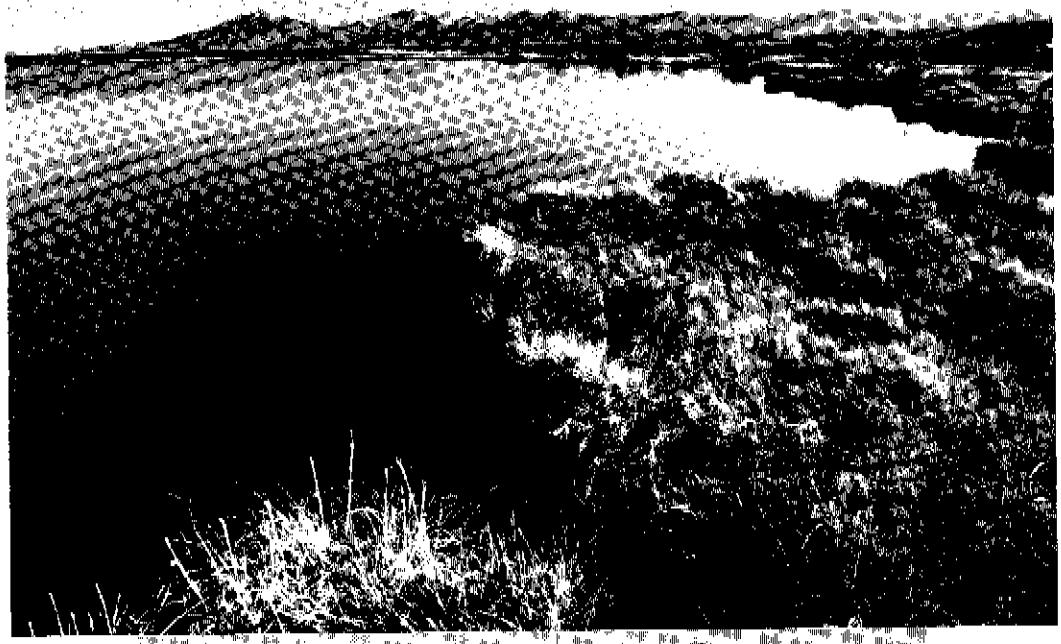
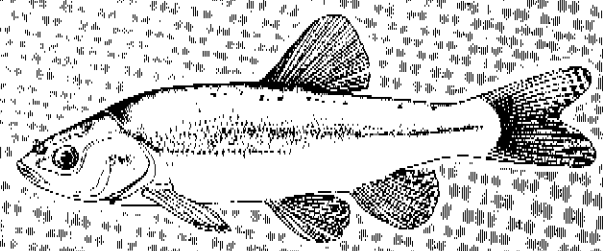
RECOVERY PLAN





BORAX LAKE CHUB

Gila boraxobius

Recovery Plan for the

Borax Lake Chub, *Gila boraxobius*

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THIS IS THE COMPLETED RECOVERY PLAN FOR THE BORAX LAKE CHUB, GILA BORAXOBIUS. IT DOES NOT NECESSARILY REPRESENT OFFICIAL POSITIONS OR APPROVALS OF COOPERATING AGENCIES, AND IT DOES NOT NECESSARILY REPRESENT THE VIEWS OF ALL INDIVIDUALS INVOLVED IN PREPARING THIS PLAN. IT HAS BEEN PREPARED BY DR. JACK E. WILLIAMS OF THE U.S. FISH AND WILDLIFE SERVICE TO DELINEATE REASONABLE ACTIONS THAT ARE REQUIRED TO PLACE THE BORAX LAKE CHUB IN THE BEST POSSIBLE POSITION. THIS PLAN IS SUBJECT TO MODIFICATION AS DICTATED BY NEW FINDINGS AND CHANGES IN SPECIES STATUS AND COMPLETION OF TASKS DESCRIBED IN THE PLAN. GOALS AND OBJECTIVES WILL BE ATTAINED AND FUNDS EXPENDED CONTINGENT UPON APPROPRIATIONS, PRIORITIES AND OTHER BUDGETARY CONSTRAINTS.

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Recovery Plan for the Borax Lake Chub

Executive Summary

1. Point or condition when species can be considered recovered.

   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 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.

2. What must be done to reach recovery?

   Borax Lake must be protected from disturbance. The outflows from Borax Lake must be channeled in such a fashion that Borax Lake is protected and historic wetland habitats for the species are restored. Disturbance to fragile salt-crust shoreline must be prevented. The underground water system of Borax Lake must be maintained in its natural condition. The Borax Lake chub must exist throughout its native ecosystem without threats.

3. What specifically must be done to meet the needs of #2?

Two 160-acre parcels of private land around Borax Lake must be permanently protected by The Nature Conservancy or a public resource agency. The southwest outflow in Borax Lake must be maintained while allowing adjacent marshes to rehydrate. This requires partial filling of the channel and maintenance of natural stream flows.

4. What management/maintenance needs have been identified to keep species recovered?

The following actions are identified to maintain recovery: 1) closure of fragile lands to vehicle access, 2) closure of critical habitat to livestock grazing, 3) prevention of significant road improvements, 4) closure of critical habitat to mineral and geothermal exploration, 5) prevention of use of toxic chemicals within critical habitat, 6) establishment of a monitoring program for water quality, temperature and quantity, 7) establishment of a program to monitor physical habitat characteristics, 8) establishment of a program to monitor fish population, and 9) establishment of a program to monitor the invertebrate community.

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PART I. INTRODUCTION

Brief Overview

The Borax Lake chub (*Gila boraxobius* Williams and Bond) is endemic to Borax Lake and adjacent wetlands in the Alvord Basin, Harney County, Oregon. Although first collected by scientists in 1934, the Borax Lake chub was not described as a new species until 1980 (Williams and Bond 1980).

Borax Lake, a natural lake fed from waters of several thermal springs, is perched atop large sodium-borate deposits in the Alvord Desert. The lake is situated within a 160-acre parcel of privately-owned land. Because Borax Lake is located above salt deposits on the valley floor, it is quite fragile. Modifications of the salt-crust shoreline could easily change the course and rate of lake outflow and thereby lower water levels.

During 1980, several new channels were dug along the lake's shore to facilitate irrigation of surrounding lands. Also in 1980, the U.S. Bureau of Land Management leased public lands surrounding Borax Lake for geothermal energy exploration. Modification of the lake perimeter and the threat of modified spring flows because of geothermal development prompted the U.S. Fish and Wildlife Service to declare endangered status and critical habitat for the Borax

Lake chub by emergency rule on 28 May 1980 (Federal Register 45:35821-35823). Pursuant to the Endangered Species Act of 1973, as amended, emergency rules are effective for 240 days. The species was proposed for permanent protection on 16 October 1980 (Federal Register 45:68886-68888) and a final rule designating endangered status and critical habitat was published on 5 October 1982 (Federal Register 47:43957-43962).

The rare nature of this species has been widely recognized in the scientific community. The Borax Lake chub was listed as threatened by the American Fisheries Society (Deacon et al. 1979) and as endangered by the Desert Fishes Council (Williams et al. 1985). The International Union for Conservation of Nature and Natural Resources also designated endangered status for the Borax Lake chub (Evans and Almada-Villela 1986).

Taxonomy and Systematics

The first ichthyological investigations of the Alvord Basin were made by Dr. Carl L. Hubbs and co-workers in 1934. Hubbs immediately recognized the distinctiveness of the native chubs from the basin. He and Miller (1948) considered the chub so distinct "that it may be set apart in a new genus." The striking differentiation of these chubs

caused Hubbs and Miller (1942) to consider them to have been geographically isolated from their nearest relatives in adjacent basins since the Pliocene. That conclusion still appears valid today.

Despite considerable interest within the scientific community, chubs of the Alvord Basin resisted close scrutiny until the 1970's. In 1972, Hubbs and Miller described many new fishes from the Great Basin. Their work (1972) included a brief description of the Alvord chub (Gila alvordensis) from Trout Creek in Harney County, Oregon, with a note that the species was "usually greatly dwarfed in Borax Lake."

During the late-1970's, various populations of Alvord Basin Gila, including several newly-discovered populations, were examined to determine their taxonomic identity (Williams 1980). These investigations confirmed the hypothesis of Hubbs (pers. comm. to C. E. Bond [1/]) that the Borax Lake form was distinct enough to warrant its description as a new species. Subsequently, the Borax Lake chub was described as a dwarf relative of the Alvord chub endemic to Borax Lake (Williams and Bond 1980). The Alvord chub is widespread in the basin. Both species are relegated to the subgenus Siphateles (Hubbs and Miller 1972, Williams and Bond 1980).

[1/] Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon

Species Description

The Borax Lake chub is a dwarf species of Gila, with adults typically 33-50 mm standard length (SL [2/]) (Williams and Bond 1980). Mature adults as small as 28.6 mm SL are known; on the other hand, some older females attain a standard length of more than 60 mm (Williams and Bond 1980). Colors of the Borax Lake chub are dark olive-green dorsally, with a dark line along the length of the dorsal midline. Sides are mostly silver in color with small black melanophores and a purple iridescence. The head is large with its dorsal surface concave in profile. Eyes are also quite large whereas the caudal peduncle is slender.

Williams and Bond (1980) gave the following meristic characters as typical for the species: dorsal fin rays 7, anal rays 7, pelvic rays 8, pectoral rays 13, and caudal rays 19. Scales are small, deeply-embedded, and irregular in placement. The lateral line is obsolescent. The holotype, a 50.6 mm SL male, is illustrated on this plan's cover.

Sexual dimorphism is exhibited in several characters but is not known in color (Williams and Bond 1980). Fins of males,

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[2/] Standard length is a measure of length from the anterior tip of the snout to the posterior end of the vertebral column.

especially the pectorals, are larger than in females. Nuptial tubercles are found only on mature males and can be especially prominent on the pectoral fins.

Hydrographic History and Habitat Description

The Alvord Basin occupies approximately 6,066 km^2 of typically arid land in southeastern Oregon and northwestern Nevada. It is a part of the Great Basin physiographic province, and as such, is characterized by an endorheic (i.e., internal) water drainage pattern.

During the wetter times of the late Pleistocene and pluvial periods, the basin was dominated by Lake Alvord. At its maximum extent, Lake Alvord covered approximately 1,272 km^2 up to a maximum depth of 61 m (Snyder et al. 1964). The former shoreline of this lake is still easily recognizable along the base of the mountains surrounding the valley floor.

During the past 40,000 years, and presumably much earlier as well, the level of pluvial Lake Alvord fluctuated greatly as the glaciers periodically advanced and receded. The interglacial periods brought warmer weather and desiccating

lake conditions. Benson (1978) documented the recent fluctuations of nearby pluvial Lake Lahontan in northwestern Nevada as follows: 1) low lake level 40,000 to 25,000 years before present (YBP), 2) extremely high lake levels from 25,000 to 22,000 YBP, 3) a moderately high lake level from 20,000 to 15,000 YBP, 4) an extremely high lake level from 13,500 to 11,000 YBP, and 5) an extremely low lake level between 9,000 to 5,000 YBP. Because of similar climatic cycles throughout the Great Basin, fluctuations in the level of pluvial Lake Alvord paralleled those of Lake Lahontan. Under the present climatic conditions, pluvial Lake Alvord is reduced to two intermittent remnants: Alvord Lake in Harney County, Oregon, and Continental Lake in Humboldt County, Nevada (Fig. 1).

As the waters of pluvial Lake Alvord receded, the native fishes were restricted to any remaining springs, lakes and creeks. Separate populations of the Alvord chub have been documented from at least 16 localities in the basin where waters persist (Williams 1980, Williams and Bond 1983). A stock of the ancestral "Alvord-type chub" was isolated in the springs of Borax Lake as the pluvial waters receded. For reasons not precisely clear, but probably related to the extreme environmental conditions of the springs, short

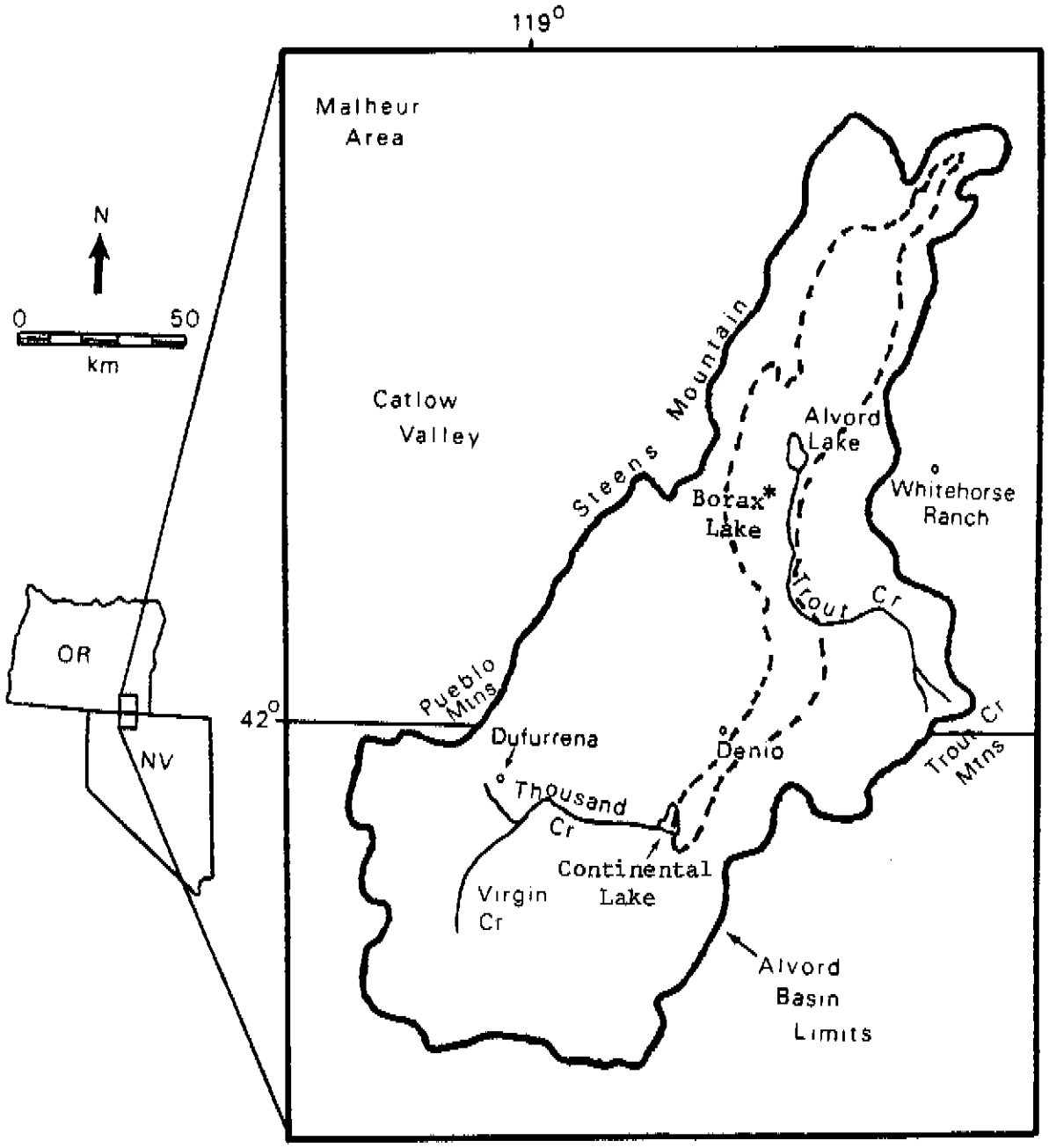

Figure 1. The Alvord Basin of southeastern Oregon and northwestern Nevada. Dashed line indicates maximum extent of pluvial Lake Alvord as delimited in Snyder et al. (1964).

generation time in the warmer waters, small number of founding individuals, or combinations thereof; the fish in Borax Lake rapidly differentiated into the form now recognized as the Borax Lake chub. The combination of prolonged isolation with exposure to extreme water conditions has proven to be a potent factor in the speciation of North American desert fishes (Miller 1948, 1950, 1981; Soltz and Naiman 1978). Thus, while the Alvord chub appears to have been isolated from chubs of adjacent basins since the Pliocene (Hubbs and Miller 1942), the Borax Lake chub would seem to have evolved within the past 10,000 years.

Borax Lake is situated on sodium-borate salts that have been deposited by spring flows. Deposition of the salts around the edge of the lake has continually increased the elevation of Borax Lake until it is now 10 m higher than the surrounding valley (Williams and Bond 1980). The increased elevation has provided the Borax Lake chub further isolation from surrounding waters.

Borax Lake is fed by waters of several springs that issue from a fault into the bottom of the lake at 35 to 40°C. Depending on ambient air conditions and distance from the

source springs, lake temperatures vary from 17 to 35°C, but are often 29 to 32°C. The lake is relatively shallow (less than 1 m), very clear and about 4.1 ha in size. Water of the lake is slightly alkaline (pH near 7.3) and the specific conductance is 2,410 (Williams and Bond 1980). Sodium is the principal cation in the lake, whereas bicarbonate, sulfate and chloride are the major anions (Mariner et al. 1974). Lake sediments are soft and easily roiled. The silt bottom, however, is interspersed with hard salt concretions. Water naturally overflows Borax Lake to create marshy areas. Historically, most water flowed from Borax Lake via a outflow from the southwest shore. This flow typically terminated in a small reservoir, Lower Borax Lake. A substantial marsh existed between Borax Lake and the reservoir. In recent years, a smaller marsh was present adjacent to the southern border of Borax Lake. A small pond also occurs in the vicinity of this southern marsh. Recent efforts have restored the flow into Lower Borax Lake and adjacent marsh areas (See Conservation Efforts section). The Borax Lake ecosystem and surrounding lands are shown in Figure 2.

In addition to Borax Lake, the Borax Lake chub has been recorded from Lower Borax Lake, the marsh area between Borax and Lower Borax Lake, the smaller southern marsh, and adjacent ponds, as well as the southwest outflow creek (Williams 1980; Williams and Bond 1980; J. E. Williams, unpubl. obs.). The aquatic habitats below Borax Lake are cooler and somewhat intermittent in nature.

In addition to the aquatic habitats, salt flats and mud flats contribute to the wide diversity of environments within the critical habitat area. More than a dozen separate springs, ranging up to 40°C, occur just to the north of Borax lake. Although these hot springs do not provide habitat for the Borax Lake chub they are among the most interesting and unusual in Oregon (R. W. Castenholz 3/, pers. comm.). The invertebrate populations of these springs and Borax Lake are poorly known and in need of study. Other animal groups in the area are relatively well-known. Because of its diversity of habitats, the Borax Lake area attracts many rare or uncommon birds, such as snowy plovers (Charadrius alexandrinus), black-necked stilts (Himantopus mexicanus), Forster's terns (Sterna fosteri), black-crowned night herons (Nycticorax nycticorax), American avocets

3/ Department of Biology, University of Oregon, Eugene, Oregon

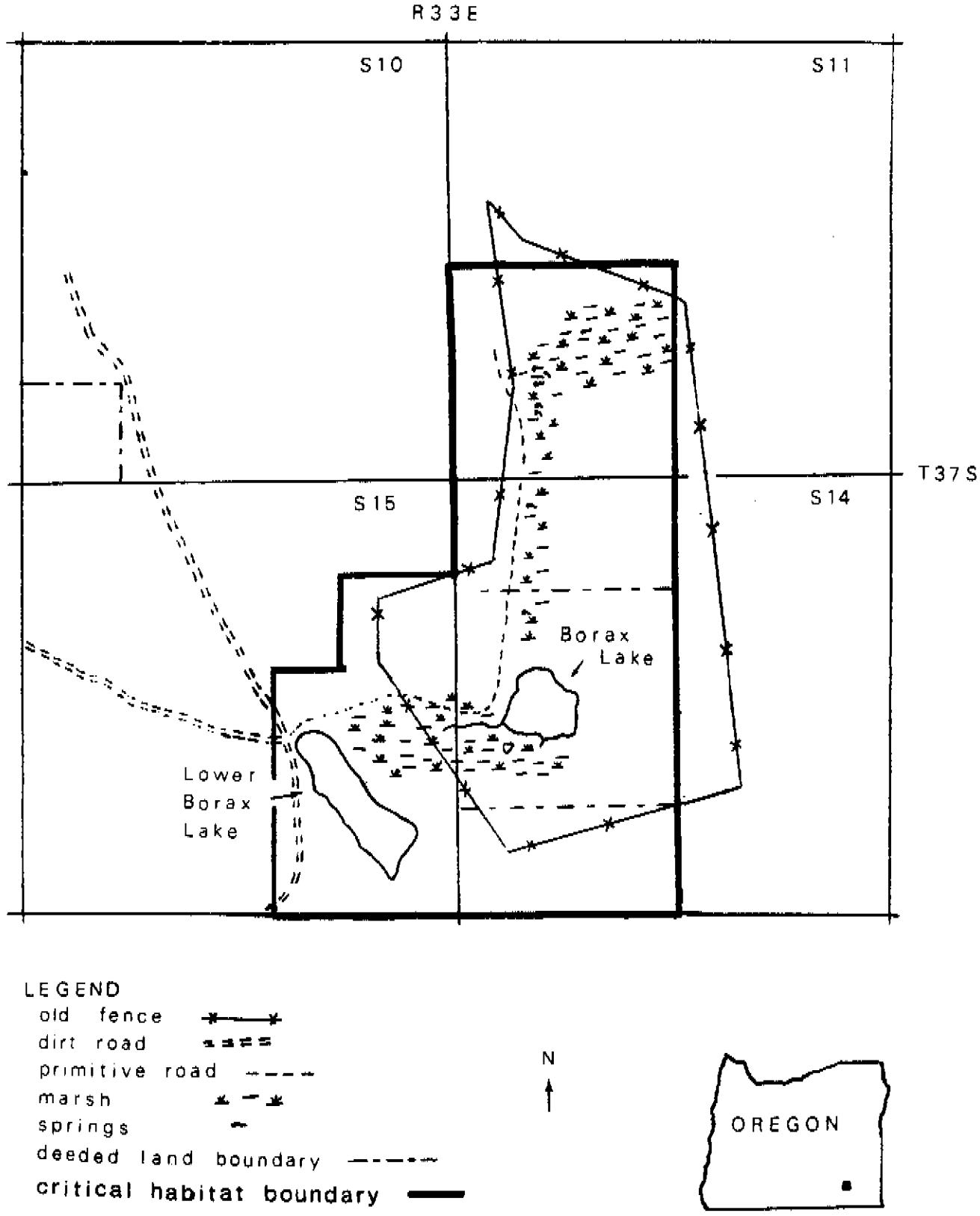

Figure 2. Borax Lake ecosystem and surrounding lands in Harney County, Oregon. Area bounded by dark border has been designated as critical habitat for Gila boraxobius.

(Recurvirostra americana), long-billed curlews (Numenius americanus), and swans (Olor spp.) (Green 1978). This area also harbors an unusual population of leopard lizards (Crotaphytus wislizeni) (Storm 1966). Much of the alkaline soils surrounding Borax Lake are dominated by saltgrass (Distichlis spicata var. stricta), and other salt-tolerant plants such as nitrophila (Nitrophila occidentalis), arrow-grass (Triglochin concinna), and bulrush (Scirpus nevadensis) (Kierstead and Pogson 1976).

Ecology

Because of the relatively constant thermal environment of Borax Lake, the Borax Lake chub spawns throughout the year. However, most spawning typically occurs in March and April (Williams 1980, Williams and Bond 1983). Some evidence exists that individual females may spawn twice annually (Williams 1980). Relative to body size, mature ova are quite large, ranging from 0.7 - 1.2 mm diameter (Williams 1980). Thus, most adult females contain approximately 70 to 200 ova prior to the onset of spawning. Larger females contain more ova. Females of 32.7 and 34.5 mm SL contained 75 and 82 ova, respectively (Williams and Bond 1983). Larger females, 39.0, 39.3, 44.6, 49.4, 90.4, and 93.0 mm SL, contained 252, 246, 380, 362, 2,143 and 6,924 ova,

respectively (Williams and Bond 1983). Females longer than 60 mm SL are exceedingly rare, but when present, may contribute substantially to recruitment of the following year class.

Young-of-the-year are prominent in Borax Lake during May and June. They are most often found in the very shallow coves around the margin of the lake. No young-of-the-year have been collected from Lower Borax Lake, and have seldom been observed in adjacent marshes which indicates that most if not all spawning occurs in Borax Lake.

No population estimates of the Borax Lake chub are available. The Fish and Wildlife Service recently issued a contract to The Nature Conservancy to perform seasonal population estimates of the Borax Lake chub during 1986 and 1987. Seasonal population sizes of fishes restricted to spring systems are often cyclic, a pattern that is likely in Borax Lake. For example, the Amargosa pupfish population (Cyprinodon nevadensis nevadensis) in Saratoga Springs in Death Valley reaches its maximum size in September, with reduced population sizes in March to April (Deacon 1968). Soltz (1974) found the largest populations of Ash Meadows pupfish (C. nevadensis mionectes) from Big Spring in Ash Meadows during spring and early autumn and smallest numbers in winter.

To the best of our knowledge, the present Borax Lake chub population size is representative of that which occurred historically at Borax Lake. At current population levels, threats to the continued existence of the species are from man-induced or deterministic events rather than from genetic drift, inbreeding or other genetic problems. Therefore, maintenance of a certain number of individuals is not as relevant to the survival of the Borax Lake chub as is protection of the integrity of the aquifer and shoreline. The population is free of threats from exotic species.

Native populations of warm spring-dwelling fishes typically exhibit drastic population declines when exotic fishes or other exotic predators are introduced (Bond 1974, Meffe et al. 1983, Miller 1961, Williams et al. 1985).

Most Borax Lake chubs live approximately one year. Few age I or II [4/] fish are present. The longest individuals collected from Borax Lake, 90.4 and 93.0 mm SL, are probably age III (Williams and Bond 1983). Older individuals are almost always female. A length-frequency analysis of 113

4/ An age I fish is between 1 and 2 years old, age II fish are between 2 and 3 years old, etc.

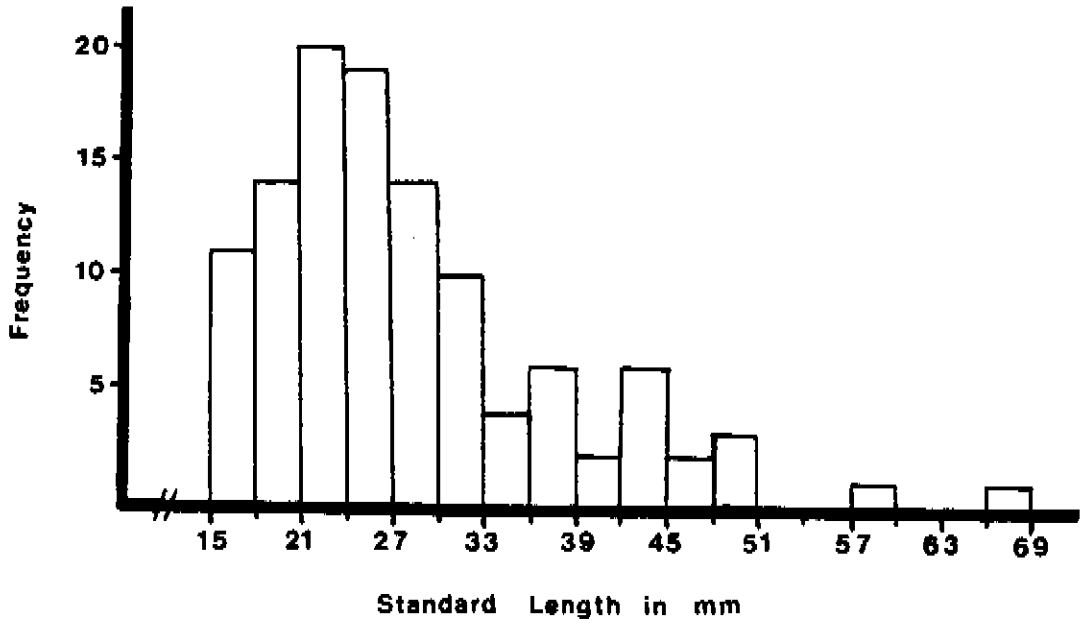

Figure 3. Length frequency of 113 Borax Lake chubs collected 5 August 1977 from Borax Lake, Oregon (from Williams and Bond 1983). See text for discussion of ages represented on graph.

individuals collected from Borax Lake on 5 August 1977 is shown in Figure 3. Individuals of 15 to about 33 mm SL are of the 1977 year class. The small number of fish from 33 to 51 mm SL are age I, whereas the two longer individuals are probably age II (Fig. 3).

Borax Lake chubs are opportunistic omnivores. The following seasonal fluctuation in food habits was reported by Williams and Williams (1980). During spring, diatoms, chironomid larvae, microcrustaceans and dipteran adults were the primary foods. Terrestrial insects also became a primary food during summer, whereas diatoms decreased in importance. In autumn, terrestrial insects, chironomid larvae and diatoms were principal foods. The importance of diatoms and microcrustaceans in the diet increased substantially during winter, while the consumption of terrestrial insects decreased dramatically. The opportunistic feeding behavior was dramatized by a May 1978 collection of fish that contained one individual with 32 gastropods (84% volume of intestine), a second fish contained 14 adult dipterans (98% volume), a third contained 775 copepods (79% volume), a fourth contained 340 first instar chironomid larvae (69% volume), and a fifth contained 485 insect eggs (64% volume) (Williams and Williams 1980). Chubs often pick foods from soft bottom sediments, but also have been observed feeding throughout the water column and at the surface.

Because of its position in the relatively simple food web in Borax Lake, the Borax Lake chub may function as a "keystone" species in the ecosystem (Williams 1983). That is, the Borax Lake chub may control structure in the invertebrate community of Borax Lake by feeding on the most abundant species it encounters.

Borax Lake chubs appear to have a broad thermal tolerance. Observations in Borax Lake indicate that the fish avoid water temperature above 34°C (Williams and Bond 1983). Laboratory experiments have shown that the chubs lose equilibrium in water above approximately 34.5°C (Williams 1980). If adequate water levels in Borax Lake are not maintained, chubs are forced into potentially lethal hot spring inflows at the bottom of the lake.

Habitat Modifications

The history of white man's use of Borax Lake dates from at least 1898, when workers began to mine the extensive salt deposits for borax (Libbey 1960). Borax Lake is the site of the original Twenty Mule Team Borax Works, which sent sacks of borax to the railhead in Winnemucca, Nevada, via wagons hauled by twenty-mule teams. This mining continued through 1907.

Vestiges of this mining operation are still visible near the lake. Two large open vats, where water was boiled away from the borax, are still present just west of Borax Lake. Remains of a sod house that provided shelter for Oriental miners are visible just to the south of the lake. Otherwise, however, virtually no traces of the mining operation remain.

The next major modifications known at Borax Lake occurred during 1980. Several new channels were opened along the north and east shoreline of the lake in an attempt to increase forage on surrounding grazing land through irrigation. Such diversions are harmful to the ecosystem because: 1) reduced flows in the southwest channel desiccate historic wetlands, 2) the water level of Borax Lake falls when the overflow rate exceeds spring inflows, and 3) chubs are washed into unsuitable habitat and are unable to ascend back into Borax Lake because of the steepness of the slope. The severity of these problems is proportional to the depth of the new channels. Deeper channels have the effect of "breaking the rim" that holds water in the lake. Diversions of water from the lake eventually led to the drying of nearby marshes, ponds and Lower Borax Lake.

Also in 1980, the Bureau of Land Management proposed to lease public land surrounding Borax Lake for geothermal energy exploration. The 160-acre parcel of private land containing Borax Lake had already been leased to Getty Oil Company for geothermal exploration. Mining of subsurface thermal waters threatened to interfere with the flow of springs feeding Borax Lake. These threats precipitated the emergency listing of the Borax Lake chub as an endangered species.

A minor, but chronic problem has been the driving of vehicles through the marsh around Borax Lake. If driven onto the shoreline, the weight of cars or trucks would readily crush the salt crusts.

Conservation Efforts

Major conservation efforts for the Borax Lake chub began on 18 May 1980, when the U.S. Fish and Wildlife designated endangered status and critical habitat for this species by emergency rule. The emergency declaration was made in response to proposed leases of 6,789 acres of BLM land surrounding Borax Lake for geothermal energy exploration and because several holes had recently been chipped into the north and east shoreline of the lake. One of the primary

protections afforded by the Endangered Species Act is the requirement of Section 7, which calls for any federal agency that authorizes, funds or carries out a program that may affect a listed species to consult with the Service to determine if the action may jeopardize the continued existence of the species or adversely modify its critical habitat. On 10 October 1980, the Service issued a Biological Opinion which declared that the proposed leasing program was likely to jeopardize the continued existence of the Borax Lake chub. The Biological Opinion called for a buffer zone of one-half mile radius around Borax Lake where no drilling or other surface disturbance would be allowed. Among other provisions, the opinion also required a monitoring program aimed at detecting any disturbance to the aquifer from drilling activities.

Ironically, the Borax Lake chub was originally described in the scientific literature on 28 August 1980 (Williams and Bond 1980), just prior to issuance of the Biological Opinion. When listed on 18 May 1980 under emergency rule, the Borax Lake chub was designated as an undescribed species, Gila sp.

On 16 October 1980, a rule was published in the Federal Register that proposed endangered status and critical habitat on a permanent basis. Emergency rules provide protection for 240 days. The emergency rule published on 18 May 1980 expired on 23 January 1981.

Anadarko Production Company was awarded the lease for geothermal exploration of the BLM land surrounding the 160-acre parcel of private land containing Borax Lake. Anadarko issued the Plan of Operation for federal lease OR-23843 in March 1982. The plan included three exploratory wells, all outside the buffer zone, and a monitoring program for Borax Lake. The drilling was never performed, but a monitoring effort was carried out by Anadarko from June 1982 through February 1983. The monitoring included measurements of water temperature, surface elevation of Borax Lake, and chemical analyses of water from the lake. Anadarko has since abandoned plans for exploratory drilling in the immediate future.

A final rule designating permanent endangered status and critical habitat for the Borax Lake chub was published in the Federal Register on 5 October 1982. Critical habitat designated in the final rule is within the darkened boundary in Figure 2 and consists of 640 acres of land in T37S, R33E,

as follows: SW1/4 Sec. 11, W1/2 Sec. 14, E3/4 of the SE1/4 Sec. 15, and the SE1/4 of the NE1/4 Sec. 15. Borax Lake, marsh areas to the south and southwest of the lake, Lower Borax Lake, and the hot springs north of Borax Lake are included within the critical habitat boundary. The area is evenly divided between private ownership (two-160 acre parcels) and public ownership (320 acres BLM). Borax Lake is in private ownership.

The next conservation effort was a major breakthrough in protection of the Borax Lake ecosystem. In June 1983, The Nature Conservancy secured a 10-year lease to the 160 acres of private land surrounding and including Borax Lake. The lease included a "first right of refusal" for sale of the property. Also included was the authority to manage the waters of Borax Lake. The Nature Conservancy has agreed, however, to cooperate with the grazing rights leaseholder on the surrounding land and to allow certain diversions of water to increase available forage for cattle. These water diversions may occur by chipping away a small spot on the east bank of Borax Lake. Thus, the lease provided the first real control over management of the land; however, protection of surface flows was not guaranteed.

In their announcement of the lease to the press, The Nature Conservancy stated that its first priority was "to redirect the outflow water from the lake back to its historical course." In September 1983, The Nature Conservancy moved to control and redirect outflows from Borax Lake. With the technical assistance of Oregon Department of Fish and Wildlife and the BLM, they repaired holes in the north and east shoreline of the lake. In an effort to direct all outflows to the southwest, the southern shoreline was reinforced. Unfortunately, this latter action encouraged desiccation of the small pond and marsh adjacent to the southern shore of Borax Lake. Also on this date, a backhoe was utilized to deepen the southwest outflow channel. A ditch was dug from approximately 4.6 m (15 feet) away from Borax Lake to about 12.2 m (40 feet) from Lower Borax Lake (Fig. 4). A small check dam was installed at the mouth of the outflow to prevent lowering of the lake level from excessive flows out the southwest ditch. The dam consisted of 2 x 6 inch boards bolted between two 2 inch pieces of channel iron. Later in September 1983, BLM reinforced the dam by placing two metal fence posts behind the boards.

The efficiency of the artificially-deepened channel in moving water to Lower Borax Lake was, perhaps, greater than expected. Lower Borax Lake rapidly filled, but the marsh area between Borax Lake and Lower Borax Lake remained dry.

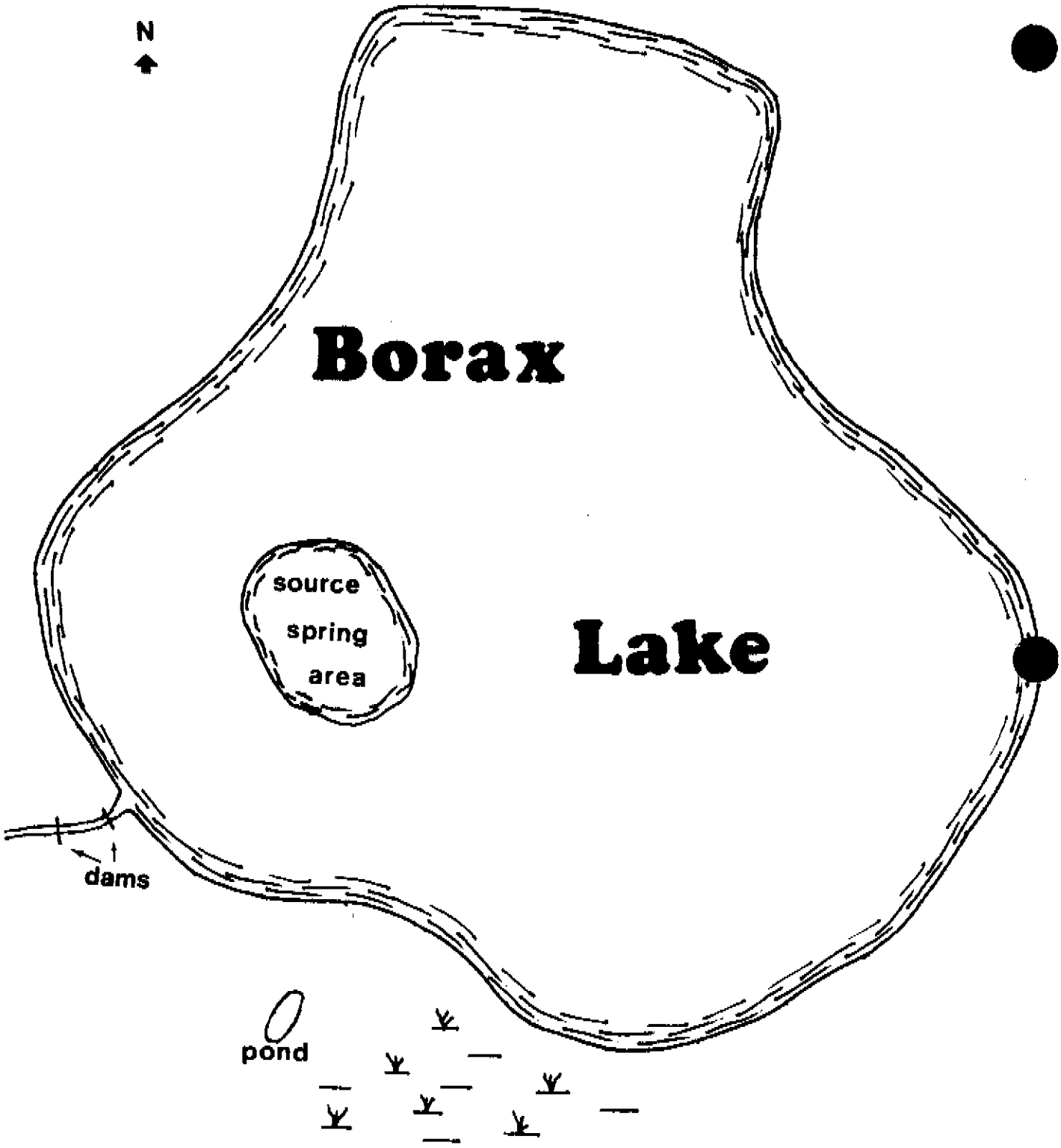

Figure 4. Borax Lake and detail of southwest outflow channel.

In an effort to rehydrate a portion of this marsh, personnel of the U.S. Fish and Wildlife Service used shovels on 24 October 1983 to breach the wall of the ditch and divert part of the outflow onto the marsh.

A second check dam was installed behind the first in early 1984. The purpose of this second dam was to provide insurance against a break or vandalism of the first dam.

In June 1984, The Nature Conservancy and U.S. Fish and Wildlife Service opened up additional side channels along the ditch in an effort to flood more of the marshland southwest of Borax Lake. Initial work also was begun on refilling portions of the artificially-deepened ditch to help spread the water over a wider area. The small pond near the southern shore of Borax Lake was full in 1985 (Bill Hosford 5/, pers. comm.). Further restoration of the marshes and other habitats are anticipated and are detailed in a Habitat Management Plan under preparation by BLM, and in Part II of this plan.

5/ Oregon Department of Fish and Wildlife, Hines, Oregon and other habitats are anticipated and are detailed in a Habitat Management Plan under preparation by BLM, and in Part II of this plan.

PART II. RECOVERY

Objectives

The primary objective of this recovery plan is to propose a series of actions that, when successfully implemented, will restore the Borax Lake chub to the point where it could be removed from the List of Endangered and Threatened Wildlife.

As an interim objective, this recovery plan provides for restoration and protection of the ecosystem to the point where the Borax Lake chub may be considered for reclassification from endangered to threatened status. Conditions to meet this interim objective include: 1) the presence of a naturally-reproducing population of the Borax Lake chub in Borax Lake that is free of exotic species, 2) permanent protection of the 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, 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.

To meet the primary objective of recovery, further protection of the Borax Lake ecosystem must be provided. The Borax Lake chub can be considered for delisting when a viable, self-sustaining population of Borax Lake chub is maintained in Borax Lake and adjacent wetlands within the 640-acre critical habitat. Conditions to meet this delisting objective include those four listed above as well as the following six criteria: 1) a viable, self-sustaining population of Borax Lake chubs, which herein defined as a naturally-sustaining population that is free of exotic species and fluctuates in size within the seasonal ranges that will be observed in 1986 - 1987, 2) permanent protection of the 160-acre parcel of land to the north of Borax Lake (T37S, R33E, Sec. 11) by The Nature Conservancy or an appropriate public resource agency, 3) withdrawal of Borax Lake waters from appropriations, 4) establishment of a fence around the 640-acre critical habitat parcel to prevent vehicle entry, 5) establishment of monitoring programs to survey habitat and fish population status, and 6) lack of any new threats to the species or ecosystem for five consecutive years. The natural integrity of the physical (e.g., temperature, flows, etc.) and chemical constituents of springs feeding Borax Lake must be maintained.

Perpetuation of the Borax Lake ecosystem is dependent upon maintenance of the fragile balance among spring flows, salt crusts, and marshes. Spring flows that feed Borax Lake must be maintained within the natural limits of discharge and quality. The salt-crust shoreline must hold enough water to provide a thermal refuge for the fish plus shallow cover for nursery of young-of-the-year. Also, the salt crusts must be protected so that outflows from the lake supply water to the natural marsh, adjacent ponds and Lower Borax Lake, rather than spilling into less favorable habitats.

Seasonal population estimates of the Borax Lake chub will be made during 1986 and 1987. To the best of our knowledge, present population sizes are representative of those that were found in the historic, natural condition at Borax Lake. The populations also should be free of exotic predators, competitors, diseases and parasites.

Maintenance of stocks of the Borax Lake chub in aquaria or in refugia outside of the Borax Lake ecosystem may provide some insurance against total loss of the "genetic conscience" of the species, but does not provide for recovery or long-term survival. Recovery actions, therefore, are concentrated almost entirely on the Borax Lake ecosystem.

Step-down Outline

Prime Objective: The primary objective of this recovery plan is to restore the Borax Lake chub to the point where it could be removed from the List of Endangered and Threatened Wildlife. Delisting can be considered upon permanent protection of water rights and two 160-acre land parcels, reestablishment of habitats, removal of threats to the ecosystem (including subsurface waters), protection of habitats, and maintenance of a viable, self-sustaining population of the Borax Lake chub.

The interim objective of this recovery plan is to restore the Borax Lake chub to the point where it can be reclassified from endangered to threatened status. This objective will be achieved when a naturally-reproducing population of the Borax Lake chub is secured by permanent protection of the 160-acre land parcel surrounding Borax Lake, reestablishment of habitats, and removal of threats to the surface and subsurface water supply. Actions to achieve these objectives are given below.

1. Secure land and water rights.

    11. Secure the 160-acre parcel of land surrounding and including Borax Lake (T37S, R33E, Sec. 14).

12. Secure the 160-acre parcel of land to the north of Borax Lake (T37S, R33E, Sec. 11).

13. Withdraw Borax Lake waters from appropriation.

2. Restore Lower Borax Lake, small pond near south shore of Borax Lake, marshes along south shore of Borax Lake, and marshes between Borax Lake and Lower Borax Lake.

21. Restore natural southwest outflow.

211. Maintain check dams as long as necessary.

212. Remove check dams when natural barrier has been restored.

22. Fill in middle and lower portions of ditch between Borax Lake and Lower Borax Lake.

3. Protect Borax Lake ecosystem.

31. Erect a fence around the 640-acre critical habitat parcel.

32. Prevent alteration of Borax Lake shoreline.

33. Prevent access road improvements.

34. Close critical habitat to vehicle use.

35. Close critical habitat to livestock grazing.

36. Close critical habitat to mineral or geothermal exploration.

37. Prevent use of herbicides and insecticides within critical habitat.

4. Monitor status of Borax Lake ecosystem.

   41. Monitor water quality.

   42. Monitor physical characteristics of habitats.

   43. Monitor fish population.

   44. Monitor invertebrate populations.

5. Encourage support of recovery plan objectives through public awareness.

   51. Provide information to press, TV and radio.

   52. Widely distribute approved recovery plan.

6. Utilize laws and regulations to protect the Borax Lake chub and its habitat.

   61. Enforce applicable State and Federal laws.

   62. Evaluate effectiveness of applicable laws and regulations.

Narrative

1. Secure land and water rights.

The Nature Conservancy presently holds a 10-year conservation lease on the 160-acre parcel of private land surrounding and including Borax Lake. This lease has provided valuable protection to the ecosystem and has given The Nature Conservancy some authority to manage the land surface. However, Getty Oil Company still holds a lease for subsurface geothermal energy exploration. Also, the conservation lease allows for periodic diversions of water from Borax Lake to the north and east to irrigate grazing land. These diversions are accomplished by chipping a hole or holes in the salt crusts surrounding the lake. Such modification is hazardous to the ecosystem because it lowers the level of Borax Lake and diverts water from marsh areas.

11. Secure the 160-acre parcel of land surrounding and including Borax Lake (T37S, R33E, Sec. 14).

Obtaining permanent protection of this parcel is the key to preservation of the Borax Lake ecosystem. With permanent protection of this parcel, maintenance of surface and subsurface

flows could be ensured. The Nature Conservancy maintains a right of first refusal in their lease and would be the most likely party to acquire the land. If their acquisition efforts are not successful, protection by an appropriate public resource agency would be necessary.

12. Secure the 160-acre parcel of land to the north of Borax Lake (T37S, R33E, Sec. 11).
Numerous thermal springs, fed by the same aquifer that supplies water to Borax Lake, occur in this parcel. Permanent protection of this parcel would help protect the aquifer by preventing drilling of wells and surface disturbance.

13. Withdraw Borax Lake waters from appropriation.
In order to protect stream flows in the southwest outflow and other areas near Borax Lake, water within the 640-acre critical habitat should be withdrawn from appropriation. Pursuant to State water law (ORS 536.410), an interested party can petition the Water Policy Review Board to withdraw the Borax Lake area from water right appropriation. If the Board issues such an order, proper surface flows to protect critical habitat would be ensured.

2. Restore Lower Borax Lake, small pond near south shore of Borax Lake, marshes along south shore of Borax Lake, and marshes between Borax Lake and Lower Borax Lake.

Although Borax Lake provides the prime habitat for the chub and probably the only spawning and rearing habitat for the species, individual fish were frequently seen in adjacent ponds, marshes and Lower Borax Lake. These habitats should be restored to increase the range of the Borax Lake chub and to provide additional refugia for the species.

21. Restore natural southwest outflow.

According to vegetation patterns and historic photographs, the primary area for discharge of water from Borax Lake was via the southwest outflow channel. Water flowing through this channel feeds the marsh area between Borax and Lower Borax Lakes, and eventually Lower Borax Lake itself.

211. Maintain check dams as long as necessary.

Because Borax Lake is situated on salt deposits approximately 10 m above the floor of the valley, water levels are determined by the number and elevation of the outflows.

If there are too many outflows, or if the outflow channels are too deep, the lake's water level will decrease and expose the fish to spring inflow temperatures that are above their critical thermal maximum.

Historically, silt and salt deposits prevented too much water from exiting the lake via the southwest outflow channel. When the channel was dug open by a backhoe during 1983, installation of a check dam was necessary to control the increased rate of flow. A second small check dam was installed in the southwest outflow channel in 1984 to prevent the lake from draining out through this artificially-deepened channel. These check dams must be maintained until such time that natural silt and salt-crust barriers have been reestablished.

212. Remove check dams when natural barrier has been restored.

Siltation and revegetation of the southwest outflow is occurring by natural processes.

This natural process should be encouraged by occasional return of salt crusts dredged from the channel back into the outflow. When the natural barrier has been sufficiently restored, one of the two check dams should be removed. Flows and siltation should then be monitored for at least one year before removal of the last check dam is considered.

22. Fill in middle and lower portions of ditch between Borax Lake and Lower Borax Lake.

In order to completely rehydrate the marsh between Borax Lake and Lower Borax Lake, the artificial ditch that was excavated through the marsh should be partially refilled. If the middle and lower portions of the ditch are mostly filled, water movement within the ditch will slow and the water will spread out to cover the historic marsh area.

3. Protect Borax Lake ecosystem.

Existing and restored habitats can be protected by limiting human access and non-beneficial use of the critical habitat area. Some of the following protective measures cannot be implemented until full control over land use on the privately-owned parcels is obtained.

However, many tasks can be implemented according to BLM jurisdiction, provisions of The Nature Conservancy's lease, or cooperation of the landowner.

31. Erect and maintain a fence around the 640-acre critical habitat parcel.

Ultimately, it will be advisable to erect and maintain a secure barbed wire fence around the entire 640-acre critical habitat area. This fence should be constructed of barbed wire in such a way to prevent entry by vehicles and cattle but to allow entry by foot-traffic and wildlife. A small stile, passage, or ladder should be provided to allow entry by people without vehicles. No large gate for vehicles should be provided. Currently BLM has sufficient funds available to fence the entire critical habitat parcel within 3 years, a barbed wire fence around the 160-acre parcel surrounding Borax Lake should be constructed as an interim measure. Old barbed wire from earlier fences should be removed. Wooden posts should be left for use as perch sites.

32. Prevent alteration of Borax Lake shoreline.

Modification of the sodium-borate crust shoreline should be prevented so that the fish's nursery areas and water level are maintained.

33. Prevent access road improvements.

Two unimproved dirt roads lead to Borax Lake from the Andrews-Fields gravel road. In order to reduce the likelihood of disturbance to this fragile ecosystem that could result from increased human use, the two access roads should not be improved. Repair of storm damage can be made up to the condition that 4WD's and pickups can travel the roads.

34. Close critical habitat to vehicle use.

The entire 640-acre critical habitat area should be closed to vehicle use in order to decrease the probability of disturbance.

35. Close critical habitat to livestock grazing.

The entire 640-acre critical habitat area should be closed to livestock grazing in order to decrease disturbance to soils, marsh vegetation and outflow channels.

36. Close critical habitat to mineral or geothermal exploration.

The entire 640-acre critical habitat area should be closed to mineral or geothermal exploration in order to decrease the probability of disturbance. Any new or renegotiated geothermal leases on land within the critical habitat boundary should include stipulations for "no surface occupancy or disturbance."

37. Prevent use of herbicides and insecticides within critical habitat .

The entire 640-acre critical habitat area should be closed to use of herbicides, insecticides and other chemicals that could be harmful to aquatic organisms. Insecticides would eliminate terrestrial insects, which are an important food item for the fish. Die-offs of large numbers of the Borax Lake chub have been noted in the past. While none of these have been traced to use of toxic chemicals, their use should be officially prohibited. As part of the Animal and Plant Health Inspection Service's program of grasshopper control, the Fish and Wildlife Service recommended

avoiding aerial application of pesticides within 2 miles of the critical habitat boundary, and then only if winds are less than 5 mph. Such caution is necessary to ensure protection of the chub and its food.

4. Monitor status of Borax Lake ecosystem.

Because of the fragility of the system and the greatly restricted range of the Borax Lake chub the the Borax Lake ecosystem will require careful monitoring. The frequency of monitoring efforts should increase above those levels given below if any new threats to the system are encountered.

41. Monitor water quality.

Water samples should be collected quarterly and examined to determine their chemical composition, minor and trace elements. Samples should be collected from Borax Lake and from a nearby hot spring north of Borax Lake. For the first two years, water quality should be monitored monthly. Values obtained can be compared to data provided by Mariner et al. (1974, 1975) and in Service files to determine if any significant changes to water supplying the Borax Lake ecosystem have occurred.

42. Monitor physical characteristics of habitats.

Physical characteristics of the habitats should be monitored at least monthly for the first two years and then quarterly thereafter. At Borax Lake, the water level, condition of shoreline, and water temperature should be checked and recorded. Graduated posts exist to measure lake water elevation. The check dams in the southwest outflow should be examined for evidence of erosion or weakness. Marsh conditions should be checked to determine condition of vegetation and water levels. Water level and water temperature of Lower Borax Lake and the small ponds adjacent to Borax Lake should also be checked. Water and air temperatures should be recorded for the hot springs north of Borax Lake.

43. Monitor fish population.

The Borax Lake chub population should be surveyed annually. Distribution of the species in Borax Lake, the southwest outflow, adjacent ponds, marshes, and Lower Borax Lake should be checked. Initially, seasonal population estimates of the chub should be made. After two years of seasonal

estimates, annual surveys should be sufficient to detect significant population changes. These surveys should also allow for the detection of any exotic fishes or other organisms that could be introduced into the lake.

44. Monitor invertebrate populations.

Samples of the invertebrate fauna from Borax Lake and nearby habitats should be made and sent to the appropriate taxonomic experts for investigation. During the first year, invertebrate surveys should be conducted monthly to detect seasonal shifts in relative diversity or abundance of the invertebrate community. After the initial surveys, sampling could be repeated only every two or three years to determine any changes in distribution, abundance or diversity of invertebrates, which could be indicative of changes in habitat quality.

5. Encourage support of recovery plan objectives through public awareness.

Public awareness and support of this recovery program can be increased by providing media coverage of the fish's status and plans for its recovery. The public needs to

be aware of the Borax Lake chub, which maintains the most restricted distribution of any vertebrate species in the Northwest. However, care must be taken to structure the publicity such that the species' recovery is highlighted. Visits to the Borax Lake area should not be encouraged except when scientific, educational or recovery goals are advanced.

51. Provide information to press, TV and radio.
Information concerning the status of the Borax Lake chub should be made available to the public upon approval of this plan and completion of significant recovery actions.

52. Widely distribute approved recovery plan.
Copies of the approved recovery plan should be widely distributed to local, State and Federal governments and all interested parties.

6. Utilize laws and regulations to protect the Borax Lake chub and its habitat.
Enforcement personnel of all land management agencies should be made aware of the location of the habitats and the types of activities that would be detrimental to the chub or its habitats.

61. Enforce applicable State and Federal Laws.

The Endangered Species Act of 1973, as amended, should be strictly enforced along with other applicable State and Federal laws in order to prevent "take" of the Borax Lake chub and to protect critical habitat.

62 Evaluate effectiveness of applicable laws and regulations.

Existing law enforcement programs should be periodically examined to determine their effectiveness. Any new laws or regulations that are necessary to protect the Borax Lake chub or its habitat should be proposed and enacted.

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PART III. IMPLEMENTATION SCHEDULE

Table 1 that follows, is a summary of scheduled actions and costs for the Borax Lake chub recovery program. It is a guide to meet the objectives of the Recovery Plan for the Borax Lake chub, as elaborated upon in Part II, Action Narrative section. This table indicates the priority in scheduling tasks to meet the objectives, which agencies are responsible to perform these tasks, a time table for accomplishing these tasks, and the estimated costs to perform them. Implementing Part III is the action of the recovery plan that, when accomplished, will satisfy the prime objective. Initiation of these actions are subject to the availability of funds.

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

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

Table 1. Implementation schedule for the Borax Lake chub recovery program

General Category	Task Plan	Task Number	Priority Number	1 Duration of Task (yrs.)	2 Responsible Agencies FWS Region	FWS Program	Other Agencies	3 Estimated Costs ($1,000s) FY1	FY2	FY3	Comments and notes
A6	Secure the 160-parcel of land surrounding Borax Lake (T37S, R33E. Sec. 14)	11	1	1	1	ACO	TNC*	To Be Determined			TNC entered into a 10 year lease in 1983 which gave them management authority
A6	Secure the 160-parcel of land to the north of Borax Lake (T37S, R33E, Sec. 11)	12	1	1	1	ACO	TNC*	To Be Determined			
A7	Withdraw Borax Lake waters from appropriation	13	1	1			ODWF* TNC				There are no direct costs to withdraw water from appropriation.
M3	Maintain check dams as long as necessary	211	1	Ongoing			TNC* BLM ODFW	0.5 0.5 0.25	0.5 0.5 0.25	0.5 0.5 0.25	
M3	Remove check dams when natural barrier has been restored	212	3	1-2			TNC*			0.5	Task may not be completed until FY4 or FY5.

Table 1. Implementation schedule for the Borax Lake chub recovery program

General Category	Task Plan	Task Number	Priority Number	1 Duration of Task (yrs.)	2 Responsible Agencies FWS Region	FWS Program	Other Agencies	3 Estimated Costs ($1,000s) FY1	FY2	FY3	Comments and notes
M3	Fill in middle and lower portions of ditch between Borax Lake and Lower Borax Lake	22	3	Ongoing			TNC* SLM*	0.5 0.5	0.5 0.5	0.5 0.5	Task will be completed when natural marsh is re-established and manipulation of water flows are no
M3	Erect a fence around the 640-acre critical habitat parcel	31	2	1			BLM*		7.0		
M3	Prevent alteration of Borax Lake shoreline	32	1	Ongoing	1	SE	TNC* BLM ODFW				No cost other than periodic inspections.
M3	Prevent access road improvements	33	2	Ongoing			BLM*				No direct cost associated with this action.
M3	Close critical habitat to vehicle use	34	3	1			BLM* TNC				No direct cost as this is an administrative action.
M3	Close critical habitat to livestock grazing	35	3	Ongoing			BLM* TNC				No direct costs associated with this action.

Table 1. Implementation schedule for the Borax Lake chub recovery program

General Category	Task Plan	Task Number	Priority Number	[1] Duration of Task (yrs.)	[2] Responsible Agencies FWS Region	FWS Program	Other Agencies	[3] Estimated Costs ($1,000s) FY1	FY2	FY3	Comments and notes
M3	Close critical habitat to mineral or geothermal exploration	36	1	1			BLM*				No direct cost as this is an administrative action.
M3	Prevent use of herbicides and insecticides within critical habitat	37	2	1			BLM* TNC ODFW				No direct cost as this is an administrative action.
R2	Monitor water quality	41	3	Continuous			TNC*	2.25	2.25	2.25	For first two years monitor water monthly; quarterly thereafter.
R2	Monitor physical characteristics of habitats	42	2	Ongoing	1	SE	 TNC* BLM ODFW	0.25 0.5 0.25 0.25	0.25 0.5 0.25 0.25	0.25 0.5 0.25 0.25	For first two years habitats should be monitored monthly, than at least four times per year.
R1	Monitor fish population	43	2	Ongoing	1	SE*	 TNC ODFW	0.5 0.25 0.25	0.5 0.25 0.25	0.25 0.25 0.25	Seasonal population estimates during first two years; annually thereafter.
R5	Monitor invertebrate populations	44	3	Continuous		1	SE* TNC ODFW		.75 .75 .75		For first year, monitor invertebrates monthly, every 2 or 3 years thereafter.

Table 1. Implementation schedule for the Borax Lake chub recovery program

General Category	Task Plan	Task Number	Priority Number	1 Duration of Task (yrs.)	2 Responsible Agencies FWS Region	FWS Program	2 Other Agencies	3 Estimated Costs ($1,000s) FY1	FY2	FY3	Comments and notes
05	Provide information to press, TV and radio	51	3	Ongoing	1	SE	TNC* ODFW BLM				No direct cost known for this action.
01	Widely distribute recovery plan	52	3	1	1	SE*	ODFW BLM TNC				No direct cost, except perhaps postage fees, known for action. FWS to provide other agencies with copies for distribution.
02	Enforce applicable State and Federal laws	61	2	Ongoing	1	LE	 ODFW* BLM OSP	0.5 0.5 0.25 0.25	0.5 0.5 0.25 0.25	0.5 0.5 0.25 0.25	
03	Evaluate effectiveness of applicable laws and regulations	62	3	Continuous	1	SE	 ODFW* BLM		0.25 0.5 0.25		Task completed every two years.

1 Definitions:
Ongoing = The action is now being implemented and will continue on an annual basis.
Continuous = The action will be implemented on an annual basis once the action has begun.

2

Agency abbreviations:

FWS = U. S. Fish and Wildlife Service	BLM = U.S. Bureau of Land Management
LE = Law Enforcement Program of FWS	ODFW = Oregon Department of Fish and Wildlife
SE = Endangered Species Program of FWS	OSP = Oregon State Police, Game Division
ACQ = Acquistion program of FWS	
TNC = The Nature Conservancy	* = Designates lead agency

3

FY 1 = 1986
Blank indicates no cost for that fiscal year.

APPENDIX

Agencies requested to provide comments during Agency Review.

State Director
Bureau of Land Management
P.O. Box 2965
Portland, Oregon 97208

Bureau of Land Management
74 S. Alvord Street
Burns, Oregon 97720

The Nature Conservancy
1234 Northwest 25th Ave.
Portland, Oregon 97210

Oregon Natural Resources
Council
1161 Lincoln Street
Eugene, Oregon 97401

National Fisheries Research
Station
Naval Station, Bldg. #204
Seattle, Washington 98115

Oregon Dept. of Fish and Wildlife
506 SW Mill Street
P.O. Box 59
Portland, Oregon 97207

Oregon Dept. of Fish & Wildlife
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Oregon Dept. of Fish & Wildlife
P.O. Box 8
Hines, Oregon 97738