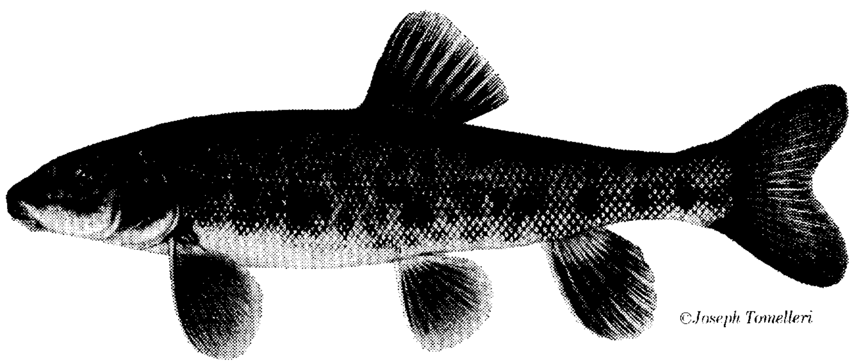
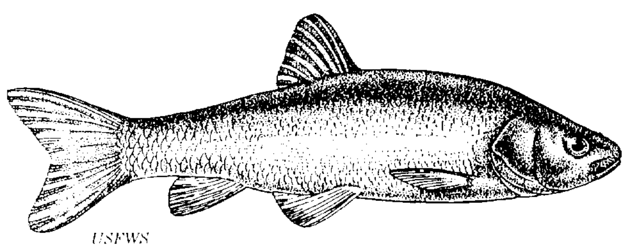
U.S. Fish & Wildlife Service

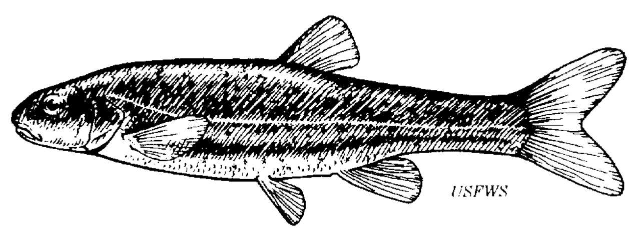
Recovery Plan for the Threatened and Rare Native Fishes of the Warner Basin and Alkali Subbasin



Warner Sucker
(Castostomus warnerensis)



Hutton Tui Chub
(Gila bicolor ssp.)



Foskett Speckled Dace
(Rhinichthys osculus ssp.)

RECOVERY PLAN FOR THE NATIVE FISHES OF THE WARNER BASIN AND ALKALI SUBBASIN:

Warner sucker (Threatened) ***Catostomus warnerensis***
Hutton tui chub (Threatened) ***Gila bicolor*** **ssp.**
Foskett speckled dace (Threatened) ***Rhinichthys osculus*** **ssp.**

Prepared By
U.S. Fish and Wildlife Service
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for
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Portland, Oregon

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

Date: 4/27/98

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Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect listed species. Plans are published by the U.S. Fish and Wildlife Service, sometimes prepared with the assistance of recovery teams, contractors, State agencies, and others. Plans are reviewed by the public and submitted to additional peer review before they are adopted by the Service. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Costs indicated for task implementation and/or time of achievement of recovery are estimates and subject to change. Recovery plans do not necessarily represent the views nor official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S. Fish and Wildlife Service **only** after they have been signed by the Regional Director or Director as **approved**. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

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ACKNOWLEDGMENTS

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EXECUTIVE SUMMARY

Current Status: The Warner sucker was federally listed as threatened in September 1985. The Foskett speckled dace and the Hutton tui chub were federally listed as threatened in March 1985. These three fishes are listed as threatened by the state of Oregon, and the Warner sucker is also listed by the State of Nevada as sensitive. There is essentially one metapopulation of the Warner sucker which is endemic to the streams and lakes geographically delineated by the Warner Basin. There are two known populations of the Foskett speckled dace which are found in Foskett and Dace Springs in the Coleman Subbasin of the Warner Basin. One population of the Hutton tui chub remains and is found in Hutton Spring in the Alkali Subbasin. Two other rare native fishes addressed in this plan occur within the Warner Basin, the Cowhead Lake tui chub (proposed endangered as of March 1998) and the Warner Valley redband trout. The Warner Basin includes portions of southeast Oregon, northern Nevada and northern California, the Alkali Subbasin is situated in Oregon.

Habitat Requirements and Limiting Factors: The Warner sucker inhabits the lakes and low gradient stream reaches of the Warner Valley. Lake morph and stream morph suckers are known to occur. The lake morph suckers normally spawn in the streams, but are often blocked from doing so by irrigation diversion structures or during low water years. Large lake-dwelling populations of introduced fishes have probably reduced recruitment by predating on young suckers. Stream habitat degradation has reduced suitable habitat and probably reduced the ability of stream morph suckers to withstand floods and droughts. The Warner sucker and the Warner Valley redband trout occupy similar habitats in the same watersheds (redband trout also occupy headwater reaches), so impacts affecting Warner suckers would also affect Warner Valley redband trout. The Foskett speckled dace and the Hutton tui chub inhabit isolated spring habitats. These areas are currently stable, but extremely restricted. Any alterations to the springs or surrounding activities that indirectly modify the springs containing these two species could lead to the extinction of these species. The Foskett speckled dace and the Hutton tui chub occupy spring habitats that are similar to each other but are in different watersheds. The general degradation of these spring habitats is a common problem throughout the basins of southeast Oregon. The Cowhead Lake tui chub occurs in Cowhead Slough, drainage ditches in historic Cowhead Lake and potentially spring habitats in the Cowhead Lake basin. These areas are similarly degraded from human/grazing impacts.

Recovery Objective: This recovery plan outlines steps designed to recover the Warner Basin and Alkali Subbasin aquatic ecosystems with specific goals for the listed species (Warner sucker, Hutton tui chub, Foskett speckled dace). Where information exists, other aquatic species are included (Warner Valley redband trout and Cowhead Lake tui chub) with the assumption that measures to improve the entire watershed will benefit other aquatic species. This recovery plan proposes different primary objectives for the three threatened species. The primary objective for the Warner sucker is the eventual delisting of the species. The Foskett speckled dace and Hutton tui chub will probably not be delisted in the near future because of their extremely isolated ranges and potential for degradation of these habitats from localized events. The primary objective, therefore, is the long-term persistence of these two species through preservation of their native ecosystems.

Warner sucker	Delisting
Hutton tui chub	Long-term persistence and conservation of their native ecosystem
Foskett speckled dace	Long-term persistence and conservation of their native ecosystem

Recovery Criteria: The Warner sucker may be considered for delisting when:

1. A self-sustaining metapopulation (a group of populations of one species coexisting in time but not in space) is distributed throughout the Twentymile, Honey, and Deep Creek (below the falls) drainages, and in

Pelican, Crump, and Hart Lakes. Self-sustaining populations will be determined based on parameters such as:

- multiple age-classes, including adults, juveniles, and young of the year, which approximate normal frequency distributions,
- a stable or increasing population size,
- documented reproduction and recruitment, and
- Self-sustaining populations form a viable metapopulation, large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural habitat changes.

2. Passage is restored within and among the Twentymile, Honey and Deep Creek (below the falls) drainages so that the individual populations of Warner suckers can function as a metapopulation.
3. No threats exist that would likely threaten the survival of the species over a significant portion of its range.

The conservation and long term sustainability of the Hutton tui chub and the Foskett speckled dace, will be met when:

1. Long-term protection to their respective habitats, including spring source aquifers, spring pools and outflow channels, and surrounding lands, is assured.
2. Long-term habitat management guidelines are developed and implemented to ensure the continued persistence of important habitat features and include monitoring of current habitat and investigation for and evaluation of new spring habitats.
3. Research into life-history, genetics, population trends, habitat use and preference, and other important parameters is conducted to assist in further developing and/or refining criteria 1) and 2), above.

Actions Needed: For Warner sucker, Hutton tui chub and Foskett speckled dace:
1. Protect and rehabilitate listed fish populations and habitat.
2. Conserve genetic diversity of populations of listed fishes.
3. Ensure adequate water supplies are available for listed fish recovery.

4. Monitor listed fish populations and habitat conditions.
5. Evaluate long-term effects of climatic trends on the recovery of listed fish.

Recovery Cost: Many costs associated with Warner sucker, Foskett speckled dace, and Hutton tui chub recovery will depend on research results and management plans that are yet to be completed. Given that, however, an attempt was made to come up with an estimate for the total cost of recovery. The estimated cost is $4.2 million. This number will need to be modified as costs are further refined.

Date of Recovery: Delisting of the Warner sucker could be initiated in 2015, if recovery criteria are met.

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I. INTRODUCTION

Brief Overview

This recovery plan provides information to guide recovery of the threatened native fishes of the Warner Basin and the Alkali Subbasin in southeastern Oregon. This plan focuses on improving the aquatic ecosystem of three species listed as threatened in 1985, the Warner sucker (*Catostomus warnerensis*), the Foskett speckled dace (*Rhinichthys osculus* ssp.), and the Hutton tui chub *(Gila bicolor* ssp.). These three fishes are also listed as threatened by the state of Oregon (Oregon Natural Heritage Program 1995). The Warner sucker and the Foskett speckled dace occur in water bodies within the Warner Basin; the Hutton tui chub occurs in the adjacent Alkali Subbasin of the Chewaucan Basin (Figure 1). Two other rare native fishes occur in the Warner Basin and are included in this recovery plan; these are the Cowhead Lake tui chub (*Gila bicolor vaccaceps*) and the Warner Valley redband trout (*Oncorhynchus mykiss* ssp.). The recovery actions for the three threatened fishes are provided in section II. These fishes have declined in numbers due to modifications of their native habitat, an occurrence widespread in Oregon's Interior Basin (Figure 1). For this reason, Appendix 1 is included as it identifies four other adjoining basins and the rare native fishes inhabiting these basins that are also showing signs of decline. As a result, it may be of some utility to promote the recovery actions described in this plan as conservation tasks for the rare native fishes in these adjacent basins.

The aim of the recovery actions is to restore more natural aquatic habitat conditions throughout the Warner Basin and Alkali Subbasin. The recovery actions apply specifically to the three threatened species and the ecosystem they live in. The recovery actions emphasize using, where possible, natural processes to return specific habitats and watersheds that have been degraded by human impacts to more natural conditions. These processes should benefit other declining rare native fishes in the Warner Basin like the Cowhead Lake tui chub and Warner Valley redband trout. Therefore, instead of focusing on single

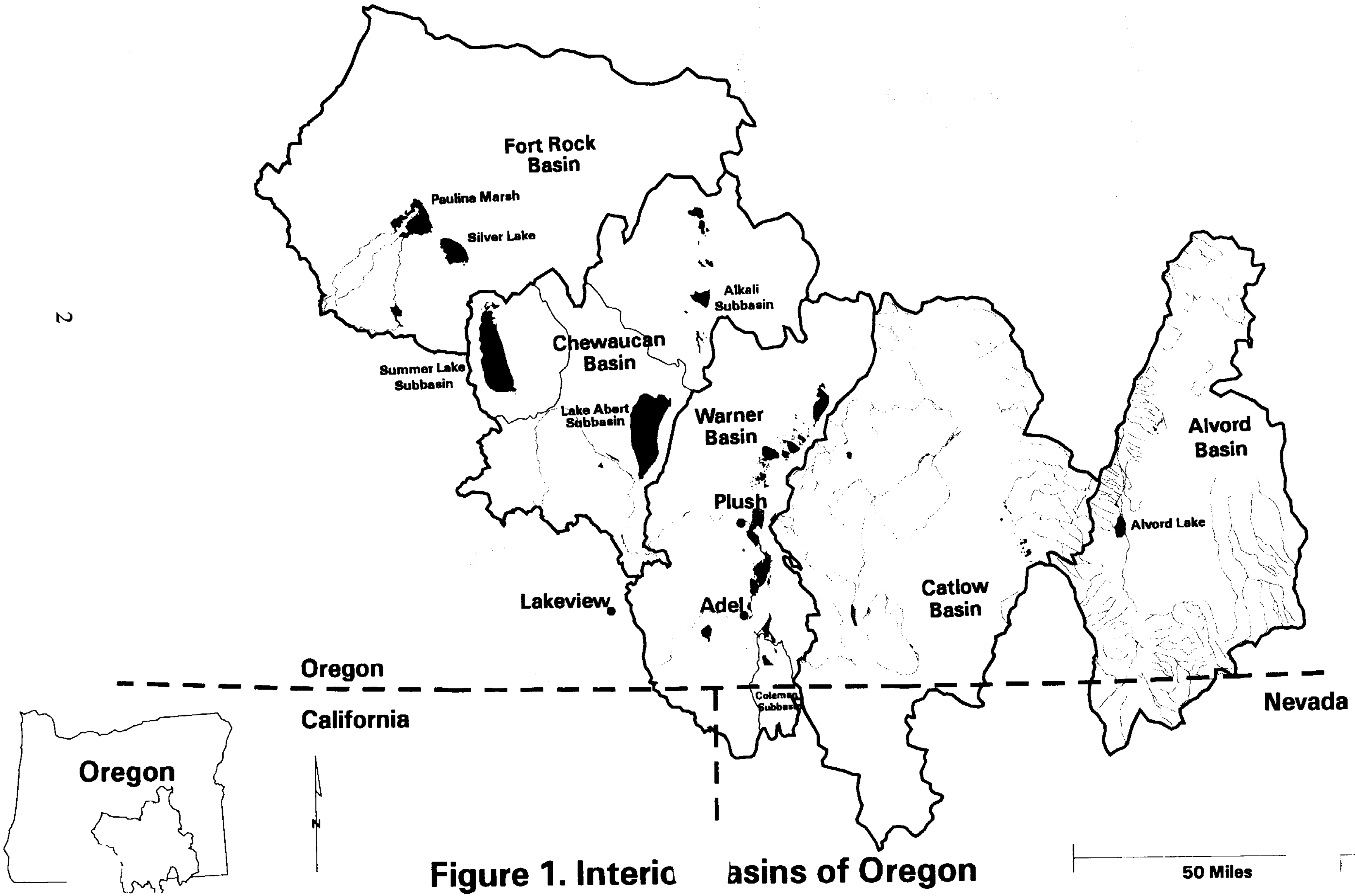

Figure 1. Interio asins of Oregon

species, the focus of this recovery plan is the conservation of the aquatic habitats in the Warner Basin and Alkali Subbasin of southeastern Oregon to conserve the variety of native fishes found within these habitats. Recovery actions that restore and conserve aquatic habitat conditions will benefit currently non-listed rare native fishes and may ensure their long term conservation. In accordance with the U.S. Fish and Wildlife Service's Recovery Priority Guidance (U.S. Fish and Wildlife Service 1983), based on a moderate degree of threat and a high recovery potential, the Warner sucker has been given a recovery priority of 8. The Hutton tui chub and the Foskett speckled dace each have been given a recovery priority of 18 based on their perceived low degree of threats and low recovery potential.

The majority of the information provided in this recovery plan addresses the Warner sucker because there is comparatively more information available for this species than for the Foskett speckled dace and the Hutton tui chub. Because of the technical nature of much of this recovery plan, a glossary has been provided on page 80. Any words, other than species names, written in "***bold italics***" have been defined in the glossary (Appendix III).

A. Physiographic Description

There are seven ***endorheic*** (closed with no outflow) basins in southeastern Oregon (Catlow, Chewaucan, Fort Rock, Goose Lake, Malheur-Harney, Alvord, and Warner) which make up the Great Basin portion of Oregon (Figure 1). The Warner Basin is divided into the Warner Lakes and Coleman Subbasins and the Chewaucan Basin is further divided into the Alkali, Lake Abert, and Summer Lakes Subbasins. Each basin has been created by the process of uplifting and tilting ***grabens*** (large sunken blocks of ground) and ***horsts*** (large uplifted blocks of ground) in a general north-south orientation. During the Pleistocene era (2 million to 10,000 years ago) each of these basins contained large lakes. Since this time there have been glaciations (wet periods) creating large lakes in each basin, and arid periods creating many smaller lakes in each basin (Hocutt and Wiley 1986). The result of these periodic episodes of isolation and joining of habitats has been differentiation, and in some instances, speciation of the native fishes of this region. Today (a period of isolation), the fish assemblages in each basin show varying levels of differentiation. The native fish fauna of each region has a core group of fishes generally consisting of one or more of the following; *Gila* sp. (chub), *Rhinichthys osculus* ssp. (speckled dace), *Oncorhynchus* sp.(trout) and *Catostomus* sp. (sucker). Because the three listed fishes occur in the Warner Basin and the Alkali Subbasin of the Chewaucan Basin, these two river basins are the focus for the biological discussions and recovery tasks identified within this recovery plan. Other rare native fishes occur throughout the other basins. Fishes within the Goose Lake and Harney-Malheur Basins are not included in this recovery plan because the species make-up of these basins is different enough to warrant individual attention.

The native fish assemblage in the Warner Basin consists of *Gila bicolor* (tui chub), *Gila bicolor vaccaceps* (Cowhead Lake tui chub), *Rhinichthys osculus* (speckled dace), *Rhinichthys osculus* ssp. (Foskett speckled dace), *Catostomus warnerensis* (Warner sucker), and *Oncorhynchus mykiss* ssp. (Warner Valley redband trout) (Williams et al. 1990). Introduced exotics are black crappie (*Pomoxis nigromaculatus*), white crappie (*Pomoxis annularis*), brown bullhead (*Ameiurus nebulosus*), and largemouth bass (*Micropterus salmoides*). The Alkali Subbasin contains only one fish taxon, the Hutton tui chub (*Gila bicolor* ssp.).

B. Description of Threatened and Rare Native Fishes of the Warner Basin and Alkali Subbasin

Threatened Fishes

Warner Sucker

Taxonomy

The Warner sucker was listed by the U.S. Fish and Wildlife Service (Service) as threatened in 1985 (U.S. Fish and Wildlife Service 1985a). Cope (1883) collected suckers he referred to as *Catostomus tahoensis* from the "third

Warner lake" (presumably Hart Lake) (Figure 2) although he noted differences in the size of scales between the Warner Lake suckers and *C. tahoensis* from Pyramid Lake, Nevada. The Warner sucker was recognized as distinct and described as a new species by J.O. Snyder (1908) based on specimens collected from the Warner Valley in 1897 and 1904. He reported the species from Warner Creek (now Deep Creek), sloughs south of Warner Creek, and Honey Creek. Relationships of the new sucker to existing species were not precisely defined, but Snyder (1908) noted affinities to *C. tahoensis* of the Lahontan Basin, and *C. catostomus* of wide distribution in northern North America. The distinctiveness of the Warner sucker as a species was confirmed by additional collections (Andreasen 1975, Bond and Coombs 1985). Relationships of the Warner sucker are clearly within the subgenus *Catostomus* (Smith 1966), although identification of the closest relative has remained elusive. Preliminary genetic results by Harris (P. Harris, Oregon State University, pers. comm., 1996) places the Warner sucker as a sister species to the Wall Canyon sucker of Nevada (species yet to be described). Morphologically, all these species are similar and probably the result of ***allopatric speciation*** (speciation in populations that are geographically isolated).

Description

The Warner sucker is a slender-bodied species that attains a maximum recorded ***Fork Length (FL)*** (the measurement on a fish from the tip of the nose to the middle of the tail where a "V" is formed) of 456 millimeters (17.9 inches). Pigmentation of sexually mature adults can be striking. The dorsal two-thirds of the head and body are blanketed with dark pigment, which borders creamy white lower sides and belly. During the spawning season, males have a brilliant red (or, rarely, bronze) lateral band along the midline of the body, female coloration is lighter. ***Breeding tubercles*** (small bumps usually found on the anal, caudal and pelvic fins during spawning season) are present along the anal and caudal fins of mature males and smaller tubercles occasionally occur on females (Coombs et al. 1979).

Sexes can be distinguished by fin shape, particularly the ***anal fin***, among sexually mature adults (Coombs et al. 1979). The anal fin of males is broad and

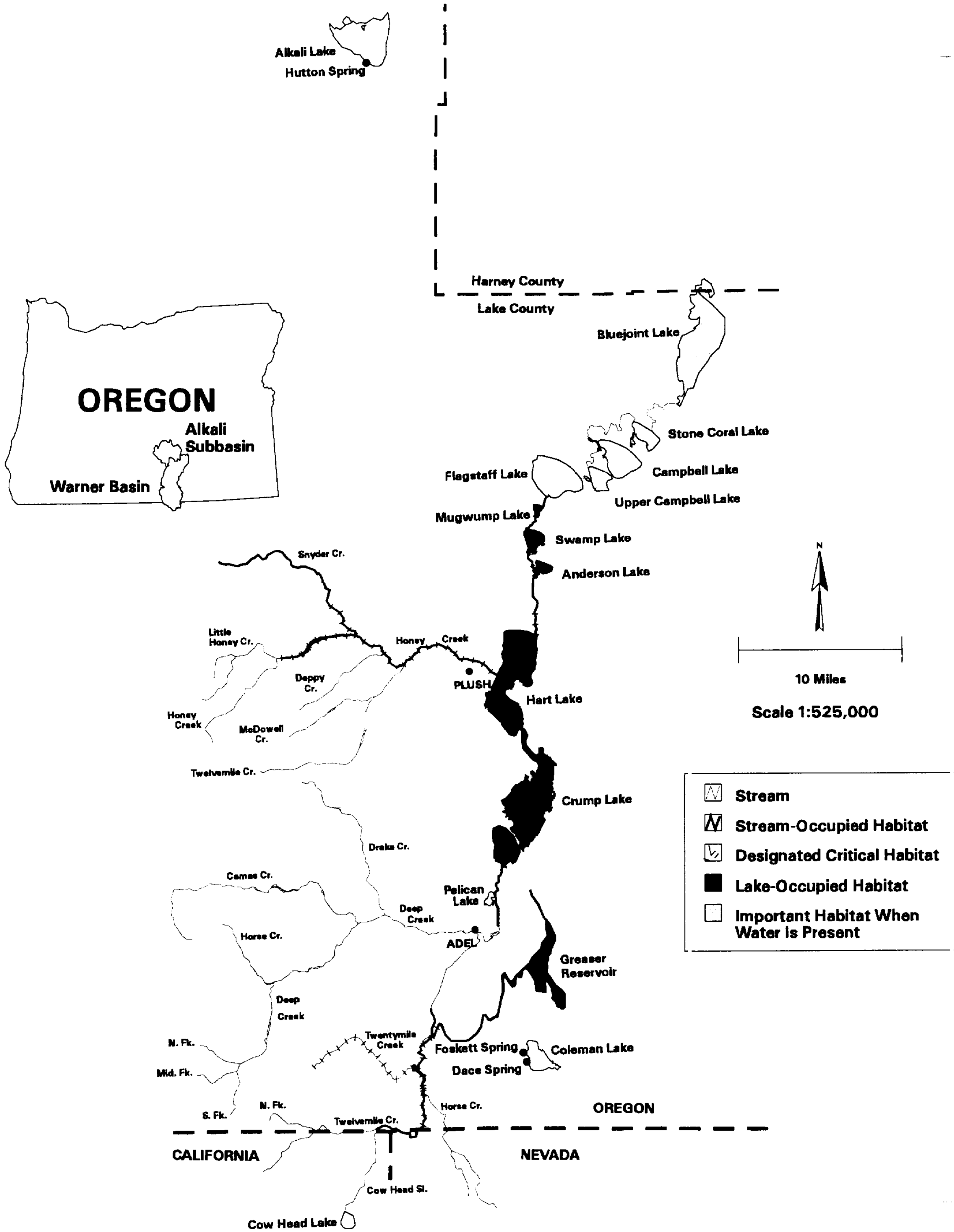

Figure 2. Map of the Warner Basin and Alkali Lake

rounded distally, whereas the female's is narrower in appearance and nearly pointed or angular. Bond and Coombs (1985) listed the following characteristics of the Warner sucker that differentiate it from other western species of *Catostomus*: ***dorsal fin*** base is short, its length typically less than, or equal to, the depth of the head; dorsal fin and ***pelvic fins*** have 9 to 11 rays; ***lateral line*** (microscopic canal along the body, located roughly at midside) has 73 to 83 scales, and greater than 25 scales around the ***caudal peduncle*** (rear, usually slender part of the body between the base of the last anal fin ray and the caudal fin base); the eye is small, 0.035 (3.5 percent ***Standard Length (SL)***) (straight-line distance from the tip of the snout to the rear end of the vertebral column) or less in adults; dark pigmentation is absent from the lower 1/3 of the body; in adults, a pigmented area extends around the snout above the upper lip; the membrane-covered opening between bones of the skull (fontanelle) is unusually large, its width more than one half the eye diameter in adults.

Hutton Tui Chub

Taxonomy

The Hutton tui chub was listed as threatened in 1985, (U.S. Fish and Wildlife Service 1985b). The Hutton tui chub (*Gila bicolor* ssp.) is an ***allopatric*** (occupying different geographical areas) form that is currently being described (hence, it has not yet received a subspecific name). Bills (1977) studied six tui chub populations in southeastern Oregon which had historically been referred to as one subspecies, *Gila bicolor oregonensis*. He determined that enough differentiation had occurred to warrant separating them into four discrete subspecies, unfortunately he did not name them. One of these subspecies is the Hutton tui chub of the Alkali Subbasin. Bills (1977) suggested that the tui chub probably gained access to the Alkali Subbasin at least 46,000 years ago and became isolated from the Fort Rock Basin between 25,000 and 32,000 years ago.

Description

Despite the undescribed status of the Hutton tui chub, there is information regarding its identification. The Hutton tui chub was found in only one spring in the Alkali Subbasin, a second spring reported to contain Hutton tui chub was not located in 1996 and therefore the existence of a second population is questionable. Bills (1977) performed an extensive examination of ***morphometric*** (measurements taken on the body) and ***meristic*** (referring to whole integer counts) characters and found the Hutton tui chub to be distinguishable from other tui chub in adjacent basins by morphology of the head. These characters are: head has a convex outline, is longer (from tip of snout to rear edge of the gill cover), deeper, and the distance between the eyes is greater than other tui chub subspecies.

Foskett Speckled Dace

Taxonomy

The Foskett speckled dace was listed as threatened in 1985, (U.S. Fish and Wildlife Service 1985b). The Foskett speckled dace (*Rhinichthys osculus* ssp.) is an allopatric form that is currently being described (hence, it has not yet received a subspecific name). The timing of the isolation between the Warner Lakes Subbasin and the Coleman Subbasin is uncertain although it might be as recent as 10,000 years ago (Bills 1977).

Description

Despite the undescribed status there is information regarding its identification. It can be distinguished from other speckled dace by external characteristics, such as: a much reduced lateral line, about 15 scales with pores; about 65 lateral line scales; a large eye; the dorsal fin is positioned well behind the pelvic fin but before the beginning of the anal fin; barbels are present on most individuals (C. Bond, Oregon State University, pers. comm., 1990).

Rare Native Fishes of the Warner Basin

The threatened Hutton tui chub is the only fish found in the Alkali Subbasin, so this section will only address the rare fishes of the Warner Basin.

Warner Valley Redband Trout

Taxonomy

Taxonomically, redband trout are grouped with rainbow trout (*Oncorhynchus mykiss*). Redband trout are found in many isolated interior areas of the Great Basin (Malheur-Harney, Catlow, Fort Rock, Warner, Chewaucan, Goose Lake Basins, but not in the Alvord Basin). The redband trout native to the Warner Basin, called the Warner Valley redband trout (*O. mykiss* ssp.), was studied by Currens (1997) and found to be most closely related to the redband trout in Goose Lake. The Warner Valley redband trout was recognized as a distinct biological unit of conservation by the American Fisheries Society (Williams et al. 1989) and was listed as a Category 2 candidate species by the Service in 1991 (U.S. Fish and Wildlife Service 1991). In 1996, changes to the Service's Candidate Policy (U.S. Fish and Wildlife Service 1996) removed this species from Candidate status.

Description

Streams in the Warner Basin were stocked with hatchery rainbow trout up until at least 1989 and some reservoirs and lakes within the basin are still stocked. There has probably been some ***introgression*** (the spread of genes of one species into the gene pool of another by hybridization and backcrossing) of hatchery trout genes into the wild Warner Valley redband trout population. Behnke (1992) found differences in body counts (vertebrae, scales above lateral line, gill rakers) for specimens collected from Honey Creek in 1968 (N=8) and 1904 (N=19). Explanations for these differences could be due to small sample bias, environmentally induced morphological changes or introgression (D. Markle, Oregon State University, pers. comm., 1997). Genetic analysis is needed to determine which explanation(s) are appropriate. Currens (K. Currens, Northwest Indian Fisheries Commission, pers. comm., 1996) reported that the redband in the Warner Basin are still genetically distinct from rainbow trout. Currens also reported that the Warner Basin ***metapopulation*** (a group of populations of one species coexisting in time but not in space) of redband trout was different from redband trout in neighboring basins. There may still be some genetically pure

Warner Valley redband trout in high elevation streams (J. Williams, Bureau of Land Management, pers. comm., 1996).

Stocking of hatchery trout ceased in 1989 and work by Currens indicates that the Warner Valley redband trout is still genetically distinct (K. Currens, pers. comm., 1996). The metapopulation of redband in the Warner Basin is presumed to have reached an equilibrium with any introgressed genes from stocked rainbow trout (J. Williams, pers. comm., 1996). For these reasons any trout caught in the Warner Basin, with the possible exception of Warner Pond, Sid Luce and Priday Reservoirs, and Vee Lake (hatchery stock are still planted in these areas), are assumed to be Warner Valley redband trout. Warner Valley redband trout have elliptical ***parr marks*** (dark bars in juveniles that are usually absent in adults), a much redder lateral stripe and white tips on the pelvic and pectoral fins that separate them from other redband trout.

Cowhead Lake tui chub

Taxonomy

The Cowhead Lake tui chub (*Gila bicolor vaccaceps*) was proposed to be federally listed as endangered by the U.S. Fish and Wildlife Service on March 30, 1998 (U.S. Fish and Wildlife Service 1998). This subspecies was first recognized as a distinct form by Hubbs and Miller (1948) and was formally described by Bills and Bond (1980). Possible relationships are with tui chub from the lakes (Hart, Crump, Pelican) in Warner Valley (Hubbs and Miller 1948); however, this was questioned by Bills and Bond (1980) on the basis of differences in ***gill raker*** (tooth-like projection on the front edge of the gill arch) length and fin and head shapes between populations in the two regions.

Description

The Cowhead Lake tui chub is similar to the Klamath tui chub, *Gila bicolor bicolor*, but is differentiated primarily on the basis of higher gill raker counts (Bills and Bond 1980). The Cowhead Lake tui chub has 19 to 25 short, "bluntly rounded" gill rakers, compared with 10 to 15 gill rakers in the Klamath tui chub. Other morphological features that characterize this subspecies are: the head is not as deep as in other chub, is relatively longer, and is convex in profile with a rounded ***interorbital*** (area between the eyes); a ***nuchal hump*** (pertaining to the back of the neck) is present, but is not very pronounced; the lower jaw is not overhung by the upper jaw; and the caudal peduncle is relatively deep. ***Predorsal scales*** (the row of scales along the middle of the back between the head and the dorsal fin) number 26 to 35 and there are approximately 57 lateral line scales. Coloration is similar to other subspecies except there is a dark lateral stripe with speckles on the head region, especially the cheek and ***operculum*** (the group of bones that form the gill coverings), and on the lower body. Reproductive males and females develop breeding tubercles, especially on the anterior rays of the ***pectoral fins*** (Moyle et al. 1995).

C. Distribution and Abundance of Threatened and Rare Native Fishes of the Warner Basin and Alkali Subbasin

In this recovery plan, "larvae" refers to the young from the time of hatching to transformation into juvenile (several weeks or months), "juvenile" refers to young that are similar in appearance to adults but not sexually mature. "Young-of-year" (YOY) refers to members of age-class 0, from transformation into juvenile until January 1 of the year following their hatching.

Threatened Fishes

Warner Sucker

Historic

The probable historic range of the Warner sucker includes the main Warner Lakes (Pelican, Crump, and Hart), and other accessible standing or flowing water in the Warner Valley, as well as the low to moderate gradient reaches of the tributaries which drain into the Valley. The tributaries include

Deep Creek, up to the falls west of Adel, the Honey Creek drainage, and the Twentymile Creek drainage. In Twelvemile Creek, a tributary to Twentymile Creek, the historic range of the sucker extended through Nevada and back into Oregon, but probably not as high as the California reach of the stream.

Early collection records document the occurrence of the Warner sucker from Deep Creek up to the falls about 5 kilometers (3.1 miles) west of Adel, the sloughs south of Deep Creek, and Honey Creek (Snyder 1908). Andreasen (1975) reported that long-time residents of the Valley described large runs of suckers in the Honey Creek drainage, even far up into the canyon area.

Current

Between 1977 and 1991, eight studies examined the range and distribution of the Warner sucker throughout the Warner Valley (Kobetich 1977, Swenson 1978, Coombs et al. 1979, Coombs and Bond 1980, Hayes 1980, White et al. 1990, Williams et al. 1990, White et al. 1991). These surveys have shown that when adequate water is present, Warner suckers may inhabit all the lakes, sloughs, and potholes in the Warner Valley. The documented range of the sucker extended as far north into the ephemeral lakes as Flagstaff Lake (Figure 2) during high water in the early 1980's, and again in the 1990's (Allen et al. 1996). The sucker population of Hart Lake was intensively sampled to salvage individuals before the lake went dry in 1992.

Stream resident populations are found in Honey Creek, Snyder Creek, Twentymile Creek and Twelvemile Creek. Intermittent streams in the drainages may support small numbers of migratory suckers in high water years. No stream resident suckers have been found in Deep Creek since 1983 (Smith et al. 1984, Allen et al. 1994), although a lake resident female apparently trying to migrate to stream spawning habitats was captured and released in 1990 (White et al. 1990). The known upstream limit of the Warner sucker in Twelvemile Creek is through the Nevada reach and back into Oregon (Allen et al. 1994). However, the distribution appears to be discontinuous and centered around low gradient areas that form deep pools with protective cover. In the lower Twentymile Slough area on the east side of the Warner Valley, White et al. (1990) collected adult and young suckers throughout the slough and Greaser Reservoir. This area dried up in

1991, but because of its marshy character, may be important sucker habitat during high flows. Larval, YOY, juvenile and adult suckers captured immediately below Greaser Dam suggest either a slough resident population, or lake resident suckers migrating up the Twentymile Slough channel from Crump Lake to spawn (White et al. 1990, Allen et al. 1996).

A population estimate of Warner suckers in streams was conducted in 1993 on the Honey Creek and Twentymile Creek drainages (Tait and Mulkey 1993b). Approximately 20 percent of available stream habitat in the Honey Creek drainage was sampled. The population sampled within Honey Creek was estimated at 77 adults, 172 juveniles, and 4,616 YOY. Approximately 60 percent of the available stream habitat in the Twentymile Creek drainage was also sampled. Estimates were 2,563 adults, 2,794 juveniles, and 4,435 YOY.

As of 1996, the Hart Lake Warner sucker population was estimated at 493 spawning individuals (with 95 percent confidence intervals of 439 to 563; Allen et al. 1996). Although this is the only quantified population estimate of Warner suckers ever made for Hart Lake, it is likely well below the abundances found in Hart Lake prior to the drought.

Hutton Tui Chub

Historic and Current

Prehistorically (about 46,000 years ago; Bills 1977) Alkali Lake is estimated to have reached a maximum depth of 82.5 meters (275 feet) and covered about 2,331 square kilometers (900 square miles). Since that time the water level has fluctuated but followed a drying trend. In 1977 the distribution of the Hutton tui chub included two springs in the Alkali Subbasin, Hutton Spring, and an unnamed spring. Hutton Spring has been diked and has a pool approximately 12 meters (40 feet) wide, 4.5 meters (15 feet) deep and is surrounded by rushes. The unnamed spring is 500 meters (1,666 feet) to the southeast of Hutton Spring. It is significantly smaller in size with a diameter of 3.3 meters (11 feet) and a depth of 0.74 meter (2.4 feet) (Bills 1977). Bills (1977) estimated 300 Hutton tui chub in Hutton Spring and 150 in the unnamed spring.

Attempts to find the unnamed spring in 1996 were unsuccessful and this population's existence is questionable.

Foskett Speckled Dace

Historic and Current

Foskett speckled dace were probably distributed throughout prehistoric (approximately 12,000 years ago) Coleman Lake during times that it held substantial amounts of water. As the lake dried, the salt content of the lake water increased. Suitable habitat would have been reduced from a large lake to any spring systems that provided enough habitat for survival.

Springs that remain within the vicinity of Coleman Lake include Foskett Spring and Dace Spring. Both springs are extremely small and shallow with limited habitat for fish. Foskett Spring has the only known native population of Foskett speckled dace. The spring originates in a pool about 5 meters (16.6 feet) across, then flows toward Coleman Lake in a narrow, shallow channel (approximately 5 centimeters (2 inches) deep and 5 centimeters (2 inches) wide). The source pool has a loose sandy bottom and is choked with ***macrophytes*** (large plants that are visible to the naked eye). The spring brook (outflow channel) eventually turns into a marsh and finally dries up before reaching the bed of Coleman Lake. Bond (U.S. Fish and Wildlife Service 1985b) estimated the population of Foskett speckled dace in Foskett Spring to be 1,500 individuals. Dambacher (pers. com. 1998) estimated there to be about 204 Foskett speckled dace in the source pool, 702 in the spring brook, and 26,881 in the shallow pool/marsh. This habitat is outside the exclosure fence and dries periodically.

Dace Spring is approximately 0.8 kilometer (0.5 mile) south of Foskett Spring. This spring may have originally been occupied by Foskett speckled dace but there were none found in the 1970's. In November 1979, 50 Foskett speckled dace were transplanted into the then fishless Dace Spring from Foskett Spring (Williams et al. 1990). In August 1980, 50 more Foskett speckled dace were introduced into Dace Spring. Dace Spring is smaller than Foskett Spring and even more choked with macrophytes. The spring outflow terminates in a cattle watering trough where fewer than 20 Foskett speckled dace were seen in 1996 (A.

Munhall, Bureau of Land Management, pers. comm., 1996). Dambacher found 19 in 1997. The watering trough is at approximately the same height/elevation as the spring head with a pipe entering into the side of the trough. This allows the fish access into the trough, but does not allow the fish to return to the spring.

Rare Native Fishes of the Warner Basin

Warner Valley Redband Trout

Historic and Current

Historically, Warner Valley redband trout were probably distributed throughout all passable creeks in the Warner Basin. This included the lakes (when they were not dry) and streams up to the headwaters.

Recent surveys (Kennedy and North 1993; Tait and Mulkey 1993a,b; Kennedy and Olsen 1994; Allen et al. 1995a,b) found redband trout in all areas that were sampled. These include: Hart and Crump Lakes; Honey Creek to about 18 kilometers (11 miles) upstream from Hart Lake; Snyder Creek, which is a tributary to Honey Creek; Twentymile Creek up to the confluence of Twelvemile Creek; Twelvemile Creek to about 14 kilometers (9 miles) upstream from the confluence with Twentymile Creek in the reach that crosses into Nevada and also upstream where Twelvemile returns to Oregon and into California. The larger lakes (Hart and Crump) dried up in 1992 after a few years of drought in the area. Redband trout were found in Hart and Crump Lakes both before and after this event, although in larger numbers after the drought (C. Allen, The Nature Conservancy, pers. comm., 1996).

Present abundance of Warner Valley redband trout in streams appears to be low. Population densities, extrapolated from 100 meter (333.3 foot) sections, ranged from 11 to 456 redband trout per 1.6 kilometer (1 mile) in Honey and Twelvemile Creeks respectively (Tait and Mulkey 1993b). In 1995, 11 redband were collected from Deep Creek and Hart and Crump Lakes. In 1996, 49 redband were collected from Honey Creek and Hart, Crump and Campbell Lakes (Allen et al. 1996). Absolute numbers can not be compared due to different methods and fishing efforts (C. Allen, pers. comm., 1996).

Cowhead Lake Tui Chub

Historic and Current

Cowhead Lake is situated in the extreme northeastern corner of Modoc County, California (southwest corner of the Warner Basin). Cowhead Lake tui chub were probably found throughout Cowhead Lake (when it held water) and the low gradient portion of Cowhead Slough.

Recent information on the distribution of the Cowhead Lake tui chub is from 1993 (Sato 1993) and 1996-97 (J. Olson, U.S. Forest Service, pers. comm., 1997). Cowhead Lake is pumped dry by the private land owners in the spring to allow grazing and haying of the lake bed. Irrigation ditches concentrate the water before it is pumped out, with the irrigation ditches retaining water. Under non-drought conditions, the Cowhead Lake tui chub is confined to the irrigation ditches in Cowhead Lake and about 4 kilometers (2.5 miles) of upper Cowhead Slough. About half the slough is on private land and the remainder is managed by the Bureau of Land Management (BLM). In 1992, during severe drought conditions, the fish were confined to turbid pools in the upper end of Cowhead Slough (Sato 1992) and in the irrigation ditches above the pump in 1993 (Sato 1993). Surveys in 1997 of Cowhead Slough on BLM land, from the confluence of Twelvemile Creek up to private land, found Cowhead Lake tui chub inhabiting all but the lower 3 kilometers (1.5 miles) of Cowhead Slough (J. Olson, pers. comm., 1997).

D. Life History and Habitat of Threatened and Rare Native Fishes of the Warner Basin and Alkali Subbasin

Threatened Fishes

Warner Sucker

This section is a brief summary of the known life history characteristics of the Warner sucker. The general distribution of the Warner sucker is known, but limited information is available on stream habitat requirements and spawning habits. Relatively little is known about feeding, fecundity, recruitment, age at sexual maturity, natural mortality, or interactions with introduced exotic fishes. More information can be found in the cited literature.

A common phenomenon among fishes is ***phenotypic plasticity*** (the ability of different individuals of the same species to have different appearances despite identical genotypes) induced by changes in environmental factors (Wooton 1990, Barlow 1995). This is most easily seen by a difference in the size of the same species living in different but contiguous, and at times ***sympatric*** (occurring in the same area), habitats for a portion of their lives (Healey and Prince 1995, Wood 1995). The Warner Basin provides two generally continuous aquatic habitat types; a temporally more stable stream environment and a temporally less stable lake environment (e.g., lakes dried in 1992). Representatives of a species occupying this continuum form a metapopulation. Observations indicate that Warner suckers and Warner Valley redband trout grow larger in lakes than they do in streams (White et al. 1990). The smaller stream morph and the larger lake morph are examples of phenotypic plasticity within metapopulations of the Warner sucker and the Warner Valley redband trout. Expressions of these two morphs in both the Warner sucker and the Warner Valley redband trout might be as simple as each species being opportunistic. When lake habitat is available, the stream morph migrates downstream and grows to become a lake morph. These lake morphs can migrate upstream to spawn or become resident populations while the lake habitat is available. Presumably, when the lake habitat dries up the lake morph is lost but the stream morph persists. When the lakes refill, the stream morph can reinvade the lakes to again become lake morphs. The lake habitat represents a less stable but more productive environment that the metapopulations of Warner suckers and Warner Valley redband trout use on an opportunistic basis. The exact nature of the relationship between lake and stream morphs remains poorly understood and not well studied.

Lake Morphs vs. Stream Morphs

The lake and stream morphs of the Warner sucker probably evolved with frequent migration and gene exchange between them. The larger, presumably longer-lived, lake morphs are capable of surviving through several continuous years of isolation from stream spawning habitats due to drought or other factors. Similarly, stream morphs probably serve as sources for recolonization of lake habitats in wet years following droughts, such as the refilling of the Warner Lakes in 1993 following their desiccation in 1992. The loss of either lake or stream morphs to drought, winter kill, excessive flows, and a flushing of the fish in a stream, in conjunction with the lack of safe migration routes and the presence of predaceous exotic fishes, may strain the ability of the species to rebound (White et al. 1990, Berg 1991).

Lake morph Warner suckers occupy the lakes and, possibly, deep areas in the low elevation creeks, reservoirs, sloughs, and canals. Recently, only stream morph suckers have exhibited frequent recruitment indicated by a high percentage of YOY and juveniles in Twelvemile and Honey Creeks (Tait and Mulkey 1993a,b). Lake morph suckers, on the other hand, were skewed towards larger, older adults (8 to 12 years old) with no juveniles and few younger adult fish (White et al. 1991) before the lakes dried up in 1992. Since the lakes refilled, the larger lake morph suckers have reappeared. Lake caught suckers averaged 267 millimeters (10.5 inches) SL in 1996 (C. Allen, pers. comm., 1996), 244 millimeters (9.6 inches) SL in 1995 (Allen et al. 1995a) and 198 millimeters (7.8 inches) SL in 1994 (Allen et al. 1995b). Stream caught fish averaged 138 millimeters (5.4 inches) SL in 1993 (Tait and Mulkey 1993b).

Age and Growth

Warner suckers recovered from an ice induced kill in Crump Lake were aged to 17 years old and had a maximum FL of 456 millimeters (17.9 inches) (White et al. 1991). Lake resident suckers are generally much larger than stream residents, but growth rates for adults are not known for either form. Sexual maturity occurs at an age of 3 to 4 years (Coombs et al. 1979), although in 1993, captive fish at Summer Lake Wildlife Management Area, Oregon, successfully spawned at the age of 2 years (White et al. 1991).

Coombs et al. (1979) measured larval growth and found a growth rate of approximately 10 millimeters (0.39 inch) per month during the summer (i.e., when the larvae were 1 to 4 months old). Sucker larvae at Summer Lake Wildlife Management Area grew as large as 85 millimeters (3.3 inches) in 3 months during the summer of 1991, but this was in an artificial environment (earth ponds) and may not reflect natural growth patterns.

Feeding

The feeding habits of the Warner sucker depend to a large degree on habitat and life history stage, with adult suckers becoming more generalized than juveniles and YOY. Larvae have terminal mouths and short digestive tracts, enabling them to feed selectively in midwater or on the surface. Invertebrates, particularly ***planktonic*** (having weak powers of locomotion) crustaceans, make up most of their diet. As the suckers grow, they develop subterminal mouths, longer digestive tracts, and gradually become generalized ***benthic*** (living on the bottom) feeders on ***diatoms*** (small, usually microscopic, plants), ***filamentous*** (having a fine string-like appearance) algae, and ***detritus*** (decomposed plant and animal remains). Adult stream morph suckers forage nocturnally over a wide variety of substrates such as boulders, gravel, and silt. Adult lake morph suckers are thought to have a similar diet, though caught over predominantly muddy substrates (Tait and Mulkey 1993a,b).

Spawning Habitat

Spawning usually occurs in April and May in streams, although variations in water temperature and stream flows may result in either earlier or later spawning. Temperature and flow cues appear to trigger spawning, with most spawning taking place at 14 to 20 degrees Celsius (57 to 68 degrees Fahrenheit) when stream flows are relatively high. Suckers spawn in sand or gravel beds in slow pools (White et al. 1990, 1991, Kennedy and North 1993). Allen et al. (1996) surmise that spawning aggregations in Hart Lake are triggered more by rising stream temperatures than by peak discharge events in Honey Creek.

Tait and Mulkey (1993b) found YOY were abundant in the upper Honey Creek drainage, suggesting this area may be important spawning habitat and a source of recruitment for lake recolonization. The warm, constant temperatures of Source Springs at the headwaters of Snyder Creek (a tributary of Honey Creek) may provide an especially important rearing or spawning site (Coombs and Bond 1980).

In years when access to stream spawning areas is limited by low flow or by physical in-stream blockages (such as beaver dams or diversion structures), suckers may attempt to spawn on gravel beds along the lake shorelines. In 1990, suckers were observed digging nests in 40+ centimeters (16+ inches) of water on the east shore of Hart Lake at a time when access to Honey Creek was blocked by extremely low flows (White et al. 1990).

Larval and Juvenile Habitat

Larvae are found in shallow backwater pools or on stream margins where there is no current, often among or near macrophytes. YOY are often found over deep, still water from midwater to the surface, but also move into faster flowing areas near the heads of pools (Coombs et al. 1979).

Larvae venture near higher flows during the daytime to feed on planktonic organisms but avoid the mid-channel water current at night. This aversion to downstream drift may indicate that spawning habitat is also used as rearing grounds during the first few months of life (Kennedy and North 1993). None of the studies conducted thus far have succeeded in capturing suckers younger than 2 years old in the lakes, and it has been suggested that they do not migrate down from the streams for 2 to 3 years (Coombs et al. 1979). The absence of young suckers in the lakes, even in years following spawning in the lakes, could be due to predation by introduced fishes (White et al. 1991).

Juvenile suckers (1 to 2 years old) are usually found at the bottom of deep pools or in other habitats that are relatively cool and permanent such as near springs. As with adults, juveniles prefer areas of the streams which are protected from the main flow (Coombs et al. 1979). Larval and juvenile mortality over a 2-month period during the summer has been estimated at 98 percent and 89 percent, respectively, although accurate larval fish counts were hampered by dense macrophyte cover (Tait and Mulkey 1993b).

Adult Habitat

White et al. (1991) found in qualitative surveys that, in general, adult suckers used stretches of stream where the gradient was sufficiently low to allow the formation of long (50 meters (166.6 feet) or longer) pools. These pools tended to have: undercut banks; large beds of aquatic macrophytes (usually greater than 70 percent of substrate covered); root wads or boulders; a surface to bottom temperature differential of at least 2 degrees Celsius (at low flows); a maximum depth greater than 1.5 meters (5 feet); and overhanging vegetation (often *Salix* spp.). About 45 percent of these pools were beaver ponds, although there were many beaver ponds in which suckers were not observed. Suckers were also found in smaller or shallower pools or pools without some of the above mentioned features. However, they were only found in such places when a larger pool was within approximately 0.4 kilometer (0.25 mile) upstream or downstream of the site.

Submersed and floating vascular macrophytes are often a major component of sucker-inhabited pools, providing cover and harboring planktonic crustaceans which make up most of the YOY sucker diet. Rock substrates such as large gravel and boulders are important in providing surfaces for ***epilithic*** (living on the surface of stones, rocks, or pebbles) organisms upon which adult stream resident suckers feed, and finer gravels or sand are used for spawning. Siltation of sucker stream habitat increases the area of soft stream bed necessary for macrophyte growth, but embeds the rock substrates utilized by adult suckers for foraging and spawning. Embeddedness, or the degree to which hard substrates are covered with silt, has been negatively correlated with total sucker density (Tait and Mulkey 1993).

Habitat use by lake resident suckers appears to be similar to that of stream resident suckers in that adult suckers are generally found in the deepest available water where food is plentiful. Not surprisingly, this describes much of the habitat available in Hart, Crump, and Pelican Lakes, as well as the ephemeral lakes north of Hart Lake. Most of these lakes are shallow and of uniform depth (the deepest is Hart Lake at 3.4 meters (11.3 feet) maximum depth), and all have mud bottoms that provide the suckers with abundant food in the form of invertebrates, algae, and organic matter.

Hutton Tui Chub

There is very little information regarding the ecology of the Hutton tui chub. Bills (1977) examined gut content and found the Hutton tui chub to be omnivorous with a majority of food eaten being filamentous algae. It appears that dense aquatic algae is needed for spawning and rearing of young (J. Williams pers. comm., 1995). No information is available on growth rates, age of reproduction or behavioral patterns.

Foskett Speckled Dace

Nothing is known about the biology/ecology of the Foskett speckled dace. The only habitat information available regards plant species found around the springs which include rushes, sedges, *Mimulus*, Kentucky bluegrass (*Poa pretensis*), thistle, and saltgrass (*Distichlis spicata*). Foskett Spring is a cool-water spring with temperatures recorded at a constant 18 degrees Celsius over a 2 year period (A. Munhall, pers. comm., 1997). No information is available on growth rates, age of reproduction, or behavioral patterns.

Rare Native Fishes of the Warner Basin

Warner Valley Redband Trout

Lake Morphs vs. Stream Morphs

Lake and stream morphs are common in the family Salmonidae (Pyramid Lake Lahontan cutthroat trout, Kamloops redband trout, Laurentian Great Lakes pink salmon [in Neilsen 1995]) and occurs in the Warner Valley redband trout. The Warner Valley redband trout lives in many of the same environments as the Warner sucker, experiences the same lake desiccations and probably employs the same methods for recolonization of the lakes once they refill. As with the Warner sucker, the loss of either lake or stream morphs to drought, winter kill, excessive flows and a flushing of the fish in a stream, in conjunction with the lack of safe migration routes and the presence of predaceous exotic fishes, may strain the ability of this species to survive into the future.

Age and Growth

There is little direct life history information available for Warner Valley redband trout. Redband trout have been aged to 8 years old and 633 millimeters (24.9 inches) FL in the Klamath watershed (ODFW 1991) and 7 years old and 711 millimeters (27.9 inches) FL in the Catlow Basin (Kunkel 1977). For the Warner Basin, maximum age has not been determined but maximum size recorded is 520 millimeters (20.4 inches) ***Total Length (TL)*** (the longest straight-line distance from the tip of the snout to the end of the tail) (C. Allen, pers. comm., 1996). Redband trout from the Catlow Basin began to mature at 2 years and most were mature by 3 years of age. Kunkel (1977) compared growth rates between stream and reservoir caught redband trout and found reservoir trout grew at a much faster rate (length of age 2 stream trout versus reservoir trout was 147 millimeters (5.7 inches) versus 336 millimeters (13.2 inches), age 3 trout 175 millimeters (6.8 inches) versus 433 millimeters (17 inches), age 4 trout 215 millimeters (8.4 inches) versus 533 millimeters (20.9 inches)). These apparent differences in size, between stream and lake morphs, are consistent with observations in the Warner Basin. Warner Valley redband trout grow to be larger in the lakes than they do in the streams (C. Allen, pers. comm., 1996).

Habitat

Habitat information is mostly inferential. Studies focusing on Warner sucker habitat have recorded redband trout presence, but this information only shows habitat usage by redband trout, not preference. Warner Valley redband trout use all habitat types from the lake bottom dominated by rock and mud substrate, to high gradient upper stream reaches dominated by pools and riffles with small boulder and cobble substrate.

Cowhead Lake Tui Chub

Age and Growth

Cowhead Lake tui chub appear to live to at least age 3+, by which time they can be 80 millimeters (3.1 inches) SL (Moyle and Yoshiyama 1992). The maximum size recorded was 116 millimeters (4.5 inches) SL (Bills and Bond 1980). During the first year they average 40 to 50 millimeters (1.5 to 1.9 inches) SL and average 60 to 80 millimeters (2.3 to 3.1 inches) SL by year 2 (Moyle and Yoshiyama 1992).

Habitat

Habitat on private land has not been well studied. The only habitat studies for the Cowhead Lake tui chub refer to Cowhead Slough, managed by Surprise Resource Area, BLM. Cowhead Slough is used to drain Cowhead Lake in the spring. Water from the lake is pumped into a ditch which drains into Cowhead Slough. Flows peak during the pumping period and diminish during the dry summers. There are several creeks leading into the lake and slough; Eightmile, Ninemile and Elevenmile Creeks and a few other unnamed creeks. These provide intermittent water, via snowmelt and run-off, to Cowhead Lake and Slough. There are apparently several faults at the upper end of the slough that also provide subsurface flow (Sato 1992). Cowhead Slough consists mainly of pools (95 percent) and riffles (5 percent) that wind through a small lava canyon. Pools can be fairly large (to 50 square meters (555 square feet)) and are interconnected by shallow trickles in the summer. The wetter spring and fall seasons provide much more connectivity, and percentages of pools to riffles is about even (S. Chappell, BLM, pers. comm., 1995). In 1974, the average depth of pools was 0.5 meter (1.6 feet) and maximum depth was 1.2 meter (4 feet), flow was 0.01 cubic meter (0.5 cubic foot) per second. Vertical water temperature stratification occurred with surface temperatures at 32 degrees Celsius and bottom temperatures at 18 to 19 degrees Celsius. The bottom was mud (80 percent), with boulder/bedrock (15 percent) and sand (5 percent) making up smaller percentages (Moyle and Yoshiyama 1992).

E. Reasons for Decline and Current Threats

The major threats to the continued existence of the native fishes in the Warner Basin and Alkali Subbasin are human induced stream channel and watershed degradation, irrigation diversion practices, and predation and competition from introduced fishes. These three factors have worked both independently and in unison to threaten the viability of the species discussed in this plan and probably affect other native aquatic and riparian associated species across the interior basins of Oregon. The Warner sucker and the Warner Valley redband trout generally appear to occupy similar habitats in the same watersheds (although trout reside more in the upper reaches of streams than suckers do), so impacts affecting Warner suckers would also be expected to affect Warner Valley redband trout. The Foskett speckled dace and the Hutton tui chub occupy similar spring habitats in different watersheds. Factors affecting these two species are site specific and current management of these areas appears to be maintaining stable population numbers. Apart from these two sites, spring habitats in other basins are generally areas of high use by humans and/or livestock. The Cowhead Lake tui chub is found in both spring and stream systems, although a large portion of the range is on private land. Programs benefitting both stream and spring systems have the potential to benefit the Cowhead Lake tui chub habitat on public land. Benefits to habitat on private land have not been identified.

General Stream Channel and Watershed Degradation

The characteristics of a watershed are based on the interactions between geology, climate, hydrology, soils, topography, flora, and fauna (Meehan 1991). Humans have the ability, within a short period of time, to drastically change the flora, fauna, and hydrology within a watershed through logging activities, agriculture, poorly managed livestock grazing, recreation, mining, and road building (Meehan 1991). Topography dictates that activities occurring within a watershed will have effects on the aquatic habitat that drains that watershed. Healthy riparian zones have the ability to buffer the effects between uplands and the aquatic environment and vice versa. The need to manage riparian and watershed resources to maintain biological integrity of associated wetlands, springs, streams, and rivers is well documented (Baltz and Moyle 1984, Knight and Bottorf 1984, Elmore and Beschta 1987, Debano and Schmidt 1989, Green and Kaufman 1989, Hunter 1991, Platts 1991).

Natural processes (floods, fire, insect infestations) cause changes to riparian areas which can lead to erosion of streambanks. However, in natural systems, erosion usually occurs in equilibrium with bank rebuilding. Rangeland riparian communities have been most affected by livestock grazing (Kovalchik and Elmore 1992, Bureau of Land Management 1994). Hydrologic and vegetation changes in response to increased human, livestock, and other activities include:

- Soil compaction, lower soil infiltration rates, and increased surface erosion
- Accelerated loss of streamside and instream cover with increasing bank and streambed erosion
- Increased stream channel capacity with less dissipation of flood energy over the floodplain
- Straightening of stream channel resulting in higher water velocity, especially at headcuts and cut meanders
- Increased peak flow and reduced summer flow
- Changes in timing of peak and low flows
- Increased flood energy causing either downcutting or (if bedrock is near the surface) braiding
- Lowered floodplain water tables and reduced availability of soil moisture
- Increased silt deposition on spawning gravels and invertebrate food production areas
- Increased water temperature
- Decreases in pool habitat
- ***Eutrophication*** (oxygen depletion) of ponds and lakes

Signs of watershed degradation are common in the interior basin of Oregon and include fences hanging in mid-air because the banks have collapsed beneath them, head-high and higher cutbanks, damaged riparian zones, bare banks, large sagebrush flats where there were once wet meadows (White et al. 1991), and spring systems with reduced riparian vegetation and increased sedimentation (A. Munhall, pers. comm., 1996).

Irrigation Diversion Practices

The first large scale human impact to migration of fishes within the Warner Basin was the construction of irrigation diversion structures in the late 1930's (Hunt 1964). Low diversion structures are generally less of an obstacle to trout than they are to suckers. These structures hampered downstream fish migrations, but they did not completely block all migration, as seen by the persistence of stream spawning lake morph suckers and trout. The improved function of irrigation diversion structures over the years probably resulted in less frequent passage by fishes. One factor that may have helped suckers and trout negotiate the dams was their tendency to cue on higher stream flows. Such flows often happened before the irrigation season, and so would not occur when diversion boards were in place. Peak flows after the start of the irrigation season may have flooded the stream channels in the lower floodplains such that out-of-channel flow in the floodplain may have provided passage around the blockage.

Blockage of upstream migration is not the only effect of small irrigation diversions. Adult fish that have spawned and are moving downstream can become diverted from the main channel to be trapped in unscreened irrigation canals. Larval, postlarval, YOY, and juvenile suckers and trout may also be diverted with the main flow to become trapped in unscreened irrigation canals. The diversions in the Honey Creek drainage were screened for a time in the 1950's but the screens were later removed by Oregon Department of Fish and Wildlife (ODFW) because they were deemed too bothersome to maintain. In 1994, ODFW, in cooperation with private landowners, tested self-maintaining screens at one of the major points of diversion on Honey Creek. These screens were removed by ODFW shortly after their installation due to design flaws that did not pass allocated water (J. Johnson, ODFW, pers. comm., 1996).

In high water years, the amount of water diverted from streams may be only a portion of the total flow, but in drought years, total stream flows often do not meet existing water rights, and so entire streams may be diverted. Over a series of drought years, reduced flows can cause drops in lake levels and sometimes, especially in conjunction with lake pumping for irrigation, cause complete dry-ups, as was the case with Hart Lake in 1992. Water diversions can also cause large and often sudden changes in water levels in downstream sucker habitats. This may cause the stranding of any fishes that are moving through the stream, slough, or lake at that time.

Cowhead Lake fills most winters and is drained each spring. Draining Cowhead Lake restricts usable habitat to the drainage ditches. Flushing of pumped water through Cowhead Slough may flush fish out of the Slough and reduce the population size. Pumping of the lake reduces late season flow through Cowhead Slough.

Introduced Predaceous Fishes

The native species composition in the Warner Basin includes some ***piscivorous*** (fish eating) fishes like the Warner Valley redband trout and, to some degree, the tui chub. This ***ichthyofauna*** (fish community occurring in the area being considered) evolved together with each species inhabiting a ***niche*** (ecological role of a species in a community) and coexisting. The introduction of exotic piscivorous fishes disrupted this balance and the native ichthyofauna has suffered. In the early 1970's, ODFW stocked white crappie, black crappie, and largemouth bass in Crump and Hart Lakes. Prior to this, brown bullhead and non-native rainbow trout were introduced into the Warner Valley. The adults of all five species feed on small fishes to varying degrees, and bass also prey on larger fish (Wydoski and Whitney 1979). Crappie and bullhead have established large lake populations while the bass have become abundant in slough habitats.

Both deliberate and incidental introduction of non-native fishes, aquatic invertebrates, and aquatic plants throughout the United States has been a management and conservation problem for over a century. These introductions have often resulted in the decline and/or extirpation of native aquatic organisms, especially fish, through competition, predation, and other interactions (Courtenay and Stauffer 1984). Predation by introduced brown trout (*Salmo trutta*) has greatly reduced the populations of a small sucker species in Virginia (Garman and Nielson 1982). Similarly, predation by a number of introduced fishes on the larvae and juveniles of the razorback sucker (*Xyrauchen texanus*) in the Colorado River has contributed to the virtual extinction of this species (Miller et al. 1982).

The introduction of exotic predaceous fishes to the Warner Valley in the early 1970's was probably the final factor that led to large reductions in the numbers of Warner suckers. Even with degraded stream habitats and migration corridor blockages, sucker populations were apparently able to maintain themselves by what little spawning could be accomplished in the lower stream reaches, the lakes, or by suckers spawning higher in the drainages. With the development of huge populations of crappie (in the lakes) and largemouth bass (in the sloughs), thousands of acres of what were once fairly safe rearing habitats became highly hazardous for young suckers and trout. Williams et al. (1990) noted large numbers of white crappie at the mouth of Honey Creek where larval suckers may have been entering Hart Lake.

The presence of the introduced exotic fishes may also threaten the sucker and trout through competitive interactions as well as predation. Brown bullhead are bottom oriented omnivores (Moyle 1976) that may compete directly with suckers for the same food sources. Bullhead may also prey on sucker eggs in the lower creek or lake spawning areas as well as on sucker larvae and juveniles. Young crappie probably eat many of the same zooplankton and other small invertebrates that young suckers depend on. Habitat use by young Warner suckers remains poorly understood, but there may be competition between suckers and other fishes for what scarce cover resources are available.

Anecdotal evidence suggests that the large runs, up Honey Creek above the diversions, of lake morph redband trout from Hart Lake also ceased shortly after the crappie populations took hold in about 1980. In 1990, a single 344 millimeter (13.5 inch) SL redband trout was caught in Hart Lake. None were caught in 1991. The coinciding declines of the lake morph redbands and suckers at the time of exploding crappie populations suggests a clear threat to both native fishes (C. Allen, pers. comm., 1996).

A difficulty in managing introduced fishes for the conservation of native species is their popularity in the recreational fishery. In 1982 and 1983, crappie caught in the flooded north valley lakes were both abundant and large. Near state record size crappie were common and attracted anglers from all over the country. Anecdotal stories from local residents and Hart Mountain National Antelope Refuge staff describe lake shores packed with fishermen and campers. Claims of catches of over 100 large crappie a day were common. This fishery began to fade in 1987 and 1988 as lake levels slowly dropped and the northern-most lakes dried up.

The complete drying up of the Warner Lakes in 1992 appeared to eliminate the habitat for the introduced exotic species. This loss of habitat did not result in the elimination of the exotic species. The sloughs and ditches at the south end of the valley did not dry-up and are known to hold large numbers of crappie, bullhead, and bass which provide sources for re-introductions to the lakes (G. Anderson, ODFW, pers. comm., 1993). Although absolute numbers of exotic species have declined since the drought, ratios of species have not changed significantly and numbers are rebounding (C. Allen, pers. comm., 1996). The listing of the Warner sucker has precluded further legal introductions, however, illegal introductions could still be carried out by anglers. Prevention of such illegal activities in the remote Warner Valley is difficult, and at least six successful illegal introductions have occurred in the adjacent Burns District of ODFW since 1985 (G. Anderson, pers. comm., 1993).

Threats to Spring Systems

Springs and wet meadow areas have relatively high amounts of soil moisture and can support higher levels of plant growth that extend longer into the season than drier sites. This can lead to a disproportionate amount of use by livestock, especially late in the grazing season. The impacts by livestock generally reduce the integrity and complexity of these spring areas in much the same way riparian areas are degraded. Impacts range from reduction of the riparian vegetation surrounding spring areas by trampling and grazing to increased sedimentation from trampling and decreasing aquatic vegetation from the smothering effects of silt. Some springs have also been tapped or partially diverted to watering troughs.

The Lakeview Resource Area of Lakeview District BLM currently maintains fences at Foskett and Dace Springs to prevent cattle use. For species inhabiting such small spring systems, loss of habitat can equate with extinction. Even minor mechanical manipulations of the springs such as channelization or diversion of the spring for agriculture or irrigation purposes could lead to loss of habitat. The outflow from Dace Spring terminates in a cattle watering trough where a number of Foskett speckled dace were seen in 1996. Although troughs may provide some permanent water, it is unlikely that these above-ground water sources provide the dace with suitable, sustainable habitat. Foskett speckled dace probably get entrained in the flow to the trough but access back to the spring is not possible. The overflow water from the trough spills to the ground and any dace entrained in this flow (particularly larval dace) would die. Plants are abundant at both Foskett and Dace Springs. The effects of increased plant growth on the habitat requirements of the Foskett speckled dace are unknown.

Hutton Spring is within 3.2 kilometers (2 miles) of a metallurgical waste disposal site and a chemical waste disposal site. Wastes from the metalurgical dump were removed and the site cleaned by the Oregon Department of Environmental Quality (DEQ). The chemical contamination is mainly herbicides (2,4-D; 2,4-DCP; MCPA) that were dumped by a private company between 1967 and 1971. In 1976, the State was unsuccessful in legal attempts to have the private company clean the site. This led to the need to declare the site unsafe and the State subsequently purchased the land (10.3 acres) for the purpose of containing the chemicals. The location of the dump site is about 2 miles south of Hutton Spring. A plume of contamination has migrated about 600 meters (2,000 feet) west northwest and has reached West Alkali Lake. The State bought an additional 400 acres of the contaminated site to monitor movement of the plume and has installed fences to prevent cattle from entering the contaminated area. DEQ has assessed the area and reported that the catastrophic spread of contamination into surrounding springs (including Hutton Spring) appeared to be extremely remote (Brian McClure, DEQ, pers. comm., 1995).

F. Current Conservation Efforts

Warner Sucker

Salvage, Refuge Populations, and Captive Propagation

In early 1991, the threat of a fifth consecutive drought year prompted the agencies responsible for managing the Warner sucker to plan a salvage operation to establish a refuge population of suckers at the Service's Dexter National Fish Hatchery and Technology Center (Dexter) in New Mexico. Salvage operations consisted primarily of intensive trap netting in Hart Lake to collect suckers, then transportation of the captured fish to a temporary holding facility (a series of five small earth ponds linked by a 200 meter (666.6 foot) ditch) at ODFW's Summer Lake Wildlife Management Area. The suckers were held at Summer Lake Wildlife Management Area for 5 months until September 1991, when 75 adults were recaptured and transported to Dexter.

While being held at Summer Lake Wildlife Management Area, the suckers from Hart Lake spawned successfully, leaving an estimated 250+ young in the Summer Lake Wildlife Management Area holding ponds after the adults were taken to Dexter. The young suckers did well in the ponds, growing approximately 85 millimeters (3.3 inches) during their first summer and reaching sexual maturity at the age of only 2 years. Sucker larvae were observed in the ponds during the summer of 1993, just over 2 years after the original wild suckers from Hart Lake were held there. Approximately 30 of the 2-year-old suckers were captured and released in Hart Lake in September 1993. In June 1994, over 100 10 to 17.5 centimeter (4 to 7 inch) Warner suckers were observed in the Summer Lake Wildlife Management Area ponds. In 1996, 9 adult fish were observed in these ponds along with about 20 larvae.

The suckers taken to Dexter were reduced from 75 to 46 individuals between September 1991 and March 1993, largely due to *Lernaea* (anchor worm) infestation. In March 1993, the 46 survivors (12 males and 34 females) appeared ready to spawn, but the females did not produce any eggs. Between March 1993 and March 1994, *Lernaea* further reduced the population to 20 individuals (5 males and 15 females) (B. Jensen, USFWS, pers. comm., 1994). In May 1994, the 5 males and 7 of the females spawned, producing a total of approximately 175,000 eggs. However, for reasons that are not clear, none of the eggs were successfully fertilized. The remaining 20 fish at Dexter died in 1995 (B. Jensen, pers. comm., 1995). In November of 1995, approximately 65 more suckers from Summer Lake Wildlife Management Area were transferred to Dexter for spawning purposes but as yet no attempts to spawn these fish have occurred.

Fish Passage Improvements

In 1991, the BLM installed a modified steep-pass Denil fish passage facility on the Dyke diversion on lower Twentymile Creek. The Dyke diversion structure is a 1.2 meter (4 feet) high irrigation diversion that was impassable to suckers and trout before the fishway was installed. It blocked all migration of fishes from the lower Twentymile Creek, Twentymile Slough and Greaser Reservoir populations from moving upstream to spawning or other habitats above the structure. No studies have been conducted to monitor the effectiveness of this fish ladder. Hopefully, the fishway will re-establish a migration corridor, and allow access to high quality spawning and rearing habitats.

An evaluation of fish passage alternatives has been done for diversions on Honey Creek which identifies the eight dams and diversions on the lower part of the creek that are barriers to fish migration (Campbell-Craven Environmental Consultants 1994). In May 1994, a fish passage structure was tested on Honey Creek. It consisted of a removable fishway and screen. The ladder immediately provided passage for a small redband trout. These structures were removed by ODFW shortly after their installation due to design flaws that did not pass allocated water.

Research

Research through 1989 summarized in Williams et al. (1990) consisted of small scale surveys of known populations. Williams et al. (1990) primarily tried to document spawning and recruitment of the Hart Lake population, define the distributional limits of the sucker in the streams, and lay the groundwork for further studies. White et al. (1990), conducted trap net surveys of the Anderson Lake, Hart Lake, Crump Lake, Pelican Lake, Greaser Reservoir, and Twentymile Slough populations. A population estimate was attempted for the Hart Lake population, but was not successful. Lake spawning activity was observed in Hart Lake, though no evidence of successful recruitment was found.

White et al. (1991) documented the presence of suckers in the Nevada reach of Twelvemile Creek. This area had been described as apparently suitable habitat by Williams et al. (1990), but suckers had not previously been recorded there.

Kennedy and North (1993) and Kennedy and Olsen (1994) studied drift behavior and distribution of sucker larvae in streams in an attempt to understand why recruitment had been low or nonexistent for the lake morphs in previous years. They found that larvae did not show a tendency to drift downstream and theorized that rearing habitat in the creeks may be vital to later recruitment.

Tait and Mulkey (1993a,b) investigated factors limiting the distribution and abundance of suckers in streams above the man-made stream barriers. The detrimental effects of these barriers are well-known and easily understood, but there may be other less obvious factors that are also affecting the suckers in streams. These studies found that general summertime stream conditions, particularly water temperature and flows, were poor for most fish species. Recent studies have concentrated on population estimates, marking fish from Hart Lake and monitoring the recolonization of the lakes by native and non-native fishes (Allen et al. 1995a,b, Allen et al. 1996).

Improved Federal Land Management

The Federal agencies responsible for management of the habitat in the Warner Basin have consulted on activities that might impact the Warner sucker. On May 21, 1995, the BLM, Forest Service (FS), National Marine Fisheries Service (NMFS), and the Service signed the Streamlining/Consultation Guidelines (streamlining: Streamlining Consultation Procedures Under section 7 of the ESA) to improve communication and efficiency between agencies. In the Warner Basin, the outcome of streamlining has been regular meetings between the Federal agencies conducting and reviewing land management actions that may affect Warner suckers. These meetings have greatly improved the communication among agencies and have afforded all involved a much better understanding of issues throughout the entire watershed. As a result of close coordination, the FS and BLM have modified many land management practices, thus reducing negative impacts, and in many cases bringing about habitat improvements to Warner suckers and Warner Valley redband trout.

Foskett Speckled Dace

Foskett and Dace Springs occur on public land and are managed by Lakeview District BLM. This habitat is currently fenced from cattle use and is in stable condition. Until 1979, the only spring containing Foskett speckled dace was Foskett Spring. In 1979, and again in 1980, 50 Foskett speckled dace were transplanted to Dace Spring. No other transplant attempts have been made and this population in Dace Spring is now confined to the water trough.

Hutton Tui Chub

Hutton Spring is privately owned and the habitat is in good condition primarily due to conscientious long-term land stewardship by the landowner. This habitat is currently fenced from cattle use and is in stable condition.

G. Determination of Critical Habitat for the Listed Species

"Critical habitat," as defined in section 3(5)(A) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.) means: (i) the specific areas within the geographical area occupied by the species at the time it is listed, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by a species at the time it is listed upon a determination by the Secretary that such areas are essential for the conservation of the species.

The term "conservation," as defined in section 3(3) of the Act, means: the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to the Act are no longer necessary. Therefore, in the case of critical habitat, conservation represents protection of the areas essential to recover a species to the point of delisting (i.e., the species is recovered and is removed from the list of endangered and threatened species).

Critical habitat was designated for the Warner sucker on September 27, 1985 (U.S. Fish and Wildlife Service 1985a) and includes the following areas: Twelvemile Creek from the confluence of Twelvemile and Twentymile Creeks upstream for about 6 stream kilometers (4 stream miles); Twentymile Creek starting about 14 kilometers (9 miles) upstream of the junction of Twelvemile and Twentymile Creeks and extending downstream for about 14 kilometers (9 miles); Spillway Canal north of Hart Lake and continuing about 3 kilometers (2 miles) downstream; Snyder Creek, from the confluence of Snyder and Honey Creeks upstream for about 5 km (3 miles); Honey Creek from the confluence of Hart Lake upstream for about 25 kilometers (16 miles) and 16 meters (50 feet) on either side of these waterways (Figure 1).

No critical habitat has been designated for the Foskett speckled dace or the Hutton tui chub. Part of the requirements for determination of critical habitat is exact location information. With the very restricted ranges, occurrence in low numbers, and occupation of small springs that are extremely vulnerable to destruction or modification, the designation of critical habitat was not prudent.

Role of Critical Habitat in Species Conservation

A designation of critical habitat may not, by itself, achieve recovery, but is one of several measures available to contribute to conservation of a species. Critical habitat focuses conservation activities by identifying areas that contain essential habitat features (primary constituent elements) regardless of whether the areas are currently occupied by the listed species. Such designations alert Federal agencies, States, the public, and other entities about the importance of an area for the conservation of a listed species. Critical habitat also identifies areas that may require special management or protection. Areas designated as critical habitat receive protection under section 7 of the Act with regard to actions carried out, funded, or authorized by Federal agencies. Section 7 of the Act requires that Federal agencies insure that their actions are not likely to destroy or adversely modify critical habitat.

Designation of critical habitat does not create a management plan for a listed species. Designation does not automatically prohibit certain actions, establish numerical population goals, or prescribe specific management actions (inside or outside of critical habitat). However, critical habitat may provide added protection for areas designated and thus assist in achieving recovery. Areas outside of critical habitat that contain one or more of the primary constituent elements may still be important for conservation of a species. Areas not designated as critical habitat also may be of considerable value in maintaining ecosystem integrity and supporting other species, thus indirectly contributing to recovery. The designated critical habitat for the Warner sucker should benefit the Warner Valley redband trout because of the overlap in habitat requirements for both species. Cowhead Lake and Cowhead Slough, and therefore the known distribution of the Cowhead Lake tui chub, are not included in Warner sucker critical habitat.

Relationship of Recovery Plan to Designated Critical Habitat

The Recovery Plan for the Threatened and Rare Native Fishes of the Warner Basin and Alkali Subbasin was developed to delineate reasonable actions which are believed to be necessary to recover and/or protect the Warner sucker, Hutton tui chub, and Foskett speckled dace. These actions improve watershed conditions which should also benefit Warner Valley redband trout. Those areas where Cowhead Lake tui chub are found on public land should benefit from this plan as well. Critical habitat (designated for Warner sucker only) delineates the areas important to the species' recovery, as they were understood at the time of the species' listing. Therefore, the critical habitat and the recovery plan together will assist in the recovery of the Warner sucker by both identifying important habitats, and directing the recovery efforts of Federal agencies as required in section 7(a)(1) of the Act.

Recovery Plan Tasks as Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. One means to do so is by implementing conservation recommendations. Conservation recommendations are discretionary actions that an agency or private entities may undertake to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, to develop information, or to help conserve candidate species or species of concern.

In the case of a number of rare native fishes found outside the Warner Basin and the Alkali Subbasin (see Appendix I), the following discussion, and tasks provided in the recovery plan, may be viewed as conservation recommendations based on the recovery planning effort that went into developing this overall recovery plan. Such conservation can be undertaken individually or with the technical assistance, usually through a written conservation agreement, of the Service and any other interested parties. One reason these conservation agreements are useful and important is that they may contribute significantly to the Service's decision to list or not list a species that has been petitioned for listing under section 4 of the Act. In other words, the presence of adequate conservation measures to protect a species, such as a comprehensive conservation agreement based on the recommendations provided in this plan, may provide adequate protection to a species to avoid the need to list that species in the face of other threats.

The likelihood of similarity of habitat requirements, threats, or conservation needs should not be the only considerations in applying tasks from this plan to other basins or species. Before applying these recovery plan tasks to other basins, one should ensure: a) that the task has been reviewed for applicability to the basin in question (e.g., are irrigation diversions really a problem in other basins); b) whether there is an opportunity to apply the task (e.g., is there a landowner willing to improve passage over a diversion?); c) what other tasks may be needed to adequately conserve these species; and d) whether the given task under consideration is the highest priority task that should be undertaken at this time, given a), b) and c), above. Tasks other than those listed may also be applicable or even necessary to fully conserve other species.

H. Recovery Strategy

This recovery plan proposes different primary objectives for the three threatened species. The primary objective for the Warner sucker is the eventual delisting of the species. The Foskett speckled dace and Hutton tui chub will probably not be delisted in the near future because of their extremely isolated ranges and potential for degradation of these habitats from localized events. The primary objective, therefore, is the long-term persistence of these two species through preservation of their native ecosystems. The recovery strategy for the Warner sucker therefore includes reducing the threats that originally led to the listing of the species. These activities would include protection and rehabilitation of populations and habitat, conservation of genetic diversity of the populations, controlling introduced exotic fishes, securing adequate water supplies for the continued survival of the species, monitoring populations and habitat conditions, and evaluation of long-term effects of climatic trends on the recovery of listed fish.

The Service does not foresee the delisting of the Hutton tui chub and the Foskett speckled dace in the near future. The goal of this recovery plan is for the conservation and long term sustainability of these two species. This can be accomplished by the long-term protection of their respective habitats, development and implementation of long-term habitat management guidelines to ensure the continued persistence of important habitat features, and research into life-history, genetics, population trends, habitat use and preference, and other important parameters to assist in further developing and/or refining long-term protection.

II. RECOVERY

A. Recovery Objective and Criteria

The objective of this recovery plan for fishes in the Warner Basin and Alkali Subbasin is to restore and maintain the natural aquatic and riparian habitats of the Warner Basin and Alkali Subbasin so that: (1) the Warner sucker's continued existence is ensured in its native ecosystem which results in its removal from the list of threatened and endangered species; and (2) the springs and outflow channels occupied by the Hutton tui chub and the Foskett speckled dace are protected, resulting in the long-term persistence of these two species. Because the Hutton tui chub and Foskett speckled dace inhabit such small and isolated habitats, it is not likely that any measures taken by the Service, or other governmental or non-governmental entities, are likely to significantly reduce the risk of extinction to these species to the point that delisting would be prudent. All recovery criteria may be revised on the basis of new information (including research specified as recovery tasks).

The Warner sucker may be considered for delisting when:

1. A self-sustaining metapopulation is distributed throughout the Twentymile, Honey, and Deep Creek (below the falls) drainages, and in Pelican, Crump, and Hart Lakes. Self-sustaining populations will be determined based on parameters such as:
    - comprised of multiple age-classes, including adults, juveniles, and YOY, which approximate normal frequency distributions,
    - a stable or increasing population size,

- documented reproduction and recruitment, and
- self-sustaining populations form a viable metapopulation, large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural habitat changes.

2. Passage is restored within and among the Twentymile Creek, Honey Creek, and Deep Creek (below the falls) drainages so that the individual populations of Warner suckers can function as a metapopulation.

3. No threats exist that would likely threaten the survival of the species over a significant portion of its range.

Specific information on Warner sucker life history and habitat requirements is necessary to determine the characteristics of self-sustaining and viable Warner sucker populations and the extent and connectivity of habitats needed to support them. Upon completion of task 413, the measurable characteristics of self-sustaining populations and adequate passage among populations will be defined and the plan objectives expanded as appropriate.

The conservation and long-term sustainability of the Hutton tui chub and the Foskett speckled dace will be met when:

1. Long-term protection to their respective habitats, including spring source aquifers, spring pools and outflow channels, and surrounding lands is assured.

2. Long-term habitat management guidelines are developed and implemented to ensure the continued persistence of important habitat features and includes monitoring of current habitat and investigation for and evaluation of new spring habitats.

3. Research into life-history, genetics, population trends, habitat use and preference, and other important parameters are conducted to assist in further developing and/or refining criteria 1) and 2), above.

Tasks necessary to achieve the recovery plan objective of delisting the Warner sucker are listed below. These same tasks are necessary to facilitate the conservation and long-term sustainability of the Hutton tui chub and the Foskett speckled dace. The individual actions required to accomplish each task are described in the following "Narrative Outline of Recovery Actions".

1. Protect and rehabilitate fish populations and habitat
2. Conserve genetic diversity of fish populations
3. Ensure adequate water supplies are available for listed fish recovery
4. Monitor fish populations and habitat conditions
5. Evaluate long-term effects of climatic trends on the recovery of fishes

B. Step-down Outline and Narrative of Recovery Actions

The following step-down outline identifies and describes recovery tasks. A narrative is not given if the task is self-explanatory. Tasks may apply to private lands. Where that occurs, the Service would pursue conservation agreements. Conservation agreements are voluntary agreements between the Service, one or more landowners, agencies, conservation districts watershed councils, and other governmental or non-governmental entities that are jointly interested in the conservation of a listed or non-listed species. Conservation agreements may be accompanied by financial support that is cost-shared among all participants. Many programs are available that involve Federal funding. Most of these programs include minimum time periods for agreements to be in effect. By outlining the areas in which the Service believes these recovery tasks might be applied as conservation recommendations, the Service is in no way seeking regulatory control or oversight over land management activities in these areas.

1. **Protect and rehabilitate fish populations and habitat.**

11. **Protect fish populations.**

111. **Identify existing habitats.** Though Warner sucker habitats are generally well known, a complete summary of available information on locations of known sucker habitats is needed. Known habitat areas would then be the starting focus of subsequent tasks. Additional spring habitats for Foskett speckled dace and Hutton tui chub are uncertain, since the status of the second population of each species is in question. Check spring habitat annually for fish presence and survey for new spring habitats.

112. **Assess the quality of existing habitats.**

1121. **Assess quality of existing habitats on Federal lands.** Federal agencies should gather data on condition of habitats and riparian areas in or upstream of Warner sucker habitats, or near Foskett and Dace Springs. Determine any changes to land management needed to maintain or improve habitat conditions.

1122. **Assess quality of existing habitats on non-Federal lands.** Seek landowner permission to study and assess habitat quality on these lands. Discuss with landowners the potential for making land management changes, if deemed prudent, that would maintain or improve habitat conditions yet still provide for the social and economic value of the lands in question.

113. **Maintain high quality habitats to prevent species declines.**

1131. **Maintain high quality habitats on Federal lands to prevent species declines**. Federal agencies should develop goals to maintain high quality habitats. Where current agency land management is deemed inadequate to protect (i.e., maintain or improve upon current conditions) high quality habitat conditions, recommend modifications to agencies to bring about needed changes in land use. Set management recommendations conservatively until such time as watershed analyses are completed (see task 1211, below), or other long term plans can be made for spring dwelling fishes. Such analyses may provide for additional information that may allow for a relaxation of some habitat or species protection measures.

1132. **Maintain high quality habitats on non-Federal lands to prevent species declines**. With landowner permission, develop land management recommendations to maintain high quality habitats, as needed. Where it would help the landowner or to secure funds, develop Conservation Agreements with landowners to formalize habitat management strategies. Because landowners are not likely to have significant resources for research and development of land management strategies, recommendations are not likely to be as restrictive as for Federal lands (unless agreed to by landowner). Where appropriate, consider and pursue exchange or acquisition of these lands from willing landowners. Incentives, such as long term grazing leases and development of watering facilities away from these habitats should also be considered as a part of such exchange or acquisition plans.

114. **Improve poor quality habitat conditions**.

1141. **Improve poor quality stream habitat conditions on Federal lands**. Federal agencies should develop goals to restore poor quality stream habitats. Encourage Federal agencies to modify land management activities to bring about restoration as quickly as is feasible by making restoration the primary goal of land management, with other uses secondary. Some prioritization of habitats or stream reaches may be necessary to meet budget constraints and reduce overall impacts to Federal land or resource users, but management recommendations should be designed conservatively until such time as watershed analyses are completed (see task 1211, below). Such management strategies should be coordinated through development of Conservation Agreements with the Federal agencies.

1142. **Investigate, and install as appropriate, physical improvements to Foskett and Dace Springs.** Investigations are needed to determine the habitat requirements of Foskett speckled dace. Once this information is gathered, modifications may be suggested for Foskett Spring. Dace Spring is currently not providing habitat for Foskett speckled dace and may need more immediate modifications. If refugial sites are selected under task 211, below, these same activities may need to be carried out at such sites as well.

1143. **Improve poor quality habitat conditions on non-Federal lands**. Seek opportunities to establish riparian or aquatic species/habitat Conservation Agreements on non-Federal lands un order to implement habitat improvement or restoration activities. When funds allow, assist in funding of restoration actions through such programs as Partners for Wildlife or Endangered Species Act section 6 funds.

12. **Improve watershed conditions throughout Warner Basin and Alkali Subbasin.**

121. **Assess current watershed conditions**. Watershed analysis is a technically rigorous procedure with the purpose of developing and documenting a scientifically-based understanding of the ecological structure, functions, processes, and interactions occurring within a watershed.

1211. **Assess current watershed conditions on Federal lands**. Federal agencies should conduct watershed analyses on their lands within the Warner Basin watershed. These analyses would focus on identifying the current health and function of watersheds and on identifying areas in need of management changes to meet overall watershed function goals and objectives. Current guidelines are provided in the *Federal Guide for Watershed Analysis* (Regional Interagency Executive Committee 1995), but updates of this guide and other appropriate documentation can also be used. Apply these principles, as appropriate, to Foskett Spring.

1212. **Assess current watershed conditions on non-Federal lands**. Where landowners are willing, the current status of non-Federal lands within the Warner Basin watershed and Alkali Subbasin should be analyzed. These analyses would focus on identifying the current health and function of watersheds, and on identifying areas in need of management changes to meet overall watershed function goals and objectives.

122. **Improve watershed conditions.**

1221. **Improve watershed conditions on Federal lands.** On Federal lands, the outcome of watershed analyses will be recommendations for changes in land management to bring about the improvement of watershed structure and function. These changes may be described as long-term goals and objectives for managing the lands addressed in the analyses, or they may be short term immediate changes in management, or both. These strategies should be documented through Conservation Agreements between the Service and Federal agencies. Whatever the nature of these recommendations, Federal agencies should be encouraged to pursue immediate implementation of short-term changes and of working towards achieving long-term goals and objectives. The result should be a timely improvement of watershed conditions with benefits to listed and unlisted fish species.

1222. **Improve watershed conditions on non-Federal lands.** Where willing landowners have worked with the Service or other State and Federal agencies to address watershed conditions, they should be encouraged to modify their land management to be consistent with the recommendations developed through the watershed analysis process. Where it would help the landowner, develop Conservation Agreements with landowners to formalize land management strategies in compliance with watershed analyses.

13. **Reestablish stream migration corridors for Warner suckers and Warner Valley redband trout.**

131. **Evaluate problems with fish passage in Warner Basin streams and develop plans for passage and screening**. These passage and screening plans would involve willing landowners to improve or establish migration past diversion structures both upstream and downstream between habitats. Where landowners are willing, any passage and/or screening improvements to diversion structures should be made the focus of Conservation Agreements.

132. **Implement the passage and screening plans on Warner Basin streams**.

133. **Monitor the effectiveness of Warner Basin passage and screening structures**. Any Conservation Agreements established should allow for continued access to facilities for maintenance and/or monitoring of their effectiveness. Monitoring would be designed to determine how effective the passage and screening structures are, and how to improve them if needed. Maintenance responsibilities should be spelled out in the Conservation Agreement.

14. **Control populations of exotic fishes in the Warner Basin**.

141. **Prevent future stocking of exotic fishes in listed fish habitats**. Prevent the future stocking of exotic fishes such as largemouth bass, crappie, and other species like hatchery trout in the lakes and

streams of the Warner Basin and in other listed and unlisted fish habitats.

1411. **Develop a Conservation Agreement with Oregon Department of Fish and Wildlife to prevent future stocking of non-native species in listed and unlisted fish habitats.**

1412. **Develop and implement a public education program to reduce or eliminate illegal translocations of exotic fishes within habitats in the Warner Basin, or from outside basins into the Warner Basin.** Methods could include publications, signage, and/or other means of getting information out to the public. Public education aimed at the fishing public should focus on the merits of fishing already introduced exotics and of protecting the habitats of native species.

142. **Investigate impacts of exotic fish populations on the Warner sucker**. While it is suspected that exotic game fishes have had a major impact on the Warner sucker through predation and competition, research to determine the exact nature and impact of these interactions is difficult and has been done only incidental to other Warner sucker research. Consequently, little is known about these interactions. Conduct research such as stomach content analyses of exotic game fishes to determine the impacts of these introduced species on the Warner sucker. Other studies on habitat preferences of exotics and small suckers may help define areas of overlap that may be eliminated in the future.

143. **Monitor exotic fish populations in the Warner Basin**. The abundance and distribution of exotic game fishes may greatly

affect Warner sucker survival and recruitment in a given year. This monitoring could be done in conjunction with the monitoring of Warner sucker populations specified in task 41 below.

144. **Evaluate options to further control or eliminate exotic fishes**. Opportunities, such as droughts that reduce habitats to small areas, or other means that would allow for the eradication of exotics, should be utilized to reduce populations and effects of exotic fishes. Special emphasis should be placed on piscivorous exotic fishes.

2. Conserve genetic diversity of fish populations.

Conserving the genetic diversity found within and between populations and/or morphs of Warner sucker, Foskett speckled dace, and/or Hutton tui chub will greatly increase the likelihood of long-term survival and recovery of these species as environmental conditions change. Conserving genetic diversity is best done by protecting extant habitats and populations of a species, which is the intention of task 1, above. However, other means of conserving genetic diversity, such as the establishment of refugial populations and/or artificial propagation, should be considered for these fishes because of their limited number of populations and individuals.

21. **Assess the need for refugial populations**. The establishment of refugial populations is one method of ensuring the survival of a species if its habitat and/or wild populations are threatened. Determine if the establishment of one or more refugial populations of listed fishes is necessary to ensure the survival of these species and maintain genetic diversity.

211. **Assess the need for establishment or reestablishment of refugial populations within the Warner Basin, Coleman**

Subbasin, or Alkali Subbasin. Water quality and watershed improvements will require many years of restoration efforts. During that time, listed fish populations will continue to be exposed to stressful environmental conditions due to poor water quality, continued lack of recruitment, and other potential risks. However, any refugial populations of listed fish should be within their native basins to prevent escapement into non-native waters. Determine if the establishment of one or more refugial populations of listed fishes in each basin is logistically possible and necessary for recovery of the species.

212. **Develop a genetic management plan for any refugial populations deemed important to the Warner Basin, Coleman Subbasin, or the Alkali Subbasin.** A genetic management plan would assist managers in determining the appropriate frequency, timing, and numbers of fish to be transferred in inter-population transfers to maintain refugial populations. The plan would be designed to comply with accepted tenets of conservation genetics and endangered species policy, and would be implemented after its completion.

213. **Determine how to manage extant refugial populations outside the Warner Basin and the feasibility of reintroducing individuals from extant refugial populations back into the Warner Basin**. Captive populations of Warner suckers now exist in Summer Lake Wildlife Management Area, Oregon, and at Dexter National Fish Hatchery and Technology Center, New Mexico. Determine how these populations should be managed to contribute to recovery of the species. Warner

suckers from the extant refugial populations could be reintroduced into the Warner Basin to bolster wild populations if the individuals in the refugial populations have not been hybridized with other suckers and are free of disease. Determine if such reintroductions would contribute to the recovery of the species.

22. **Evaluate captive propagation**. Evaluate the need for captive propagation and potential for improving listed fish populations through supplementation.

221. **Assess the need for captive propagation**. Evaluate the status of listed fish populations and assess the need for captive propagation using the best available information and expertise.

222. **Refine captive propagation techniques**. Propagation techniques should be refined to improve survival and reproduction. Full consideration should be given to the development of genetic management plans if it is decided that a captive propagation program is to be implemented for returning Warner suckers from captive populations to the wild. The Dexter National Fish Hatchery and Technology Center is currently propagating Warner suckers captured from Summer Lake Wildlife Management Area. These fish are a mixture of several generations of offspring from the original Warner suckers salvaged from Hart Lake in 1991.

3. **Maintain adequate or improve inadequate water supplies for fish recovery.**

The most important component of fish habitat in the Warner Basin and the Coleman and Alkali Subbasins is water. Water in these areas is a scarce resource, being in an arid area regularly subject to drought. Stream diversions, and livestock watering further reduce the amount of water available to fishes in springs and streams. In the Warner Basin, the timing and magnitude of flows is most important in meeting needs of fishes. In the Coleman and Alkali Subbasins, the groundwater sources producing spring habitats of listed fishes is of concern. Maintaining adequate flows or improving inadequate flows needed to provide for fish recovery is an important step.

31. **Determine stream flows required for Warner sucker recovery**. In the Warner Basin, determine stream flow conditions in Honey, Deep, and Twentymile Creeks required to maintain adequate sucker habitat in these streams as well as the associated lakes. Consider migration corridor, spawning habitat, and stream and lake habitat maintenance needs when making such determinations.

    In Coleman and Alkali Subbasins, similar studies should be done that focus on the groundwater sources to the surface springs. Determine the amount of flows necessary to maintain and improve habitat conditions for recovery.

32. **Develop plans for ensuring stream and spring flows**. In the Warner Basin, develop a plan for ensuring adequate stream flows in Honey, Deep, and Twentymile Creeks required to maintain sucker habitat to the extent that both the stream- and lake-resident suckers can recover. Although it is impossible to ensure stream flows sufficient to meet this objective 100 percent of the time due to the constant and unpredictable threat of drought, and the inherent variability of flows as compared to existing water rights, such a plan could minimize the effects of droughts on stream flows and decrease the likelihood of lakes and streams drying up during droughts. Such a plan would likely include and complement

components of other recovery tasks such as 113 and 132, and could perhaps be developed simultaneously or merged with them. Planning should include the development of Conservation Agreements with landowners based on willing participation.

In Coleman and Alkali Subbasins, develop a plan to protect spring inflows deemed necessary to support recovery. Such concepts as administrative withdrawal of the groundwater sources to these springs from further appropriation or development for geothermal uses should be considered, as well as any other means to protect these flows.

33. **Implement the plans for ensuring water flows**. Incentives to landowners to maintain adequate stream flows should be investigated. Purchase of water rights from willing sellers in the Warner Basin and Alkali Subbasin should also be considered.

4. Monitor fish populations and habitat conditions.

Monitoring is necessary to determine trends in fish population sizes and the conditions of the habitat they occupy. This information is essential in determining the effectiveness of recovery efforts. Monitoring is also needed to determine whether land management decisions made during watershed analyses are having the effects predicted and are bringing watershed conditions to the goals established.

41. **Monitor fish populations**. One delisting criterion for the Warner sucker calls for self-sustaining sucker populations in lakes and streams in the Warner Basin; thus, data obtained from monitoring suckers will be the basis for determining recovery success and delisting status. This will also apply to criteria for long-term conservation of the Foskett speckled dace and Hutton tui chub.

411. **Develop monitoring plans for each species to define monitoring protocols, including methodologies and frequencies of surveys.** All life history stages need to be surveyed to determine abundances of both lake and stream morph Warner sucker year-classes, and all stages of Foskett speckled dace and Hutton tui chub. Data on the abundance of each year-class or life history stage within each fish habitat is necessary for a successful monitoring project. Develop appropriate sampling methods for obtaining these data. Adapt monitoring strategies as necessary to improve data collection and/or value.

412. **Monitor populations and spawning success of lake and stream morph Warner suckers, and Foskett speckled dace and Hutton tui chub**. Monitor populations of lake and stream morph Warner suckers, Foskett speckled dace, and Hutton tui chub, including abundance of each year-class or life history stage to determine recruitment success. One component of monitoring should focus on habitat features that may have been directly or indirectly impacted by tasks listed above. Other components of monitoring should focus on the biology of these species as discussed in task 411.

413. **Conduct research aimed at developing population viability analyses for Warner sucker, Hutton tui chub, and Foskett speckled dace, respectively.** Research should include, but not be limited to, the goals of providing information on: (1) the abundance of YOY, juvenile, and adult (of multiple year-classes) suckers in all populations, and the relationship of their abundance to climate; (2) factors influencing the recruitment of all three species into

their respective populations; (3) the genetic variability of each species across their respective population(s); (4) life history attributes such as age at first spawning, residence time of larvae and YOY, spawning behavior, etc.; and (5) other characteristics of these species that may assist in further defining and expanding recovery plan objectives.

42. **Monitor fish habitats.** As land management changes are made through implementation of tasks in this plan, the conditions of fish habitats should be monitored to see if the changes have the effect(s) predicted. This monitoring may be helpful in adapting tasks to be implemented later in time to improve overall effectiveness of recovery plan tasks.

5. Evaluate long-term effects of climatic trends on the recovery of fishes.

The effects of current land and water use on these fishes are greatly exacerbated by drought, and a prolonged drought could make the recovery of the species more difficult. For example, the drought of 1987 to 1994 reduced stream habitat and desiccated the Warner Lakes, extirpating the lake-resident Warner sucker population. Evaluate the effects of climate on the recovery effort over the entire period of recovery for each species, and revise recovery tasks and time frames if necessary.

6. Develop and implement a public outreach program.

An effective public outreach program should be developed to increase awareness and understanding of recovery efforts for the threatened and rare native fishes of the Warner Basin and Alkali Subbasin. Interested parties should be continually involved in and updated on all aspects of this recovery effort so that potential conflicts can be identified and resolved as soon and as much as possible.

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IV. IMPLEMENTATION SCHEDULE

The table that follows is a summary of scheduled actions and costs for the Warner sucker, Foskett speckled dace and Hutton tui chub recovery program. It is a guide to meet the objectives of the Recovery Plan for the Warner sucker, Foskett speckled dace and Hutton tui chub, as elaborated upon in Part II, Narrative Section. This table indicates the priority in scheduling tasks to meet objectives, identifies the agencies responsible for performing the tasks, and indicates the estimated costs to each agency. Implementing Part IV is the action of the recovery plan that, when accomplished, should bring about the recovery and therefore delisting of the Warner sucker, and the long-term persistence and conservation of the native ecosystem of the Foskett speckled dace and the Hutton tui chub.

RECOVERY ACTION PRIORITIES

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

2 = An action that must be taken to prevent a significant decline in species' population/habitat quality, or some other significant negative impact short of extinction.

3 = All other actions necessary to provide for full recovery of the species

Abbreviations and terms:

Continuous	=	Task will be implemented on an annual basis once it has begun
CA	=	Conservation Agreement

Responsible Parties:

Service	=	U.S. Fish and Wildlife Service
BLM	=	Bureau of Land Management
ODFW	=	Oregon Department of Fish and Wildlife
FS	=	U.S. Forest Service
NRCS	=	Natural Resource Conservation Service
OSU-EXT	=	Oregon State University Agricultural Extension
UCD-EXT	=	University of California Davis Agricultural Extension
TNC	=	The Nature Conservancy
PVT	=	Private Landowners
WC	=	Watershed Councils
ONHP	=	Oregon Natural Heritage Program
OWRD	=	Oregon Water Resources Department

IV. IMPLEMENTATION SCHEDULE

Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost in $1,000	Cost Estimate ($1,000)				Comments
						1998	1999	2000	2001	
1	111	Identify existing habitat	4	BLM FS ONHP ODFW	96	10 10 2 2	10 10 2 2	10 10 2 2	10 10 2 2	
1	1121	Assess quality of existing habitats on Federal lands	4	BLM FS ODFW	48	5 5 2	5 5 2	5 5 2	5 5 2	
1	1131	Manage and promote good quality habitats on Federal lands to prevent species declines	Continuous	Service BLM FS ONHP ODFW	200	1 3 3 1 1	1 3 3 1 1	2 5 5 1 1	2 5 5 1 1	
1	1142	Investigate and install physical improvements to Foskett and Dace Springs	3	BLM	60	10	20	30		
1	131	Evaluate problems with fish passage in Warner Basin streams and develop plans for passage and screening	4	Service BLM ODFW	58	2 10 10	2 5 5	2 5 5	2 5 5	Coordinate with PVT
1	133	Monitor the effectiveness of Warner Basin passage and screening structures	4	BLM ODFW	40	5 5	5 5	5 5	5 5	Coordinate with PVT

Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost in $1,000	Cost Estimate ($1,000)				Comments
						1998	1999	2000	2001	
1	1411	Develop a CA with ODFW to prevent future stocking of non-native species in the affected area	2	Service ODFW	4	1 1	1 1			
2	1122	Assess quality of existing habitats on non-Federal lands	4	NRCS ODFW WC ONHP	56	5 5 2 2	5 5 2 2	5 5 2 2	5 5 2 2	Coordinate with PVT
2	1132	Secure good quality habitats on non-Federal lands to prevent species declines	Continuous	Service NRCS ODFW WC	135	3 2 2 2	3 2 2 2	3 2 2 2	3 2 2 2	Coordinate with PVT
2	1143	Improve poor quality habitat conditions on non-Federal lands	Continuous	Service NRCS ODFW WC	120	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	Coordinate with PVT
2	1412	Develop and implement a public education program to reduce or eliminate illegal translocation of exotic fishes within habitats in the Warner Basin	4	Service ODFW OSU-Ext UCD-Ext	68	2 5 2 2	2 5 2 2	4 15 4 4	3 10 3 3	
2	142	Investigate impacts of exotic fish populations on the Warner sucker	Continuous	BLM FS ONHP ODFW	210	5 5 2 2	5 5 2 2	5 5 2 2	5 5 2 2	Coordinate with PVT

Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost in $1,000	Cost Estimate ($1,000) 1998	1999	2000	2001	Comments
2	143	Monitor exotic fish populations in the Warner Basin	Continuous	BLM FS ONHP ODFW	300	5 5 5 5	5 5 5 5	5 5 5 5	5 5 5 5	Coordinate with PVT
2	144	Evaluate options to further control or eliminate exotic fishes	Continuous	Service BLM FS ONHP ODFW	330	2 5 5 5 5	2 5 5 5 5	2 5 5 5 5	2 5 5 5 5	
2	212	Develop genetic management plan for refugial populations deemed important to the Warner Basin, Coleman Subbasin or Alkali Subbasin	2	Service ODFW	24	5 5	7 7			
2	213	Determine how to manage refugial populations outside the Warner Basin and the feasibility of reintroduction back to the Warner Basin	4	Service	17	2	5	5	5	
2	221	Assess the need for captive propagation	2	Service	6	3	3			
2	222	Refine captive propagation techniques	5	Service	50	10	10	10	10	

Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost in $1,000	Cost Estimate ($1,000) 1998	1999	2000	2001	Comments
2	412	Monitor populations and spawning success of lake and stream morph Warner suckers, Foskett speckled dace and Hutton tui chub	Continuous	Service ODFW ONHP BLM FS	375	1 2 2 10 10	1 2 2 10 10	1 2 2 10 10	1 2 2 10 10	
2	413	Conduct research aimed at developing population viability analyses for Warner suckers, Hutton tui chub, and Foskett speckled dace	2	Service ODFW ONHP BLM	16			2 2 2 2	2 2 2 2	
2	42	Monitor fish habitats	Continuous	FS-Fremont FS-Modoc BLM-Lakeview BLM-Cedarville	750	20 5 20 5	20 5 20 5	20 5 20 5	20 5 20 5	Part of ongoing land management programs
2	5	Evaluate long-term effects of climatic trends on the recovery of fishes	Continuous	Service ODFW OSU-Ext UCD-Ext	118	5 5 5 5	1 2 2 2	1 2 2 2	1 2 2 2	
3	1211	Assess current watershed conditions on Federal lands	4	FS-Fremont FS-Modoc BLM-Lakeview BLM-Cedarville	320	30 10 30 10	30 10 30 10	30 10 30 10	30 10 30 10	Part of ongoing land management programs

Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost in $1,000	Cost Estimate ($1,000)				Comments
						1998	1999	2000	2001	
3	1212	Assess current watershed conditions on non-Federal lands	10	Service WC NRCS	50	1 2 2	1 2 2	1 2 2	1 2 2	Coordinate with PVT
3	1221	Improve watershed conditions on Federal lands	Continuous	FS-Fremont FS-Modoc BLM-Lakeview BLM-Cedarville	330	8 3 8 3	8 3 8 3	8 3 8 3	8 3 8 3	Part of ongoing land management programs
3	1222	Improve watershed conditions on non-Federal lands	Continuous	Service WC NRCS	165	1 5 5	1 5 5	1 5 5	1 5 5	Coordinate with PVT
3	31	Determine stream flows required for Warner sucker recovery	4	Service ODFW	16	2 2	2 2	2 2	2 2	
3	32	Develop plans for securing stream and spring flows	3	Service ODFW OWRD FS BLM WC	54		3 3 3 3 3 3	3 3 3 3 3 3	3 3 3 3 3 3	Coordinate with PVT
3	33	Implement the plans for securing water flows	Continuous	Service ODFW FS BLM WC	75	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	Coordinate with PVT

Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost in $1,000	Cost Estimate ($1,000)				Comments
						1998	1999	2000	2001	
3	6	Develop and implement a public information program	Continuous	Service BLM ODFW	75	3 1 1	3 1 1	3 1 1	3 1 1	
Total Cost					4166	439	451	471	433	

APPENDIX I

Conservation of rare fishes outside the Warner Basin and the Alkali Subbasin

Although this recovery plan is designed to provide recovery and conservation planning guidance for the threatened fishes of the Warner Basin and the Alkali Subbasin, the tasks described herein are applicable to other species as conservation recommendations. For example, the impacts to Warner Valley redband trout of a lack of passage and screening structures at irrigation diversion dams in the Warner Basin are undoubtedly similar to the impacts to the native redband trout from similar situations in the nearby Chewaucan Basin. As a result, it may be of some utility to promote the recovery tasks described in this plan as conservation recommendations for the native fishes of other basins. Conservation recommendations are those activities that would have a conservation benefit for a non-listed species (which could be a candidate species or a species of concern) if they were undertaken by an agency or landowner. One important reason for carrying out programs to conserve these rare non-listed species is the fact that conservation recommendations, especially if carried out within the framework of an approved Conservation Agreement between the Service and the agency or landowner, may help ensure the overall long term conservation for these species.

The applicability of Warner Basin recovery tasks to other basins and species for use as conservation recommendations in the development of conservation agreements depends on the similarities of both the fish faunas, and the threats facing these faunas, to the fauna and issues of the Warner Basin. To a certain extent, the fish faunas of all of the interior basins of southeastern Oregon are similar to each other. This similarity is a remnant of the historical pattern of colonization, isolation, and differentiation of fishes of this large portion of the State, which is in turn driven by the geologic and climatologic history of the area (see Introduction). Specifically, the basins or subbasins, and the fishes found in each, as listed in Table 1, are of sufficient similarity to the Warner Basin that using Warner Basin recovery tasks as conservation recommendations may be worthwhile.

By including references to the fishes of other basins in this section of this recovery plan, it is expressly not the Service's intention to construe that this is the recovery plan for these additional species. Rather, we intend that the rationale and thought process used to develop this recovery plan be available to help guide conservation efforts for non-listed species in areas where issues and species are similar to those of the Warner Basin and Alkali Subbasin. If it were the Service's intent to try and apply this recovery plan across additional basins to cover these additional species, we would have to provide a much more detailed description of the condition of each additional basin, the fishes (and other aquatic species) present in each basin, and the threats these species face as a result of land management activities in these basins, as has been provided in this plan for the Warner Basin and Alkali Subbasin.

Table 2 is a list of recovery tasks outlined in the recovery plan that should be considered for use as conservation recommendations if applied (and modified, as appropriate) to the other species in other basins listed in Table 1. Since effective implementation of these recommendations may require adapting them to local conditions, the Service is both willing and able to assist interested parties in this process. The Service can help take these recovery recommendations, adapt them to local conditions, and assist in implementing them within the framework of some sort of Conservation Agreement. Other Federal, state, local or private entities identified in the implementation schedule for the recovery plan may also be able to assist. While the Service cannot guarantee funding assistance, the Service does have programs that can assist in the carrying out of conservation recommendations and in developing Conservation Agreements for non-listed species. These programs are designed to help secure the conservation status of non-listed species with the ultimate goal that the need to list them as threatened or endangered in the future can be avoided.

Conservation Agreements are voluntary agreements between the Service, one or more landowners, agencies, watershed councils, and other governmental or non-governmental entities that are jointly interested in the conservation of a listed or non-listed species. Conservation Agreements may be accompanied by financial support that is cost-shared among all participants. By outlining the areas in which the Service believes these recovery tasks might be applied as conservation recommendations, the Service is in no way seeking regulatory control or oversight over land management activities in these areas. The reasons for proposing this approach to conservation are simply an attempt to bring about the conservation of the species listed in Table 1, and that of the ecosystems upon which these species depend. The Service also hopes that by identifying these areas in an official document, interested parties will both become aware of the potential to carry out these described recommendations, and seek the Service's involvement in developing Conservation Agreements.

Table 1. Common and scientific names of other rare fish species of the Interior Basin of Oregon, and the basin/subbasins they are found in, that may benefit from implementation of recovery tasks from the recovery plan as conservation recommendations.

Species Common Name	Species Scientific Name	Basin and/or Subbasin
Silver Basin tui chub	*Gila bicolor ssp.*	**Fort Rock Basin**
redband trout	*Oncorhynchus mykiss* ssp.	**Fort Rock Basin**
Oregon Lakes tui chub, XL and Brattain Springs	*Gila bicolor oregonensis.*	**Chewaucan Basin** Abert Lake subbasin From: Chewaucan River, XL and Brattain Springs
Summer Lake Basin tui chub	*Gila bicolor* ssp.?	**Chewaucan Basin**, Summer Lake subbasin
redband trout	*Oncorhynchus mykiss* ssp.	**Chewaucan Basin**
Catlow tui chub	*Gila bicolor* ssp.	**Catlow Basin**
Sheldon tui chub	*Gila bicolor eurysoma*	**Catlow Basin**
redband trout	*Oncorhynchus mykiss* ssp.	**Catlow Basin** Guano Creek
Alvord chub	*Gila alvordensis*	**Alvord Basin**

Table 2. Other rare fish species of the Interior Basins of Oregon that may benefit from implementation of recovery tasks as conservation recommendations and the applicable recovery plan tasks.

Species Common Name	Basin and/or Sub-Basin	Applicable Plan Tasks
Silver Basin tui chub	**Fort Rock Basin**	111, 112, 113, 114, 14, 141, 142, 143, 144, 2, 21, 22, 3, 31, 32, 33, 4, 41, 42, 5
redband trout	**Fort Rock Basin**	111, 112, 113, 114, 12, 122, 13, 14, 141, 142, 143, 144, 2, 21, 22, 3, 31, 32, 33, 4, 41, 42, 5
Oregon Lakes tui chub, XL and Brattain Springs	**Chewaucan Basin** Abert Lake subbasin From: Chewaucan River, XL and Brattain Springs	111, 112, 113, 114, 14, 141, 142, 143, 144, 2, 21, 22, 3, 31, 32, 33, 4, 41, 42, 5
Summer Lake Basin tui chub	**Chewaucan Basin**, Summer Lake subbasin	111, 112, 113, 114, 14, 141, 142, 143, 144, 2, 21, 22, 3, 32, 33, 4, 41, 42, 5
redband trout	**Chewaucan Basin**	111, 112, 113, 114, 12, 121, 122, 13, 14, 141, 142, 143, 144, 2, 21, 22, 3, 31, 32, 33, 4, 41, 42, 5
Catlow tui chub	**Catlow Basin**	111, 112, 113, 114, 12, 122, 14, 141, 142, 143, 144, 2, 21, 22, 3, 31, 32, 33, 4, 41, 42, 5
Sheldon tui chub	**Catlow Basin**	111, 112, 113, 114, 12, 121, 122, 13, 14, 141, 142, 143, 144, 2, 21, 22, 3, 31, 32, 33, 4, 41, 42, 5
redband trout	**Catlow Basin** Guano Creek	111, 112, 113, 114, 12, 122, 14, 141, 142, 143, 144, 2, 21, 22, 3, 31, 32, 33, 4, 41, 42, 5
Alvord chub	**Alvord Basin**	111, 112, 113, 114, 12, 122, 14, 141, 142, 143, 144, 2, 21, 22, 3, 31, 32, 33, 4, 41, 42, 5

APPENDIX II

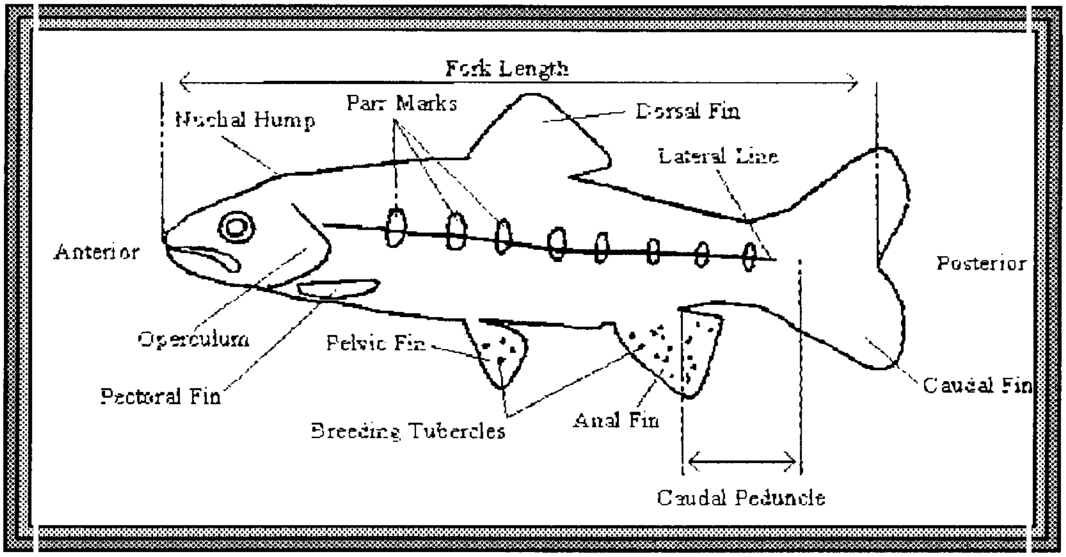

Figure 3. Drawing of a generic fish. Definitions of labels from drawing correspond with bold text words identified in the glossary.

APPENDIX III

Glossary

Adfluvial: Migration up a river, stream or creek.

Allopatric: Occurring in a different geographic area from another population or species.

Allopatric Speciation: Speciation in populations that are geographically isolated.

Anterior: Towards the head of an organism. See Figure 3.

Benthic: Living on the bottom of a stream, river, pond, or lake.

Breeding Tubercles: Small bumps usually found on the anal, caudal and pelvic fins during spawning season. Males tend to have more than females. See Figure 3.

Candidate Species: Plant or animal considered for possible addition to the list of Endangered and Threatened Species.

Caudal Peduncle: Rear, usually slender, part of the body between the base of the last anal fin rays and the caudal fin base. See Figure 3.

Delisting: Official removal of a species from the list of Threatened and Endangered Species.

Desiccation: Drying out.

Detritus: Decomposed plant and animal remains.

Diatoms: Small, usually microscopic, plants.

Diurnal: Active during daylight hours.

Endemic: Native to, and restricted to, a particular geographic region.

Endorheic: A closed basin, with no outflow.

Ephemeral: Lasting a short time.

Epilithic: Living on the surface of stones, rocks, or pebbles.

Extirpated: No longer present; not occurring in the area. Locally extinct.

Eutrophication: A process by which pollutants cause a body of water to become overly rich in organic and mineral nutrients, so that algae grow rapidly and deplete the oxygen supply.

Fecundity: The potential reproductive capacity of an organism or population.

Filamentous: Having a fine string or even hair-like thickness and appearance.

Fins: **Caudal.** See Figure 3.

Anal. See Figure 3.

Pelvic. See Figure 3.

Pectoral. See Figure 3.

Dorsal. See Figure 3.

Fork Length (FL): The measurement on a fish from the tip of the nose to the middle of the tail where a "V" is formed. See Figure 3.

Genetic Diversity: This term is used when discussing a population or a single species, not an individual organism. This term refers to all the genetic variability contained within the individuals making up the population or species.

Gill Raker: Tooth-like projection on the front edge of the gill arch; often used to trap food items.

Grabens: Large sunken blocks of ground.

Horsts: Large uplifted blocks of ground.

Ichthyofauna: The fish community occurring in the area being considered.

Interorbital: Area between the eyes

Introgression: The spread of genes of one species into the gene pool of another by hybridization and backcrossing.

Lateral Line: Microscopic canal along the body, located roughly at midside. This canal is a rearward extension of a sensory canal system on the head and contains sense organs which detect pressure changes, like water current, or waves passing through the water. See Figure 3.

Lateral Line Scales: The number of scales along the lateral line.

Macrophytes: Large plants that are visible to the naked eye.

Meristic: Referring to whole integer counts (1,2,3,...) on the body (i.e. number of dorsal rays, number of scales, number of pelvic spines...).

Metapopulation: A group of populations of one species coexisting in time but not in space.

Morph: A form; any individuals of a group that varies; any local population of a species (with many populations) exhibiting distinctive morphology or behavior.

Morphometric: Measurements taken on the body.

Niche: The ecological role of a species in a community.

Nuchal hump: Pertaining to the back of the neck. See Figure 3.

Operculum: The group of bones that form the gill coverings. See Figure 3.

Parr Marks: Dark bars in juveniles that are usually absent in adults. See Figure 3.

Phenotypic Plasticity: The ability of different individuals of the same species to have very different appearances despite identical genotypes as a response to changes in the environment.

Physiographic: Pertaining to geographic features on the earth's surface.

Piscivorous: Fish eating.

Planktonic: Pertaining to animal or plant life that resides in water that has weak powers of locomotion and is carried by currents, tides, and waves.

Predorsal Scales: The row of scales along the middle of the back between the head and the dorsal fin.

Recruitment: The influx of new members into a population by reproduction or immigration.

Recovery: Improvement in the general status of the species to the point at which listing is no longer appropriate.

Standard Length (SL): The straight-line distance from the tip of the snout to the rear end of the vertebral column.

Sympatric: Living, occurring in the same area.

Taxonomy: The theory and practice of describing, naming and classifying organisms.

Total Length (TL): The longest straight-line distance from the tip of the snout to the end of the tail.

Vascular Macrophytes: Typically larger plants, having a simple vascular system, like grasses.

APPENDIX IV

Summary of the Agency and Public Comments on the Draft Recovery Plan for the Threatened and Rare Native Fishes of the Warner Basin and Alkali Subbasin.

I. Background

In September 1997, the Service released the draft recovery plan for the threatened and rare native fishes of the Warner Basin and Alkali Subbasin for a 60-day public comment period, ending on November 24, 1997. Over 100 copies of the recovery plan were sent out for review during the comment period.

A total of 11 letters/comments were received, each containing varying numbers of issues. Many specific comments reoccurred in letters. Many of the specific comments, related to wording, clarity, and issues were incorporated, where appropriate, into the final plan and are not addressed in the following section. Issues/comments raised during the public comment period that were not addressed or incorporated into this final plan are discussed below. Four letters arrived from private individuals and these have been sent specific responses to their questions.

This section provides a summary of general demographic information, including the total number of letters/comments received from various affiliations and states. A complete index of those providing comments, by affiliation is available from the U.S. Fish and Wildlife Service, Oregon State Office, 2600 SE 98th Avenue, Suite 100, Portland, Oregon 97266. All letter of comment on the draft plan are kept on file in the Oregon State Office.

Demographic Information

The following is a breakdown of the number of letters received from various affiliations:

Federal Agencies	4
State Agencies	2
Environmental /Conservation Organizations	1
Individuals	3

II. Summary of Major Comments and Service Responses

Issue 1: The inclusion of the Warner Valley redband trout and the Cowhead Lake tui chub in this recovery plan would preclude these species from being listed in the future.

Response: The purpose of this recovery plan is to provide guidance and goals, that if followed and reached, should lead to the recovery or permanence of the threatened species in the Warner Basin and Alkali Subbasin. These species are the Warner sucker, Hutton tui chub and Foskett speckled dace. This recovery plan may benefit other aquatic species in these basins, including the Warner Valley redband trout and the Cowhead Lake tui chub. If the Warner Valley redband trout or the Cowhead Lake tui chub are listed in the future, this recovery plan will be assessed for benefits to these species but their inclusion here does not preclude them from being listed in the future.

Issue 2: The recovery plan implies that there will be benefits to the Warner Valley redband trout and Cowhead Lake tui chub. The Warner Valley redband trout overlaps in distribution with the Warner sucker but is also found in headwaters above Warner sucker distribution. Also, approximately 60 percent of the distribution of the Cowhead Lake tui chub is on private lands that will not be affected by Federal actions.

Response: Warner Valley redband trout are found in headwaters above Warner sucker distribution. The approach of this recovery plan is an aquatic ecosystem approach that includes the entire Warner Basin. Improvements need to be made throughout the watershed, including headwater reaches, because these areas provide essential clean water and cool water temperatures that are necessary for Warner suckers lower down in the systems. Similarly, the distribution of the Cowhead Lake tui chub is in the Warner Basin although it does not overlap with Warner sucker distribution. The Cowhead Lake region provides essential clean water and cool water temperatures that are necessary for Warner suckers lower down in the system. Improvements to the Cowhead Lake region are necessary for recovery of the Warner sucker and as such should benefit the Cowhead Lake tui chub.

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