

17233 Develop and implement Habitat Management Plans with willing Nevada private landowners for out-of-basin LCT habitat

Habitat Management Plans should be developed and implemented with cooperating private landowners to secure LCT habitat as applied under task 11133.

1724 Implement revised Humboldt River basin Fisheries Management Plan for out-of-basin LCT populations in Nevada

Management activities for LCT in out-of-basin range in Nevada as identified in the revised Humboldt River basin FMP should be implemented after completion of public and governmental agency review, and compliance with applicable state and federal legislation.

1725 Monitor out-of-basin LCT populations in Nevada

Monitoring described under task 112 should be applied to LCT populations identified under Interior Nevada basins in Appendix E.

173 Manage and monitor out-of-basin LCT populations in the Alvord Lake basin

Oregon Department of Fish and Wildlife and BLM should continue implementing management for LCT populations in the Alvord Lake basin of Oregon, as identified in Appendix E. These populations were derived from stocks within the Coyote Lake basin (Hanson et al. 1993) and may be considered as donor stocks for reintroductions.

1731 Complete the Lahontan Subbasins Fisheries Management Plan

The draft Lahontan Subbasins FMP (Hanson et al. 1993) identifying management priorities for out-of-basin LCT populations within the Alvord Lake basin in Oregon should be completed.

1732 Develop a Cooperative Management Agreement for the Alvord Lake basin

A CMA for the Alvord Lake basin should be developed among ODFW, BLM, and other interested organizations and individuals, as applied under task 1112.

1733 Develop Habitat Management Plans with willing Alvord Lake basin private landowners

Habitat Management Plans should be developed for site specific projects with willing private landowners to promote voluntary partnerships to manage and improve LCT habitat as applied under task 1113.

17331 Identify Alvord Lake basin private landowners with LCT habitat

Private landowners with LCT habitat should be identified as applied under task 11131.

17332 Contact Alvord Lake basin private landowners with LCT habitat

Private landowners with LCT habitat should be contacted as applied under task 11132.

17333 Develop and implement Habitat Management Plans with willing Alvord Lake basin private landowners

Habitat Management Plans should be developed and implemented with cooperating private landowners to secure LCT habitat as applied under task 11133.

1734 Implement the Lahontan Subbasin Fisheries Management Plan

Management activities for Alvord Lake basin LCT identified in the Lahontan Subbasin FMP should be implemented after compliance with applicable state and federal legislation.

1735 Monitor LCT populations within Alvord Lake basin

Monitoring described under task 112 should be applied to LCT populations within the Alvord Lake basin.

174 Manage and monitor Utah LCT populations in out-of-basin range

Management agencies should continue to protect and enhance LCT populations in out-of-basin range that are identified under Utah Bonneville basins in Appendix E. These populations have been identified by some taxonomists as being derived from the original Pyramid Lake strain, and should be maintained until their future potential and need can be evaluated.

1741 Complete the UDWR Draft Native Cutthroat Trout Management Plan

The draft Native Cutthroat Trout Management Plan (UDWR 1993) identifying management for LCT in Utah should be completed.

1742 Develop a Cooperative Management Agreement for LCT in Utah

A CMA for LCT management in Utah should be developed among UDWR, FWS-Region 6, BLM, and other interested organizations and individuals, as applied under task 1112. Fish and Wildlife Service - Region 6 will be responsible for coordinating development of the CMA.

1743 Develop Habitat Management Plans with willing Utah private landowners

Habitat management plans should be developed for site specific projects with willing private landowners to promote voluntary partnerships to manage and improve LCT habitat as applied under task 1113.

17431 Identify Utah private landowners with LCT habitat

Private landowners with LCT habitat should be identified as applied under task 11131.

17432 Contact Utah private landowners with LCT habitat

Private landowners with LCT habitat should be contacted as applied under task 11132.

17433 Develop and implement Habitat Management Plans with willing Utah private landowners

Habitat Management Plans should be developed and implemented with cooperating private landowners to secure LCT habitat as applied under task 11133.

1744 Implement UDWR Native Cutthroat Trout Management Plan

Management activities for LCT in Utah should be implemented after completion of public and governmental agency review, and compliance with applicable to state and federal legislation.

1745 Monitor LCT populations in Utah

Monitoring described under task 112 should be applied to existing LCT populations in Utah.

1746 Investigate the genetics of LCT populations in Utah

The genetics of LCT populations in Utah that are identified in Appendix E should be investigated to determine what extent of the original Pyramid Lake genotype may exist.

2 Conduct biological studies and research to validate recovery objectives

Research should be conducted to collect baseline data necessary to validate LCT recovery objectives. As research and population viability analyses (PVA) are applied, strategies should be formulated to achieve appropriate recovery objectives.

21 Investigate ecologic and genetic importance of lacustrine LCT populations

The ecologic and genetic importance of LCT populations in Walker, Pyramid, Independence, and Summit Lakes requires investigation to determine if they are distinct vertebrate population segments and to formulate appropriate recovery objectives.

22 Conduct population viability analyses for LCT

Population viability analyses for LCT should be conducted to validate recovery objectives. In addition to population and habitat monitoring described in task 1, other research is required to apply PVA and determine the number of viable populations necessary for survival of lacustrine and fluvial LCT over a specified time period.

221 Identify research to apply LCT population viability analyses

Different PVA models may be required to determine appropriate recovery objectives for lacustrine and fluvial LCT. Biological studies and research should be identified to apply pertinent deterministic and stochastic processes to PVA.

222 Collect data for LCT population viability analyses

Data should be collected for studies and research identified in task 221.

223 Apply PVA to validate LCT recovery objectives

Population viability analyses should be applied to validate LCT recovery objectives when demographic, environmental, and genetic information become available.

224 Conduct research to validate PVA models

Research should be conducted to validate assumptions, applications, credibility, and criteria of PVA models.

3 Coordinate fisheries management activities to complement LCT conservation

Fisheries management activities such as regulating LCT harvest, and fish stocking programs, should be coordinated to complement LCT conservation.

31 Regulate LCT harvest to maintain viable populations

Lahontan cutthroat trout can be easily caught, and populations fluctuate widely in response to environmental conditions. Angler harvest should be evaluated periodically to determine incidence of mortality and other factors that may influence viability of LCT populations.

311 Inform public of current fishing regulations and seasons

Information should be provided to the public about specific regulations necessary to maintain viability of fish populations. Information related to fishing regulations, species identification, handling and care of fish, and fisheries management activities, should be conveyed to the public by regulation brochures, mass media, and posted signs as necessary.

3111 Inform public through Oregon fishing regulations

3112 Inform public through Nevada fishing regulations

3113 Inform public through California fishing regulations

3114 Inform public of tribal regulations

312 Periodically evaluate effectiveness of state/tribal fishing regulations to limit LCT harvest

State and tribal fishing regulations to limit LCT harvest should be evaluated for effectiveness at least once every five years, depending on the status of the population managed. Some LCT populations in California, Nevada, and Oregon are currently closed to fishing because of low numbers, or they provide stock for transplant purposes into other habitat within that basin. Schedules to evaluate effectiveness of regulations for each LCT population should be developed to prevent the reduction of populations below viable numbers.

32 Develop a coordinated fish stocking review process for each LCT population segment and out-of-basin populations

A fish stocking review process should be coordinated among FWS, states, and tribal fish management agencies to investigate and determine effectiveness of reintroduction programs, and prevent introductions of non-native salmonids into LCT habitat. Hatchery stock of rainbow, cutthroat, brook, and brown trout are used extensively to enhance recreational fisheries resources. Non-native salmonid species should not be stocked where access to LCT habitat is potentially available.

321 Coordinate Oregon fish stocking program review process

322 Coordinate Nevada fish stocking program review process

323 Coordinate California fish stocking program review process

324 Coordinate Tribal fish stocking program review process

A fish stocking review process for Pyramid Lake and Summit Lake Paiute Indian Tribes should be coordinated since both tribes have facilities to propagate LCT and may be called upon to provide stock for future reintroductions or strain development.

4 Review, evaluate and revise LCT recovery plan

The LCT recovery plan was based on the best available biological information. This recovery plan should be revised after ecologic, genetic, population viability, and other research described in task 2 has been completed. Thereafter, the plan should be reviewed, evaluated, and revised when appropriate tasks are completed and new information becomes available.

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PART III. IMPLEMENTATION SCHEDULE

The Implementation Schedule that follows is a summary of actions and estimated costs for this recovery program. It is a guide to meet the objective discussed in Part II of this plan. This schedule indicates the priority in scheduling tasks to meet objectives, identifies agencies responsible for performing each task, and estimates costs to each agency. These actions, when accomplished, will satisfy the recovery objective. Initiation of these actions is subject to the availability of funds.

Priorities in Column 1 of the following implementation schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality, or other significant adverse impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of LCT.

Recovery Plan Implementation Schedule for Lahontan cutthroat trout

Priority #	Task #	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000)				
						FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
1	152	Monitor LCT populations in Quinn River/Black Rock Desert basin	On-going	*NDOW	120	5	5	5	5	5
				*ODFW	48	2	2	2	2	2
				BLM	48	2	2	2	2	2
				USFS	48	2	2	2	2	2
				SLPT	120	5	5	5	5	5
1	1511	Complete state FMPs for Quinn River/Black Rock Desert basin	1	*NDOW	3	3	0	0	0	0
				*ODFW	3	3	0	0	0	0
1	1512	Develop a CMA for Quinn River/ Black Rock Desert basin	1	*FWS	1	1	0	0	0	0
				NDOW	1	1	0	0	0	0
				ODFW	1	1	0	0	0	0
				BLM	1	1	0	0	0	0
				USFS	1	1	0	0	0	0
1	15131	Identify Quinn River/Black Rock Desert basin private landowners	2	*FWS	2	1	1	0	0	0
				USFS	1	1	0	0	0	0
				BLM	1	1	0	0	0	0
1	15132	Contact Quinn River/Black Rock Desert basin private landowners	Continuous	*FWS	Unknown					
				USFS	Unknown					
				BLM	Unknown					
1	1514	Implement Quinn River/Black Rock Desert FMPs	Continuous	*NDOW	Unknown					
				*ODFW	Unknown					
				BLM	Unknown					
				USFS	Unknown					
				SLPT	Unknown					
1	15133	Develop and implement HMPs with Quinn River/Black Rock Desert basin private landowners	Continuous	*FWS	Unknown					

Recovery Plan Implementation Schedule for Lahontan cutthroat trout

Priority #	Task #	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
2	112	Monitor LCT populations in Humboldt River basin	On-going	*NDOW	1200	50	50	50	50	50
				BLM	360	15	15	15	15	15
				USFS	360	15	15	15	15	15
2	122	Monitor LCT populations in Truckee River basin	On-going	*CDFG	120	5	5	5	5	5
				*NDOW	48	2	2	2	2	2
				USFS	72	3	3	3	3	3
2	132	Monitor LCT populations in Carson River basin	On-going	*CDFG	120	5	5	5	5	5
				USFS	72	3	3	3	3	3
2	142	Monitor LCT populations in Walker River basin	On-going	*CDFG	120	5	5	5	5	5
				USFS	72	3	3	3	3	3
2	15181	Establish Interagency working group for Summit Lake basin	Continuous	*FWS	24	1	1	1	1	1
				SLPT	24	1	1	1	1	1
				BIA	24	1	1	1	1	1
				BLM	24	1	1	1	1	1
				NDOW	24	1	1	1	1	1
2	15182	Maintain LCT spawner access up Mahogany Creek	On-going	*SLPT	24	1	1	1	1	1
				NDOW	24	1	1	1	1	1
2	15183	Maintain stream flow to Summit Lake for annual recruitment	On-going	*SLPT	Unknown					
				BIA	Unknown					
2	15184	Manage livestock use within the Summit Lake drainage basin	On-going	*SLPT	Unknown					
				*BLM	Unknown					
				BIA	Unknown					
				NDOW	Unknown					

Recovery Plan Implementation Schedule for Lahontan cutthroat trout

Priority #	Task #	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
2	15185	Manage minnow populations in Summit Lake	On-going	*SLPT	Unknown					
2	15186	Monitor water quality of Summit Lake drainage basin	On-going	*SLPT	24	1	1	1	1	1
				*BLM	24	1	1	1	1	1
2	162	Monitor LCT populations in Coyote Lake basin	On-going	*ODFW	120	5	5	5	5	5
				BLM	48	2	2	2	2	2
2	321	Coordinate Oregon fish stocking program review process	Continuous	*FWS	24	1	1	1	1	1
				ODFW	24	1	1	1	1	1
				BLM	24	1	1	1	1	1
2	322	Coordinate Nevada fish stocking program review process	Continuous	*FWS	24	1	1	1	1	1
				NDOW	24	1	1	1	1	1
				BLM	24	1	1	1	1	1
				USFS	24	1	1	1	1	1
2	323	Coordinate California fish stocking program review process	Continuous	*FWS	24	1	1	1	1	1
				CDFG	24	1	1	1	1	1
				USFS	24	1	1	1	1	1
2	1111	Update Humboldt River basin FMP	2	*NDOW	20	0	10	10	0	0
				FWS	2	0	1	1	0	0
				BLM	2	0	1	1	0	0
				USFS	2	0	1	1	0	0
2	1211	Update Truckee River portion of of the California and western Nevada FMP	1	*CDFG	10	0	10	0	0	0
				NDOW	2	0	2	0	0	0
				FWS	1	0	1	0	0	0
				USFS	1	0	1	0	0	0

Recovery Plan Implementation Schedule for Lahontan cutthroat trout

Priority #	Task #	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
2	1311	Update Carson River portion of the California and western Nevada FMP	1	*CDFG	10	0	10	0	0	0
				FWS	1	0	1	0	0	0
				USFS	1	0	1	0	0	0
2	1411	Update Walker River portion of the California and western Nevada FMP	1	*CDFG	10	0	10	0	0	0
				FWS	1	0	1	0	0	0
				USFS	1	0	1	0	0	0
2	1515	Revise Summit Lake FMP	1	*SLPT	16	0	16	0	0	0
				BIA	1	0	1	0	0	0
				NDOW	1	0	1	0	0	0
				BLM	1	0	1	0	0	0
				FWS	1	0	1	0	0	0
2	1611	Complete the Lahontan Subbasins FMP	1	*ODFW	20	0	20	0	0	0
				BLM	1	0	1	0	0	0
				NDOW	1	0	1	0	0	0
				FWS	1	0	1	0	0	0
2	1112	Develop a CMA for the Humboldt River basin	1	*FWS	1	0	1	0	0	0
				NDOW	1	0	1	0	0	0
				USFS	1	0	1	0	0	0
				BLM	1	0	1	0	0	0
2	1212	Develop a CMA for the Truckee River basin	1	*FWS	1	0	1	0	0	0
				CDFG	1	0	1	0	0	0
				NDOW	1	0	1	0	0	0
				USFS	1	0	1	0	0	0
2	1312	Develop a CMA for the Carson River basin	1	*FWS	1	0	1	0	0	0
				CDFG	1	0	1	0	0	0
				USFS	1	0	1	0	0	0

Recovery Plan Implementation Schedule for Lahontan cutthroat trout

Priority #	Task #	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
2	1412	Develop a CMA for the Walker River basin	1	*FWS	1	0	1	0	0	0
				CDFG	1	0	1	0	0	0
				USFS	1	0	1	0	0	0
2	1516	Develop a CMA for the Summit Lake basin	1	*FWS	1	0	1	0	0	0
				SLPT	1	0	1	0	0	0
				NDOW	1	0	1	0	0	0
				BIA	1	0	1	0	0	0
				BLM	1	0	1	0	0	0
2	1612	Develop a CMA for the Coyote Lake basin	1	*FWS	1	0	1	0	0	0
				ODFW	1	0	1	0	0	0
				BLM	1	0	1	0	0	0
2	11131	Identify Humboldt River basin private landowners with existing or potential LCT habitat	2	*FWS	2	0	1	1	0	0
				BLM	1	0	1	0	0	0
				USFS	1	0	1	0	0	0
2	12131	Identify Truckee River basin private landowners with existing or potential LCT habitat	1	*FWS	1	0	1	0	0	0
				USFS	1	0	1	0	0	0
2	13131	Identify Carson River basin private landowners with existing or potential LCT habitat	1	*FWS	1	0	1	0	0	0
				USFS	1	0	1	0	0	0
2	14131	Identify Walker River basin private landowners with existing or potential LCT habitat	1	*FWS	1	0	1	0	0	0
				USFS	1	0	1	0	0	0

Recovery Plan Implementation Schedule for Lahontan cutthroat trout

Priority #	Task #	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
2	15171	Identify Summit Lake Indian Reservation private landowners with LCT habitat	1	*FWS BIA	1 1	0 0	1 1	0 0	0 0	0 0
2	16131	Identify Coyote Lake basin private landowners with LCT habitat	1	*FWS BLM	1 1	0 0	1 1	0 0	0 0	0 0
2	11132	Contact Humboldt River basin private landowners with existing or potential LCT habitat	Continuous	*FWS BLM USFS	Unknown Unknown Unknown					
2	12132	Contact Truckee River basin private landowners with existing or potential LCT habitat	Continuous	*FWS USFS	Unknown Unknown					
2	13132	Contact Carson River basin private landowners with existing or potential LCT habitat	Continuous	*FWS USFS	Unknown Unknown					
2	14132	Contact Walker River basin private landowners with existing or potential LCT habitat	Continuous	*FWS USFS	Unknown Unknown					
2	15172	Contact landowners with LCT habitat within the Summit Lake Indian Reservation	Continuous	*FWS BIA	Unknown Unknown					
2	16132	Contact Coyote Lake basin private landowners with LCT habitat	Continuous	*FWS BLM	Unknown Unknown					

Recovery Plan Implementation Schedule for Lahontan cutthroat trout

Priority #	Task #	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
2	1114	Implement revised Humboldt River basin FMP	Continuous	*NDOW	Unknown					
				FWS	Unknown					
				BLM	Unknown					
				USFS	Unknown					
2	1214	Implement Truckee River portion of the revised California and western Nevada FMP	Continuous	*CDFG	Unknown					
				NDOW	Unknown					
				FWS	Unknown					
				USFS	Unknown					
2	1314	Implement Carson River portion of the revised California and western Nevada FMP	Continuous	*CDFG	Unknown					
				FWS	Unknown					
				USFS	Unknown					
2	1414	Implement Walker River portion of the revised California and western Nevada FMP	Continuous	*CDFG	Unknown					
				FWS	Unknown					
				USFS	Unknown					
2	1614	Implement the Lahontan Subbasin FMP	Continuous	*ODFW	Unknown					
				BLM	Unknown					
				NDOW	Unknown					
				FWS	Unknown					
2	324	Coordinate Tribal fish stocking program review process	Continuous	*FWS	22	0	0	1	1	1
				PLPT	22	0	0	1	1	1
				SLPT	22	0	0	1	1	1
				BIA	22	0	0	1	1	1
2	11133	Develop and implement HMPs with Humboldt River private landowners	Continuous	*FWS	Unknown					

Recovery Plan Implementation Schedule for Lahontan cutthroat trout

Priority #	Task #	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
2	12133	Develop and implement HMPs with Truckee River private landowners	Continuous	*FWS	Unknown					
2	13133	Develop and implement HMPs with Carson River private landowners	Continuous	*FWS	Unknown					
2	14133	Develop and implement HMPs with Walker River private landowners	Continuous	*FWS	Unknown					
2	15173	Develop and implement HMPs with Summit Lake Indian Reservation private landowners	Continuous	*FWS	Unknown					
2	16133	Develop and implement HMPs with Coyote Lake private landowners	Continuous	*FWS	Unknown					
		NEED 1			3798	162	278	166	152	152

Recovery Plan Implementation Schedule for Lahontan cutthroat trout

Priority #	Task #	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
2	21	Investigate ecologic and genetic importance of lacustrine LCT	10	*FWS	450	0	60	60	60	60
				CDFG	75	0	10	10	10	10
				NDOW	75	0	10	10	10	10
				SLPT	75	0	10	10	10	10
				PLPT	75	0	10	10	10	10
2	221	Identify research to apply LCT population viability analyses	2	*FWS	60	0	40	20	0	0
				BLM	10	0	10	0	0	0
				USFS	10	0	10	0	0	0
				CDFG	10	0	10	0	0	0
				NDOW	10	0	10	0	0	0
				ODFW	3	0	3	0	0	0
				UDWR	1	0	1	0	0	0
				SLPT	2	0	2	0	0	0
				PLPT	2	0	2	0	0	0
2	222	Collect data for PVA	10	*FWS	200	0	20	20	20	20
				BLM	100	0	10	10	10	10
				USFS	100	0	10	10	10	10
				CDFG	100	0	10	10	10	10
				NDOW	150	0	15	15	15	15
				ODFW	50	0	5	5	5	5
				UDWR	10	0	1	1	1	1
				SLPT	30	0	3	3	3	3
				PLPT	50	0	5	5	5	5
2	223	Apply PVA to develop LCT recovery objectives	1	*FWS	20	0	20	0	0	0
2	224	Conduct research to validate PVA models	10	*FWS	300	0	0	30	30	30

Recovery Plan Implementation Schedule for Lahontan cutthroat trout

Priority #	Task #	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
2	4	Review, evaluate and revise LCT recovery plan	Continuous	*FWS	Unknown					
		NEED 2			1968	0	287	229	209	209
2	1531	Select reintroduction streams within the Quinn River/Black Rock Desert basin	1	*NDOW	10	0	0	0	0	0
				BLM	10	0	0	0	0	0
				USFS	10	0	0	0	0	0
				FWS	5	0	0	0	0	0
2	1532	Prepare reintroduction plans for Quinn River/Black Rock Desert basin	3	*NDOW	30	0	0	0	0	0
				BLM	30	0	0	0	0	0
				USFS	30	0	0	0	0	0
				FWS	15	0	0	0	0	0
2	1533	Implement reintroduction plans for Quinn River/Black Rock Desert basin	10	*NDOW	Unknown					
				BLM	Unknown					
				USFS	Unknown					
2	1534	Monitor reintroductions for Quinn River/Black Rock Desert basin	Continuous	*NDOW	300	0	0	0	0	0
				BLM	1500	0	0	0	0	0
				USFS	1500	0	0	0	0	0
3	1131	Select reintroduction streams within the Humboldt River basin	1	*NDOW	10	0	0	0	0	0
				BLM	10	0	0	0	0	0
				USFS	10	0	0	0	0	0
				FWS	5	0	0	0	0	0

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Priority #	Task #	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
3	1231	Select reintroduction streams within the Truckee River basin	1	*CDFG	10	0	0	0	0	0
				NDOW	10	0	0	0	0	0
				USFS	10	0	0	0	0	0
				FWS	5	0	0	0	0	0
3	1331	Select reintroduction streams within the Carson River basin	1	*CDFG	10	0	0	0	0	0
				USFS	10	0	0	0	0	0
				FWS	5	0	0	0	0	0
3	1431	Select reintroduction streams within the Walker River basin	1	*CDFG	10	0	0	0	0	0
				USFS	10	0	0	0	0	0
				FWS	5	0	0	0	0	0
3	1132	Prepare Humboldt River basin reintroduction plan	1	*NDOW	10	0	0	0	0	0
				BLM	10	0	0	0	0	0
				USFS	10	0	0	0	0	0
				FWS	5	0	0	0	0	0
3	1232	Prepare Truckee River basin reintroduction plan	1	*CDFG	10	0	0	0	0	0
				NDOW	5	0	0	0	0	0
				USFS	10	0	0	0	0	0
				FWS	5	0	0	0	0	0
3	1332	Prepare Carson River basin reintroduction plan	1	*CDFG	10	0	0	0	0	0
				USFS	10	0	0	0	0	0
				FWS	5	0	0	0	0	0
3	1432	Prepare Walker River basin reintroduction plan	1	*CDFG	10	0	0	0	0	0
				USFS	10	0	0	0	0	0
				FWS	5	0	0	0	0	0

Recovery Plan Implementation Schedule for Lahontan cutthroat trout

Priority #	Task #	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
3	1133	Implement Humboldt River basin reintroduction plan subbasin	5	*NDOW	Unknown					
				USFS	Unknown					
				BLM	Unknown					
3	1233	Implement Truckee River basin reintroduction plan	5	*CDFG	Unknown					
				*NDOW	Unknown					
				USFS	Unknown					
3	1333	Implement Carson River basin reintroduction plan	5	*CDFG	Unknown					
				USFS	Unknown					
3	1433	Implement Walker River basin reintroduction plan	5	*CDFG	Unknown					
				USFS	Unknown					
3	1134	Monitor Humboldt River basin reintroductions	Continuous	*NDOW	300	0	0	0	0	0
				BLM	1500	0	0	0	0	0
				USFS	1500	0	0	0	0	0
3	1234	Monitor Truckee River basin reintroductions	Continuous	*CDFG	150	0	0	0	0	0
				*NDOW	75	0	0	0	0	0
				USFS	150	0	0	0	0	0
3	1334	Monitor Carson River basin reintroductions	Continuous	*CDFG	150	0	0	0	0	0
				USFS	150	0	0	0	0	0
3	1434	Monitor Walker River basin reintroductions	Continuous	*CDFG	150	0	0	0	0	0
				USFS	150	0	0	0	0	0
		NEED 3			7950	0	0	0	0	0

Recovery Plan Implementation Schedule for Lahontan cutthroat trout

Priority #	Task #	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
3	3111	Inform public of Oregon regualtions	On-going	*ODFW	Unknown					
3	3112	Inform public of Nevada regulations	On-going	*NDOW	Unknown					
3	3113	Inform public of California regulations	On-going	*CDFG	Unknown					
3	3114	Inform public of tribal regulations	On-going	*PLPT	Unknown					
				*SLPT	Unknown					
3	312	Evaluate effectiveness of regulations	On-going	*NDOW	Unknown					
				*CDFG	Unknown					
				*ODFW	Unknown					
				*PLPT	Unknown					
				*SLPT	Unknown					
		NEED 4			Unknown					
3	1715	Monitor LCT populations existing out-of-basin range in California	On-going	*CDFG	480	20	20	20	20	20
				BLM	240	10	10	10	10	10
				USFS	240	10	10	10	10	10
3	1725	Monitor LCT populations existing out-of-basin range in Nevada	On-going	*NDOW	240	10	10	10	10	10
				BLM	240	10	10	10	10	10
				USFS	240	10	10	10	10	10
3	1735	Monitor LCT populations within Alvord Lake basin	On-going	*ODFW	240	10	10	10	10	10
				BLM	240	10	10	10	10	10

Recovery Plan Implementation Schedule for Lahontan cutthroat trout

Priority #	Task #	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
3	1745	Monitor LCT populations in Utah	On-going	*UDWR	120	10	0	10	0	10
				BLM	120	10	0	10	0	10
3	1746	Investigate genetics of LCT populations in Utah	1	*UDWR	10	10	0	0	0	0
3	1711	Update FMP for out-of-basin populations in California and western Nevada	1	*CDFG	Unknown					
				*NDOW	Unknown					
				BLM	Unknown					
				USFS	Unknown					
				FWS	Unknown					
3	1721	Update Humboldt River basin FMP for out-of-basin LCT populations in Nevada	1	*NDOW	Unknown					
				BLM	Unknown					
				USFS	Unknown					
				FWS	Unknown					
3	1731	Complete the Lahontan Subbasins FMP for LCT within Alvord Lake basin	1	*ODFW	Unknown					
				BLM	Unknown					
				FWS	Unknown					
3	1741	Complete the UDWR Draft Native Cutthroat Trout FMP	1	*UDWR	75	0	50	25	0	0
				BLM	20	0	10	10	0	0
				FWS	20	0	10	10	0	0
3	1712	Develop a CMA for out-of-basin LCT populations in California	1	*FWS	1	0	1	0	0	0
				CDFG	1	0	1	0	0	0
				USFS	1	0	1	0	0	0

Recovery Plan Implementation Schedule for Lahontan cutthroat trout

Priority #	Task #	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000)				
						FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
3	1722	Develop a CMA for out-of-basin LCT populations in Nevada	1	*FWS	1	0	1	0	0	0
				NDOW	1	0	1	0	0	0
				BLM	1	0	1	0	0	0
				USFS	1	0	1	0	0	0
3	1732	Develop a CMA for Alvord Lake basin	1	*FWS	1	0	1	0	0	0
				ODFW	1	0	1	0	0	0
				BLM	1	0	1	0	0	0
3	1742	Develop a CMA for LCT in Utah	1	*FWS	1	0	1	0	0	0
				UDWR	1	0	1	0	0	0
				BLM	1	0	1	0	0	0
3	17131	Identify California private landowners with LCT habitat in out-of-basin range	1	*FWS	1	0	1	0	0	0
				USFS	1	0	1	0	0	0
3	17231	Identify Nevada private landowners with LCT habitat in out-of-basin range	1	*FWS	1	0	1	0	0	0
				USFS	1	0	1	0	0	0
3	17331	Identify Alvord Lake basin private landowners with LCT habitat	1	*FWS	1	0	1	0	0	0
				BLM	1	0	1	0	0	0
3	17431	Identify Utah private landowners with LCT habitat	1	*FWS	1	0	1	0	0	0
				BLM	1	0	1	0	0	0
3	17132	Contact California private landowners with out-of-basin LCT habitat	Continuous	*FWS	Unknown					

Recovery Plan Implementation Schedule for Lahontan cutthroat trout

Priority #	Task #	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000)				
						FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
3	17232	Contact Nevada private landowners with out-of-basin LCT habitat	Continuous	*FWS	Unknown					
3	17332	Contact Alvord Lake basin private landowners with LCT habitat	Continuous	*FWS	Unknown					
3	17432	Contact Utah private landowners with LCT habitat	Continuous	*FWS	Unknown					
3	1714	Implement revised FMP for out-of-basin populations in California and western Nevada	On-going	*CDFG *NDOW BLM USFS	Unknown Unknown Unknown Unknown					
3	1724	Implement revised Humboldt River basin FMP for out-of-basin LCT populations in Nevada	On-going	*NDOW BLM USFS	Unknown Unknown Unknown					
3	1734	Implement the Lahontan Subbasin FMP for LCT in Alvord Lake basin	On-going	*ODFW BLM	Unknown Unknown					
3	1744	Implement UDWR Native Cutthroat Trout Management Plan	On-going	*UDWR BLM	Unknown Unknown					
3	17133	Develop and implement HMPs with California private landowners for out-of-basin LCT habitat	Continuous	*FWS	Unknown					
3	17233	Develop and implement HMPs with Nevada private landowners for out-of-basin LCT habitat	Continuous	*FWS	Unknown					

Recovery Plan Implementation Schedule for Lahontan cutthroat trout

Priority #	Task #	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
3	17333	Develop and implement HMPs with Alvord Lake basin private landowners	Continuous	*FWS	Unknown					
3	17433	Develop and implement HMPs with Utah private landowners for out-of-basin LCT habitat	Continuous	*FWS	Unknown					
		NEED 5			2546	120	181	155	90	110
				TOTALS	16262	282	746	550	451	471

Continuous = Task will be implemented on an annual basis once it is begun.
On-going = Task is currently being implemented and will continue until action is no longer necessary for recovery.
Unknown = Implementation of task and associated cost cannot be determined with certainty.
LCT = Lahontan cutthroat trout
FMP = Fishery Management Plan
MOU = Memorandum of Understanding
* = Lead Agency

Responsible Parties:
BIA = Bureau of Indian Affairs
BLM = Bureau of Land Management
CDFG = California Department of Fish and Game
FWS = Fish and Wildlife Service
NDOW = Nevada Division of Wildlife
ODFW = Oregon Department of Fish and Wildlife
PLPT = Pyramid Lake Paiute Tribe
SLPT = Summit Lake Paiute Tribe
UDWR = Utah Division of Wildlife Resources
USFS = United States Forest Service

PART IV. APPENDICES

A. Great Basin cutthroat trout meristic characters

B. Existing self-sustaining Lahontan cutthroat trout populations within probable historic habitat

C. Size distribution of 92 fluvial Lahontan cutthroat trout populations

D. Status and management problems of Lahontan cutthroat trout populations (1977-1991)

E. Lahontan cutthroat trout occupied and potential habitats

F. Definitions

G. Public comments

APPENDIX A:
GREAT BASIN CUTTHROAT TROUT MERISTIC CHARACTERS

Typical modal values are in parentheses. Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) data are from Behnke (1981), except Summit Lake basin data provided by Cowan (1992). Paiute cutthroat trout (*Oncorhynchus clarki seleniris*) data are from Trotter (1987).

Species/ Hydrographic basin/ Specialized form	Gillrakers	Scales/Lateral series	Pyloric caeca	Comments
O. c. henshawi				
Truckee/Carson/ Walker River basins. Lacustrine form.	21-28(23-25)	150-180(160-170)	40-80(50-65)	Heredity base for large size; spots evenly distributed on body and ventral region.
Humboldt River basin. Fluvial form.	18-24(21)	125-155(135-145)	40-70(50-60)	Fewer spots, seldom on ventral region.
Whitehorse Creek, Coyote Lake basin. Fluvial form.	18-23(21)	130-165(145-150)	40-60(45-48)	Taxonomy of *O. c. henshawi* in Whitehorse Creek confirmed by Williams (1991). Spots similar to Humboldt subspecies. Branchiostegal rays 9-11.
Alvord basin. Lacustrine form.	20-26(23-24)	125-150(135)	35-50(42)	Presumed extinct. Spotting sparse. Basibranchial teeth poorly developed. Branchiostegal rays 8-9.
Summit Lake basin. Lacustrine form.	17-26(22)	124-144(130)	37-64(49)	Spot pattern variable. Basibranchial teeth variable, 0-13. Branchiostegal rays 7-12. Sample size = 42 fish.
O. c. seleniris				
Carson River basin. Fluvial form.	21-27	150-180	50-70	No spots

APPENDIX D:
STATUS AND MANAGEMENT PROBLEMS OF LAHONTAN CUTTHROAT TROUT BY BASIN
(1977-1991)

Basin/subbasin Name	Number of Populations	Occupied Habitat	Population	Status	Management Problems by Priority
Truckee River basin	7 streams	8.0 mi.	500	Insecure	1) displacement, 2) habitat, 3) barriers
	1 lake	700 ac.	100	Insecure	1) displacement, 2) spawning, 3) angler use
Carson River basin	5 streams	9.0 mi.	3000	Insecure	1) displacement, 2) habitat, 3) barriers
Walker River basin	5 streams	11.0 mi.	1000	Insecure	1) displacement, 2) habitat, 3) barriers
Humboldt River basin	93 streams	317.5 mi.	96000	Secure	1) habitat, 2) displacement, 3) hybridization
Marys River subbasin	17 streams	68.7 mi.	23000	Secure	1) habitat
East Humboldt River area	6 streams	13.2 mi.	4000	Insecure	1) displacement, 2) habitat
North Fk. Humboldt subbasin	12 streams	44.1 mi.	8000	Insecure	1) habitat, 2) displacement
South Fk. Humboldt subbasin	20 streams	57.7 mi.	15000	Insecure	1) displacement, 2) habitat, 3) hybridization
Maggie Creek subbasin	7 streams	13.6 mi.	7000	Insecure	1) habitat
Rock Creek subbasin	6 streams	24.9 mi.	9000	Insecure	1) habitat
Reese River subbasin	9 streams	33.3 mi.	11000	Secure	1) displacement, 2) habitat
Little Humboldt River subbasin	15 streams	58.0 mi.	18000	Insecure	1) displacement, 2) habitat, 3) hybridization
Lower Humboldt River area	1 stream	4.0 mi.	Unknown	Insecure	1) habitat
Quinn River/Black Rock Desert basin	15 streams	57.5 mi.	1000	Insecure	1) habitat, 2) hybridization, 2) displacement
	1 lake	600 ac.	2000	Insecure	1) competition, 2) spawning, 3) habitat
Coyote Lake basin	10 streams	56.3 mi.	8600	Insecure	1) habitat, 2) displacement
Outside Lahontan basin					
Nevada basins	11 streams	20.1 mi.	4500	Secure	1) habitat, 2) displacement
California basins	9 streams	12.2 mi.	5000	Secure	1) displacement, 2) habitat
Oregon basins	9 streams	Unknown	200	Insecure	1) habitat
Utah basins	3 streams	2.0 mi.	675	Insecure	1) habitat, 2) viability
Hatchery Supplemented Populations					
Nevada	2 lakes	Unknown	Unknown	Recreation	1) habitat, 2) viability, 3) angler use
	1 lake	Unknown	Unknown	Broodstock	1) viability, 2) habitat
California	1 lake	Unknown	Unknown	Recreation	1) hybridization, 2) habitat, 3) angler use

APPENDIX B:

EXISTING SELF-SUSTAINING LAHONTAN CUTTHROAT TROUT POPULATIONS WITHIN PROBABLE HISTORIC HABITAT

Probable historic habitat data are cited from Gerstung (1986), except for Humboldt River basin data cited from Coffin (1983). Existing occupied habitat data were assembled from unpublished inventory data maintained by California Department of Fish and Game, Nevada Division of Wildlife, and Oregon Department of Fish and Wildlife. Estimates of historic habitat for Coyote Lake basin were unavailable.

Basin	Probable Historic Habitat Streams (miles)	Probable Historic Habitat Lakes (acres)	Existing Occupied Habitat Streams (miles)	Existing Occupied Habitat Lakes (acres)	Percent of Probable Historic Habitat Occupied
Truckee River	360	284,000	8	700	2.2% Streams 0.2% Lakes
Carson River	300	None	9	None	3.3% Streams
Walker River	360	49,400	11	None	3.1% Streams
Honey Lake	150	None	None	None	None
Quinn/ Black Rock	386	590	58	590	15.0% Streams 100.0% Lakes
Humboldt River	2,210	None	318	None	14.4% Streams
TOTAL STREAMS	3,766		404		10.7% Streams
TOTAL LAKES		333,990		1,290	0.4% Lakes

APPENDIX C:
SIZE DISTRIBUTION OF 92 FLUVIAL LAHONTAN CUTTHROAT TROUT POPULATIONS

Populations for which data were available are presented with numeric notations that represent the following basin or subbasin, and the number (N) of LCT populations sampled: 1 = Truckee River (N=2 of 7); 2 = Carson River (N=3 of 5); 3 = Walker River (N=2 of 5); 4 = Black Rock Desert (N=2 of 4); 5 = Quinn River (N=5 of 11); 6 = Coyote Lake (N=4 of 10); 7 = Marys River (N=17 of 17); 8 = North Fork Humboldt River (N=7 of 12); 9 = East Humboldt River area (N=6 of 6); 10 = South Fork Humboldt River (N=8 of 20); 11 = Maggie Creek (N=3 of 7); 12 = Rock Creek (N=5 of 6); 13 = Reese River (N=4 of 9); 14 = Little Humboldt River (N=4 of 15); 15 = Out-of-basin (N=20 of 32). Data on Lahontan cutthroat trout populations sizes were assembled from Coffin (1983), Gerstung (1986), Cowan (1991), Perkins et al. (1991), Hanson et al. (1993), and from unpublished inventory data maintained by CDFG, NDOW, and UDWR.

Population Size						
<100	100-500	500-1000	1000-2000	2000-5000	5000-10000	>10000
Independence[1]	Pole[1]	Marys R. Bsn.[7]	E.F. Carson[2]	Whitehorse[6]	N.F. Humboldt[8]	S.F.Lit.Hum.[14]
Washburn[5]	Murray Canyon[2]	W.F. Marys R.[7]	L.Whitehorse,B[6]	Willow[6]	Coyote[11]	
Riser[5]	Poison Flat[2]	Gance[8]	Chimney[7]	Marys R.[7]	Washington[13]	
Eight-mile[5]	By-Day[3]	Conrad[9]	Draw[7]	Cutt[7]		
Camp Draw[7]	Murphy[3]	Lee[10]	Hanks[7]	E.F. Marys R.[7]		
Basin[7]	Mahogany[4]	Nelson[12]	Foreman[8]	T[7]		
GAWS[7]	Summer Camp[4]	Crane Canyon[13]	4th Boulder[9]	Wildcat[7]		
Short[7]	Sage[5]	Sheep[14]	N.F. Cold[9]	N.Furlong[10]		
Williams Bsn.[7]	Crowley[5]	Macklin[15]	Beaver[11]	Upper Rock[12]		
Mahala[8]	L. Whitehorse[6]	Marshall Can.[15]	Lewis[12]	Toe Jam[12]		
E.F. Sherman[9]	Anderson[7]	Portuguese[15]	Marysville[13]	Tierney[13]		
Sherman[9]	Conners[7]	Cow[15]	S.F. Indian[14]			
Pearl[10]	California[8]	Morrison[15]				

APPENDIX C (continued, page 2 of 2)

Population Size						
<100	100-500	500-1000	1000-2000	2000-5000	5000-10000	>10000
Gennette[10]	Cole Canyon[8]					
P.Hanson[15]	Road Canyon[8]					
L.Alvord[15]	2nd Boulder[9]					
Pike[15]	Dixie[10]					
Van Horn[15]	Welch[10]					
Denio[15]	Carville[10]					
Cottonwood[15]	Cottonwood[10]					
L. McCoy[15]	Maggie[11]					
Antelope[15]	Frazier[12]					
B. Alvord[15]	Secret[14]					
Willow[15]	E.Fork[15]					
	E.Fork,Trib.[15]					
	Milk Ranch[15]					
	O'Harrel[15]					
	Bettridge[15]					
Total Number of Populations Sampled (Percent Composition)						
24	28	13	12	11	3	1
(26.1)	(30.4)	(14.1)	(13.0)	(12.0)	(3.3)	(1.1)

APPENDIX E: LAHONTAN CUTTHROAT TROUT OCCUPIED AND POTENTIAL HABITATS

Populations are organized by basin and subbasin associations. They are divided into three major management units including: 1) Western Lahontan Basin, 2) Northwestern Lahontan Basin, and 3) Humboldt River Basin. All existing LCT populations are considered important until recovery objectives are determined. A list of potential LCT reintroduction sites is provided. Stream miles listed are approximate, based on most current information available, and are not meant to limit recovery management activities to a specific distance or segment of stream system. Land ownership is also referenced (BLM = Bureau of Land Management, FS = Forest Service, Pr. = Private, SLPT = Summit Lake Paiute Tribe).

Bold =	**Populations documented from 1976 to present through surveys.**
*** =**	**Introduced or reintroduced populations.**
Shaded =	**Populations determined best suited for recovery.**

I. WESTERN LAHONTAN POPULATION SEGMENT

Truckee River basin
No potential for a metapopulation exists within the Truckee River basin. Currently one lake with 700 surface acres, and seven small stream populations with 8.0 miles of occupied habitat support self-sustaining populations. Independence Creek and Independence Lake are one interrelated population.

Current or Recently Existing Populations
Independence Lake, CA (700 acres) FS, Pr.
Independence Creek, CA (1.0 miles) FS
Pole Creek*, CA (1.0 miles) FS
Upper Truckee River*, CA (4.5 miles) FS.
Bronco Creek*, NV (5.6 miles) FS, Pr.
Hill Creek*, NV
West Fork Gray Creek*, NV
East Fork Martis Creek*, CA
Pyramid Lake*, NV **(Artificially maintained hybrid population of Summit, Independence, Heenan, and Walker Lake strains)**

Potential Sites
Central Fork Gray Creek, NV
Deep Canyon Creek, NV
Silver Creek, CA
Deer Creek, CA
Hell Hole Creek, CA
Perazzo Creek, CA
Cold Stream Creek, CA

Carson River basin
No potential for a metapopulation exists within the Carson River basin. Currently six self-sustaining stream populations with about 9.5 miles of occupied habitat exists. Two lakes support managed populations of LCT.

Current or Recently Existing Populations
East Fork Carson River*, CA (5.0 miles) FS
Murray Canyon Creek*, CA (2.0 miles) FS
Raymond Meadows Creek*, CA (0.5 miles) FS
Poison Flat Creek*, CA (1.0 miles) FS
Golden Canyon Creek*, CA

Heenan Lake*, CA	**(Artificially maintained population of Independence Lake strain)**
Heenan Creek*, CA	**(Supports a limited, naturally maintained population of Carson River strain LCT which may be slightly introgressed with rainbow trout)**
Bull Lake*, CA	**(Supports a naturally maintained population of Carson River strain LCT which may be slightly introgressed with rainbow and Paiute cutthroat trout)**

Potential Sites
Horsethief Creek, CA
Willow Creek, CA
Charity Valley Creek, CA
Forestdale Creek, CA
Mountaineer Creek, CA
Jeff Davis Creek, CA
Charity Valley Creek, CA

Walker River basin
No potential for a metapopulation exists within the Walker River basin. Currently five self-sustaining stream populations with about 11.0 miles of occupied habitat exist.

Current or Recently Existing Populations
By-Day Creek, CA (2.0 miles) FS, Pr.
Murphy Creek*, CA (2.0 miles) FS
Slinkard Creek*, CA (2.0 miles) FS
Mill Creek*, CA (3.0 miles) FS
Bodie Creek*, CA and NV (2.0 miles) BLM, FS, Pr.

Walker Lake*, NV	**(Artificially maintained hybrid population of Walker, Pyramid, Heenan, Summit Lake, Yellowstone cutthroat trout, and unknown strains)**

Walker River basin (continued)

Potential Sites
Wolf Creek, CA (5.0 miles) FS
Silver Creek, CA
Atastra Creek, CA
Lower Slinkard Creek, CA
Rough Creek, CA and NV
Aurora Canyon Creek, CA
Clearwater Creek, CA
Cottonwood Creek, CA
Slinkard Creek, tributaries 1 & 2, CA

II. NORTHWESTERN LAHONTAN BASIN POPULATION SEGMENT

Black Rock Desert Basin
This basin has the potential for a small metapopulation associated with Summit Lake and its tributary streams, Mahogany, Summer Camp, and Snow Creek. Summit Lake has about 600 surface acres, and the four streams have about 14 miles of occupied habitat. Both lacustrine and fluvial forms of LCT occur in the Summit Lake basin.

Current or Recently Existing Populations
Summit Lake, NV (600 acres) SLPT
Mahogany Creek, NV (12.0 miles) BLM, SLPT
Summer Camp Creek, NV (3.5 miles) BLM, Pr.
Snow Creek*, NV (4.6 miles) BLM, SLPT
Upper Leonard Creek*, NV (2.0 miles) BLM, Pr.

Potential Sites
Chicken Creek, NV
North Fork Battle Creek, NV
Big Creek, Pine Forest Range, NV
Happy Creek, NV
Mary Sloan Creek, NV
Rodeo Creek, NV
Granite Creek, NV
Colman Creek, NV
House Creek, NV
Cold Springs Creek, NV
Red Mountain Creek, NV
Raster Creek, NV
Bartlett Creek, NV
Paiute Creek, NV
Jackson Creek, NV
Donnelly Creek, NV
Cottonwood Creek, NV
Log Cabin Creek, NV

Quinn River Basin
This basin has a very limited potential for metapopulation development within the upper McDermitt Creek area. Recent surveys have documented LCT in eleven streams with about 44.0 miles of habitat. Some populations are very low in abundance and may have undergone extinction from recent drought impacts.

Current or Recently Existing Populations
Sage Creek, NV and OR (8.0 miles) BLM
Line Canyon Creek, OR (2.5 miles) BLM
Washburn Creek, NV (11.7 miles) BLM,Pr.
Crowley Creek, NV (18.3 miles) BLM,Pr.
Riser Creek, NV (16.0 miles) BLM,Pr.
Eight-mile Creek, NV (4.5 miles) FS
South Fork Flat Creek, NV (1.0 miles) FS
Indian Creek*, OR (5.0 miles) BLM, Pr.
Rock Creek, Montana Range, NV, BLM
East Fork Quinn River, NV, FS
Rebel Creek, NV, FS

Potential Sites
Andorno Creek, NV, FS
McDermitt Creek, NV and OR, BLM, Pr.
Flat Creek, NV, FS
Cottonwood Creek*, OR (4.0 miles) BLM, Pr.
Ten Mile Creek*, OR (5.0 miles) BLM, Pr.

Coyote Lake Subbasin
A small metapopulation exists with Whitehorse Creek and its tributary streams. No potential for expansion of this metapopulation exists. Ten streams with approximately 56.3 miles of occupied habitat exists. This basin can be managed for LCT with no additional introductions with priorities on habitat management.

Current or Recently Existing Populations
Whitehorse Creek, OR (20.0 miles) BLM,Pr.
Little Whitehorse Creek, OR (10.3 miles) BLM,Pr.
Fifteen Mile Creek*, OR (1.0 miles) BLM,Pr.
Doolittle Creek, OR (5.0 miles) BLM, Pr.
Cottonwood Creek*, Tributary to Whitehorse, OR (1.5 miles) BLM, Pr.
Little Whitehorse Creek, Trib. B., OR (3.5 miles) BLM, Pr.
Willow Creek, OR (13.0 miles) BLM, Pr.
Willow Creek, Trib. E. OR (2.0 miles)
Antelope Creek*, OR
Twelve Mile Creek*, OR

Potential Sites
Fish Creek, OR

III. HUMBOLDT RIVER BASIN POPULATION SEGMENT

Marys River Subbasin

This subbasin has the most significant metapopulation potential with most of the system occupied by LCT. A total of 17 streams within the subbasin have been identified as LCT habitat, or important spawning tributaries during normal and wet cycles. An estimated 68.7 miles of habitat exists for LCT in a network of interconnecting streams. This subbasin can be managed with existing LCT populations with priorities on habitat management.

Current or Recently Existing Populations

Marys River, NV (25.0 miles) FS, BLM, Pr.
Anderson Creek, NV (2.1 miles) FS, BLM, Pr.
Camp Draw Creek, NV (.5 miles) FS
Chimney Creek, NV (2.0 miles) FS, BLM
Conners Creek, NV (1.0 miles) BLM
Cutt Creek, NV (5.0 miles) BLM
Draw Creek, NV (2.0 miles) FS, BLM
East Fork Marys River, NV (4.0 miles) FS
Hanks Creek, NV (14.0 miles) BLM
Marys River Basin Creek, NV (2.3 miles) FS
T Creek, NV (5.2 miles) FS, BLM, Pr.
West Fork Marys River, NV (3.8 miles) FS
Wildcat Creek, NV (.8 miles) FS, BLM, Pr.
Basin Creek, NV (.5 miles) FS
GAWS Creek, NV (.1 mile) FS
Short Creek, NV (.1 mile) FS
Williams Basin Creek, NV (.3 miles) FS

Potential Sites

Currant Creek, NV, BLM, Pr.

North Fork Humboldt River Subbasin

During cooler cycles and normal to wet years the North Fork subbasin has metapopulation potential from the headwaters downstream to the confluence of Pie Creek. Otherwise many of the streams within this subbasin are isolated from intermixing of gene pool stock. This subbasin currently has 12 stream populations where LCT have been observed in recent years with a total of 44.1 miles of occupied habitat. This subbasin can be managed of LCT with existing populations with priorities on habitat management.

Current or Recently Existing Populations

North Fork Humboldt River, NV (20 miles) FS, BLM, Pr.
California Creek, NV (2.4 miles) FS, Pr.
Foreman Creek, NV (6.0 miles) FS, Pr.
Gance Creek, NV (2.8 miles) FS, Pr.
Cole Canyon Creek, NV (1.0 miles) FS
Road Canyon Creek, NV (1.3 miles) FS
Warm Creek, NV (1.0 miles) FS, Pr
Mahala Creek, NV (1.6 miles) FS, BLM, Pr.

North Fork Humboldt River Subbasin (continued)
Pie Creek, NV (.5 miles) BLM, Pr.
Jim Creek, NV (3.0 miles) FS, Pr.
Winters Creek, NV (3.0 miles) FS, Pr.
Dorsey Creek, NV (1.5 miles) BLM, Pr.

Potential Sites
Beaver Creek, NV
Pratt Creek, NV
West Fork Beaver Creek, NV

East Humboldt River Area
The East Humboldt River drainage area includes six isolated streams with about 13.2 miles of occupied habitat. Displacement of LCT by introduced trout is a major problem in this subbasin. All populations are remnant populations isolated from each other with no metapopulation potential.

Current or Recently Existing Populations
Fourth Boulder Creek, NV (3.9 miles) FS
Second Boulder Creek, NV (.7 miles) FS
East Fork Sherman Creek*, NV (2.0 miles) BLM, Pr.
Sherman Creek*, NV (2.0 miles) BLM, Pr.
Conrad Creek, NV (1.5 miles) FS
North Fork Cold Creek, NV (3.1 miles) FS, Pr.

Potential Sites
John Day Creek, NV

South Fork Humboldt River Subbasin
The South Fork Humboldt River subbasin supports a number of small, isolated LCT populations. There is currently no metapopulation potential within this subbasin. Displacement by introduced trout species is significantly impacting LCT in the Ruby Mountains and remnant LCT populations are declining. As many as 20 populations existed in the 1970's with about 57.7 miles of habitat, but these populations have decreased to about 8-10 by 1990. Currently as few as six streams may have 20 miles of occupied habitat.

Current or Recently Existing Populations
Dixie Creek, NV (7.0 miles) BLM, Pr.
Lee Creek, NV (1.3 miles) FS
North Furlong Creek, NV (4.5 miles) FS
Pearl Creek*, NV (4.0 miles) FS, BLM, Pr.
Welch Creek, NV (2.2 miles) FS
Carville Creek, NV (1.4 miles) FS, Pr
Gennette Creek, NV (1.0 miles) FS, Pr.
Cottonwood Creek, NV (.3 miles) FS
Mitchell Creek*, NV (1.3 miles) FS, Pr.
North Fork Mitchell Creek*, NV (5.0 miles) FS, Pr.
Green Mountain Creek, NV (.4 miles) FS

South Fork Humboldt River Subbasin (continued)
North Fork Green Mountain Creek, NV (3.8 miles) FS
Mahogany Creek, NV (3.9 miles) FS
Segunda Creek, NV (1.7 miles) FS
Long Canyon Creek, NV (5.0 miles) FS, Pr.
Rattlesnake Creek, NV (1.3 miles) FS, Pr.
McCutcheon Creek, NV (2.5 miles) FS, Pr.
Smith Creek, NV (2.2 miles) FS, Pr.
Middle Fork Smith Creek, NV (6.0 miles) FS
North Fork Smith Creek, NV (2.9 miles) FS

Potential Sites
Brown Creek, NV

Maggie Creek Subbasin
This subbasin has a small metapopulation potential which includes all the LCT streams within the area during normal and above normal water years. The subbasin has seven streams with remnant populations of LCT present occupying about 13.6 miles of stream habitat. This subbasin can be managed with existing LCT populations with priorities on habitat management in the Maggie Creek system downstream to the narrows.

Current or Recently Existing Populations
Maggie Creek, NV (4.0 miles) BLM, Pr.
Beaver Creek, NV (2.8 miles) BLM, Pr.
Coyote Creek, NV (4.8 miles) BLM, Pr.
Little Jack Creek, NV (1.0 miles) BLM, Pr.
Toro Canyon Creek, NV
Williams Canyon Creek, NV (1.0 miles) BLM, Pr.
Little Beaver Creek, NV

Potential Sites
Susie Creek, NV

Rock Creek Subbasin
This subbasin has a small metapopulation potential including the streams above Willow Creek Reservoir during normal to wet years. Six stream populations exist with 24.9 miles of occupied habitat. An occasional LCT is found in Willow Creek Reservoir from downstream migration from tributary streams. This subbasin can be managed with existing LCT populations with priorities on habitat management.

Current or Recently Existing Populations
Frazier Creek, NV (1.5 miles) BLM, Pr.
Lewis Creek, Nv (3.8 miles) BLM, Pr.
Nelson Creek, NV (2.6 miles) BLM, Pr.
Upper Rock Creek, NV (10.0 miles) BLM, Pr.
Toe Jam Creek, NV (6.0 miles) BLM, Pr.
Upper Willow Creek, NV (1.0 miles) BLM, Pr.
Willow Creek Reservoir, NV, Pr.

Reese River Subbasin
This subbasin has no metapopulation potential. Competition from introduced trout species restricts abundance of LCT. This subbasin has nine streams segments with LCT which occupy more than 33.3 miles of habitat.

Current or Recently Existing Populations
Marysville Creek, NV (5.0 miles) FS, Pr.
Tierney Creek, NV (8.0 miles) FS, Pr.
Washington Creek*, NV (7.0 miles) FS, Pr.
Crane Canyon Creek, NV (1.0 miles) FS
Stewart Creek, NV (1.0 miles) FS, Pr.
North Fork Stewart Creek, NV (1.7 miles) FS
Middle Fork Stewart Creek, NV (.6 miles) FS
Cottonwood Creek, NV (2.0 miles) FS, Pr.
Mohawk Creek, NV (7.0 miles) FS, Pr.

Potential Sites
Illinois Creek, NV, FS
Corral Creek, NV, FS

Little Humboldt River Subbasin
This subbasin has a small metapopulation associated with the South Fork Little Humboldt River and its tributaries, and a number of isolated populations associated with the North Fork Little Humboldt River. The South Fork Little Humboldt River system can be managed with existing LCT populations with priorities on habitat management. Recent surveys have documented about fifteen streams with about 58.0 miles of occupied habitat.

Current or Recently Existing Populations
South Fork Little Humboldt River, NV (16.0 miles) BLM, Pr.
Secret Creek, NV (2.5 miles) BLM
Sheep Creek, NV (3.0 Miles) BLM
Pole Creek, NV (4.3 Miles) BLM, Pr.
Indian Creek, NV (5.5 miles) FS, BLM, Pr.
South Fork Indian Creek, NV (4.5 miles) FS
Abel Creek, NV (4.0 miles) FS
Long Canyon Creek, NV (4.5 miles) FS
Lye Creek, NV, FS
Mullinex Creek, NV, FS
Deep Creek, NV (4.7 miles) FS
Road Canyon Creek, NV (4.8 miles) FS
North Fork Little Humboldt River, NV, FS
Dutch John Creek, NV, FS
Round Corral Creek, NV (4.2 miles) FS, Pr.

Potential Sites
Singas Creek, NV, FS
Stonehouse Creek, NV (4.0 miles) FS
North Fork Cabin Creek, NV

Lower Humboldt River Area
Habitat for LCT in the Lower Humboldt River area is restricted to about 4.0 miles. The only existing population occurs in Rock Creek in the Sonoma Range. No other LCT populations are proposed for this area.

Current or Recently Existing Populations
Rock Creek*, Sonoma Range, NV (4.0 miles) BLM, Pr.

IV. OUT OF BASIN POPULATIONS

Interior Nevada Basins
Introductions of LCT have been made in a number of historically barren stream systems throughout central Nevada during the past century. The following waters are known to have LCT present. Some populations are of recent origin.

Pete Hanson Creek*, Pine Creek subbasin, NV (0.5 miles) BLM
Decker Creek*, Toiyabe Range, NV (1.0 miles) FS, Pr.
Santa Fe Creek*, Toiyabe Range, NV (3.0 miles) FS
Shoshone Creek*, Toiyabe Range, NV (3.0 miles) FS
Edwards Creek*, Desatoya Range, NV (5.6 miles) BLM, Pr.
Topia Creek*, Desatoya Range, NV (.5 miles) BLM
West Fork Deer Creek*, Snake Range, NV (2.5 miles) BLM, Pr.
Mosquito Creek*, Monitor Range, NV (1.0 miles) FS
Willow Creek*, Desatoya Range, NV (2.0 miles) BLM
North Fork Pine Creek*, Toquima Range, NV
South Fork Thompson Creek*, Ruby Mountains, NV (1.0 miles) FS

Alvord Lake Basin, Oregon
Nine isolated populations of LCT have been introduced into the Alvord Lake subbasin in Oregon from Coyote Lake subbasin between 1970 and 1980. Surveys conducted through 1983 indicate seven populations may currently exist. Willow and Mosquito Creeks may contain LCT, but their presence has not been confirmed (Hanson et al. 1993). No pure Alvord Lake subbasin LCT currently exists, although hybrid populations exist in Trout Creek, OR, and Virgin Creek, NV.

Little Alvord Creek*, Steens Mountains, OR
Pike Creek*, Steens Mountains, OR
Cottonwood Creek*, Steens Mountains, OR
Little McCoy Creek*, Steens Mountains, OR
Willow Creek*, Steens Mountains, OR
Big Alvord Creek*, Steens Mountains, OR
Mosquito Creek*, Steens Mountains, OR
Van Horn Creek*, Pueblo Mountains, OR
Denio Creek*, Pueblo Mountains, OR

Out-of-Basin Populations (continued)

California Basins
Many streams in California were stocked with LCT during the past century. The following streams have documented LCT populations.

Yuba River system streams
Macklin Creek*, CA (1.0 miles)
East Fork Creek*, CA (0.5 miles)
Unnamed tributary to East Fork Creek*, CA (0.7 miles)

Stanislaus River system streams
Disaster Creek*, CA (2.0 miles)

Mokelumne River system streams
Marshall Canyon Creek*, CA (1.5 miles)
Milk Ranch Creek*, CA (1.0 miles)

San Joaquin River system streams
West Fork Portuguese Creek*, CA (1.5 miles)
Cow Creek*, CA (2.0 miles)

Owens River system streams
O'Harrel Creek*, CA (2.0 miles)

Utah Bonneville Basins
The following Utah waters have documented LCT populations.

Bettridge Creek*, UT (1.0 miles)
Morrison Creek* (Donner Creek), UT (1.0 miles)
Spring Creek*, UT
Camp Creek Reservoir*, UT

APPENDIX F:
DEFINITIONS

Activity Plan - is a detailed and specific plan for a single resource program to implement the more general resource management plan decisions (BLM 1991).

Adfluvial - Migrating between lakes and rivers or streams.

Alleles - one of several alternate states of a gene.

Basibranchial teeth - Teeth borne on the median ventral plate overlying basibranchial bones between the gill arches (Behnke 1992). Also known as hyoid teeth (Trotter 1987). The development of basibranchial teeth is a character used to distinguish between cutthroat trout and rainbow trout (Trotter 1987).

Basin - A hydrologic area with a common drainage system.

Branchiostegal rays - Bony processes that support the membranes enclosing the gill chamber, below the operculum (gill cover) (Behnke 1992). The number of branchiostegal rays is a meristic character used to separate various subspecies of cutthroat trout (Trotter 1987).

Closed population - An isolated population of individuals that receives no immigrants from other populations (Thomas et al. 1990).

Cover - Anything that provides visual or physical protection for an animal. Cover for fish includes vegetation that overhangs the water, undercut banks, rocks, logs and other woody debris, turbulent water surfaces, and deep water.

Demographic stochasticity - Random fluctuations in birth and death rates (Thomas et al. 1990).

Deterministic extinctions - Extinctions caused by permanent or long-term change of a critical component of habitat.

DNA - Deoxyribonucleic acid, the hereditary material of genes. Most DNA is organized into chromosomes within cell nuclei, but about 1% of a cell's DNA resides in mitochondria. Modern analytical techniques allow DNA fragments to be compared between individuals and species, providing a powerful taxonomic and systematic tool (Compare *mitochondrial DNA*)(Behnke 1992).

Ecosystem - An interacting natural system in which the component organisms and the abiotic environment function as a whole (BLM 1991).

Effective population size - The number of individuals actually contributing genes to the next generation.

Electrophoresis - A technique used to detect variation in proteins, involving the use of an electric field to cause the proteins to migrate along a gel (commonly starch) and then observing their relative positions on the gel by protein-specific stains (Thompson et al. 1987; Utter et al. 1987). Because each protein--and each variant of a protein--is uniquely coded by DNA, electrophoretic analysis of proteins provides evidence of an organism's genetic makeup (Behnke 1992).

Endangered species - Endangered species as defined by the Endangered Species Act of 1973 and amended in 1988, is any species of animal or plant which is in danger of extinction throughout all or a significant portion of its range.

Environmental stochasticity - Random variation in environmental attributes (Thomas et al. 1990).

Epilimnion - A warmer less dense upper stratum of lakes resulting from thermal stratification.

Fluvial - Living in or pertaining to rivers.

Founder effect - Genetic drift due to the founding of a population by a small number of individuals.

Genetic stochasticity - Random changes in genetic variation caused by such factors as inbreeding, which can alter the survival and reproductive probabilities of individuals.

Genetic variation - Differences of the genetic constitution possessed by an individual or population.

Genetic drift - Variation in gene frequency from one generation to another.

Gene frequency - A descriptive measure to describe how often a particular gene is encountered among a random sample of individuals (Thomas et al. 1990).

Gill rakers - Bony processes arrayed along gill arches. The rakers divert solid objects from the respiratory gill filaments and also trap food particles from the water (Behnke 1992). The number of gill rakers is a meristic character used to separate various subspecies of cutthroat trout (Trotter 1987).

Great Basin - An area of the western United States located between the Rocky Mountains and the Sierra Nevada that has no drainage to the sea. Includes parts of Nevada, Utah, Oregon, California, Idaho, and Wyoming and is comprised of more than 200 interior drainages.

Green line - A specific area where a more or less continuous cover of perennial vegetation is encountered when moving away from the perennial water source.

Lacustrine - Living in or pertaining to lakes.

Lahontan basin - A major basin within the Great Basin that was fed by the Truckee, Carson, Walker, Susan, Quinn, and Humboldt Rivers. It has a drainage or hydrologic area of about 45,000 square miles and during the Pleistocene contained 8,500 square mile Lake Lahontan. The Lahontan basin encompasses much of northern Nevada and parts of eastern California and southern Oregon.

Lateral series - The scales along the length of the fish two rows up from the lateral line (Behnke 1992). The number of scales comprising the lateral series is a meristic character used to separate various subspecies of cutthroat trout (Trotter 1987).

Metapopulation - A population comprised of a set of populations that are linked by migration, allowing for recolonization of unoccupied habitat patches after local extinction events (Thomas et al. 1990).

Mitochondrial DNA (mtDNA) - DNA housed within mitochondria. All mtDNA molecules are inherited from the mother and they are identical within an individual, though they may vary among individuals. Mitochondrial DNA molecules are smaller than nuclear DNA molecules and hence easier to analyze; they also mutate more readily, facilitating diagnosis of individuals and species (Behnke 1992).

Model - An idealized representation of reality developed to described, analyze, or understand the behavior of some aspect of it; a mathematical representation of the relationships under study (Thomas et al. 1990).

Population viability analysis (PVA) - The estimation of extinction probabilities by analyses that incorporate identifiable threats to population survival into models of the extinction process. Population viability analysis determines the number of individuals or populations required to achieve a specified level of viability.

Proper functioning condition - The functioning condition of riparian/wetlands is a result of interactions among geology, soil, water, and vegetation. Riparian/wetland areas are functioning properly when adequate vegetation is present to dissipate stream energy associated with high water flows, thereby reducing erosion and improving water quality; filter sediment and aid floodplain development; improve floodwater retention and groundwater recharge; develop root masses that stabilize streambanks against cutting action; develop diverse pond and channel characteristics to provide habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and support greater biodiversity (BLM 1991).

Pyloric caeca - Tubular pouches extending from and opening into the posterior stomach or anterior intestine (Behnke 1992). The number of pyloric caeca is a meristic character used to separate various subspecies of cutthroat trout (Trotter 1987).

Recovery - The process by which the decline of an endangered or threatened species is arrested or reversed, and threats to its survival are neutralized, so that its long-term survival in nature can be ensured (USFWS 1990).

Recovery Plan - A document which delineates, justifies, and schedules the research and management actions necessary to support recovery of a species, including those that, if successfully undertaken, are likely to permit reclassification or delisting of the species (USFWS 1990).

Riparian area - Lands adjacent to creeks, streams, and rivers where vegetation is strongly influenced by the presence of water (Chaney et al. 1990).

Species - The term "species" for the purposes of the Endangered Species Act of 1973 as amended in 1988, is any subspecies of fish or wildlife or plants, and any distinct populations segment of any species or vertebrate fish or wildlife which interbreeds when mature.

Stochastic - Subject to random (chance) variation. A stochastic process or model proceeds at rates that can vary unpredictably, and its outcome can be calculated only in terms of probabilities (Behnke 1992).

Streamside Management Zone (SMZ) - A designated zone that consists of the stream and an adjacent area of varying width where management practices that might affect water quality, fish, or other aquatic resources are modified. It is a zone which acts as an effective filter and adsorptive zone for sediment; maintains shade; protects aquatic and terrestrial riparian habitats; protects channel and streambanks; and promotes floodplain stability. The zone may be wider than just the riparian area (Platts 1990).

Subbasin - A hydrologic subunit of a river basin, e.g., the Marys River subbasin is a subunit of the Humboldt River basin, and the Humboldt River drainage basin is a subunit of the Lahontan basin.

Subpopulation - A well-defined set of interacting individuals that comprise a proportion of a larger, interbreeding population (Thomas et al. 1990).

Threatened species - Threatened species as defined by the Endangered Species Act of 1973 as amended in 1988, is any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Viable Population - The minimum conditions for the long-term persistence and adaptation of a species or population in a given place (Soulé 1987, Koenig 1988).

APPENDIX G:
PUBLIC COMMENTS

The Technical/Agency Draft Recovery Plan for Lahontan Cutthroat Trout *Oncorhynchus clarki henshawi* (Salmonidae) was made available to the public for comment as required by the 1988 amendments to the Endangered Species Act of 1973, as amended. The public comment period was announced in the Federal Register on February 24, 1993, and closed on April 26, 1993. The Service solicited comments on the document from individuals and/or agencies identified below. Before completion of this final recovery plan, the Service received 75 response letters from individuals or agencies as denoted by * on the list below. Consolidated agency comments are denoted by (*). Individuals who provided verbal or written comments given at two public meetings coordinated by the Elko County Commissioners on April 21, 1993 and by the Humboldt County Commissioners on May 25, 1993 are listed on pages G-17 and G-18, respectively. The comments provided in these letters and meetings were considered in preparation of this final recovery plan, and incorporated as appropriate.

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