

Borax Lake Chub

(Gila boraxobius)

5-Year Review: Summary and Evaluation



Photo: Alan Mauer/Fish and Wildlife Service

August 2012

**U.S. Fish and Wildlife Service
Oregon Fish and Wildlife Office
Portland, Oregon**

5-YEAR REVIEW
Species reviewed: Borax Lake chub (*Gila boraxobius*)

OFWO File Number: 8183.0069

TABLE OF CONTENTS

1.0	GENERAL INFORMATION.....	1
1.1	Reviewers.....	1
1.2	Methodology used to complete the review:.....	1
1.3	Background	1
2.0	REVIEW ANALYSIS.....	3
2.1	Application of the 1996 Distinct Population Segment (DPS) policy.....	3
2.2	Recovery Criteria.....	3
2.3	Updated Information and Current Species Status	12
2.4	Synthesis	23
3.0	RESULTS	25
3.1	Recommended Classification:.....	25
3.2	New Recovery Priority Number	25
3.3	Listing and Reclassification Priority Number:	25
4.0	RECOMMENDATIONS FOR FUTURE ACTIONS	26
5.0	REFERENCES.....	27
	Signature Page.....	31

5-YEAR REVIEW
Borax Lake chub (*Gila boraxobius*)

1.0 GENERAL INFORMATION

1.1 Reviewers:

Lead Field Office:

Oregon Fish and Wildlife Office - Bend Field Office

Alan Mauer (541) 383-7146

Nancy Gilbert (541) 383-7146

Cooperating Field Office(s):

Not applicable

Cooperating Regional Office(s):

Not applicable

1.2 Methodology used to complete the review:

In order to conduct this 5-year review for the Borax Lake chub, the Fish and Wildlife Service (Service): gathered information available since the time of listing, including annual "Progress Reports" by Oregon Department of Fish and Wildlife (ODFW) (Scheerer and Jacobs 2005; 2006; 2007; 2008; 2009; and 2010; and Scheerer and Bangs 2011), and a review of the conservation status of the Borax Lake chub by Williams and Macdonald (2003); reviewed activities undertaken since the time of listing to determine if recovery actions have progressed; reviewed new information regarding the status of the threats to the species; reviewed the recovery criteria in the recovery plan and made recommendations for future actions. This review was conducted by Oregon Fish and Wildlife Office's Bend Field Office. The ODFW Assistant Project Leader for the Native Fish Investigation Project reviewed the draft 5-year review.

The notice of initiation of a 5-year review was published in the *Federal Register* on April 11, 2006. This notice requested any information concerning the status of the Borax Lake chub. No information was received in response to the *Federal Register* notice.

1.3 Background:

1.3.1 Federal Register Notice citation announcing initiation of this review:

The Service announced the initiation of a 5-year review of 70 species including the Borax Lake chub, under section 4(c)(2)(B) of the Endangered Species Act (Act) in an April 11, 2006, *Federal Register* notice (Fish and Wildlife Service 2006).

1.3.2 Listing History:

Original Listing

Federal Register notice: Endangered and threatened wildlife and plants; Emergency determination of endangered status and critical habitat for Borax Lake chub (Fish and Wildlife Service 1980).

Date listed: May 28, 1980

Entity listed: The species Borax Lake chub (*Gila boraxobius*)

Classification: Endangered

Revised Listing, if applicable

Federal Register notice: Endangered and threatened wildlife and plants; Endangered status and critical habitat for Borax Lake chub (Fish and Wildlife Service 1982).

Date listed: October 5, 1982

Entity listed: The species Borax Lake chub (*Gila boraxobius*)

Classification: Endangered

1.3.3 Associated Rulemakings:

Critical habitat for Borax Lake chub was designated at the time of listing (Fish and Wildlife Service 1982). No 4(d) rules, experimental populations, or similarity of appearance cases have been proposed.

1.3.4 Review History:

This is the first 5-year review for the Borax Lake chub. A status review was conducted in 2003.

1.3.5 Species' Recovery Priority Number at start of this 5-year review:

The Borax Lake chub was assigned a recovery priority number of 2. A priority number 2 means the species has a high degree of threat and a high potential for recovery.

1.3.6 Current Recovery Plan or Outline:

Name of plan or outline: “Recovery Plan for the Borax Lake Chub, *Gila boraxobius*” (Fish and Wildlife Service 1987)

Date issued: February 4, 1987

Dates of previous revisions, if applicable: Not applicable

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

Yes
 No

2.1.2 Is the species under review listed as a DPS?

Yes
 No

2.1.3 Was the DPS listed prior to 1996?

Not applicable

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy?

Yes
 No

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved Recovery Plan containing objective, measurable criteria?

Yes
 No

2.2.2 Adequacy of Recovery Criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?

Yes
 No

The “Recovery Plan for the Borax Lake Chub, *Gila boraxobius*” (Recovery Plan) was finalized in 1987, and since then additional studies of the Borax Lake chub and the ecology and habitat of Borax Lake have been conducted (Salzer 1992, Scoppettone et al. 1995, Furnish et al. 2002, and Scheerer and Jacobs 2005; 2006; 2007; 2008; 2009; and 2010; and

Scheerer and Bangs 2011). Although, additional information on the biology of Borax Lake chub and its habitat has been generated since the completion of the Recovery Plan, the recovery criteria remain pertinent to address threat factors.

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria?

Yes
 No

2.2.3 List the recovery criteria as they appear in the Recovery Plan, and discuss how each criterion has or has not been met, citing information:

Borax Lake chub occurs as a single population in a small 4.1 hectare (10.2 acre) geothermally heated alkaline lake in southeastern Oregon. The Recovery Plan for the Borax Lake chub states: “The Borax Lake chub will be recovered when complete control exists over management of surface and subsurface waters by The Nature Conservancy or a public resource agency within the [259 hectares] 640 acres of critical habitat; and when a self-sustaining population of Borax Lake chubs has been maintained free of threats for five consecutive years” (Fish and Wildlife Service 1987).

The Recovery Plan described an “interim objective” for potential reclassification to threatened status, as well as a “primary objective” for recovery that could result in removal of the species from the List of Endangered and Threatened Wildlife.

The following four conditions were established as interim criteria for reclassification from endangered to threatened status:

1. the presence of a naturally-reproducing population of Borax Lake chub in Borax Lake that is free of exotic species;
2. permanent protection for the 64.75 hectare (160-acre) parcel of land surrounding and including Borax Lake (T37S, R33E, Sec. 14) by The Nature Conservancy or other appropriate public resource agency;
3. removal of threats to subsurface waters from geothermal energy exploration or development; and
4. re-establishment of ponds and natural marshes adjacent to Borax Lake in order to create more chub habitat, and reestablishment of Lower Borax Lake by waters from Borax Lake in order to create more habitat.

To meet the primary objective of recovery, the Recovery Plan stated that the above four conditions must be met as well as the following six conditions:

1. a viable, self-sustaining population of Borax Lake chubs, which is herein defined as a naturally-sustaining population that is free of exotic species and fluctuates in size within the seasonal ranges observed in 1986 to 1987;
2. permanent protection for the 64.75 hectare (160-acre) parcel of land to the north of Borax Lake (T37S, R33E, Sec. 11) by The Nature Conservancy or other appropriate public resource agency;
3. withdrawal of Borax Lake waters from appropriations;
4. establishment of a fence around the 259 hectare (640-acre) critical habitat area to prevent vehicle entry;
5. establishment of monitoring programs to survey habitats and fish population status; and
6. lack of any new threats to the species or ecosystem for five consecutive years.

The Recovery Plan also states: “The natural integrity of the physical and chemical constituents of springs feeding Borax Lake must be maintained.”

In 2003, the Service contracted with Southern Oregon University’s AuCoin Institute for Ecological, Economic and Civic Studies and the Oregon Chapter of The Nature Conservancy (TNC) to prepare a review of the conservation status of the Borax Lake chub. As part of this review an expert panel of 16 scientists was convened and tasked with providing their scientific opinion regarding remaining threats, listing status, and needed management and monitoring actions. Their 2003 report “A Review of the Conservation Status of the Borax Lake Chub, an Endangered Species” (Conservation Review) found all six of the major recovery task groups identified in the 1987 Recovery Plan have been more than half implemented, three have been “mostly implemented” and one had been fully implemented. Within these major task groups, some individual tasks have not been implemented or are only partially implemented, and some tasks may no longer be necessary.

The Conservation Review also identified remaining threats to the Borax Lake chub including: 1) impacts to the aquifer resulting from future significant increases in ground water withdrawal on private land; 2) impacts associated with vehicle access and recreational use; 3) potential introduction of non-native species; and 4) due to the “greatly restricted range” of the Borax Lake chub to a single area, it is vulnerable to catastrophic loss despite the existing protections (Williams and Macdonald 2003). It concluded “[s]ubstantial progress has been made towards recovery of the Borax Lake chub”, and recommended that “downlisting would be appropriate in the immediate future provided that there is a positive outcome to BLM’s land use planning effort for the Borax Lake

ecosystem and provided that regular monitoring of the ecosystem is initiated and maintained”. The Conservation Review also identified needed management and monitoring to address threats from recreational use, potential introduction of non-native species, potential future groundwater withdrawal, and vulnerability to catastrophic loss. In particular, the report identified the development and implementation of a monitoring strategy as critical to the conservation of the Borax Lake ecosystem. The Conservation Review concluded that delisting of the Borax Lake chub was not appropriate at the time the review was conducted.

Below we discuss how each of the interim and primary criteria have or have not been met:

Recovery Plan Interim Criterion 1: “the presence of a naturally-reproducing population of Borax Lake chub in Borax Lake that is free of exotic species” has been met for Borax Lake chub. The Borax Lake chub have been naturally reproducing (see section 2.3.1.2 for population information) and periodic surveys have not identified the presence of any exotic species (see section 2.3.2.3). The potential introduction of exotic species including diseases and parasites is an ongoing concern for isolated fish populations like the Borax Lake chub (Williams and Macdonald 2003, Williams et al. 2005, Goble and Scott 2006). The Conservation Review provided four specific recommendations to address concerns relative to potential introductions of non-native species (see section 2.3.2.3). The ODFW Borax Lake chub Progress Reports also recommend monitoring to detect the presence of exotic species. The Service, BLM, TNC, and ODFW are working together on the development of a Borax Lake chub cooperative agreement (cooperative agreement) (see Recovery Plan Primary Criterion 2). The plan is intended to be completed in 2012, and includes measures to reduce the probability of introducing non-native species.

Recovery Plan Interim Criterion 2: “permanent protection for the 64.75 hectare (160-acre) parcel of land surrounding and including Borax Lake (T37S, R33E, Sec. 14) by The Nature Conservancy or other appropriate public resource agency” has been met by the acquisition of the privately owned lake and surrounding land by TNC including subsurface mineral rights. The BLM has designated the public land surrounding Borax Lake as an Area of Critical Environmental Concern (ACEC). The designated critical habitat has been fenced but is open to vehicle use on designated existing roads on BLM managed lands only. The TNC no longer permits vehicular access to the preserve except for handicap access or scientific research. The ODFW (Scheerer and Jacobs 2005; 2006; 2007; 2008; 2009; 2010; and Scheerer and Bangs 2011) and the Conservation Review (Williams and Macdonald 2003) identified impacts resulting from recreation and off-highway vehicle use as a concern. Managing vehicle and boat access have been identified as priority tasks in the cooperative agreement.

Recovery Plan Interim Criterion 3: “removal of threats to subsurface waters from geothermal energy exploration or development” has been substantially met on

federally managed lands. With the passage of the Steens Mountain Cooperative Management and Protection Act of 2000 (Steens Act) and the completion of the Steens Andrews Resource Management Plan (RMP), the BLM has withdrawn the Alvord Known Geothermal Resource Area (KGRA) from mineral and geothermal exploration and development (BLM 2005a). The Steens Act congressionally designated a Mineral Withdrawal Area encompassing 364,217.1 hectares (900,000 acres) of the planning area on BLM administered lands. The mineral withdrawal area contains the majority of the Alvord KGRA, including Borax Lake and surrounding public lands, with the exception of 134.4 hectares (332 acres) located approximately 7.242 kilometers (4.5 miles) from Borax Lake (BLM 2005b). Private lands within this area are not affected by the mineral withdrawal. Approximately 809.4 hectares (2,000 acres) of privately owned land occur within a 4.83 kilometer (3-mile) radius of Borax Lake and are not subject to BLM's withdrawal. The potential exists that geothermal development could occur on private land in the vicinity of Borax Lake (see section 2.3.2.1).

Recovery Plan Interim Criterion 4: “reestablishment of ponds and natural marshes adjacent to Borax Lake in order to create more chub habitat, and reestablishment of Lower Borax Lake by waters from Borax Lake in order to create more habitat.” The Conservation Review found that the natural outflow pattern has been reestablished. The diversion of water on the northwestern, northern and northeastern shore is now stable and no additional chipping of the shoreline crust occurs. There are some overflow channels that still allow water to flow into the wetlands to the north, but it is not to the extent it was conducted in the past when it resulted in drying of the marshland and overflow channel to the south. The overflow ditch which in the past was operated to divert water out of Borax Lake was plugged with a series of check dams. These are now filled in and water on the south and southwest side of the Lake flows into a wetland and marsh area (Williams and Macdonald 2003).

Williams and Macdonald (2003) observed that water flow out of the lake infiltrates through the wetland/marsh area and chubs would not be able to pass through the marsh area into the lower Borax Lake. Occupancy of lower Borax Lake would not likely contribute to the recovery of the species. The lower lake dries during summers with low precipitation, and it is questionable whether the habitat is adequate for over-winter survival. Without productive year-round habitat, the chub are not likely to persist in lower Borax Lake. Rather than contributing additional habitat for the chub, it may actually function as a population “sink”. Therefore, the Service no longer considers lower Borax Lake to be additional chub habitat.

Recovery Plan Primary Criterion 1: “a viable, self-sustaining population of Borax Lake chubs, which [is] herein defined as a naturally-sustaining population that is free of exotic species and fluctuates in size within the seasonal ranges observed in 1986 to 1987” (15,276 to 8,578) has been met (see Table 1 and section 2.3.1.2). Population abundance estimates conducted from 1991-1996 indicate a fluctuating

population ranging from a low of 8,259 fish to 35,650 fish (Scheerer and Jacobs 2010). The ODFW developed a mark-recapture sampling protocol in 2005 that can be used to study the trend of the population. The ODFW estimated the population of Borax lake chub from 2005 through 2011, with the population ranging from a low of 8,246 fish in 2006 to a high of 26,571 in 2011 (Scheerer and Jacobs 2010 and Scheerer and Bangs 2011), (see Table 1. also see section 2.3.1.2).

Table 1. Adjusted Peterson mark-recapture estimates for Borax Lake chub 1986-2011 (from Scheerer and Bangs 2011).

Year	Estimate	Lower 95% Confidence Limit	Upper 95% Confidence Limit
1986	15,276	13,672	17,068
1987	8,578	7,994	9,204
1988	4,132	3,720	4,589
1989	14,052	13,016	15,172
1990	19,165	18,117	20,273
1991	33,000	31,795	34,251
1992	25,255	24,170	26,388
1993	35,650	34,154	37,212
1994	13,421	12,537	14,368
1995	35,465	33,533	37,510
1996	8,259	7,451	9,153
1997	10,905	10,377	11,459
2005	14,680	12,585	17,120
2006	8,246	6,715	10,121
2007	9,384	7,461	11,793
2008	12,401	10,681	14,398
2009	14,115	12,793	15,573
2010	25,489	23,999	27,071
2011	26,571	24,949	28,301

Recovery Plan Primary Criterion 2: “permanent protection for the [64.75 hectare] 160-acre parcel of land to the north of Borax Lake (T37S, R33E, Sec. 11) by The Nature Conservancy or other appropriate public resource agency” has been met. In 1983, the BLM designated the public lands surrounding Borax Lake as an Area of Critical Environmental Concern. Following this designation, the area was fenced to exclude livestock grazing. In 1983, TNC leased two 64.75 hectare (160-acre) private land parcels, one surrounding Borax Lake and the other immediately to the north. With the purchase of these two parcels by TNC in 1993, all lands designated as critical habitat were in public or conservation ownership. With the acquisition by TNC, diversion of water for irrigation and livestock grazing within designated critical habitat ceased.

The BLM manages public lands around Borax Lake consistent with the Andrews/Steens Resource Management Plan (BLM 2004). The RMP provides additional protection of Borax Lake chub critical habitat by directing BLM to

pursue the establishment of a conservation agreement or other cooperative agreement among BLM, TNC, Service, ODFW, or other private landowners to manage and protect the area for the conservation or recovery of the Borax Lake chub, including closing the area to livestock grazing, off-road vehicle travel, and limiting or closing vehicle access. In addition, the area within the fenced enclosure (fully encompassing critical habitat) is closed to livestock grazing (BLM 2004 and 2005a).

The BLM, Service, TNC, and ODFW initiated a cooperative effort to prepare a management plan and interagency agreement for the Borax Lake and the BLM Area of Critical Environmental Concern consistent with the RMP. Four key elements addressed in the cooperative agreement are:

1) Recreation and visitor use

- Motorized vehicle access and overnight camping will be closed within 30.5 meters (100 feet) of Borax Lake.
- Borax Lake will be closed to motorized watercraft
- All non-designated roads within the Borax Lake ACEC will be closed to motorized vehicle use, and barriers will be constructed to prevent motorized vehicle access.
- Cleansing of permitted watercraft will be required to prevent introduction of invasive species

2) Public information and interpretation

- An onsite interpretive area will be constructed and include informational signs on the current management of Borax Lake including conservation of the Borax Lake chub and measures to control invasive species

3) Groundwater withdrawal

- Existing management by BLM through the RMP includes the closure of the ACEC for saleable minerals, withdrawal from exploration for locatable minerals, and the ACEC is not available for mineral leasing.
- ODFW will provide conservation recommendations to the Oregon Department of Geology and Mineral Industries (DOGAMI) on any permit application that could impact the Borax lake ecosystem.

4) Monitoring

- The population of Borax Lake chub will be monitored annually to track long term trends including photo points and pedestrian surveys to monitor lake environmental conditions.

Recovery Plan Primary Criterion 3: “withdrawal of Borax Lake waters from appropriations” has been met. With acquisition of Borax Lake by TNC, surface waters on their land cannot be appropriated. Additionally, in 1991, the ODFW filed for application for the water rights to Borax Lake for conservation purposes. Groundwater is not protected from extraction by filing of water rights on private lands. There is approximately 809.4 hectares (2,000 acres) of private lands within a 4.83 kilometer (3-mile) radius of Borax Lake. The relationship between groundwater extraction and the Borax lake ecosystem has not been thoroughly assessed. Borax Lake is a fault-controlled geothermal system (Fairley and Hinds 2004). Future studies are needed to provide a better understanding of the relationship between fault mechanics and groundwater hydrology (Fairley et al. 2003).

Recovery Plan Primary Criterion 4: “establishment of a fence around the 259 hectare (640-acre) critical habitat area to prevent vehicle entry” has been partially met. The designated critical habitat is fenced and gated, but the area is not closed to vehicle access. Associated impacts from vehicles and recreation include damage to soils, wetlands, and lake shorelines from off-highway vehicles and impacts to water quality, lake substrates, and lake shorelines from wading, camping, and boating.

The 2003 Conservation Review identified vehicle access and recreational use resulting in disturbance to the fragile soil crusts to the west, northwest and northeast of Borax Lake. Substantial off-road vehicle damage was also noted by Scheerer and Jacobs annual reports (2005 through 2010) and by Scheerer and Bangs (2011) on the northern shore of Borax Lake.

The Andrews/Steens Resource Area, Burns District BLM, has prepared an Environmental Assessment (EA) to analyze potential effects of constructing facilities to modify public access and enhance public understanding of the Borax Lake Area. The Burns District BLM published an EA and signed the Finding of No Significant Impacts in May, 2010. The EA would allow the BLM to close roads in the vicinity of Borax Lake, realign fence surrounding Borax Lake to limit vehicle access, install interpretive signs, and improve an area to designate for visitor parking.

Recovery Plan Primary Criterion 5: “establishment of monitoring programs to survey habitats and fish population status” has been largely met. Numerous studies of the ecology and habitat of Borax Lake have been conducted (Salzer 1992; Scoppettone et al. 1995; Furnish et al. 2002; Scheerer and Jacobs 2005; 2006; 2007; 2008; 2009; and 2010; and Scheerer and Bangs 2011). The Nature Conservancy conducted abundance estimates from 1986 through 1997. The

ODFW conducted mark-recapture population surveys from 2005 through 2011, developed survey protocol, and recommended a long-term monitoring strategy (Scheerer and Jacob 2005; 2006; 2007; 2008; 2009; 2010; and Scheerer and Bangs 2011). They also conducted surveys to monitor the condition of the lake shoreline, and outflows and adjacent wetlands. Twelve photo points were established around the perimeter of the lake, temperatures were recorded and disturbances were noted.

Numerous studies monitoring water quality occurred during the 1980s and 1990s including Cummings and St. John (1993), Scoppettone et al.(1995), Cummings and Johnson (1997), and data from 1991-1996 from the Remote Automatic Weather Station (information included deep and shallow lake water temperatures, pH, specific conductance and salinity). Additional physical data including hydrologic information, substrate mapping, outflow monitoring, tracking of water levels, and geological and slope stability was gathered in the 1990s (Scoppettone et al.1995, and Wilson 2000).

The Conservation Review conducted in 2003 states that “It is clear that the development and implementation of a monitoring strategy is critical to conservation of the Borax Lake ecosystem. Monitoring is important for several reasons including: 1) identifying any new disturbance to the ecosystem; 2) identifying introduced species; and 3) developing a better understanding of the ecosystem, including natural and human-induced disturbances” (Williams and Macdonald 2003). The ODFW proposed a monitoring strategy and stated that implementation of a monitoring strategy is important to identify any new disturbance to the ecosystem and to identify introduced species (Scheerer and Jacobs 2005; 2006; 2007; 2008; 2009; 2010; and Scheerer and Bangs 2011). The Cooperative Management Plan referenced above will include population monitoring, and pedestrian survey and photo points to monitor the trend of local lake environmental conditions.

Recovery Plan Primary Criterion 6: “lack of any new threats to the species or ecosystem for five consecutive years” has been largely met except for the threat of geothermal energy development (see section 2.3.2.1). The 2003 Conservation Review identified remaining threats to the Borax Lake chub including: 1) impacts to the aquifer resulting from future significant increases in ground water withdrawal on private land; 2) impacts associated with vehicle access and recreational use; 3) potential introduction of non-native species; and 4) due to the “greatly restricted range” of the Borax Lake chub to a single area, it is vulnerable to catastrophic loss despite the existing protections (Williams and Macdonald 2003) (see discussion under Recovery Plan Interim Criterion 1 and 3, and Recovery Plan Primary Criterion 2, 3, and 4, and sections 2.3.2.1, 2.3.2.3, 2.3.2.4, and 2.3.2.5). Although most recovery criteria have largely been met, the threat of geothermal energy development remains outstanding and has potential to threaten the entirety of Borax Lake and thus the entire population of Borax Lake chub (see section 2.3.2.1).

The Recovery Plan also states: “The natural integrity of the physical and chemical constituents of springs feeding Borax Lake must be maintained.” We do not have any information that indicates any changes have occurred to the physical and chemical constituents of the springs feeding Borax Lake. For information on physical and chemical characteristics see discussion under Recovery Plan Primary Criterion 5 and section 2.3.1.6.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species’ biology and life history:

Since the Recovery Plan was completed in 1987, there have been several investigations and subsequent reports on the Borax Lake chub and the Borax Lake ecosystem including: information on life history, population dynamics, habitat use, distribution and identification of spawning habitats, population estimates, sampling procedures, seasonal diversity and relative abundance of benthic invertebrates and plankton, surveys of algae, and water quality parameters (water temperature, dissolved oxygen, pH, conductivity, and total dissolved solids) (Salzer 1992, Scopettone et al. 1995, Perkins 1996, Furnish et al. 2002, and Scheerer and Jacobs 2005; 2006; 2007; 2008; 2009; 2010; and Scheerer and Bangs 2011).

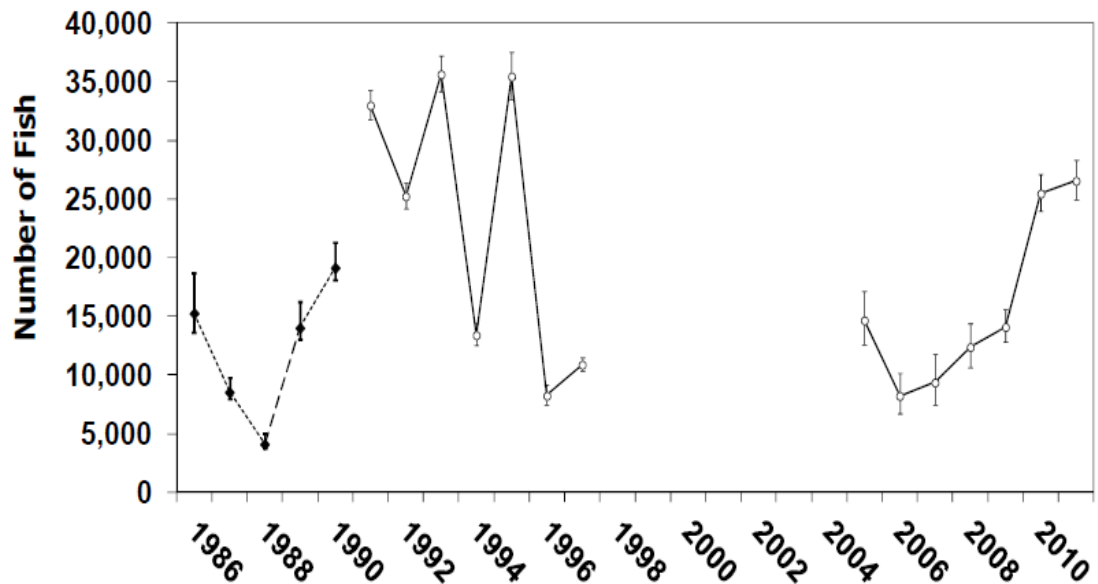
2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate), or demographic trends:

Abundance

Population abundance estimates for the Borax Lake chub have been conducted inconsistently over the years. Surveys were conducted from 1986-1997 by TNC (Salzer 1997), but no surveys were conducted from 1998 through 2004. From 2005 until 2011, ODFW conducted population abundance estimates. From 1986 to 1990 the abundance estimates were obtained by trapping only the perimeter of the lake. Population abundance estimates obtained annually from 1991 to 1997 utilized a grid system set throughout Borax Lake. Salzer (1992) found that perimeter-only sampling resulted in a substantial under estimation of population abundance. For these reasons, it has been suggested that the surveys from 1986-1990, which estimated the population along the perimeter of the lake, may not be comparable to those from 1991-1997 which estimated the population throughout the entire lake (See Table 1. and Figure 1.).

In order to test the comparability between the two sample designs, the ODFW simulated a randomized trapping design using data from the 1991 sampling by Salzer (1992). The ODFW selected a random 50% subsample of the data from the 63 traps fished on a grid pattern in 1991 and calculated a single sample mark-recapture estimate using the catch data (marked and unmarked fish) from the subsample. When this estimate was compared to the estimate from all 63 traps, the estimates were found to be essentially identical (within 4%) (Scheerer and Jacobs 2006). The random selection of traps from the grid simulates the random placement of traps within the lake (Scheerer and Jacobs 2006). From these analyses, it may be concluded that estimates obtained from random trapping are comparable with estimates obtained from grid-based trapping (Scheerer and Jacobs 2006) (see Figure 1.).

Figure 1. Borax Lake chub population abundance estimates from 1986 through 1997 and from 2005 through 2011. Horizontal bars represent 95% confidence limits. In 1986-1990 (solid symbols), only the perimeter of the lake was trapped. After 1990 (open symbols), the entire lake was trapped. Estimates from 1986-1990 are not directly comparable to later estimates (Salzer 1992) (Table from Scheerer and Bangs 2011).



The ODFW conducted population estimates in September 2005, through 2011. See Table 1 for a summary of results of the population estimates. Abundance estimated in 2010 and 2011 was approximately 25,849 fish and 26,571 fish respectively, similar to some of the highest estimates from the early 1990's. This is a significant increase over the estimates from 2005 through 2009 and was double the average of approximately 12,000 fish over the same time period. Lake temperatures recorded in 2010 were substantially cooler than those recorded in 2006 through 2009, which may have been responsible for improved chub survival (Scheerer and Jacobs

2010). Current estimates from 2005 through 2011 indicate the population overall is stable or increasing (see Figure 1.).

Age Structure

Description of the age structure, the age at maturity and possibly seasonal patterns of growth during the first year of life contribute to understanding the demographics of the population. Age and size class data has been collected using different techniques including opercle analysis to determine age, and length frequency analysis to determine size classes.

Information from Williams and Bond (1983) indicates that the population consisted primarily of age 1 fish, and a few age 2 and age 3 fish based primarily on length frequency data. Scopettone (1995) conducted an opercle bone aging analysis which indicated that 67-79 percent of the Borax Lake chub were less than one year old and ranged in size from 43 to 63 mm. A few individuals were aged at 10+ years old and ranged in size from 110 to 124 mm. Scopettone refers to the age analysis as “based primarily on length frequency data suspect ages” due to the lack of validation of the annuli measurements (Scopettone 1995).

Surveys done by ODFW in 2005 through 2011 found a broad range of length-frequency indicated by the range of sizes from few age-classes represented with only one apparent peak, to a broad range of sizes with no discernible age classes (Scheerer and Jacobs 2005; 2006; 2007; 2008; 2009; 2010; and Scheerer and Bangs 2011). Interpretation of the age class data is complicated by the short life span and protracted spawning period of Borax Lake chub. Because small cyprinids typically show substantial overlap in length-at-age, a study to validate and assess change in age structure over time would be beneficial (Scheerer and Jacobs 2009). Additional investigations into the age structure and duration of the life cycle of Borax Lake chub is needed to interpret the length frequency data collected.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding):

Harris (2000) examined the systematics of the Genus *Siphateles* using mitochondrial DNA. Harris (2000) describes the Genus *Siphateles* (Cope) (1883) as monotypic, and Borax Lake chub as one of three recognized species of *Siphateles*, not *Gila* (see the following discussion regarding taxonomic classification or changes in nomenclature). Harris states that “The oldest cladogenetic event within *Siphateles* is the divergence of *S. alvordensis* + *S. boraxobius* in the Alvord Desert of southeastern Oregon.” No additional new information on genetics of the Borax Lake chub was found.

2.3.1.4 Taxonomic classification or changes in nomenclature:

There have not been any changes to the taxonomic classification of Borax Lake chub since the time it was listed in 1982. The 2004 edition of the American Fisheries Society (AFS) “Common and Scientific Names of Fishes from the United States, Canada and Mexico” discusses the common use of the genus name *Siphateles* for three of the species of *Gila* including Borax Lake chub (Nelson et al. 2004). Bailey and Uyeno (1964) placed *Siphateles* in synonymy with *Gila*. The AFS publication discusses the current use of *Siphateles*, but does not conclude the necessity of a genus name change at this time. We will not try to resolve the dispute over nomenclature here, but recognize that Borax Lake chub is still recognized as *Gila* by AFS and the name may change to *Siphateles* in the future.

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors), or historic range (e.g. corrections to the historical range, change in distribution of the species’ within its historic range):

The known range of the Borax Lake chub has not changed since the time of listing. The Borax Lake chub consists of a single population that inhabits Borax Lake and its adjacent wetlands in Harney County, Oregon. Lower Borax Lake continues to exist ephemerally and, in years of high precipitation, the lower lake is inundated. Lower Borax Lake which contained chubs during wet years in the mid-1980’s, was dry from 1989 to 1991. The Conservation Review conducted in 2003 stated “Lower Borax Lake holds water in most years and the ponds and wetlands to the south and southwest of Borax Lake have been reestablished” (Williams and Macdonald 2003). Based on field observations in the summer of 2005 and 2006 the lower lake was dry (see section 2.2.3 Recovery Plan Interim Criterion 4).

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

The total habitat available to the Borax Lake chub is 4.1 hectares (10.2 acres) including the surrounding wetlands (Scheerer and Jacobs 2005). Borax Lake is a geothermally-heated alkaline spring-fed lake. The lake is perched 10 meters (30 feet) above the desert floor on large sodium-borate deposits. Water depth of Borax Lake averaged approximately 1.0 meter (3.3 feet), with a maximum measured depth of 27 meters (88.6 feet) at the thermal vent (Scheerer and Jacobs 2005). A 0.5 meter (1.6 feet) thick flocculent silt covers the lake bottom, with patches of bedrock, fine gravel, and sparse growth of aquatic macrophytes. Average lake temperatures ranged from highs of 39.2 degrees Celsius (102.6 degrees Fahrenheit) in the vent to a low of 22 degrees Celsius (71.6 degrees Fahrenheit) on the

Northeast shoreline (Scheerer and Jacobs 2006; 2007; and 2009). Observations in 2005 through 2011 indicate Borax Lake and most of the surrounding shoreline are in good condition, except for localized areas of off-road vehicle damage on the northern shore and other human impacts to the shoreline (Scheerer and Jacobs 2005; 2006; 2007; 2008; 2009; 2010; and Scheerer and Bangs 2011).

In the past, water was diverted from the lake at the south outflow to flood the lower lake and irrigate some of the grazed land. Two small check dams were constructed to protect the shoreline and prevent diverting water through the channel (Williams and McDonald 2003).

In 2002 and 2003, Koski and Wood (2003) measured temperature, conductivity, and pH from waters in the Alvord, Mickey, and Borax Lakes thermal areas. They found that the waters are consistent in chemical composition within a thermal area, but the three thermal areas differ from one another. Chemical composition within a thermal area varies over only narrow limits, but the emergence temperatures of nearby springs can vary by as much as 30 degrees Celsius (86 degrees Fahrenheit) (Fairley et al. 2003).

2.3.1.7 Other:

The State of Oregon enacted an Endangered Species Act (Oregon ESA) in 1987 and amended it in 1995. The Borax Lake chub was State listed as Endangered in 1987. See section 2.3.2.4 for a description of the Oregon ESA.

In 2002, the Oregon Fish and Wildlife Commission adopted the Native Fish Conservation Policy to ensure conservation and recovery of native fish in Oregon. As part of this policy, interim risk assessments were completed for selected native fish species in 2005, including the Borax Lake chub (ODFW 2005a). The ODFW concluded, based on criteria defined in the Native Fish Conservation Policy” [OAR 635-007-0507], that the Borax Lake chub is “at risk”. The rating is based on lack of recent information on abundance, low population estimates in 1996 and 1997, lack of information on productivity; and limited distribution. The Borax Lake chub was not considered at risk for reproductive independence and interspecific hybridization. At risk status provides for an elevated priority for monitoring and development of the conservation plan, and modifications to fish management practices within the ODFW statutory authority.

Implementation of the policy will occur through the development of a conservation plan which will include current and desired biological status, primary threat factors, short- and long-term management strategies,

monitoring and research needs, and reporting. The BLM, ODFW, TNC and the Service are working collaboratively on a cooperative agreement for Borax Lake and the chub. This cooperative management agreement could serve as the basis for a conservation plan pursuant to the Oregon Native Fish Conservation Policy. Until a conservation plan is completed, the ODFW will manage this species according to existing statutes and administrative rules.

In 2006, the ODFW finalized their Oregon Conservation Strategy (Strategy) (ODFW 2005b). The Strategy is an overarching State-wide approach for conserving fish and wildlife through the use of voluntary measures and collaboration. The Borax Lake chub is a “strategy species” for the Northern Basin and Range Ecoregion in southeast Oregon. Strategy species include rare and at risk species. The Strategy identifies species requirements, limiting factors, data gaps, and actions needed to conserve these species. The Borax Lake chub is described in the Strategy as vulnerable to random or localized disturbance, and has been affected by off-road vehicles and past land management practices. Identified data gaps include population abundance and productivity. According to the Strategy, needed conservation actions include continuing efforts to maintain habitat and water quality.

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

The 1982 listing rule stated: “The Borax Lake chub is endemic to Borax Lake and its outflow. Borax Lake is an extremely fragile aquatic ecosystem which, because of its position, approximately [10 meters] 30 feet above the valley floor, is vulnerable to adverse alteration.” At the time of listing in 1982, the primary threats to the species consisted of potential impacts from geothermal energy development, diversion of the Lake’s outflows by alteration of the shoreline crust, and potential development of a recreation facility.

Since the time of listing, a number of actions have been taken to reduce the impacts listed above. The 64.75 hectare (160-acre) private land parcel containing Borax Lake was purchased by TNC in 1993. Subsurface mineral rights are included (see section 2.2.3 Primary Criterion 2). After TNC acquisition in 1993, surface waters on their land cannot be appropriated. ODFW filed for water rights at Borax Lake in 1991 to prevent further attempts at diverting the water and to insure maintenance of Borax Lake elevation. No other filings are known. Additionally, actions have been taken to reduce the impact from diverting water to the

eastern side of the lake. The practice of chipping away the shoreline crust has been stopped. The diversion ditch which was used to fill the lower lake has been filled in several locations by installing check dams. The check dams were established to protect the lake shoreline.

During their review, Williams and Macdonald (2003) noted threats consisting of significant recreational and off-highway vehicle use resulting in disturbance to the soil salt crusts to the west, northwest, and northeast of Borax Lake. In conducting surveys 2005-2011, investigators noted that most of the shoreline was in good condition, but off-road vehicle damage was observed on the northern shore (Scheerer and Jacobs 2009; 2010; and Scheerer and Bangs 2011).

The Andrews/Steens Resource Management Plan provides additional protection of Borax Lake chub critical habitat by directing BLM to pursue the establishment of a conservation agreement or other cooperative agreement among BLM, TNC, Service, ODFW, or other private landowners to manage and protect the area for the conservation or recovery of the species (see section 2.2.3 Primary Criterion 2, 3, and 4).

The Passage of the Steens Mountain Cooperative Management and Protection Act of 2000 (Steens Act) and the BLM Resource Management Plan withdrew mineral and geothermal resources from development on Federal lands within the Alvord KGRA. Private land within these areas are not affected by the mineral withdrawal (see section 2.2.3 Recovery Plan Interim Criterion 3).

In 2008, BLM and DOGAMI received inquiries on behalf of private landowners in Alvord Basin regarding the development of geothermal resources. BLM was contacted regarding electrical transmission and access right-of-way (ROW) to cross BLM lands in order to explore and develop commercial geothermal electrical power (BLM 2008). The developer, Pueblo Valley Geothermal LLC, has met with BLM to discuss interest in obtaining a ROW permit. Although the Steens Act and subsequent RMP withdrew the Alvord KGRA from geothermal development, the RMP could allow a ROW permit because the area in question is not within the Cooperative Management and Protection Area boundary, and ROWs are recognized as valid use of public lands under sections 302 and 501 of the Federal Land Policy Act (BLM 2005a). The BLM would be responsible under the National Environmental Policy Act (NEPA) to analyze any proposed ROW project including the connected action, and assess the direct or indirect effects of issuance of a ROW on Borax Lake chub pursuant to section 7 of the ESA.

The proposed power plant would be capable of generating 1-10 mega-watt production. Pueblo Valley Geothermal LLC has acquired a 53 year lease

on approximately 809.4 hectares (2,000 acres) from landowners located south of Alvord Lake, and approximately 1.6 to 4.8 kilometers (1 to 3 miles) from Borax Lake (Pers. Comm. Hall 2009). Pueblo Valley Geothermal LLC also placed an advertisement in the publication “Geothermal Energy Weekly” seeking investor for the geothermal project (Geothermal Energy Association 2010). The developer informed the Service that he is progressing with resource assessments regarding the total megawatt and economic potential (Pers. Comm. Hall 2011). No formal permit applications had been received by BLM and DOGAMI (Pers. Comm. Houston 2008; 2010; and 2011).

Pueblo Geothermal LLC submitted an informal proposal to BLM on January 31, 2012, seeking to acquire 3,360 acres of BLM land in the vicinity of the Borax Lake geothermal aquifer in the interest of developing an air cooled binary geothermal plant to produce 20-25 megawatts of electricity (Pers. Comm. McLain 2012). BLM responded with a letter on March 14, 2012, explaining that although a land exchange for the purpose of geothermal development is technically feasible, the land Pueblo Valley Geothermal LLC is interested in acquiring is within a mineral withdrawal area enacted by Congress as part of the Steens Act and as a result would require an act of Congress to reverse that designation (BLM Letter 2012). Based on resource concerns, funding, and staffing priorities the BLM has informed the Pueblo Valley Geothermal LLC that such a land exchange is non-feasible at this time (BLM Letter 2012).

Potential impacts resulting from geothermal development that were identified at the time of listing include effects to water elevation in Borax Lake due to the interconnecting aquifers or springs. Drilling could disrupt the hot water aquifer that supplies Borax Lake. Potential impacts from geothermal energy drilling could include changes to the aquifer pressure or temperature and the potential to lessen or eliminate in-flows to the lake from the geothermal aquifer. This alteration could range from a change in temperature to a complete elimination of the flows (Fish and Wildlife Service 1982). The final rule also notes that a section 7 consultation was conducted on exploratory drilling in 1980. The biological opinion stipulated that water quantity and quality in Borax Lake and springs to the northwest must be monitored, and all operations must cease if there is any significant change in Borax Lake water quantity or quality until the problem is solved. We have no information that would change these statements of potential impacts if geothermal energy development were to be developed.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

The 1982 listing rule stated that there are “none”. No information is

available to change this statement.

2.3.2.3 Disease or predation:

The 1982 listing rule stated that there are “none”. No known occurrence of disease or predation affecting the population of Borax Lake chub has occurred since the time of listing. The Conservation Review of the Borax Lake chub conducted by Williams and Macdonald (2003) discussed the introduction of non-native species, including diseases and parasites as a growing concern for isolated fish populations. This report states that “. . . hot spring environments are susceptible to invasion from aquarium fishes and invertebrates with subsequent declines in native species” (Williams and Macdonald 2003). The Conservation Review also recognized that the unusual water quality and soils of the Borax Lake area are likely to retard establishment of introduced species (Williams and Macdonald 2003).

No non-native species have been discovered in Borax Lake in any of the surveys conducted since the time of listing (Williams and Macdonald 2003; Scheerer and Jacobs 2005; 2006; 2007; 2008; 2009; 2010; and Scheerer and Bangs 2011). The presence of non-native invasive species in Oregon has increased, and the probability for introduction increases as more people visit the remote areas of Oregon. There is a risk of such invasions occurring through human caused mechanism, and the potential magnitude of the impact is great due to the highly restricted distribution of this species.

The Conservation Review included recommendations for future management to address non-native species concerns including: 1) regular monitoring to increase the likelihood of finding non-native species; 2) restrict vehicle and boat access to the ecosystem; 3) conduct off-site assays of survival for potentially introduced aquatic species in Borax Lake water; and 4) initiate outreach efforts for key user groups. Similarly, ODFW recommended monitoring to detect unauthorized introductions of nonnative fish before the results are irreversible (Sheerer and Jacobs 2009).

Since 2005, ODFW has conducted annual population estimates including visual monitoring of the condition of the lake shoreline, outflows, and adjacent wetlands including presence of invasive species. However, no contingency plan is in place should invasive species or other catastrophic event occur. The BLM, ODFW, TNC and the Service have developed a draft cooperative management agreement that will include monitoring for non-native species, restrictions on vehicle and boat access and outreach and education (see section 2.2.3 Recovery Plan Primary Criterion 2).

2.3.2.4 Inadequacy of existing regulatory mechanisms:

The 1982 listing rule stated: “The Borax lake chub is on the Oregon endangered species list but its habitat is not protected by Oregon State laws.”

The 1982 listing was apparently referring to Oregon sport fishing regulations that designated Borax Lake chub as a “protected fish” and prohibited take or possession. The Borax Lake chub was listed as Endangered by the State of Oregon as part of the original enactment of the Oregon ESA in 1987. The Oregon ESA prohibits the “take” (kill or obtain possession or control) of listed species without an incidental take permit. The Oregon ESA applies to actions of State agencies on State-owned or leased land, and does not impose any additional restrictions on the use of private lands (ORS 496.192). Under the Oregon ESA, State agencies (other than State land owning or managing agencies) determine the role they may serve in contributing toward conservation or take avoidance (OAR 635-100-0150). The Oregon ESA also directs that Survival Guidelines (OAR 635-100-0130 and 0135) or an approved endangered species management plan (OAR 635-100-0140) be prepared. Because the Borax Lake chub was State-listed prior to these 1995 amendments, these requirements do not apply to this species. The Oregon ESA regulates the “take” of Borax Lake chub, but does not directly regulate or restrict activities that affect its habitat, because it is located on private land.

The Conservation Review conducted in 2003, identified the withdrawal from geothermal energy exploration and development (via the Steens Mountain Cooperative Management and Protection Act) as a new regulatory mechanism which contributed to the conservation of Borax Lake chub. However, as discussed in section 2.2.3 Recovery Plan Interim Criterion 3, and section 2.3.2.1 private lands are not subject to this withdrawal.

The Pueblo Valley Geothermal LLC has informed the Service of their intention to develop lands within 3 miles of Borax Lake for geothermal power generation (see section 2.3.2.1). The developer has met with BLM, TNC, DOGAMI, Harney County, and the Service to express his interest in proceeding with exploration drilling and subsequently a 1 to 10 Megawatt generation facility.

The Oregon 1971 Geothermal Resources Act authorized the Department of Geology and Mineral Industries to control the drilling, re-drilling, and deepening of wells for the discovery and production of geothermal resources. To obtain a permit to drill a geothermal exploration or production well, the applicant must apply to DOGAMI in accordance with the Oregon Administrative Rules (OAR 632-20-005). DOGAMI routes copies of the application to other state agencies including ODFW for

review and comment. Issues related to resource concerns and protection must be resolved to the satisfaction of DOGAMI prior to issuance of a permit to drill as required under ORS 522.125.

Although the State process for issuing a drilling permit on private land includes review by ODFW and other entities, there is no apparent requirement in the permit issuance process to assure protection of Borax lake chub and its habitat under State regulations. The restricted range of the Borax Lake chub, increases the magnitude of risk to the population if potential threats from drilling into the geothermal aquifer result in impacts to Borax Lake and the Borax Lake chub (see section 2.3.2.1).

In 2005, the BLM finalized the Andrews/Steens RMP and Record of Decision. The RMP provides for the establishment of a cooperative agreement among the BLM, TNC, ODFW and the Service to manage and protect the Borax Lake area for the conservation of the Borax Lake chub, including closing the area to livestock grazing, off-road travel, and limiting or closing vehicle access (see section 2.2.3 Recovery Plan Primary Criterion 2) (BLM 2005a). The BLM will also coordinate development of water quality standards and monitoring with the Oregon Department of Environmental Quality and other agencies.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

The 1982 listing rule stated that there are “none”. The Conservation Review conducted in 2003, states: “Because of its highly restricted distribution, dependence on a single water source, perched topographic position, and existing threats to its fragile habitat, the Borax lake chub is vulnerable to catastrophic loss.” Such disturbance could take the form of vandalism, introduction of non-native species, or destruction or collapse of the lake shoreline, introduction of toxic chemicals, or draining of the lake”. The Conservation Review acknowledges that such events may be rare, but that the scope of such damage would likely be substantial and difficult to reverse (Williams and Macdonald 2003).

Risk Factors

A species’ habitat requirements, population size, range, and distribution, and dispersal abilities, among other factors, help to determine its vulnerability to extinction. Key risk factors include small population size, dependence upon a rare habitat type, inability to move away from sources of stress or habitat degradation, restrictions to a small geographic area, and vulnerability to catastrophic loss resulting from random or localized disturbances (Williams et al. 2005). These factors all apply to the Borax Lake chub.

Small population size. Population abundance estimates for the Borax Lake chub indicate substantial population fluctuations ranging from a low of 4,132 to a high of 35,650 fish (Scheerer and Jacobs 2010) (see section 2.3.1.2). From 2005 through 2010, Borax chub abundance has averaged approximately 14,000 fish. Current abundance estimates are down compared to the mean abundance of approximately 29,000 fish from 1991 through 1995 (Scheerer and Jacobs 2009). However, the population estimates conducted in 2010 and 2011 were up significantly to 25,489 and 26,571 fish (Scheerer and Jacobs 2010 and Scheerer and Bangs 2011). The population has exhibited an increasing trend in abundance over the past 7 years (Scheerer and Bangs 2011). It is unknown why there is a lower abundance in recent years in comparing the estimates from 1991 through 1995 to the estimates from 2005 through 2011 (see Figure 1 and section 2.3.1.2), or whether these fluctuations are within the range of normal.

Dependence upon a specific rare habitat type and inability to disperse. The Borax Lake chub is known to occur only within Borax Lake. Due to the relatively small size of Borax Lake and the lack of connectivity to other aquatic habitat, the Borax Lake chub is not able to disperse away from stress, habitat degradation, or disturbance factors. There are no streams or drainages or other aquatic connections that provide alternate habitat or allow for emigration.

Restriction to a small geographic area and vulnerability to stochastic events. The Borax Lake chub only occurs at Borax Lake. Because of its highly restricted distribution and dependence on a single water source, Borax Lake chub are vulnerable to catastrophic loss. Any threat that manifests itself has the potential to affect the entire population at once, and thus the risk of extinction posed by a threat is higher than for a widespread species.

The 2003 Conservation Review and the ODFW progress reports identified the need to develop and implement a monitoring strategy for the Borax Lake ecosystem and the chub. The ODFW, BLM, TNC, and the Service are working collaboratively on a cooperative management agreement and interagency agreement for the Borax Lake chub (see Section 2.2.3 Recovery Plan Primary Criterion 2). Implementation of the monitoring element of the plan will provide early identification of habitat degradation and disturbances, or other threats (e.g. invasive species), such that appropriate management actions can be taken.

2.4 Synthesis

The Borax Lake chub is endemic to Borax Lake and its outflow. Borax Lake is an extremely fragile aquatic ecosystem which, because of its position, approximately 30 feet

above the valley floor, is vulnerable to adverse alteration (Fish and Wildlife Service 1982 and Williams and Macdonald 2003). At the time of listing in 1982, the primary threats to the species consisted of potential impacts from geothermal energy development, diversion of the lake's outflows by alteration of the shoreline crust, and potential development of a recreation facility (Fish and Wildlife Service 1987).

Substantial progress has been made in implementing the 1987 Recovery Plan (see section 2.2.3). The Recovery Plan called for protection of the Borax Lake ecosystem from disturbances through acquisition of key private lands, protection of subsurface and surface waters, closure of fragile lands to vehicle access, removal of livestock grazing, monitoring, and other recovery actions (Fish and Wildlife Service 1987). Significant conservation objectives that address the primary threats to the Borax Lake chub have been accomplished. The 64.75 hectare (160-acre) private land containing Borax Lake including water rights and subsurface mineral rights was purchased by TNC for conservation purposes. The BLM designated the public lands as an ACEC and the area was fenced to exclude livestock grazing. The entire 104.8 hectares (259 acres) of designated critical habitat for the Borax Lake chub is in public or conservation ownership. The passage of the Steens Mountain Cooperative Management and Protection Act of 2000 and the BLM Resource Management Plan withdrew the mineral and geothermal resources from development within the Federal lands of the Alvord KGRA. The designated critical habitat is fenced and gated, but the area is not closed to vehicle access. Detailed studies and monitoring of Borax Lake and the chub have occurred since the time of listing.

As identified in sections 2.3.2.1, 2.3.2.3, 2.3.2.4, and 2.3.2.5 remaining threats to the Borax Lake chub and the ecosystem include potential geothermal energy development on private lands, recreational activities such as all-terrain vehicle use and camping along the shoreline, and vulnerability to the introduction of non-native species and catastrophic impacts (Scheerer and Jacobs 2005; 2006; 2007; 2008; 2009; and 2010; Scheerer and Bangs 2011; and Williams and McDonald 2003) (see section 2.3.2). In an effort to address some of these remaining threats, and consistent with their RMP, the BLM has initiated the development of a cooperative management plan and interagency agreement with the Service, TNC, and ODFW. The management plan should be completed in 2012, and will collaboratively address the management and monitoring of Borax Lake chub including the cooperating roles and responsibilities of the three agencies and TNC (see Recovery Plan Primary Criterion 2). The management plan is intended to address vehicle access, recreational use including boating, emergency contingency needs, non-native species, public education, and monitoring.

The remaining risk of geothermal energy development within 1-3 miles of Borax Lake could result in significant changes to Borax Lake and the Borax Lake chub. The Borax Lake chub is found only in Borax Lake and its outflows. Because of its restricted range, any threat to the species that manifests itself has the potential to affect the entire population at once, and thus the risk of extinction posed by a threat is high. Therefore, due to the progress made in reducing the overall threats to Borax Lake chub we find that the species is not currently in danger of extinction, and therefore no longer warrants

listing as Endangered. However, in consideration of the remaining risk of geothermal energy development on the 809.4 hectares (2,000 acres) of land under lease for geothermal development in the vicinity of Borax Lake, we find that the Borax Lake chub is in danger of becoming endangered, and therefore recommend it be reclassified from endangered to threatened.

3.0 RESULTS

3.1 Recommended Classification:

- Downlist to Threatened**
- Uplist to Endangered**
- Delist**
 - Extinction*
 - Recovery*
 - Original data for classification in error*
- No change is needed**

3.2 New Recovery Priority Number 8

Brief Rationale:

The recovery priority number assigned when Borax Lake chub were listed as endangered in 1982 was 2. The priority number was reviewed by the Service in 2012. Given the substantial accomplishments of recovery objectives, and reductions in threats, we recommend changing the recovery priority number to 8 which is a medium degree of threat with a high potential for recovery. The primary remaining threat is due to the potential for geothermal development within 3 miles of the lake. Other remaining risks are threats related to vehicle access and recreation which are currently being resolved through action being taken by the BLM.

3.3 Listing and Reclassification Priority Number:

- Reclassification (from Threatened to Endangered) Priority Number:** NA
- Reclassification (from Endangered to Threatened) Priority Number:** 6
- Delisting (regardless of current classification) Priority Number:** NA

Brief Rationale: The Borax Lake chub reclassification from endangered to threatened should be prioritized at 6 because the impact to management of the Borax Lake area would be low and the Service has not been petitioned to delist or downlist the Borax Lake chub. The change in classification does not cause an unwarranted management burden and would not restrict human activities (Fish and Wildlife Service 1983). Currently the land is owned by TNC, so there is no additional burden of consultation on other federal agencies. Management activities currently consist of conducting annual population estimates which are

not costly, so the protections do not divert resources from other species conservation.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

1. The Service, BLM, ODFW, and TNC should complete the initiated cooperative management plan and interagency agreement for the Borax Lake chub. The management plan should include a monitoring strategy consistent with recommendations by Williams and Macdonald (2003) and Scheerer and Jacobs (2007) and should address: 1) chub population monitoring, 2) habitat and shoreline monitoring and protection; 3) invertebrate and water quality monitoring; 4) public education; 5) vehicle management and monitoring; 6) recreational use including boating; and 7) emergency contingency needs.
2. Acquire groundwater and surface rights to geothermal development on private lands to compliment the Federal land mineral withdrawal within the Alvord Known Geothermal Resource Area. Protection of the groundwater and surface mineral rights would aid in conservation of the geothermal aquifer which potentially affects the Borax Lake ecosystem.
3. Because the Borax Lake chub is vulnerable to catastrophic impacts and the potential introduction of invasive species, frequent monitoring should be conducted to: reduce the likelihood of significant loss to the species; detect introduced species; and increase the capability to respond quickly to new threats.
4. The Service hereby abandons management objectives for maintaining the lower lake as habitat for Borax Lake chub, as it is now considered to be poorly suitable habitat that would likely serve as a population sink.

5.0 REFERENCES

- Bailey and Uyeno. 1964. Nomenclature of the blue chub and the tui chub, cyprinid fishes from the Western United States. *Copeia* (1964):238-239.
- Bureau of Land Management (BLM). 2004. Andrews/Steens resource management plan final environmental impact statement. Hines, Oregon.
- Bureau of Land Management (BLM). 2005a. Andrews/Steens resource management plan Andrews Management Unit record of decision and resource management plan. Hines, Oregon.
- Bureau of Land Management (BLM). 2005b. Biological assessment for the proposed Andrews Management Unit/Steens Mountain Cooperative Management and Protection Area resource management plan/final environmental impact statement. Hines, Oregon.
- Cummings, M.L., unpublished. Extent and location of the geothermal aquifer in the Alvord Basin, Harney County, Oregon; a study based on strontium isotope geochemistry of rocks and fluids. Report to BLM PO no. 1422H952-P4-4885.
- Fairley, J.P. and J.J. Hinds. 2004. Rapid transport pathways for geothermal fluids in an active Great Basin fault zone. *Geology* 32(9):825-828.
- Fairley, J., J. Heffner, and J. Hinds. 2003. Geostatistical evaluation of permeability in an active fault zone. *Geophys. Res. Lett.* 30.
- Fish and Wildlife Service. 1980. Endangered and threatened wildlife and plants; Emergency determination of Endangered status and critical habitat for Borax Lake chub. *Federal Register* 45: 35821-35823.
- Fish and Wildlife Service. 1982. Endangered and threatened wildlife and plants; Endangered status and critical habitat for Borax Lake chub. *Federal Register* 47: 43957-43962.
- Fish and Wildlife Service. 1983. Endangered and threatened species listing and recovery priority guidelines. *Federal Register* 48: 43098-43105.
- Fish and Wildlife Service. 1987. Recovery plan for the Borax Lake chub. Portland, Oregon. 57 pp. http://ecos.fws.gov/docs/recovery_plans/2006/060619.pdf
- Fish and Wildlife Service. 2006. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 70 species in Idaho, Oregon, Washington, and Hawaii, and Guam. *Federal Register* 71: 18345-18348.
- Furnish, J., J. McIver, and M. Teiser. 1993. A survey of algae and invertebrates associated with Borax Lake, Harney County, Oregon. Report to U.S. Bureau of Land Management, March 1993.

- Geothermal Energy Association. 2010. Geothermal energy weekly. A publication of the geothermal energy association. March 15, 2010. <http://www.geo-energy.org/reports.aspx> (accessed Sept. 3, 2010)
- Goble, D.D. and J. M. Scott. 2006. Recovery management agreements offer alternative to continuing ESA listings. *Fisheries* 31:35-36.
- Harris, P.M. 2000. Systematic studies of the genus *Siphateles* (Ostariophysi: Cyprinidae) from Western North America. Doctoral thesis. Oregon State University, Corvallis, Oregon.
- Koski, A.K. and S.A. Wood. 2003. The geochemistry of geothermal waters in the Alvord Basin, southeastern Oregon. University of Idaho, Moscow, Idaho.
- Nelson, J.S., E.J. Crossman, H. Espinosa-Pérez, L.T. Findley, C.R. Gilbert, R.N. Lea, and J.D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico, sixth edition. American Fisheries Society special publication 29. Bethesda, Md.
- Oregon Department of Fish and Wildlife. 2005a. Native fish status report. Oregon Department of Fish and Wildlife, Salem, Oregon.
- Oregon Department of Fish and Wildlife. 2005b. Oregon Conservation Strategy. Oregon Department of Fish and Wildlife, Salem, Oregon.
- Perkins, D. L., C. E. Mace, G. G. Scopettone, and P. H. Rissler. 1996. Identification of spawning habitats used by endangered Borax Lake chub (*Gila boraxobius*). Final Report to: The Nature Conservancy, Portland, Oregon. Submitted by: U.S. Geological Survey, Biological Resources Division, Reno, Nevada.
- Salzer, D. 1992. Population estimates for the Borax Lake chub: 1991 Results and a comparison of sampling procedures. A report to: Oregon Department of Fish and Wildlife, Portland, Oregon. Submitted by: The Nature Conservancy, Oregon Field Office, Portland, Oregon.
- Salzer, D. 1997. Results of the 1997 Borax Lake chub population sampling. Memorandum from The Nature Conservancy, Oregon Field Office, Portland, Oregon.
- Scheerer, P.D. and S.E. Jacobs. 2005. Borax Lake chub population assessment and monitoring strategy. Oregon Department of Fish and Wildlife, Salem, Oregon.
- Scheerer, P.D. and S.E. Jacobs. 2006. 2006 Borax Lake chub investigations. Oregon Department of Fish and Wildlife, Salem, Oregon.
- Scheerer, P.D. and S.E. Jacobs. 2007. 2007 Borax Lake chub investigations. Oregon Department of Fish and Wildlife, Salem, Oregon.

- Scheerer, P.D. and S.E. Jacobs. 2008. 2008 Borax Lake chub investigations. Oregon Department of Fish and Wildlife, Salem, Oregon.
- Scheerer, P.D. and S.E. Jacobs. 2009. 2009 Borax Lake chub investigations. Oregon Department of Fish and Wildlife, Salem, Oregon.
- Scheerer, P.D. and S.E. Jacobs. 2010. 2010 Borax Lake chub investigations. Oregon Department of Fish and Wildlife, Salem, Oregon.
- Scheerer, P.D. and B.L. Bangs. 2011. 2011 Borax Lake chub investigations. Oregon Department of Fish and Wildlife, Salem, Oregon.
- Scoppettone, G. G., P. H. Rissler, B. Nielsen, and M. Grader. 1995. Life history and habitat use of Borax Lake chub (*Gila boraxobius* Williams and Bond) with some information on the Borax Lake ecosystem. U.S. Geological Survey, Northwest Biological Science Center, Reno, Nevada.
- Williams, J. E., and C. E. Bond. 1980. *Gila boraxobius*, a new species of cyprinid fish from southeastern Oregon with a comparison to *G. alvordensis* Hubbs and Miller. Proceeding of the Biological Society of Washington. 93:291-298.
- Williams, J. E., and C. A. Macdonald. 2003. A review of the conservation status of the Borax Lake chub, an endangered species. A final report to: U.S. Fish and Wildlife Service, Portland, Oregon. Submitted by: Southern Oregon University, Ashland, Oregon.
- Williams, J. E., C. A. Macdonald, C. D. Williams, H. Weeks, G. Lampman, and D.W. Sada. 2005. Prospects for recovering endemic fishes pursuant to the U.S. Endangered Species Act. Fisheries 30(6):23-29.
- Wilson, S. 2000. Stability of Borax Lake. Thesis submitted to Portland State University, Portland Oregon.
- Personal Communications:
- Bureau of Land Management (BLM). 2008. Email communication from Karla Bird to Nancy Gilbert regarding a notification to BLM of interest in developing geothermal resources within 3 miles of Borax lake, dated August 11, 2008.
- Bureau of Land Management (BLM). 2012. Letter Dated March 14, 2012, to Drew Honzel, Pueblo Valley Geothermal, from Rhonda Karges, Andrews/Steens Resource Area Manager.
- Hall, Peter. 2009. Personal Communication with Peter Hall in a meeting conducted at the Bend Field Office of the Fish and Wildlife Service on November 16, 2009.

Hall, Peter. 2011. Personal Communication with Peter Hall via phone conversation with Alan Mauer, Bend Field Office of the Fish and Wildlife Service on August 10, 2011.

Houston, Robert. 2008. Telephone conversation with Robert Houston at Oregon Department of Geology and Mineral Industries (DOGAMI) on August 13, 2008, to enquire if an application for well drilling in the Alvord or Pueblo Valleys of Oregon had been received.

Houston, Robert. 2010. Telephone conversation with Robert Houston at Oregon Department of Geology and Mineral Industries (DOGAMI) on September 2, 2010, to enquire if an application for well drilling in the Alvord or Pueblo Valleys of Oregon had been received.

Houston, Robert. 2011. Email message from Robert Houston at Oregon Department of Geology and Mineral Industries (DOGAMI) on August 9, 2011 affirming no additional correspondence with Pueblo Valley Geothermal to date.

McLain, Tara (BLM). 2012. Email dated June 13, 2012, to Nancy Gilbert, Subject: Borax Chub.

Signature Page

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Borax Lake chub (*Gila boraxobius*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: 6

Review Conducted By: Alan Mauer

Approved Paul Henyon Date 8/23/12
Lead Field Supervisor, Fish and Wildlife Service