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In the Office of Endangered Species
Fish and Wildlife Service
United States Department of the Interior

A Petition for Rules to List Great Basin Redband Trout (*Oncorhynchus mykiss* ssp) as Threatened or Endangered Under the Endangered Species Act

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Oregon Natural Desert Association, Oregon Trout, Native Fish Society, and Oregon Chapter of Trout Unlimited formally request U.S. Fish and Wildlife Service to list the indigenous redband trout (*O. mykiss*) of the Great Basin (*O. mykiss* ssp), in particular redband populations in the Catlow, Fort Rock (Silver Lake), Harney (Malheur Lake), Goose Lake, Warner Valley, and Chewaucan (Lake Abert/Summer Lake) Basins as threatened or endangered pursuant to the Endangered Species Act, and to designate critical habitat for it concurrent with listing.

Petitioners file this petition under the Endangered Species Act (herein after the "Act" or "ESA"), 16 U.S.C. sections 1531-1543 (1982). This petition is filed under 5 U.S.C.

section 553(e), and 50 C.F.R. part 424.14 (1990), which granted interested parties the right to petition for the issue of a rule from the Assistant Secretary of the Interior. The petitioners' request that Critical Habitat be designated is pursuant to 50 CFR 414.12, and pursuant to the Administrative Procedures Act (5 U.S.C. 553).

The United States Fish and Wildlife Service (USFWS) has jurisdiction over this petition. Petitioners understand that this petition sets in motion a specific process placing definite response requirements on the USFWS and very specific time constraints upon those responses. The petitioners are conservation organizations.

Failure to grant the requested petition will adversely affect the aesthetic, recreational, commercial, research, and scientific interests of petitioning organizations' members and of the citizens of the United States. Aesthetically, recreationally, and commercially, the public shows increasing demand for "wild trout" fisheries (Behnke 1987), and increasing concern for biodiversity in general, especially salmonid and genetic diversity. Practically, with their resiliency in the face of environmental extremes, these indigenous redband trout offer substantial promise for desert fishery management (Behnke 1987). Should they fall victim to extinction, no natural recolonization will be possible due to the closed nature of the basins, and it is unlikely that the streams that they inhabit can be successfully restocked with other types of trout, which quickly perish in the harsh Great Basin environment. Scientifically, researchers consider redband trout to be an *indicator species*. They exhibit a uniquely high degree of resiliency compared to other aquatic species within their ecosystems, and therefore their decline indicates that the watersheds that they inhabit are being overstressed. For example USDA (1996) outlined that in the Goose Lake Basin,

> **"habitat needs of redband trout were selected to assess limiting factors within the Thomas Creek Watershed because it is believed that addressing these factors will provide healthy, stable aquatic ecosystems that meet the needs of all aquatic-dependent species in the watershed."**

Addressing the decline of Great Basin redband trout by listing them under the Endangered Species Act will therefore serve to substantially restore and maintain the health not only of these populations of unique fish, but of aquatic ecosystems in the basins subject to this petition.

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List of Great Basin Redband Trout Populations

CATLOW VALLEY BASIN
FORT ROCK (SILVER LAKE) BASIN
HARNEY (MALHEUR LAKE) BASIN
GOOSE LAKE BASIN
WARNER VALLEY BASIN
CHEWAUCAN (LAKE ABERT/SUMMER LAKE) BASIN

I. PETITIONERS

Oregon Natural Desert Association is a tax-exempt, non-profit public interest organization with over 1,000 members. Its mission is to promote the preservation, protection and rehabilitation of Oregon's arid-land environment and native species and to educate the general population on the values of preserving the natural arid-land environment.

Oregon Trout is a non-profit, charitable, education and scientific fish conservation organization incorporated under the laws of the State of Oregon. Oregon Trout's 4000 members are made up of concerned anglers and conservationists who have organized to preserve, protect, and restore native fish and their ecosystems in Oregon.

Native Fish Society is a non-profit grassroots regional organization that promotes conservation, protection, and restoration of native fishes in the Northwest. Its membership supports scientifically sound conservation, protection, and recovery actions for native fish and their habitats.

Oregon Council of Trout Unlimited is a cold-water conservation group dedicated to the protection of wild salmon and their habitat. Trout Unlimited has 2,000 members in Oregon and over 100,000 members nationally.

II. EXECUTIVE SUMMARY

Numerous scientific reports, studies, and articles have documented that Great Basin redband trout (*Oncorhynchus mykiss ssp.)*, which occurs in the Catlow, Fort Rock, Harney, Warner Lakes, Goose Lake, and Chewaucan Basins in southern Oregon, northern California, and northern Nevada, have declined substantially relative to historic numbers and range (Kostow 1995, Dambacher and Stevens 1996, Lee et al. 1997, USDA/USDI 1997, Howell 1997, Williams et al. 1989). As a result, a high risk currently exists that they will become extinct in the foreseeable future. Non-anadromous redband trout populations in the Great Basin and Columbia Plateau are already extinct in 72% of their historic range, and strong populations remain in only 10% of their historic habitat (USDA/USDI 1997). Redband trout that occur outside of the range of steelhead are

currently classified as depressed in 94% of watersheds in the Columbia River Basin, including the Great Basin, where they still exist (Howell 1997).

Great Basin redband trout have evolved in high desert stream environments that are characterized by unpredictable and intermittent flows, high summer water temperatures, high alkalinity, drought, and fire. As a result, they have historically been subject to naturally high levels of population fluctuation, and have evolved traits that allow them to survive in conditions inhospitable to other types of trout. They have not, however, evolved traits that allow them to overcome the **combined stresses** thrust upon them by their naturally harsh environment **and by disruption of their habitat by human activity**. Recent reports and surveys have found these redband populations to be severely depressed, with few or no fish remaining in areas where riparian and stream habitat conditions are severely degraded (Lee et al. 1997, ODFW 1990-1996, Kostow 1995, USDA 1996).

All Great Basin redband trout populations are faced with similar threats to their existence. The causes of the declines in Great Basin redband trout populations and range have been most strongly associated with past and current destruction, modification, and curtailment of their aquatic habitat and range by humans (Williams et al. 1989, Dambacher and Stevens 1996, Dambacher 1995, Howell 1997, Kostow 1995, Lee et al 1997, USDA 1996). Most riparian and stream habitat in these basins have been and continue to be severely degraded by livestock grazing, logging in their headwaters, and by the dewatering and fragmentation of habitat associated with irrigation practices (Dambacher and Stevens 1996, Dambacher 1995, Kostow 1995, Howell 1997, USDA 1996, USDA/USDI 1997). Other human-caused factors that may affect these redbands' continued existence are competition from or introgression with exotic hatchery rainbow trout and other species of introduced exotic fish (Lee et al 1997, Kostow 1995, Currens 1996, Phelps et al. 1996), and the inadequacy of existing regulations.

Currently, habitat degradation of redband habitats is the greatest threat to their existence. Sigler and Sigler (1987) in their book *Fishes of the Great Basin* concluded that "protection of the habitat required by desert fish species in the Great Basin is essential if

Great Basin redband trout are unusual not only in their ecological setting in high elevation deserts, but they are unique among redbands in occupying closed desert basins, in which they are physically isolated from all other forms of *O. mykiss*. The first ever genetic comparison of redband trout to include all Great Basin trout populations by Currens (1997) supports fishery geneticists Berg (1987) and Williams et al. (1989), who proposed that Great Basin redband trout are genetically distinct from all other groups of *O. mykiss*. Because Great Basin forms of redband trout are thought to have split from *O. mykiss* early in the evolution of the taxon (Behnke 1992), Great Basin redband trout represent a significant legacy in the evolution of all *O. mykiss*, as well as a significant legacy in the evolution of redband trout *O. mykiss*. In addition, they are a unique and distinct group of

locally adapted desert fish. The populations that compose it, therefore, represent a significant portion of the genetic diversity of *O. mykiss*.

Protection under the Endangered Species Act is currently critically necessary to prevent the extinction of Great Basin redband trout, and to ensure that adequate resources are made available for recovery efforts. Critical habitat should be designated in aquatic systems essential to the conservation of Great Basin redband trout. These include all streams and lakes containing indigenous Great Basin redband trout in the physically isolated Catlow, Fort Rock, Harney, Goose Lake, Warner, and Chewaucan basins in Oregon, Nevada, and California.

III. CLASSIFICATION, NOMENCLATURE, AND BIOLOGY OF *ONCORHYNCHUS MYKISS* SUBJECT TO THIS PETITION.

A. Common Names for *O. mykiss* in the Western United States

The most recognized common names for *Oncorhynchus mykiss* are steelhead and rainbow trout. Throughout its entire range in the Western North America, which extends from Alaska to Baja, Mexico, it consists of two separate major evolutionary groups that are each referred to by different common names. "Coastal rainbow trout" (Behnke 1992) is the common name for *O. mykiss* that occur **west** of the Cascade Crest (Figure 1), and "Redband trout", preceded by the name of the locality, is the common name for *O. mykiss* with life cycles centered **east** of the Pacific Crest. Redband trout occur from British Columbia to the northern portion of the Sacramento River Basin in northern California (Behnke 1992). Redband trout is also the common name for a number of *O. mykiss* populations located east of the Cascade Crest that **do not have access to the ocean because they are geographically isolated in closed basins or by large barrier waterfalls**. These isolated populations occur in (1) a portion of the White River on the east side of Mt. Hood (Currens 1997); (2) the Upper Klamath Lake Basin in Oregon and California (Buchanan et al. 1990, 1991, 1994; Hemmingson et al. 1992, 1993); (3) the McCloud River Basin in Northern California, and (4) the northern Great Basin, i.e. in the Catlow, Fort Rock, Harney, Goose Lake, Warner Valley, and Chewaucan Basins (Behnke 1992, 1987, Kostow 1995, Shreck and Behnke 1971). The Great Basin redband trout is the subject of this petition. These fish are most often termed "redband trout" (Kostow 1995, Behnke 1992) or "Great Basin redband trout" (Moskowitz and Rahr 1994, Kostow 1995). They have often been called Oregon desert basin redband trout (Kostow 1995, Behnke 1992), although they also extend into California and Nevada. They are sometimes referred to as "rainbow" trout (eg. ODFW 1990), and "red-banded" trout (Shreck and Behnke 1971). We use the terms "redband trout" and "Great Basin redband trout" to refer to *O. mykiss* populations that are indigenous to the Great Basin in southern Oregon, northern California, and northern Nevada and are subject to this petition.

B. Differentiation within *Oncorhynchus mykiss*

In the western United States, *Oncorhynchus mykiss* occur from Alaska to Baja, Mexico, and are differentiated into two major evolutionary groups: coastal rainbow trout and

redband trout (Allendorf and Utter 1979, Allendorf 1975, Behnke 1992, Figure 1). Although these two groups have not been taxonomically distinguished formally (though they have been distinguished informally by Behnke 1992), their genetic distinctiveness is widely recognized by fish biologists, taxonomists, and geneticists. The range of *O. mykiss* is physically separated by the crest of the Cascade Mountains, with coastal rainbow trout naturally occurring on the west side of the range, and redband trout naturally occurring on the east side of the range (Behnke 1992). These two groups differ substantially in their morphological characteristics (Behnke 1992, 1987, Table 1). Genetically, redband trout have fewer chromosomes (58) than coastal rainbow trout (58-64) (Wilmot 1973), and differ considerably according to allozyme analysis (Allendorf 1975, Allendorf and Utter 1979, Currens 1997). The most recent genetic analyses (Berg 1987; Richard N. Williams Personal Communication, Currens 1997) have confirmed significant differentiation between redband *O. mykiss* and coastal rainbow trout *O. mykiss*. Environmentally, coastal rainbow trout are adapted to the cool, often forested streams of Western Oregon, and often migrate to the ocean. Redband trout, however, have evolved to tolerate the drier conditions that occur to the east of the Cascades. Great Basin redband, which is also widely recognized by fish biologists and geneticists to be genetically distinct from other redband groups (Behnke, 1992, Richard N. Williams, Pers. Comm., Currens, 1997) evolved to tolerate the high water temperatures, large diurnal fluctuations in water temperature, drought, and intermittent stream flows that characterize desert environments.

C. Classification of redband trout.

Redband trout were first considered to be rainbow trout or a subspecies of cutthroat trout (Behnke 1987). However, cutthroat trout (*Oncorhynchus clarkii*) are now known to have diverged from the evolutionary line that became redband trout early in the evolution of western North American trout (Figures 2 and 3). Redband trout and coastal rainbow trout diverged from a common ancestor more recently (Figure 2 and 3). Most recently, redband trout were considered to be a separate major evolutionary group of rainbow trout (Behnke 1987, 1992).

Concerning differentiation of *Oncorhynchus mykiss*, Behnke (1992) proposed 3 groups—(1) redband trout of the Columbia River Basin, (2) redband trout of the Sacramento River Basin, and (3) the coastal rainbow trout (i.e. Figure 4; Behnke 1987, 1992). Behnke (1992) concluded that other forms of *O. mykiss*, including the redband trout native to Oregon desert basins (i.e. the Great Basin redband), "cannot be consistently distinguished from the three groups listed above. Presently, their classification is a matter of personal preference and professional judgment". But Behnke recognized that Great Basin redband are ecologically distinct from other forms. More recently, genetic analyses by Currens (1997) clarified many of the taxonomic and phylogenetic questions. He showed that the redband in all of the closed basins in the Great Basin have long been isolated from other populations and are genetically distinct.

While Columbia and Sacramento Basin redbands have historically produced steelhead (defined as "anadromous" trout, meaning that they migrate to the ocean to mature before returning to the streams of their birth to spawn), Great Basin redband populations are

confined to their individual basins and are thus non-anadromous. They complete their life cycles within the basins of their origin (Lee et al. 1997).

More recently in an analysis for the Interior Columbia River Ecosystem Management Plan (ICBEMP), which includes the northern Great Basin containing redband subject to this petition, Lee et al. (1997) divided non-anadromous redband trout into two groups::

> "those *sympatric* with or *allopatric* with steelhead. We considered allopatric redband trout those that evolved outside the historical range of steelhead**. We assumed the allopatric form was potentially genetically and evolutionarily distinct from other redband trout because of this isolation.** We considered sympatric redband trout to be the non-anadromous form historically derived from or associated with steelhead."

Great Basin redband trout subject to this petition can be classified as *non-anadromous redband trout, which are allopatric with steelhead*.

The authors of the draft environmental impact statement (DEIS) of the ICBEMP called non-anadromous trout outside the range of the steelhead the "*resident-interior*" form, whereas redbands that exist within the range of the steelhead were termed the "*resident*" form (USDA/USDI 1997). Redbands subject to this petition can, therefore, also be referred to as *Great Basin resident-interior redband trout* or *Great Basin allopatric redband trout*.

The most recent genetic data—the first ever comparison of the allozyme characters of redband trout in various redband populations within and outside the Great Basin (Currens 1997)—showed considerable genetic differentiation to exist between Columbia Basin and Great Basin redband trout, and among *all* redband populations examined (Tables 2-4, figure 5).

D. Descriptions of Great Basin redband trout and their habitat.

Kostow (1995) described the Great Basin desert streams and lakes that make up the range of Great Basin redband trout as "remnants" of larger Pleistocene lake beds. She continued

> "During the Pleistocene, Great Basin redband trout occupied large alkaline lakes. The desiccation of the lakes formed stream/marsh/lake or stream/marsh complexes. In most basins, it appears the redband trout established adfluvial life histories, migrating among highly productive rearing areas in lakes with adjacent marshes and spawning areas in streams (as in Goose Lake, Warner Lake, Klamath Lake, and Malheur Lake basins) or among productive marshes and streams (as in Paulina Marsh in Fort Rock Basin, Chewaucan Marsh, and Catlow Marsh). The marshes and lakes connected various populations that entered them from different drainages in the basins. During drought episodes that caused complete desiccation of the lakes

and marshes, streams provided refuges for populations that returned to the lakes when they refilled."

Desiccation of the larger Pleistocene lakes left the redband isolated in basins, with no aquatic linkages between these lakes and non-Great Basin streams or among these six Great Basin populations. Since the final desiccation of these major lakes occurred at least 10,000 years ago, the trapped redband evolved with their individuals environments and differentiated from other redband groups and from other Great Basin populations. Selective pressures upon Great Basin redbands have favored adaptations that allow them to survive in harsher, more unstable environments than their coastal relatives and most of their Columbia River relatives (Meehan 1994). Great Basin redband are differentiated from other redbands in their morphological (Table 1) and genetic characteristics (Tables 2-4, Fig. 5) (Behnke 1992, Currens 1997).

Great Basin redband trout exhibit elliptical par marks that often include dorsal and ventral supplementary rows, a tendency for yellow and orange tints on the body, a trace of a cutthroat mark, light-colored tips on dorsal, anal, and pelvic fins, more numerous scales and fewer pyloric caeca than coastal rainbow trout, and, in some cases, vestigial basibranchial teeth (Behnke 1992). The ancient influence of selection in large, pluvial lakes is evident in their increased number of gillrakers, spotting pattern, and proclivity for piscivory (Behnke 1987).

E. Life History.

Great Basin redband trout have not evolved with access to the ocean and have therefore evolved to migrate only within their resident basins. Thus, these fish have life histories distinct from redband trout that migrate to the ocean (eg. Columbia River and Snake River redbands). Within the basins subject to this petition, two life history patterns have been identified for Great Basin redband trout: (1) stream resident (fluvial) and (2) lake resident (adfluvial) (Lee et al. 1997) (Table 5).

Stream resident (**fluvial**) populations of Great Basin redband spend their entire life cycles in flowing waters, ranging from small tributaries to large rivers (Moyle et al 1989). They may often spend their entire lives within a reach of 100-200 meters (Howell 1997). Once the trout reach maturity—at about 15-20 cm (Howell 1997)—they return to the headwaters of the streams they inhabit to spawn. Spawning is often in the spring (Mar.-June), though they may reproduce at any time of the year (Lee et al. 1997, Kunkel 1976). This is in contrast to anadromous redbands such as those from the Columbia River, which produce **summer** run steelhead (Behnke 1992). The timing of spawning migrations is likely affected by water temperature and stream flow (USDA 1996). In the fall, redbands migrate to overwintering areas within their streams. They eat mainly streamside and benthic macroinvertebrates (Kunkel 1976)

When lacustrine habitat such as lakes and marshes is available, and migratory corridors connect it with surrounding streams, **adfluvial** populations of Great Basin redband trout flourish. These populations consist of trout that spend most of their life cycles in lakes

and reservoirs, before returning to stream headwaters and tributaries within their native basin to spawn. This adfluvial form is much larger and more fecund than the fluvial form. Migratory juveniles of this life history type typically migrate downstream after one to three years to mature in lakes (Lee et al. 1997). Sexual maturity occurs at three to five years, though growth is variable, depending on genetic and environmental conditions, including water temperature (Kunkel 1976, Lee et al 1997). Once they have reached maturity, adults migrate back up the streams that feed into the lake, towards their ancestral spawning grounds in headwaters and tributaries (Thurow 1990 in Lee et al 1997). Spawning typically occurs in gravelly substrates in the spring, and may be triggered by water temperatures (USDA 1996). Eggs usually hatch in 4 to 7 weeks with "swim up" occurring 4 to 7 days later (Sigler and Sigler 1987).

F. Habitat requirements.

Like other species of trout, redband trout abundance has been strongly correlated with riparian cover components, including undercut banks, large woody debris, and overhanging vegetation (Thurow 1988 in Lee et al 1997). Healthy streamside vegetation, especially tree and shrub species, provides both shade that maintains the lower water temperatures required by trout during hot, dry summer months (i.e. temperatures not exceeding 21 degrees Celsius; Bowers et al. 1979), and habitat for terrestrial insects, which redbands eat. Streamside vegetation should shade at least 75 percent of the stream surface during the hours of 11:00 AM to 4:00 PM from June to September (Bowers et al. 1979). Loss of such riparian cover has been associated with reduced numbers and production of fish (Li et al. 1994 and Tait et al. 1994 *in* Lee et al 1997). This likely accounts for the finding of Lee et al (1997) that on land managed by the U.S. Forest Service,

> "redband trout were more likely to be present or strong in watersheds less

Concerning in-stream habitat, Kunkel (1976) found fluvial Great Basin forms he studied to be associated with higher gradient channels, often in riffles or with substrates dominated by boulders, cobbles, and pocket water. Redbands also occupy lower gradient streams. Pools, which provide important holding and rearing habitat, resting places, overwintering areas, and refuges from floods, drought, and extreme temperatures for juvenile and adult salmonids, should be available; and requirements for spawning include loose gravelly substrates to provide for oxygenation of streamwater. Such gravel and cobble substrates are also important for maintenance of healthy populations of benthic (stream bottom-dwelling) macroinvertebrates—another primary food source of redband trout (Kunkel 1976). Water temperatures in redband streams should not exceed 21 degrees Celsius (Bowers et al. 1979), and those above 26.6 degrees Celsius can be lethal (Charlon et al. 1970). Adfluvial redband trout are both insectivorous and piscivorous (Kunkel 1976).

IV. QUALIFICATION OF GREAT BASIN REDBAND TROUT AS A "DISTINCT POPULATION SEGMENT" PROTECTABLE UNDER THE ACT

Great Basin redband trout, which includes redband from the Catlow, Harney, Warner, Goose Lake, Chewaucan, and Fort Rock Basins, qualify for listing under the Endangered Species Act as a distinct population segment. Although a change in nomenclature has not formally designated these trout as a subspecies, unique taxonomic status for Great Basin redband trout has been proposed by Behnke (1992) and indirectly supported by Kostow (1995). Redband are declining in population and range throughout their range, which constitutes a significant portion of the entire range of *O. mykiss*. The Act states that the term *species*

> "includes any subspecies of fish or wildlife or plants, and any distinct population segment of species of vertebrate, fish, or wildlife which interbreeds when mature."[1]

Great Basin redband trout can be listed according the Endangered Species Act's definition of species, since it interbreeds with sympatric redband trout when mature (Lee et al. 1997), and it is endangered, or is likely to become endangered, because of "present and threatened destruction, modification, or curtailment of habitat and range[2]" (Sections X, XVI of this petition), "other natural or manmade factors[3]" (Sections X, XVI of this petition), and "the inadequacy of existing regulations[4]" (Sections XV, XVI of this petition) as required by the Act (Also see Tables 8-11, and Figure 6). Under this definition of species, they are protectable as a distinct population segment of vertebrate.

In order for a taxon to be considered a "distinct population segment of vertebrate", and thus qualify for listing under the Act, three elements must be considered (USFWS, Federal Register 61(26):4725). These are the *discreteness*, *significance*, and *conservation status* of the taxon:

1. **Discreteness**: Substantial scientific information, including morphological (Behnke 1987, 1992) and genetic (Berg 1987, Currens 1997, Phelps et. al 1996) evidence, demonstrates that Great Basin redband trout is a discrete unit, i.e. has become "markedly separated from other populations" of *O. mykiss*. The allozyme data of Currens (1997) provides the most recent information concerning the genetic discreteness between Great Basin redband and all other redband trout. According to genetic and phylogenetic analyses (Currens 1997), Great Basin redband populations are genetically distinct from Klamath Basin and Columbia River populations. Only Harney Basin shows some former linkages to Columbia River populations, due to its having been connected at one time to the Malheur River (Currens 1997). But Harney Basin became isolated from the Columbia River system 10,000 or more years ago and is genetically distinct from existing Columbia River redbands. This significant genetic isolation between Great Basins and other

[1] Endangered Species Act of 1973 as amended through the 100th Congress. U.S.D.I. 1988, Fish and Wildlife Service, Washington D.C.
[2] Endangered Species Act of 1973 as amended through the 100th Congress. U.S.D.I. 1988, Fish and Wildlife Service, Washington D.C.
[3] Ibid.
[4] Ibid.

populations (and among all Great Basin populations) is due to the physical isolation of the six populations, which occupy closed basins, meaning that all streams drain into the separate basins and have no aquatic connections between each other or to other river systems or other redband populations. Genetic separation can be attributed to the phenomenon that *physical isolation among populations of a taxa results in genetic differentiation* (Thorgaard 1983, Utter et al. 1992, 1973). Great Basin redband populations have been physically isolated both from other *O. mykiss* and from each other for at least 10,000 years (Behnke 1992, Allison 1979). The one exception is the Goose Lake population, which may have had outward access into the Pit River during historic times (Kostow 1995), but is nonetheless genetically distinct (Currens 1997). Great Basin redband trout are therefore physically reproductively isolated and evolutionarily distinct from other redband trout. In terms of the Act, they can be considered to be "markedly separated from other populations" of *O. mykiss* "as a result of physical factors," as required by USFWS to be considered "discrete".[5]

2. **Significance**: There are two requirements for a population to be considered "significant". The first is that each distinct population must be:

> "persisting in an ecological setting unique for the taxon".[6]

Among all *O. mykiss*, Great Basin redband trout are the only group that exists in isolated high desert watersheds that have been physically isolated from other watersheds for thousands of years (Behnke 1992, Kostow 1995). Equally important, these fish are unusual among *O mykiss* in being adapted to harsh, high desert environments characterized by hot summers, cold winters, large diurnal temperature fluctuations, drought, intermittent stream flows, and alkali waters (Behnke 1992, Kostow 1995, Currens, pers. comm., and Richard N William's, U. Idaho, pers. comm.) No other form of *O. mykiss* exists in closed basins (or in the Great Basin) in such an arid, extreme environment. This includes the redband *O. mykiss* of the Upper Klamath Basin of Oregon and California, the McCloud River Basin of California, and the White River of Oregon, which are not desert redbands, and the redband *O. mykiss* in Canada and the Columbia and Sacramento River Basins, which exist only in stream systems that have (or historically had) access to the Pacific Ocean. In fact, no other *native* species of trout can exist in the Great Basis stream environment. Other trout species that have been introduced into these Great Basin lakes have died out before breeding. Therefore, if redband trout are allowed to go extinct, no other native species of trout can replace them.

The six populations of Great Basin redband are also ecologically bound together by being subject to the same factors causing their decline. Throughout the range of Great Basin redband trout, livestock grazing along streams and water diversions are the greatest threats. These threats, when combined with natural environmental stresses of drought, and extreme temperatures, make them a natural unit for management under the Act.

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[5] USFWS, Federal Register 61(26):4725
[6] Ibid.

[7].

The Catlow, Fort Rock, Chewaucan, Goose Lake and Warner Valley populations have been geographically and reproductively isolated from other populations of the species for at least 10,000 years (Behnke 1992), as has the Harney Basin (Gerald Smith[8], University of Michigan, Museum of Zoology, Pers.Comm.) . Some specialists believe the Great Basin redband populations represent a group of *O. mykiss* that diverged early in the evolution of this species, and has been present in the Great Basin for at least 32,000 years (Behnke 1992) and possibly over a million years (Gerald Smith, Pers. Comm). Furthermore, such "significance" was supported by Lee et al. (1997) and by the authors of the ICBEMP DEIS (USDA/USDI 1997), who stated that resident-interior redband

> **"likely represent a critical element of the evolutionary history of (*O. mykiss*)."**

Great Basin redband trout is therefore significant to *O. mykiss* because its continued existence is critical for untangling the evolutionary history of the entire species. Moreover, the overall range of *O. mykiss* would be substantially reduced if Great Basin redband trout populations were lost; **due to the geographical isolation of each basin, not one of them could ever be naturally recolonized should its indigenous redband trout go extinct.**

Other scientists have described the significance of Great Basin redband trout as follows: Behnke (1987, 1992) stated that each individual population in itself has its own "morphological peculiarities" (outlined in Table l). He emphasized that in these basins, "the redband trout evolved differentiated populations" due to the isolated nature of the basins (Behnke 1986). Shreck and Behnke (1971) stated that

> "there is marked variability in meristic characters of these trout from different geographical areas, suggesting that they were isolated from each other for a long period of time."

The genetic data of Berg (1987) also described the distinctness of Great Basin redband trout, leading the researcher to suggest that its various populations have:

> "independently diverged from the common ancestor."

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[7] Ibid.

[8] Geologist who's work currently focuses on basins subject to this petition, Museum of Zoology, University of Michigan, Ann Arbor.

Other scientists and resource management agencies have also noted the contribution of Great Basin redband trout to the overall genetic diversity within *O. mykiss*. Williams and others (1989) of the American Fisheries Society considered there to be sufficient genetic diversity within Great Basin redband trout to consider Catlow Valley, Goose Lake, and Warner Valley redband trout as distinct subspecies. Oregon Department of Fish and Wildlife suggested that each population differs markedly enough from other populations to constitute its own gene conservation group or subspecies (ODFW 1993, Kostow 1995). These designations have yet to be officially recognized by the scientific community, but the above suggestions and conclusions demonstrate the overwhelming opinion among fisheries experts most familiar with Great Basin redband that these **trout are genetically isolated from other redband and represent a significant portion of overall genetic variability within *O. mykiss***.

Finally, if the Great Basin redband trout go extinct, *O. mykiss* will lose a significant portion of its range. The six desert basin populations that constitute the Great Basin redband trout occur in southern Oregon, northern California, and northern Nevada on the southernmost edge of the range of redband trout. This entire portion of the range of *O. mykiss* would be lost forever, since there can be no natural recolonization into these basins. This is well illustrated by the fact that hatchery trout introduced into the Great Basin lakes and rivers have died out before breeding. Extinction of Great Basin redband trout would create a significant gap at the southern periphery of *O. mykiss*.

3. **Conservation Status:** The third element considered by USFWS is:

> "the population segment's conservation status in relation to the Act's standards for [9]

Howell (1997) cited USDA/USDI (1997) to support his statement that:

> **"The status of redbands outside of the range of the steelhead, which includes Catlow Valley and other desert basins, is particularly bleak. Redbands in 94% of those watersheds are classified as depressed."**

Great Basin redband trout currently occupy only a fraction of their former range, at a fraction of their historical numbers, and are in danger of extinction. USFWS formally recognized this status in the November 15, 1994 Federal Register (Vol. 59, P. 219.) when it classified the Catlow Valley, Warner Valley, and Goose Lake Basin populations as C-2 species. More information on this status is detailed in sections IX, X, XV, and XVI, in Tables 8-11, and in Figure 6. The present or threatened destruction, modification, or curtailment of redband trout habitat threatens this distinct population segment (detailed in section IX, XVI), as do "other factors" (detailed in section X, XVI), and the inadequacy of existing regulations (detailed in sections XV, XVI). Great Basin redband is composed of populations that are now each isolated and small, none of which could be naturally recolonized if extirpated by a random or stressful disturbance or climatic event.

[9] Ibid.

Morphological and genetic data, plus this conservation status, are sufficient to justify designation of Great Basin redband trout as a distinct population segment qualifying for protection under the Endangered Species Act.

V. PRESENT LEGAL STATUS OF *Oncorhynchus mykiss* ssp

The rarity of Great Basin redband trout has been recognized by Federal, State, and professional organizations. As a result, its populations have received a number of legal designations, including as species of special concern by the U.S. BLM, the U.S. Forest Service, the states of Oregon or California, and the American Fisheries Society (Williams et. al. 1989) (Table 6). *Species of special concern* are generally defined as those taxa that "may become threatened or endangered by relatively minor disturbance to their habitat, or that require additional information to determine their status" (Williams et al. 1989).

Table 6: Summary of present legal status of Great Basin redband trout. "X" indicates designation indicated by each column heading.

Basin/	Former USFWS C-2 Species[10], Federal Register Nov. 15, 1994, Vol. 59, P. 219.	Species of Special Concern, Ca. (USDA/ USDI 1997)	Sensitive-vulnerable species[11], Oregon (Kostow 1995, USDA/USDI 1997)	Species of Special Concern[12], U.S. BLM (USDA/ USDI 1997)	Species of Special Concern, U.S. Forest Service (USDA/ USDI 1997)	1995 OR Natural Heritage Program Status	Species of Special Concern, American Fisheries Soc. (Williams et al. 1990)
Catlow	X		X	X	(No USFS land)	3	X
Fort Rock			X	X	X		*
Harney			X	X	X	3	*
Goose Lake	X	X	X	X	X	3	X
Warner Valley	X		X	X	X	3	X
Chewaucan			X	X	X		*

*Redband trout from these basins as species of special concern by the American Fisheries Society, but were included in the "Interior redband trout" group.
Natural Heritage Program abbreviations: 3=rare, uncommon, or threatened, typically with 21-100 occurrences. Harney Basin was included in the Inland/Interior redband group

VI. HISTORICAL DISTRIBUTION

Great Basin redband trout historically occupied a vast geographic area of the northern Great Basin (USDA/USDI 1997). Behnke (1992) believed that desert basin populations were in the Columbia Basin by around 32,000 years ago and became isolated from the Columbia populations during the early phase of the Tahoe glaciation. Others, however, believe that redband trout have existed in the northern Great Basin for far longer, possibly a few million years (Gerald Smith[13], Pers. Comm.).

By 15000-10,000 years ago, the series of large Columbia Basin Pleistocene lakes, which were inhabited by redbands had desiccated into the smaller waterbodies found today (Behnke 1987; See Map, Figure 4b). Since that time, the fish of each smaller basin, i.e. Catlow, Warner, etc., have remained reproductively and physically isolated from other populations. The only exceptions may be the Harney and Goose Lake Basin populations. Though some feel the Harney Basin may have been connected to other redband trout populations as recently as 4-5,000 years ago (Bisson and Bond 1971), others have

[10] *Category 2 candidate species*, were considered by USFWS to be those taxa for which "listing under the Endangered Species Act may be appropriate, but persuasive data is unavailable." (Federal Register 15 November 1994).
[11] *Sensitive species* in the state of Oregon are determined according to lists of Federal candidate species, state lists of endangered, threatened, rare, endemic, unique, or vanishing species, and other sources as appropriate in order to focus on conservation management strategies (ODFW 1993).
[12] *Species of special concern* are defined as those taxa that "may become threatened or endangered by relatively minor disturbance to their habitat, or that require additional information to determine their status" (Williams et al. 1990). Goose Lake Redband Trout are also Modoc National Forest indicator species (Sato and Williams 1996).
[13] Geologist who's work currently focuses on basins subject to this petition, Museum of Zoology, University of Michigan, Ann Arbor.

estimated the separation of Malheur Lake from the Malheur River to have occurred 15-17,000 years ago (Gerald Smith, University of Michigan, Museum of Zoology, Pers. Comm.). Only the Goose Lake population, which has spilled into the headwaters of the Pit River during historic times (Kostow 1995), may have recently migrated beyond its basin. Any migration can only have been in the direction out of the lake, since the spillway is a waterfall that is impassable for any fish that would attempt inward migration (Kostow 1995). Concerning historical population numbers, Lee et al. (1997) cited Thurow (1990) to support their statement that:

> "Historical abundance of allopatric redband trout is poorly documented. Densities in high quality habitats would be expected to be similar to those observed for other resident salmonids."

Bowers et al. (1979) stated that in Southeastern Oregon, redband **"trout were once native to most streams."**

VII. CURRENT DISTRIBUTION

Great Basin redband trout currently occur as only a fraction of their former numbers (Behnke 1987) (Figure 7). Remaining populations in isolated watersheds are fragmented and remnant, and are nearly extinct in some streams (USDA/USDI 1997, Bowers and Perkins 1996). The ICBEMP DEIS (USDA/USDI 1997) states (Chapter 2, page 150) that:

> "Resident-interior populations appear to have declined most in the Northern Great Basin and Columbia Plateau where **72 percent of their historical range is presently unoccupied."**

The same report (USDA/USDI 1997) stated that:

> "resident interior redband trout also have few remaining strong populations— **current strong populations encompass 10 percent of the historical range and 20% of their current range**".

It also emphasized that:

> "**Remaining populations appear to be severely fragmented and restricted to small blocks of known or potential habitat**."

Basin-specific information on the current range of redband trout populations is detailed in Table 5.

VIII. DOCUMENTED DECLINES IN POPULATION AND RANGE

Most redband trout populations have declined substantially compared to historic numbers (Lee et al. 1997). As discussed, they occupy only a fraction of their historic range, and results of recent surveys have indicated a continuing downward trend in redband populations. Great Basin redband are not regularly censused, and few data exist. Previously censused populations show declines in both range and population size (Table 7).

Table 7: Some declines in Great Basin redband trout population numbers, and decreases in range

Basin/DPS	Population	Previous Population Assessment	Recent Population Assessment
Catlow	Threemile Creek	1700 age 1+; Density 1.5 fish/m2 (Kunkel 1976)	265 Age 1+; Density 0.055 fish/m2, (Dambacher and Stevens 1996); i.e. severely depressed and in danger of extinction (Bowers and Perkins 1996)
	Skull Creek Basin	Present in 1990 (Howell 1997)	Severely depressed and in danger of extinction, with only a few individuals above the reservoir (Wayne Bowers, Personal Communication)
Harney	Malheur and Harney Lakes	Historically Present (Kostow 1995) Historically large numbers in Malheur Lake, and present in Malheur Lake in 1941 (Hosford and Pribyl 1983)	0 (Kostow 1995). Close to extinction—Migration from Malheur Lake into Blitzen River occurred in 1997, (USFWS Malheur Refuge Manager, Personal Communication)
Goose Lake	Streams with free access into Goose Lake	All Streams connected to lake may have once supported adfluvial redbands (Anon. Personal Communication)	In 1997, only one stream (Willow Creek) supported a successful run of adfluvial redbands, and this was the first since 1981 as well as the first fish in the lake since its population crashed to 0 in 1987. (Anon Personal Communication)

IX. THE PRESENT AND THREATENED DESTRUCTION, MODIFICATION, OR CURTAILMENT OF HABITAT AND RANGE

In order to determine endangered and threatened species,

> "The Secretary shall by regulation promulgated in accordance with subsection (b) determine whether any species is an endangered species or a threatened species because of any of the following factors…(including) the present or threatened destruction, modification, or curtailment of its habitat or range."[14]
> …

[14] Endangered Species Act of 1973 as amended through the 100th Congress. U.S.D.I. 1988, Fish and Wildlife Service, Washington D.C.

Such present and threatened destruction, modification, or curtailment of the habitat or range of population segments of Great Basin redband trout subject to this petition is a major factor responsible for their threatened and/or endangered conservation status (Dambacher and Stevens 1996, USDA 1996; Howell 1997, Lee et al 1997, Currens 1996, Behnke 1992, Kostow 1995). The causes are described as follows:

A. **Livestock Grazing**

Livestock grazing is the most widespread cause of degraded riparian habitat in the arid West (reviewed by Belsky et al. 1997). It is one of the principal factors contributing to the decline of the West's native trout (Fleichner 1994), including redbands (Roberts 1986, USDA 1996). Bowers et al. (1979) stated in a report published by the United States Forest Service that

> **"man's agricultural activities in rangelands of southeastern Oregon have altered aquatic habitats more than any other land use. And of all the agriculturally oriented activities in southeastern Oregon rangelands, livestock grazing has exerted greater influence on more aquatic habitats than any other land use."**

In the basins subject to this petition, livestock degrade redband trout habitat by trampling and overgrazing, causing erosion associated with reduced vegetation cover and destabilization of stream banks (Dambacher and Stevens 1996, USDA 1996, Kunkel 1976). The results are shallow, wide streams that are unfit for juvenile rearing or adult spawning, and water too warm for trout. Such high water temperatures have been correlated with reduced native fish abundance (Belsky et al. 1997), including desert redband trout (Li et al 1994 and Tait et al 1994 in Lee et al. 1997). While native desert trout have an ability unique among salmonids to withstand brief periods of high water temperatures (Vinson and Levesque 1994), they will only survive if they can find relief in water of cooler temperatures (Bowers et al. 1979), such as that under overhanging banks, in pools, near cold-water subsurface springs or seeps (Li et al. 1994, Tait et al. 1994), or under thick stands of streamside shrubs and trees, sometime during the day. If such habitat is not available, trout may be eliminated from a stream (Bowers et al. 1979). The presence of high water temperatures in redband streams in each basin is demonstrated by their being included on Oregon Department of Environmental Quality's most recent list of "water quality limited waterbodies" (Oregon DEQ 1994/1996; Table 10, Figure 9).

Livestock grazing in riparian zones also causes substantial amounts of erosion in the stream. Undercut banks--a favorite habitat for fish since it provides shelter from high summer temperatures and protection from predators--are lost as trampled banks crumble into the stream (Appendix A). Streamwater turbidity is increased, a significant impact since trout are visual feeders. Sedimentation is also increased, resulting in the loss of spawning beds (Belsky et al. 1997). Benthic macroinvertebrates, which are a primary food source of redband trout (Kunkel 1976), are also negatively impacted, and food availability for fish is decreased. Livestock grazing continues to cause significant negative

impacts upon Great Basin redband trout in every basin subject to this petition (eg. USDA 1996, Dambacher 1995a and b, Dambacher and Stevens 1996, Kostow 1995). These are detailed in this petition in section XVI and in Appendix A.

B. **Irrigation: Dewatering of Streams and Fragmentation of Populations**

Irrigation threatens the life cycles and reproduction of Great Basin redband trout in two ways: by (1) dewatering streams, and by (2) fragmenting populations, leading to genetic isolation.

Dewatering for irrigation: Withdrawal of water for irrigation is a widespread land use practice that fragments, degrades, and eliminates redband trout habitat in the basins subject to this petition. Lower stream flows caused by dewatering affect fish populations by decreasing pool size, increasing water temperatures, and reducing the amount of water available for maintenance of riparian vegetation, and therefore wildlife and insect, communities (USDA 1996).

Moskowitz and Rahr (1994) stated that:

> "The most serious problem for eastern and central Oregon trout populations is water diversion for agriculture and livestock. Farmers and ranchers compete for scarce water, often reducing flows to low levels or even drying streams up completely…After irrigating crops, the remaining water flows back into stream(s) and rivers, often carrying agricultural chemicals, pesticides, and animal feces, at water temperatures that at times exceed 80 degrees Fahrenheit…"

Lee et al. (1997) further detailed that:

> "Thurow (1988) reported four principal effects from water diversions: dewatering of stream reaches, loss of fish in unscreened diversions, blockage of migration corridors, and alteration of stream channels by earthmoving equipment."

The findings of USDA (1996) that mean late spring and summer flows in the Thomas Creek Watershed in the Goose Lake Basin have been reduced relative to historic levels, likely due to human activity, demonstrate that dewatering for irrigation may be exacerbating impacts that have already left redband trout stressed during the time of year when adequate stream flows are most critical to their survival. Further reduced summer flows may increase water temperatures and may disrupt stream continuity, leaving flow intermittent and trout isolated in disconnected pools. Moreover, the authors emphasized that mean early spring/summer flows have been reduced, and that even without additional dewatering for irrigation, the lower flows

> "may be having an effect on embryo survival due to dewatering of redds before alevins are able to migrate downstream to deeper water."

Additional dewatering may further reduce embryo survival. Dewatering for irrigation can act both alone, and in combination with other human activities, to negatively impact redband trout life cycles throughout the range of Great Basin redband (see Section XVI).

Population Fragmentation and Genetic Isolation: Fragmentation of stream habitats may increase the risk of extinction by reducing habitat area, complexity, and connectivity (Dunham et al. 1997, Reiman and McIntyre 1993, 1995, 1996; Reeves et al. 1995, Schlosser and Angermeier 1995). Since fragmentation simultaneously decreases the average area and connectivity of occupied habitats, the effects of reduced habitat area and isolation may act together to increase the risk of fish extinction (Dunham et al. 1997, MacArthur and Wilson 1967, Fahrig and Merriam 1994, Harrison and Taylor 1997). For example, in a study of endangered Lahontan Cutthroat Trout (*Oncorhynchus clarki henshawi)*, which occupy the same ecological niche in their streams as redband trout, only 32% of fragmented stream systems contained the fish, compared to 89% of interconnected stream basins (Dunham et al. 1997). The authors of this study found the results of this large scale analysis "to highlight the potential risk of extinction posed by habitat fragmentation and genetic isolation of local populations in aquatic habitats" (Reiman and McIntyre 1993). They emphasized that:

> "isolation of local populations may increase the risk of extinction by causing loss of population rescue by immigration and recolonization (Stacy and Taper 1992). In addition to isolation, habitat fragmentation reduces the size or area of remaining isolates (Fahrig and Merriam 1994). Reductions in habitat size may lead to loss of habitat complexity and life history variation, and reductions in population size; all of which may increase the risk of extinction (Fahrig and Merriam 1994; Reiman and McIntyre 1993, 1995, Schlosser and Angermeier 1995). Thus habitat fragmentation may increase the risk of local extinctions through isolation and/or area related effects, which may not be wholly independent (MacArthur and Wilson 1967."

These observations suggest that habitat fragmentation may increase the risk of extinction of both fluvial and adfluvial forms of Great Basin redband trout.

In the basins subject to this petition, fragmentation has resulted from dewatering of stream segments, as well as physical blockages such as dams, dikes, and weirs associated with irrigation practices and marsh channelization (Figure 7). Fragmentation can also be caused by livestock grazing degrading stream water quality beyond the tolerances of local fish. As USDA/USDI stated, these redband trout populations are already :

> "severely fragmented and restricted to small blocks of known or potential habitat",

and are thus subject to local extinction.

Such fragmentation is especially detrimental to Great Basin redbands, which depend on migration in order to survive in their variable environments (Lee et al. 1997). For

example, migratory corridors tie together seasonal tributaries in the various basins for adfluvial and fluvial forms and allow for dispersal of resident forms for recolonization of rebounding habitats (Dunham et al. 1997). Fragmentation and elimination of migratory corridors may be particularly disruptive to redband during drought, when they are forced by the disappearance of habitat to remain in streams. If such passage is blocked by dams or other habitat barriers, there is a high risk that redband trout populations will be unable to migrate out of desiccating water bodies during dry cycles, becoming subject to extinction. Habitat disruption, if severe enough, will result in the loss of adfluvial life history types and isolate resident forms from interacting with adfluvial fish.

The loss of adfluvial forms may be especially harmful to the long-term existence of the populations, since adfluvial fish are larger and the females more fecund. This lowering of fecundity lowers the overall population segments' productivity and therefore their genetic variability.

Even if Great Basin redband trout can survive the impacts described above, fragmentation of habitat described above may subject these fish to genetic bottlenecks. This is because migration is an important mechanism for maintenance of genetic variability in redband populations (Leary et al. 1992 in Lee et al. 1997). When dams or weirs prevent migration, some redbands are inevitably isolated in small blocks of habitat. The gene pools of such isolated populations are substantially smaller than those that normally contribute to redband reproduction, and genetic drift may result (Nehlsen et al. 1992). The speed at which this may impact the genetic diversity of redband trout results on the is illustrated by a current study that has found that **redband trout in habitat fragmented by dams over the last 100 years or less to have levels of genetic diversity that are significantly less than redbands in unfragmented areas, and are comparable to levels of reduced genetic diversity found in populations that have been isolated for thousands of years** (Ken Currens, Personal Communication). What this indicates is that human changes in the environment have inflicted, in only 100 years, the same reduction in genetic diversity that previously occurred over thousands of years. Populations of salmonids such as redband trout clearly can't keep up with such human alteration of their habitats. As Dunham et al (1997) stated in their discussion:

"isolation, by elimination of among-habitat migration or dispersal and recolonization, may lead to an irreversible pattern of progressive local extinctions."

Great Basin redband trout suffers from the impacts of habitat fragmentation and genetic isolation (Section XVI).

C. **Stream Channel Manipulation.**

The ICBEMP DEIS (USDA/USDI 1997) reported that:

> "There have…been extensive channel alterations associated with flood-control projects, floodplain development, and road construction within the range of the

redbands. Channel alterations adversely affect stream hydraulics, nutrient pathways, invertebrate production, and fish production."

Such channel manipulations have occurred within the range of Great Basin redband trout. For example, in Goose Lake Basin, USDA (1996) noted that channel alterations due to road construction, insertion of culverts, and narrowing of the floodplain may have increased bank erosion, increased the loss of large woody debris, lowered local water tables, reduced cover components, and, in general, affected flow characteristics in an entire watershed (included in Appendix A).

The result of such channel manipulation on redband populations has been shown to be catastrophic. For example, channel alterations in redband habitat in Idaho reduced fish densities by a factor of 8-to-10 (Lee et al 1997). Channel manipulation, especially the insertion of culverts and other adjustments associated with road construction, has been noted to be impacting Great Basin redband population (USDA 1996, Moskowitz and Rahr 1994, Kunkel 1976, ODFW 1990-1996; Appendix A).

D. **Timber Harvest:** Timber harvest that occurs in the vicinity of streams subject to this petition is a potentially serious threat to redband trout populations. Logging results in decreased shading of streams, and stream water temperatures increase as a result. It also causes destabilization of soil on slopes adjacent to redband streams, increasing erosion, turbidity, and sedimentation, and eliminating Great Basin redband spawning habitat. Moreover, soil is compacted by roads, and harvest and removal equipment, water infiltration is reduced, and overland flow is increased. At the landscape scale, these effects may alter watershed hydrology, as has been observed in the Goose Lake Basin, where a recent report suggested that relative to historic observations, flood events currently begin earlier in the spring and are more severe (greater and earlier peak flows), while summer flows have decreased (USDA 1996). Such changes can increase channel width, depth, cross sectional area, and slope, together reducing the ability of aquatic habitat to support redband trout. While logging threatens redband populations on public lands (ODFW 1990, 1991, USDA 1996), including those on the Fremont and Winema National Forests, greater threats likely exist on private lands, which are subject to less stringent regulation of cutting in riparian areas (smaller buffer zones), and inconsistent enforcement of those regulations.

Table 8: Summary of Factors Affecting Reproduction of Redband Trout in Basin subject to this petition. ("X" indicates *the presence of evidence* suggesting the factor to be negatively impacting the life cycle and reproductive potential of the distinct population segment. A lack of an "X" does not necessarily mean that a factor is not impacting a population, but rather that evidence is unavailable). The specific nature of these impacts is as described in section IX.

Basin	Livestock Grazing	Dewater-ing for irrigation	Population fragmenta-tion and genetic isolation	Channel manipula-tion	Timber harvest	Confirmed Presence of hatchery stocks or exotic fish
Catlow	**X**	**X**	**X**	**X**		
Fort Rock	**X**	**X**	**X**	**X**	**X**	**X**
Harney	**X**	**X**	**X**	**X**	**X**	**X**
Goose Lake	**X**	**X**	**X**	**X**	**X**	**X**
Warner	**X**	**X**	**X**	**X**	**X**	**X**
Chewau-can	**X**	**X**	**X**	**X**	**X**	**X**
Upper Klamath	**X**	**X**	**X**	**X**	**X**	**X**

X. OTHER NATURAL OR MANMADE FACTORS AFFECTING THE CONTINUED EXISTENCE OF GREAT BASIN REDBAND TROUT

The continued existence of Great Basin redband trout is also being threatened by "other natural or manmade factors[15]" These factors include "hybridization., introduction of exotic or translocated species, (and) competition." (Nehlsen et al. 1992)

A. Introgression and Competition With Hatchery Stocks or Exotic, Translocated Species

Fish introductions significantly affect populations of Great Basin redband trout, especially when occurring in concert with habitat degradation and extirpated adfluvial life history forms. Hatchery rainbow trout stocks have been introduced into many Great Basin streams, where they threaten redband trout by competing with them for resources and degrading habitat (Hosford and Pribyl 1983), and by introgression (Lee et al. 1997, Currens 1996) (Table 9). Introgression is a particularly dangerous threat because while native redband trout have adapted to the warm and often alkali streams and lakes of the Great Basin, hatchery stocks have not. This condition gives a competitive advantage to the native redbands, but also means that any introgression that occurs may reduce their ability to survive through stressful events such as drought and habitat degradation (Kostow 1995).

The influence of introgression has been partially ascertained by comparing certain features of old museum specimens, collected previous to any hatchery releases, with newly

[15] Ibid.; (Noted as a threat to be addressed by the Secretary in ESA listing decisions)

collected specimens. For example, redbands thought to exhibit non-native characters have fewer gill rakers, lower scale counts, and higher caecal counts than would occur in a "pure" population (Behnke 1992). Despite evidence for historical stocking in many streams within the desiccating basins, Behnke (1987) noted "surprising similarities between the present trout populations in the Oregon basins and the original native trout," indicating that most populations should be managed as the original stocks. He further suggests that the adaptation of redbands to the harsh environments of the basins has allowed them to resist introgression. Hatchery coastal rainbow trout, which are not adapted to the harsh northern Great Basin stream environments, simply did not survive long enough to reproduce to the degree required to become a significant part of the redband gene pool. This was observed to be the case in Southeastern Oregon, where Bowers and Perkins (1995) stated that:

> **"The inventory work completed in 1982-3 indicated that very few of the hatchery rainbow trout survived past July."**

The inability of hatchery fish to survive through high summer temperatures of the Great Basin environment may at least partially explain these results (Phelps et al. 1996). Phelps et al. (1996) compared the genetic composition of redband trout from the Malheur Lake Basin, the Goose Lake Basin, the upper Deschutes River, and the Crooked River with an ODFW hatchery rainbow trout strain. The estimated percent of alleles that were derived from hatchery rainbow trout was less than 6% in 19 of 28 collections. The researchers concluded that:

> "in many locations, reproductive isolation or limited reproductive success of the hatchery-origin fish may have occurred."

This evidence is important because it indicates that native Great Basin redband stocks can remain genetically pure despite historical stocking of the streams that they inhabit. Therefore, whether or not a stream has been historically stocked with hatchery fish, populations should be managed and protected as pure stocks wherever allozyme or other genetic data indicate the existence of non-introgressed redband trout,. Genetic analyses have suggested that although some streams within the basins subject to this petition may contain fish exhibiting signs of introgression (Currens 1996, Phelps et al. 1996, Kostow 1995), others continue to contain essentially pure redbands (Ken Currens, Personal Communication, Phelps 1996, Kostow 1995). The degree of introgression varies on a stream by stream, basis (Currens 1997, Phelps et al. 1996, Kostow 1995, Section XVI). Introgression effects will be diluted or will disappear over time once stock has been terminated.

Competition with other exotic translocated fish such as brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*) threatens redband trout by reducing the availability of food and space. Exotic warm water fish probably act as novel predators on young trout, especially in lake habitat. Such species may include carp and fish in the bass family, and also degrade redband trout habitat by competition, and by increasing turbidity in streams

and lakes (Hosford and Pribyl 1983). Competition with exotic and translocated species threatens redband trout in many of the basins subject to this petition (Table 9, Section XVI).

Table 9: Known presence of introgression and competition with hatchery or translocated species in basins subject to this petition.
X=Continue to be Present Threat; H=Historical Stocking Long Ceased; 0=No evidence for historical or present threat of introgression, or current impact by competition

Basin/Creek	Possible Hybridization with Hatchery-Reared Coastal Rainbow Trout	Competition	References
Catlow:			
Threemile, Home, Skull	**0**	**0**	Wayne Bowers, Personal Communication; Kostow 1995
Rock Creek	**H**	**0**	Wayne Bowers, Personal Communication; Kostow 1995
Fort Rock:			
Buck Creek	**H**	**X** (brook trout)	ODFW 1992
Bridge Creek	**0**	**0**	ODFW 1992 (no rainbow or brook trout found in surveys)
Silver Creek	**H** (Thompson Reservoir hatchery rainbow trout)	**X** (hatchery rainbow trout)	Kostow 1995
Harney:			
Silver Creek Basin	**H** (1987 Genetic Analysis found these redbands to be pure) Stocking of hatchery rainbow trout ceased in 1974)	**X** (hatchery rainbow trout)	Berg 1987; Bowers 1995, Currens 1996; Bowers and Perkins 1995)
Silvies River Basin	**H**	**X** (Numerous exotic species)	Bowers 1995, Currens 1996, Currens 1997
Rattlesnake Creek	**H**	**0**	Currens 1996
Blitzen River System	**H** (ceased in 1992), Riddle and McCoy creeks show little if any genetic influence of hatchery rainbow trout.	**X**	Kostow 1995; Hosford and Pribyl 1983; Phelps et al. 1996
Krumbo Creek	Only Hatchery Fish Remain	**---**	Currens (Personal Communication)
Goose Lake:			
Cottonwood Creek	**H/X?** (The only hatchery program in the basin is in	**X** (brook trout in upper portio n of creek)	Dambacher 1995; Anderson 1996; Kostow 1995, Phelps et

	Cottonwood meadows reservoir. 1995 sampling showed no hatchery fish to be escaping). A recent genetic study showed possible introgression		al. 1996
All Other Creeks	**0**	**0**	Dambacher 1995
Chewaucan River, Dairy Creek	**X** (Hatchery Coastal Rainbow Trout)	**X** (hatchery rainbow trout)	Kostow 1995
Foster Creek	**0**	**0**	Kostow 1995
Bear, Augur, Creeks	**0**	**X** (brook trout)	ODFW
Warner:			
Upper Honey Creek	**0**	**X** (brook trout)	Kostow 1995
Hart and Crump Lakes	**0**	**X** (carp)	Kostow 1995
Twelve and Twentymile Creeks	**0**	**X** (brook trout)	

In summary, although the presence of hatchery reared fish is a possibility, recent evidence suggests that the probability that exotic alleles remain in the gene pool of Great Basin redband is low. These hatchery fish were not adapted to the harsh Great Basin environment; since they and their offspring quickly die out, most Great Basin populations show no evidence of introgression.

XI. PREDICTED DOWNWARD TREND IN HABITAT CONDITIONS AND LINKS TO DOWNWARD TREND IN GREAT BASIN POPULATION SIZE AND RANGE.

Declining numbers of Great Basin redband trout have been clearly linked to habitat degradation. All indications suggest that the downward trend in Great Basin redband habitat will continue. Many redband streams in each of the basins are on Oregon Department of Environmental Quality's list of 303(d) Water Quality Limited Waterbodies (Oregon DEQ 1996), mainly due to high summer water temperatures (Table 10, Figure 9). These higher temperatures are primarily caused by a loss of streambank vegetation and overhead shade (Belsky et al. 1997). A 1996 watershed analysis conducted by ODFW in the Catlow Valley found most streams to be "in a severely degraded state with most indicators of habitat quality registering alarmingly low." Cover components, including undercut banks and riparian vegetation were shown to be particularly degraded, and DEQ listed these streams as "water quality limited waterbodies" for high summer temperatures (Table 10). Charlon et al. (1970) found a water temperature of 26.6 degrees Celsius to be the thermal tolerance limit for rainbow trout, and Bowers et al. (1979) suggested that temperatures should not exceed 21 degrees Celsius. Both of these threshold water

temperatures were approached or exceeded in many, if not most, redband trout streams subject to this petition (i.e. Dambacher 1995, USBLM 1996, ODFW 1990-1996).

In the Goose Lake Basin, 92-100% of streambanks were found to be actively eroding (Dambacher 1995). Though this finding does not directly indicate eroded stream length, it does indicate a degraded condition. It is widely known that the Goose Lake population was rapidly declining even before the onset of the 1992 and 1994 droughts, and it crashed in 1987. Fish in the Harney Basin are currently showing signs of increased stress resulting from habitat fragmentation and loss, and the presence of hatchery stocks and exotic fish species, leaving these populations at risk (Currens 1996).

The most recent ODFW report on the status of wild fish (Kostow 1995), which was based on habitat and fish surveys conducted as part of ODFW's Aquatic Inventory Project, professional observations made by ODFW biologists (ie. Anderson 1995, 1996, Bowers and Perkins 1995, 1996), and the recent ICBEMP analysis, Broadscale Assessment of Aquatic Species and Habitat by Lee et al. (1997) have all concluded that redband trout in the Great Basin to be severely depressed. This status was associated with human impacts on trout habitat that continue to occur (also see Anderson 1995). USDA/USDI (1997) emphasized that since these fish are considered to be particularly resilient to stress,

> **"the loss of a redband population could be a strong indication of disruption in the aquatic ecosystem processes."**

The authors found that "Resident interior redband trout appear to have declined the most in the Northern Great Basin and Columbia Plateau…"

Table 10: Redband Trout Streams of Oregon's Isolated Desert Basins Included on Oregon DEQ's list of 303(d) Water Quality Limited Waterbodies (DEQ 1994/1996)

Basin and Stream(s)	Description	Parameter causing inclusion on 303(d) list
Catlow:		
Home and Skull Creeks	Mouth to Headwaters	Temperature-Summer
Fort Rock:		
Buck, Bridge, Silver	Not on 1994/1996 list	
Goose Lake:		
Drews, Hay Creek	Drews Reservoir to Headwaters	Temperature-Summer
Thomas Creek	Mouth to Jaunta Ditch	Temperature-Summer
Thomas Creek	Jaunta Ditch to Headwaters	Biological Criteria-benthic macroinvertebrates, Temperature-Summer
Baurs, Camp, Cox, Crane, Dent, Shingle, Mill Creeks	Mouth to Headwaters	Temperature-Summer
Chewaucan:		
Chewaucan River	Mouth to Bagley Ditch	Temperature-Summer
Chewaucan River	Bagley Ditch to Headwaters	Biological Criteria-Benthic macroinvertebrates, Temperature-Summer
Bear, Dairy, Coffeepot, Crooked, Willow Creeks	Mouth to Headwaters	Temperature-Summer
Augur Creek	Mouth to North Fork	Temperature-Summer
Elder Creek	Mouth to Beaver Creek	Temperature Summer
Silver Creek	Mouth to Thompson Valley Res.	Temperature-Summer
West Fork Silver Creek	Mouth to Silver Creek Marsh	Temperature-Summer
Warner:		
Honey Creek	Mouth to Little Honey Creek	Temperature-Summer
Little Honey, Deep, Horse, Mud, North Fork Twelvemile, Twentymile, Willow Creeks	Mouth to Headwaters	Temperature-Summer
Twelvemile Creek	Mouth to Nat'l Forest Boundary	Temperature-Summer
Harney:		
(Maybe more than listed here) Rattlesnake, Riddle, Nicoll, Rough, Mud, Ankle, Deep Creeks, South Fork Blitzen River	Mouth to Headwaters	Temperature-Summer
Silver Creek	Moon Reservoir to Headwaters	Temperature-Summer
ScottyCreek	Mouth to N/S Confluence	Temperature-Summer

XII. SUMMARY OF CONSERVATION STATUS OF GREAT BASIN REDBAND TROUT

Howell (1997) cited USDA/USDI (1997) to support his statement that:

> **"The status of redbands outside of the range of the steelhead, which includes Catlow Valley and other desert basins, is particularly bleak. Redbands in 94% of those watersheds are classified as depressed."**

The adfluvial life history form, which is especially important to the long term viability of Great Basin populations because it shows higher rates of growth and reproduction, is particularly endangered (Kostow 1995, Table 11). It exists as only a trace of its former existence because connectivity between lakes, marshes, and streams has been virtually eliminated by migratory barriers associated with agriculture and marsh channelization (Kostow 1995). Although in some basins little information is available concerning the conservation status of Great Basin redband trout, ample evidence exists showing that they are being impacted by the same human activities that has been associated with the threatened and endangered status of other salmonids in headwater habitat (i.e. bull trout, *Salvelinus confluentes*) and desert basin habitat (Lahontan cutthroat trout), and other fish at lower elevations (eg. Warner and Klamath suckers, Catostomus spp.) This information is described on a stock-specific basis in section XVI.

Table 11: Summary of conservation status of Great Basin redband trout

Basin, Population	Conservation Status
Catlow:	
Threemile, Skull Creeks	Severely depressed, in danger of extinction (Bowers and Perkins 1996)
Home Creek	Depressed but stable (Bowers and Perkins 1996)
Rock Creek	Likely in a recovery stage (Anderson 1996)
Fort Rock:	
Buck, Bridge, Silver Creeks	Status unknown, but each sub-population is threatened by same impacts as other basins (Kostow 1995, ODFW 1990, 1992)
Harney:	
Malheur, Harney Lakes	Extinct (Kostow 1995)
Silver Creek Basin	Severely Depressed (Bowers and Perkins 1995; Kostow 1995)
Riddle and Kiger Creeks	Unknown but thought to be depressed; Suffer from habitat problems associated with depressed status in other basins (Kostow 1995)
Silvies River Basin	Probably depressed due to drought and poor land management activities (Bowers and Perkins1995); Suffer from habitat problems associated with depressed status in other basins (Kostow 1995)
Rattlesnake Creek	Unknown but thought to be depressed; Suffer from habitat problems associated with depressed status in other basins (Kostow 1995)
Blitzen River and Tributaries	Relatively healthy (Bowers and Perkins 1995) but suffer from habitat problems associated with depressed status in other basins (Kostow 1995)
Goose Lake:	
Thomas Creek Headwaters	Appear to be strong (Kostow 1995)
All other creeks: (Lower Thomas, Dairy, Kelly, Tandy, Cogswell, Crane, Cox, Cottonwood, Antelope, Drews, Mill, Dry Creeks and their tributaries)	Depressed (Anderson 1996)
Goose Lake	Severely depressed or Extinct (Kostow 1995)
Warner Lakes:	
Twelve/Twentymile Cks, Deep Creek below falls.	Severely depressed (Kostow 1995)
Twelve/Twentymile Creeks' Adfluvial Populations	Close to extinction (Kostow 1995)
Headwaters of Honey Creek, Deep Creek above falls (on U.S. Forest Service Land)	Appear to be strong (Moskowitz and Rahr 1994)
Hart, Crump Lakes	Severely depressed or Extinct (Kostow 1995)
Chewaucan: Chewaucan River	Strong (Kostow 1995)
All other redband streams	Severely depressed (Kostow 1995)
Adfluvial Populations	Extinct (Kostow 1995)

XIII. RISK OF EXTINCTION OF POPULATIONS

Nehlsen and others (1992), writing for the American Fisheries Society, cited the work of ecologists Michael Soule[16] and Daniel Simberloff[17] for their statement that:

[16] Population Geneticist, Environmental Studies Board, University of California at Santa Cruz

> "If the decline of a stock is unchecked, a threshold is reached at which the probability of extinction from genetic, demographic, or environmental stochasticity increases sharply. Habitat destruction…can reduce a population to a point where extinction from a stochastic event, such as drought or random variation in sex ratio, is virtually inevitable..."

This statement describes the current risk of extinction of each of the distinct population segments of Great Basin redband trout. Habitat destruction, the presence of hatchery and translocated fish, and other natural and manmade stress factors on the landscape exacerbate the impacts of drought and visa versa. As a result, 72 percent of their historical range is already unoccupied (USDA.USDI 1997), and that number may be higher since many populations barely survived the 1992 and 1994 droughts (eg. Skull Creek in the Catlow Valley). These fish are subject to naturally high levels of population fluctuation, which results from naturally high levels of environmental stochasticity, especially drought. Additional stresses resulting from habitat degradation, disruption, and loss by humans are proving to be too much for some populations of these resilient fish to handle. The overwhelming evidence of degraded habitat, which is correlated with decreased populations, has demonstrated that this is the case.

Populations subject to naturally high levels of environmental and demographic stochasticity have been found to be extremely susceptible to extinction when additionally stressed by human activity (Meffe and Carrol 1994, Pulliam and Dunning 1994). This holds especially true for small (Pulliam and Dunning 1994), and isolated populations (Lande and Barrowclough 1987) such as those which inhabit many Great Basin streams

The status of these populations constitute an extremely precarious situation. Habitats continue to be degraded, and populations are fragmented and small. Each population has been reduced to an isolated unit, with no gene flow possible, and with no possibility for natural recolonization from outside each smaller basin. There is a high probability that if the human impacts that continue to threaten these populations are not appropriately, and immediately, addressed, additional extinctions will occur.

XIV. OFFICIAL ACTIONS THAT SHOW THE SITUATION IS CRITICAL

Official actions that demonstrate the critical nature of the situation include the designation of the redbands subject to this petition as sensitive and candidate species, by state and federal agencies, and American Fisheries Society (Table 6). In addition, trout populations within individual basins have declined to such low levels that fishing restrictions, including complete bans, have been instituted in a number of the basins, listed as follows:

[17] Professor, Population Biology, Florida State University Department of Biological Science

Table 12: Restrictions on redband trout angling within basins subject to this petition

Basin	Year Fishing Ban or Restriction Instated
Catlow Basin:	
Rock Creek	ban, 1992 (Anderson 1996)
Threemile Creek	ban, 1995 (Bowers and Perkins 1996)
Goose Lake Basin:	ban, 1993 (Kostow 1995; Anderson 1996)
Harney Basin	Restrictions on a number of streams, including the Blitzen River system (Bowers 1995)
Warner, Chewaucan, Fort Rock	No current fishing restrictions known

Due to critically low and stressed populations of Great Basin redband trout, cooperative efforts aiming to restore and maintain populations of redband trout have been initiated among federal, state, and private interests in both the Goose Lake and Catlow basins. The Goose Lake Fishes Working Group, consisting of ODFW, federal agencies, local governments, and landowners, meets approximately monthly and has been attempting to develop a recovery program for wild fish in this basin (Anderson 1996). In the Catlow Valley, a second effort is currently being constructed among the various state, federal, and private stakeholders responsible for management of watersheds containing redband trout. In addition, in the Warner Valley a management plan is being constructed by the USFWS to protect the endangered Warner sucker and in the Chewaucan basin, private land owners and federal and state land managers, have met to address aquatic habitat problems.

The State of Oregon is in the process of developing Total Maximum Daily Loads (TMDL's) for non-point pollution sources in Great Basin Streams. This process is scheduled to be completed over the next four years.

XV. INADEQUACY OF EXISTING REGULATIONS

Despite emergency fishing regulations, non-Endangered Species Act designations by state and federal agencies and professional societies, cooperative working groups, state designation of streams as 303(d) Water Quality Limited, and current and planned conservation measures, threats to Great Basin redband trout remain unresolved. Implementation of federal and state laws designated to conserve fish resources or maintain water quality have been inadequate to prevent ongoing habitat degradation and habitat fragmentation that has resulted in the current endangered status of Great Basin redband trout. The reality is that the redband trout of these desert basins do not currently fall under any protective legislation, but rather only the policies of individual agencies. Substantial scientific evidence indicates that under these policies, the habitat associated with Great Basin redbands continues to deteriorate (Dambacher and Stevens 1996, Anderson 1995, 1996, Bowers and Perkins 1995, 1996, Kostow 1995). As a result, Great Basin redband trout populations continue to decline.

A historical context in which to observe the failure of existing regulations to restore, protect, and maintain redband trout populations during the last 15 years is provided by data from BLM (1982). The document is an EIS that covered livestock grazing impacts

on redband trout in southeastern Oregon, and it made certain predictions as to how the management actions it was proposing would affect redband trout habitat condition. Given recent studies and surveys detailing the continued decline of Catlow Valley Redband Trout (e.g. Dambacher and Stevens 1996, Howell 1997, Bowers and Perkins 1996), none of the more optimistic predictions made by BLM made about improving fish habitat occurred. For example, fish habitat on Home and Threemile Creeks was predicted to improve, but Bowers and Perkins (1996) recently characterized both populations as depressed, with Threemile Creek's population in danger of extinction. They were more accurate in their predictions for Skull Creek, where proposed grazing systems were predicted to result in poor conditions for fish. Fifteen years later, these fish are severely depressed and in danger of extinction (Bowers and Perkins 1996).

Federal and state agencies have discussed various conservation efforts aimed at improving riparian and fish habitat in the Catlow Valley, Goose Lake Basin, Warner Valley, and Chewaucan Basin. While the petitioners encourage action to alleviate the threats to redband trout detailed in this petition, a number of courts have recently held that future conservation efforts, particularly those proposed by federal agencies, cannot serve as a basis for denying ESA protections to species that meet the Act's biological listing criteria. Moreover, past experience in the Great Basin – such as the BLM EIS discussed above – demonstrate that plans to improve habitat for desert fishes have fallen far short of their expected results. If future conservation initiatives succeed in securing redband trout and their habitat, the ESA provides mechanisms to remove this species from listed status.

Once such protection is enacted and changes in land-use and management are made, scientific evidence (see Fig. 8) suggests that rapid improvements in redband habitat will occur. Such improvements have already been demonstrated. Redband trout production in five Great Basin study areas increased by an average of 184% when grazing was reduced or eliminated (Bowers et al. 1979).

XVI. GREAT BASIN REDBAND TROUT: SPECIFIC STOCK INFORMATION

A. CATLOW VALLEY

Stock Definition and Origin: The genetic analysis by Currens (1997) found that:

> "more than any other group, Catlow Valley redband trout populations appeared decoupled from any major river system."

Its unique morphological and genetic characteristics are detailed in Tables 2-4 and in Figure 5.

Conservation Status: The Catlow Valley population segment, which is composed of four populations, is threatened by a combination of livestock grazing, and stream dewatering and fragmentation. The population in Skull Creek is severely depressed and

close to extinction (Jeff Dambacher[18], Personal Communication). The population in Threemile Creek is also "severely depressed and in danger of extinction" (Bowers and Perkins 1996). Both populations are likely undergoing severe genetic bottlenecks, and it may be that the next time their populations are stressed by adverse conditions, their lack of genetic diversity will prevent them from rebounding. The population in Home Creek is "depressed but stable" (Bowers and Perkins 1996). The only recent population estimate of Catlow streams is for Threemile Creek (Dambacher and Stevens (1996), and its numbers were found to have declined significantly relative to those previously counted by Kunkel (1976; Table 7).

Dambacher and Stevens (1996) reported that "the streams of the Catlow Valley Basin appear to be in a severely degraded state, with most indicators of habitat quality (see Appendix A) "registering alarmingly low". Only 10% of the streams surveyed had pool depths that registered "high" (quality), and over half registered "low." Seventy-eight percent of the total surveyed stream length had a "low" rating for shade, 80% of reaches had low gravel quality, and over 90% of reaches in Home Creek showed actively eroding banks. This degraded state was also noted by USBLM (1995).

In 1991, ODFW (1991) reported that

> "grazing pressure in the riparian area [of Rock Creek] prior to 1990 has resulted in high proportions of units with actively eroding banks. Shading is also poor in the riparian area along all but one reach. As a result, water temperatures are high, ranging from optimum to lethal levels for trout."

Anderson (1995) had previously found this population to be "severely depressed due to

But since 1991, when livestock were excluded from Rock Creek (due to a new management plan on the FWS Hart Mountain Antelope Refuge)**, redband habitat has continually improved** (Anderson 1996). An excellent rainfall year in 1995 also helped recovery (Anderson 1995). This recovery is encouraging because it indicates the speed of recovery that is possible given a combination of elimination of livestock grazing and increased rainfall.

The recovery of the Rock Creek population and protection of its habitat from livestock grazing does not mean that Catlow Valley redband trout is adequately protected. Due to its geographic isolation from the creeks flowing off of Steens Mountain, the fish of Rock Creek may constitute their own gene conservation group (Kostow 1995). Therefore, the recovery of the Rock Creek population does not necessarily mean that the redband streams on Catlow Rim are safe from extinction. In general, the same factors that have been demonstrated to increase the risk of extinction faced by other desert basin trout populations (Dunham et al. 1997) are affecting the conservation status of Catlow Valley redband trout

[18] Oregon Department of Fish and Wildlife, Corvallis

Factors Affecting Reproduction

*Livestock Grazing***:** Howell (1997), citing a 1990 trout survey in Skull Creek in the Catlow Valley, stated that:

> "the creek's riparian area had been heavily grazed by livestock, as evidenced by bare, trampled, eroding stream banks, large amounts of fine sediment, and a wide, shallow channel."

No redbands were found in this degraded habitat. The author attributed the fish's absence to livestock impacts. Riparian areas were in especially poor condition below the dam, (Phil Howell[19], Personal Communication). Similar conditions exist on the upper section of Home Creek (Howell 1997), and have existed in the creek's lower portion (Kunkel 1976). ODFW (1995) reported that on Home Creek Tributary A, landuse was "heavy grazing" and up to 80.3 percent of the length of stream reaches had habitat units with active bank cutting and soil loss, availability of pool habitat was "poor", and field researchers commented that in reach 3, "several cows were noted grazing in the riparian area." They indicated that the water in the reach was noticeably murkier than it had been downstream. On Home Creek, the researchers noted that landuse was often "heavy grazing". Many reaches showed over 90% actively eroding banks, and

> "sightings (of redbands) were frequent up until unit 687, where an old corral was identified and cattle were present. The crew described the habitat as poor from this area on to an area known as Smith Flats and did not see significant numbers of fish until the Smith Flats area in Reach 10."

Bowers and Perkins (1996) noted that riparian areas of Skull, Threemile, and Home Creek continue to be in poor condition. As a result, summer water temperatures have consistently exceeded DEQ maximum standards (Fig. 8). They have frequently approached or exceeded the lethal temperature for rainbow trout of 26.6 degrees Celsius (Charlon et al. 1970; Appendix A), and the temperature of 21 degrees Celsius that should not be exceeded to maintain native desert trout (Bowers et al. 1979).

[19] Fishery biologist, Umatilla National Forest, Or.

Table 13: Maximum Summer Water Temperatures in Catlow Valley Streams (USBLM 1995, 1996)
Boldfaced temperatures exceed thermal tolerance limit for rainbow trout of 26.6 degrees Celsius..

Stream	Maximum Summer Water Temperature (Degrees Celsius)	Date
Lower Skull	**33.29**	8/16/86 (approximately 300 readings at or above 26.6 degrees)
Mid Skull	**28.75**	7/23/96 (102 readings at or above 26.6 degrees)
Lower Home	22.59	8/4/95
Mid Home	**30.36**	7/25/96
Upper Home	**26.23S**	7/12/96
Threemile (above diversion)	24.32	8/10/96

Dewatering for irrigation: An unscreened diversion was noted at unit one of Threemile Creek (ODFW 1995). The Threemile Reservoir population, which has collapsed to zero fish (Dambacher and Stevens 1996) is an artificial population, but has the components of a larger adfluvial population. It is a microcosm for the way that dewatering and fragmentation of stream habitat is affecting the conservation status of adfluvial populations in the natural lakes of other basins subject to this petition—the collapse of the Threemile Reservoir population following alteration of the irrigation schedule demonstrates how connectivity is critical to restoring and maintaining adfluvial populations.

Habitat fragmentation and genetic isolation: the dam that creates Skull Creek Reservoir prevents migration to and from spawning habitat in Skull Creek.

Channel Manipulation: In a survey at the mouth of Home Creek, Kunkel (1976) found that where the stream had been channelized, and the streambanks had been subjected to heavy livestock grazing, cover was sparse and the area was virtually devoid of trout. The researcher further noted that:

> "Wilmot (1973) mentioned that trout were plentiful in the pool below the bridge (that crosses Threemile Creek). At that time road improvement was being conducted in the form of widening and filling the existing road, and a culvert was placed in the stream. During the present study, no chubs were captured in that area, and of the few trout observed, most were migrants from the reservoir. The same road crosses Home Creek."

Introgression and Competition With Exotic Hatchery Stocks or Translocated Species: There is no evidence that Home, Threemile, or Skull Creeks, or Threemile Reservoir, has ever been stocked with hatchery fish. Hubbs and Miller (1948) claimed that the redband trout in the Catlow Valley was introduced by ranchers. However, the genetic analysis by Currens (1997):

> "suggested that these trout were indigenous redband trout."

The isolated population in Rock Creek has a definite history of hatchery releases, though no fish have been released since at least the 1950's (Wayne Bowers[20], Personal Communication).

Inadequacy of Existing Regulations: Catlow Valley redband trout currently are in an extremely precarious situation, i.e. in danger of extinction. The policies of state and federal agencies have continued to result in severely depressed populations and degraded habitat conditions. The steps by ODFW, BLM, USFWS, and Roaring Springs Ranch towards constructing a Conservation Agreement aimed at protecting the redband trout populations are encouraging. However, such a Conservation Agreement in itself does not provide the same assurances that would be guaranteed by ESA protection, i.e. that adequate measures will be taken in time to prevent the extinction of Catlow Valley redband trout. In addition, they provide limited opportunity for public involvement in drafting and implementing the agreements. Conservation agreements in general do not afford the assurance of legal protection that a species will not go extinct, since they are non-binding. Each population is now isolated and small, and natural recolonization would not be possible should redbands in one or more of the streams be subjected to a random or stressful disturbance or climatic event. Listing of Great Basin redband trout is clearly necessary to protect the Catlow Valley populations.

B. FORT ROCK (SILVER LAKE) BASIN

Stock Definition and Origin: Allozyme data collected from several populations in the basin have demonstrated the unique genetic character of Fort Rock Basin redband trout (Currens 1997; Tables 2-4, Figure 5). Morphologically, these fish display distinct characteristics as well (Table 1). The outstanding feature of four specimens from the Fort Rock Basin described by Behnke (1992) was the presence of basibranchial teeth. Specimens in Buck and Bridge Creeks showed almost no morphological difference from those taken in 1904, indicating minimal, if any, genetic influence of hatchery fish on the morphology of these redbands (Behnke 1992). The morphological and genetic data are sufficient to justify inclusion of Fort Rock Basin redband trout as a part of a Great Basin redband trout distinct population segment qualifying for protection under the Endangered Species Act.

Conservation Status: Kostow (1995) stated that:

> "Little information is available on the abundance or life histories of these populations. Limited sampling in about a mile each in lower Buck and Bridge creeks in 1993 captured 30 to 35 fish of all age classes."

ODFW surveys of Buck and Bridge Creek populations indicated that they are suffering from the same impacts associated with the depressed status of other basins' populations (ODFW 1990, 1992). An ODFW survey of Bridge Creek in 1990 counted a total 47 "rainbow" (likely redband) trout of length greater than 6 cm at 8 survey points, with 2

[20] SE Region Fishery biologist, ODFW, Burns, Or.

sites being devoid of trout. On Buck Creek, a 1990 ODFW survey counted only 15 "rainbow" (likely redband) trout greater than 6 cm at 9 sites. No redbands were found at three of the sites. A 1991 ODFW survey of the same creek counted 94 total "rainbow" (likely redband) trout among three sites. Factors affecting the conservation status of Fort Rock Basin redband trout have been demonstrated to increase the risk of extinction faced by other desert basin trout populations (Dunham et al. 1997).

Factors Affecting Reproduction

Livestock grazing: Kunkel (1976) noted that along Buck Creek, heavy grazing had resulted in "trampled stream banks, lack of streamside cover, and smooth channels." Such areas were found to support few, if any, trout. Livestock impacts on private lands continue to be a main threat to redband populations (Moskowitz and Rahr 1994). ODFW's 1990 habitat inventory of Buck Creek noted some areas to be "heavily tromped/grazed," and the 1992 ODFW habitat inventory of Bridge Creek noted the occurrence of grazing within the surveyed area.

Dewatering for irrigation: Water withdrawals and unscreened diversions on private lands are considered a main threat to these populations (Moskowitz and Rahr 1994). The section of Silver Creek below the reservoir is "dewatered annually to satisfy downstream irrigation demands"(Kostow 1995). Therefore, any redds remaining in spawning beds in that section of Silver Creek probably dry up, and, in such a case, overall reproduction would be decreased. A wooden irrigation headgate was also noted along Buck Creek by ODFW (1990).

Fragmentation and genetic isolation: ODFW (Kostow 1995) stated that:

> "Paulina Marsh is much smaller than its historical range and has been broken into small, discontinuous fragments near the outlets of tributary streams by extensive draining and channelization has occurred over much of the original marsh."

Moskowitz and Rahr (1994) further found that:

> "Unscreened diversions on private land prevent upstream and downstream fish

ODFW's 1990 survey of Buck Creek noted the presence of a number of manmade dams, and of a wooden irrigation headgate, all of which reduced the ability of redband trout to migrate.

Channel Manipulation: Substantial channel manipulation, including the presence of culverts associated with road construction, is present in at least in Bridge (ODFW 1992) and Buck (ODFW 1990) Creeks (Appendix A).

Timber Harvest: Logging in forested riparian areas of the Fremont National Forest or on private lands threatens the reproduction and life cycles of Fort Rock redband trout. The Canyon Timber Sale, for example, was indicated by ODFW (1992) to be threatening redband habitat in all reaches of Bridge Creek in the Fremont National Forest. The timber sale was subsequently withdrawn.

Introgression and Competition With Exotic Hatchery Stocks or Translocated Species: Introgression is not considered to have altered Fort Rock populations, with the possible exception of Silver Creek. The genetic data of Currens (1997) from fish taken from headwaters of Buck and Bridge Creeks show the persistence of this basin's original redband stocks. Buck and Bridge Creek do not currently contain hatchery populations (Kostow 1995). Hatchery-reared coastal rainbow trout are suspected to have escaped from Thompson Reservoir and may have interbred with redbands if they existed in Silver Creek below the reservoir (Kostow 1995). Brook trout that were captured in Buck Creek by Kunkel (1976) and ODFW in 1990 and 1991, and may compete with redbands. No brook trout were found in Bridge Creek in ODFW's 1992 fish survey.

Inadequacy of Existing Regulatory Mechanisms: The fact that relatively little is known about the status of this distinct population segment indicates a failure of state and federal agencies to monitor it. Given significant human impacts that have been described to be threatening Fort Rock Basin redband trout habitat, these salmonids could go extinct without anybody knowing. Each sub-population is now isolated and small, and natural recolonization would not be possible should redbands of one or more of the streams be subjected to a random or stressful disturbance or climatic event. Listing of Great Basin redband trout is clearly necessary to protect these unique fish.

C. GOOSE LAKE BASIN

Stock Definition and Origin: Berg (1987) suggested sufficient genetic distinctness to exist to justify subspecies designation (Williams et al. 1989). Kostow (1995) also suggested that this group is "very unique in terms of allozyme variation," and such was confirmed by the genetic analysis of Currens (1997; Tables 2-4, Figure 5). Phelps et al. (1996) similarly found samples of Goose Lake Redband Trout taken from Cottonwood Creek to differ substantially from other redband trout. Morphologically, Goose Lake specimens have, on average, higher numbers of gill rakers than those from other Oregon basins, with the exception of the Warner Valley (Behnke 1992), and some fish in Thomas and Davis creek had basibranchial teeth (Behnke 1992).

Conservation Status: ODFW (Kostow 1995) stated that:

> "While spawning occurred in the headwaters of Thomas Creek during the 1992 drought, populations of the remaining creeks of the Goose Lake Basin are currently severely depressed, and some may have gone extinct."

A total of 768 redband trout were found in 12 of 13 streams recently sampled by

ODFW (Dambacher 1995a). No fish were found in Dog Creek. Fish were widely distributed throughout the upper portions of the basin, but generally absent in the lower portion (Dambacher 1995a), which is most strongly impacted by livestock grazing and irrigation practices. While populations are expected to recover somewhat following two good water years (Anderson 1996), Moskowitz and Rahr (1994) pointed out that:

> "only three creeks of the ten which historically flowed into Goose Lake continue to provide habitat for adfluvial redband trout."

The situation may be far worse, since while every stream connected to the lake (far more than 10) is thought to have once supported an adfluvial population that successfully migrated to and from it, in spring 1997, redband migrated into only one Oregon stream, Willow Creek. This is the first such migration since 1981. The last strong run into Oregon streams was in 1978 and there were none between 1982 and 1995 (Anderson 1995), despite better than average water years from 1978-1986. In the Thomas Creek watershed, a serious lack of rearing habitat, including pools, large woody debris, undercut banks, and shade was found to be limiting redband trout populations (see Appendix A); excessively high water temperatures were recorded in all order 3 and 4 perennial streams; and the macroinvertebrates populations, which serve as a primary food source for redband trout, were found to be declining (USDA 1996). Factors known to increase the risk of extinction faced by other desert basin trout populations (Dunham et al. 1997), are affecting the conservation status of Goose Lake redband trout.

Factors Affecting Reproduction

Livestock Grazing: Livestock are having a current negative impact on Goose Lake redband populations (USDA 1996, Dambacher 1995a, Appendix A). In recent stream surveys, 90-100 percent of reach lengths had habitat units with active bank cutting and soil loss (Appendix A). Cover values and pool availability also registered very low in these surveys (Appendix A). Water temperatures have been measured close to and above the thermal tolerance limit for rainbow trout (USDA 1996).

Dewatering for irrigation: Oregon Department of Fish and Wildlife (Kostow 1995) stated that:

> "much of [Goose Lake] water resources are overappropriated."

Dewatered stream segments are left with insufficient amounts of water to support trout. As a result, mortality is increased, and reproduction, including the ability to migrate to and from Goose Lake and spawning areas, is decreased.

Fragmentation and genetic isolation: Adfluvial redband trout find refuge in tributaries when the lake dries, and recolonize when the lake fills (Lee et al 1997). However, ODFW (Anderson 1995) reported that:

"unscreened diversions associated with irrigation have made recolonization

Dambacher (1995) stated that "a critical element that must be considered is the connectivity of headwater habitats to Goose Lake. Drews Creek is isolated from Goose Lake by the Drews Reservoir dam." The researcher suggested that "the upstream and downstream migration of fishes throughout the lower valley may be the most critical factor facing recovery efforts for lake populations, and should perhaps be addressed as the highest priority for restoration." This would include restoring the connectivity of lower Thomas Creek , which could be altered to provide better passage to and from Goose Lake, and would also benefit the Crane Creek population.

Timber Harvest: Timber harvest within the Fremont National Forest and on private forested lands threatens redband populations (ODFW 1995). Hydrological evidence indicates that past logging within the Thomas Creek watershed has resulted in larger and earlier spring flows, and lower summer flows than occurred historically (USDA 1996). It is also causing substantial erosion (USDA 1996, Appendix A)

Introgression and Competition With Exotic Hatchery Stocks or Translocated Species: The genetic analysis conducted by Berg (1987) found resident redband trout in Lassen, Willow, and Thomas Creek systems to have retained their genetic integrity in spite of past planting of hatchery rainbow trout in these systems. There is only one current trout hatchery program in this basin—a coastal rainbow trout program in Cottonwood Meadows Reservoir. Anderson (1996) reported that 1995 sampling showed no hatchery fish to be escaping into Cottonwood Creek. However, Phelps et al. (1996) found 33.8 percent of alleles in a sample redband from this system to reflect the contribution of a hatchery strain. The authors questioned the accuracy of this measurement because of historical connections to the Sacramento River in California. Introgression may threaten redband trout in this stream in the future. Brook trout were recently found only in the upper portion of Cottonwood Creek (Dambacher 1995). They may impact native trout through competition. Brown trout (*Salmo truta*), also present in the basin, may competitively impact redbands, but not in Oregon streams (Dambacher 1995).

Inadequacy of Existing Regulatory Mechanisms: As of 1997, the conservation strategy plan produced by the Goose Lake working group has been criticized by the U.S. Fish and Wildlife Service as possibly not acceptable (Anderson 1996). ODFW (Anderson 1996) stated that:

> **"to date, cooperative efforts with Oregon private landowners in the Goose Lake Basin to solve major fish passage and screening issues has been disappointing."**

As a result, it appears unlikely that the habitat problems associated with the depressed status of Goose Lake redband trout will be adequately addressed in the near future.

D. WARNER LAKES BASIN

Stock Definition and Origin: Coombs et al. (1979) reported "closure of the basin approximately 120,000 years ago," resulting in the evolution of unique redband trout in the Warner Valley. Allozyme data from Currens (1997) (Tables 2-4 , Figure 5) support this conclusion in his findings that these redbands are unique in their genetic characteristics, and Williams et al (1989) of the American Fisheries Society classified them as a distinct subspecies. They are also morphologically unique (Table 1) as samples collected in 1904 contained the highest average number of gill rakers of any of the desert basin redbands.

Conservation Status: Kostow (1995), summarizing information provided by ODFW field personnel who work closely with Warner Valley redband trout, stated that:

> "Populations in Twentymile and Twelvemile creeks are thought to be very low," and "adfluvial populations in this system are close to extinction."

Moskowitz and Rahr (1994) also noted the depressed status of Twelve and Twentymile Creeks. Eighteen total days of sampling of Hart and Crump Lakes and other lowland aquatic habitat by Oregon Natural Heritage Program (ONHP) produced only ten redband trout out of a total of 6,534 fish (Anderson 1996, Appendix A). The previous year, only one redband trout out of a total of 3,628 fish was found in surveys of the Warner Lakes by ONHP between July 12 and August 14 (Anderson 1995, Appendix A). Recolonization of the lakes by trout currently inhabiting surrounding streams is extremely difficult due to habitat barriers associated with irrigation (Kostow 1995). The populations in the headwaters of the Deep and Honey Creek basins appear to be healthy (Moskowitz and Rahr 1994). A 1990 ODFW survey in the Deep Creek Basin found 92 redbands in Dismal Creek, 40 in Mosquito Creek, 48 in Deep Creek. In addition, 64 were counted in Mud Creek and 63 in Willow Creek. Reproduction occurred in headwater areas of Deep and Honey creeks even during the 1992 drought (Kostow 1995). Alarmingly, two days of sampling by ODFW in Deep Creek in 1995 produced only one trout (Anderson 1996). The exact location was not noted.

Factors Affecting Reproduction

Livestock Grazing: Moskowitz and Rahr (1994) stated that in the Warner Valley,

> "Redband populations on private lands are severely depressed because of habitat loss due to overgrazing."

ODFW (1990) conducted habitat and fish surveys in Dismal, Deep, Mosquito, and Willow Creeks, and reported livestock grazing to be a land use along at least some reaches of each creek.

Dewatering for irrigation: Irrigation diversions in the Warner Valley dewater streams; drought conditions exacerbate this human caused impact (Moskowitz and Rahr 1994). Coombs et al. (1979) detailed that

> "longtime residents of Warner Valley recall that in the 1930's, prior to extensive use of irrigation water, suckers were very abundant and would ascend the creeks in the spring in great numbers."

While this report by Coombs et al. detailed impacts of irrigation on suckers rather than redband, it is important because redband must migrate up creeks, and therefore have likely been impacted as well. Impacts upon redbands, including those caused by unscreened diversions, were indicated by Anderson (1995) to remain unresolved, with "ranchers remain(ing) cautious relative to encouraging more fish screens on Honey Creek."

Fragmentation and genetic isolation: Most streams are blocked by irrigation diversion structures that dewater streams immediately above the lakes and cause physical blockages that make recolonization of the lakes unlikely (Kostow 1995). Access to spawning habitat is also blocked (Moskowitz and Rahr 1994).

Channel Manipulation: Channel manipulations, especially the addition of culverts where redband streams intersect with roads (see Appendix A) is impacting redband trout habitat on Mosquito (ODFW 1990) Creek and likely other streams as well.

Timber Harvest: Moskowitz and Rahr (1994) stated that in the Warner Valley,

> "Logging on headwater areas has reduced riparian area diversity and limited future sources of large woody debris for instream structure and complexity."

The 1990 ODFW habitat surveys reported timber harvest in a number of stream reaches in the Warner Basin.

Introgression and Competition With Exotic Stocks or Translocated Species: Hatchery programs are restricted to reservoirs that do not have native trout (Kostow 1995). Exotic warm water species occupy the Warner Lakes and likely compete with adfluvial redbands, but don't hybridize with them. Brook Trout are present in upper Honey Creek and may impact that redband population through competition (Kostow 1995, Moskowitz and Rahr 1994).

Inadequacy of existing regulatory mechanisms: The fact that little is known about the status of these populations indicates a failure of state and federal agencies to monitor them. Given the significant human impacts that threaten their habitat, Warner Valley redband trout could go extinct without anybody knowing.

The USFWS recovery plan for the Warner sucker, if it is ever adapted, will likely benefit some redband populations. However, sucker and redband habitats do not sufficiently

overlap to the extent required for this plan to ensure protection of Warner Valley redband trout. Each population is now isolated and small, and natural recolonization would not be possible should redbands of one or more of the streams be subjected to a random or stressful disturbance or climatic event. Listing is clearly necessary to protect these unique redband trout.

E. CHEWAUCAN (LAKE ABERT/SUMMER LAKE) BASIN

Stock Definition and Origin: Behnke (1992) reported that:

> "Redband trout of the Chewaucan Basin predominantly retain the native genotype, and should be considered representatives of the native trout of the basin"

The trout in Elder and Dairy creeks were observed to be "typical of native redband trout in coloration, spotting, and par markings" (Behnke 1992). The single population isolated in upper Foster Creek in a hanging valley on Winter Rim above Summer Lake has never been subject to stocking, and is considered to be genetically pure (Kostow 1995). These fish contain unique morphological (Table 1) and genetic (Tables 2-4, Figure 5) characteristics.

Conservation Status: Kostow (1995) (after an interview with local biologists) reported the observations of ODFW field personnel who work closely with Chewaucan Basin redband trout that:

> "The Chewaucan River population or populations is the most robust in the group and survived through the 1992 drought. All other populations are seriously depressed."

ODFW (Kostow 1995) also reported that:

> "no adfluvial populations remain in the system"

These populations apparently migrated only into Chewaucan marsh, which is essentially no longer in existence due to extensive channelization, draining, and water diversion (Kostow 1995). Migratory barriers associated with these alterations have eliminated connectivity between the marsh and the streams that once emptied into it, though given the opportunity, adfluvial redbands would likely return. The population in Foster Creek, which has never been stocked with hatchery fish, has never been monitored (Kostow 1995). Of nine tributaries surveyed by electro-fishing by ODFW in 1992, only five were thought to be above the legal limit (Oregon Wild Fish Management Policy OAR-635-7-525 through 529) of 300 adults for compliance with the Oregon Wild Fish Management Policy (Moskowitz and Rahr 1994). Surveys of Crooked Creek by ODFW in 1991 reflected poor habitat conditions, including heavy irrigation and livestock grazing. In this stream, ODFW fish presence/absence surveys in 1992 observed a total of 53 redbands among 15 sites, with 36 concentrated at one site and 9 sites where no redbands were

Cover values and bank stability were also found to be poor along Crooked Creek (Appendix E), where ODFW fish surveys reported stream temperatures up to 26 degrees Celsius, essentially the thermal tolerance limit for rainbow trout (26.6 degrees Celsius; Charlon et al. 1970). The 1991 habitat survey of this stream by ODFW reported heavy cattle grazing in all 3 reaches. The report found each reach to have over 98% actively eroding banks and high percentages of silt substrates (up to 61%). It stated that:

> "The riparian, bank, and wood summary indicates sparse vegetation, heavy bank

Such impacts have been associated with reduced native salmonid abundance in general (Dambacher and Stevens 1996, USDA/USDI 1997). These reductions in cover components likely contribute to the inclusion of most streams that contain redband trout in the Lake Abert Basin on Oregon DEQ's list of Water Quality Limited Waterbodies (Table 10).

Dewatering for irrigation: Due to irrigation diversions and channelization, all streams terminate before they reach Chewaucan Marsh, thus eliminating the ability of adfluvial fish to migrate (Kostow 1995). ODFW (1992) reported that Crooked Creek "has a large number of unscreened diversions and irrigation canals."

Fragmentation and genetic isolation: ODFW (Kostow 1995) reports that Chewaucan Marsh has been fragmented by extensive channelization, draining of marshlands, and water diversions. As a result, all streams currently terminate before they reach the marsh,

rendering them reproductively isolated and eliminating the possibility of recolonization of populations that become locally extinct. ODFW (1992) reported the presence of extensive irrigation diversions and canals along Crooked Creek.

Channel Manipulation: Numerous roads and associated culverts fragment redband habitat in at least Augur and Bear Creeks (Appendix A). The marsh has been extensively channelized, reducing redband trout habitat.

Timber Harvest: Logging operations potentially threaten populations in the Fremont National Forest and on private lands within the basin.

Introgression and Competition With Exotic Hatchery Stocks or Translocated Species: No hatchery fish have ever been planted in the single population of redbands that exists in Foster Creek in the Summer Lake Basin (Kostow 1995). In the Lake Abert Basin, two streams that contain redbands—the Mainstem Chewaucan and Dairy Creek--have been stocked, **and are continuing to be stocked**, with domesticated coastal rainbow trout (Kostow 1995). Competition and introgression with these hatchery rainbow, and also brook trout, may threaten Chewaucan Basin redbands (Moskowitz and Rahr 1994). Brook trout are present in Crooked Creek (ODFW 1992) and may be in other streams (not found in 1992 ODFW survey of Bear Creek). They may compete with redband.

Inadequacy of existing regulatory mechanisms: The policies of state and federal agencies have continued to result in depressed populations and degraded habitat conditions. The fact that relatively little is known about the status of these populations indicates a failure of state and federal agencies to monitor them. Given the significant human impacts that have been described to be threatening their habitat, and the depressed status of the fish populations in most of the streams, Chewaucan Basin redband trout could go extinct without anybody knowing. Each population is now isolated and small, and natural recolonization would not be possible should redbands of one or more of the streams be subjected to a random or stressful disturbance or climatic event.

F. HARNEY BASIN

Stock Definition and Status: Behnke (1992) detailed that specimens from the Harney Basin

> "retain the predominant redband appearance, with tints of yellow and orange and

Bowers and Perkins (1995) stated that:

> "Scale analysis has shown that the life history of the redband population in the Silvies River Basin varies from the life history of other known populations of redbands."

Populations appearing genetically pure despite possible stocking with hatchery fish in the past include the Silvies River system (Currens 1997, Kostow 1995) and Silver Creek (Berg 1987, Kostow 1995). The populations of Riddle and Kiger Creeks appear to be unique as well (Kostow 1995), and populations in the Donner and Blitzen Basin also show unique genetic characters (Kostow 1995). Phelps et al (1996) found the percent of alleles that were derived from hatchery rainbow trout to be only 0.6% in McCoy Creek, and 4.9% in Kiger Creek, **both variables being lower percentages than two streams** (Fox Canyon and Howard Creeks outside this basin) **that are considered to have never been stocked.** All of these creeks contain Harney Basin redband trout that are unique in their morphological and genetic characteristics (Tables 1-4, Fig. 5) and exist in a basin that has been geographically isolated for up to 15-17,000 years (Gerald Smith, Pers. Comm.).

Conservation Status: ODFW (Kostow 1995) reported the Silver Creek group to be currently:

> "severely depressed as a result of ongoing habitat problems."

Bowers and Perkins (1995) stated that

> "The population of trout (in Silver Creek) is severely depressed because of the drought, roading, logging, overgrazing, and the 1990 fires."

They added that "the density of redband trout found in Silver Creek was lower than densities of trout found in other southeastern Oregon streams, due to "poor riparian habitat conditions." Populations in the Donner and Blitzen River Basin, Riddle and Kiger Creeks, and the Silvies River were thought by Kostow (1995) to be:

> "depressed due to the combined effects of habitat problems, including cattle grazing, water withdrawals and passage barriers, and the 1992 and 1994 droughts."

Howell (1997) noted that:

> "While the Blitzen River once supported an adfluvial population that migrated to and from Malheur Lake, that life history form has declined to a handful of fish."

USFWS managers of the Malheur Refuge confirmed in Spring 1997 (Personal Communication) that this life history is still expressed, and needs to be further protected and enhanced. Such measures are required to maintain the biological and genetic diversity of redband trout in the Harney Basin. Bowers (1997, Personal Communication) said that populations in the Blitzen River system seem to be recovering following the end of drought conditions, as well as the removal of livestock from all but about 30 percent of riparian areas in the watershed. He stated that while riparian areas along the South Fork of the Blitzen River are currently protected from livestock as a result of a recent Federal Court injunction, habitat conditions still need to improve. The court injunction, moreover,

is not permanent protection, and BLM may seek to return livestock to the South Fork if conditions of the court injunction are met, or if the lower court's decision is overturned or appeal.

The conservation status of redband trout was also expressed by Currens (1996), who wrote that this "heart of redband country" currently has "a dangerously irregular beat." He urged land managers to "consider these genetic analyses to be vital signs to the health of this system." "Ignoring these vital signs and the magnitude of their demographic and ecological implications," he warned, "will inevitably make management of these populations more difficult, if not impossible, in the future."

Factors Affecting Reproduction

Livestock grazing: Bowers and Perkins (1995) blamed low densities of trout in Silver Creek on low summer stream flows and poor riparian habitat conditions. Others noting livestock impacts on the habitat of Harney Basin redbands include Moskowitz and Rahr (1994). Bowers and Perkins (1995) stated that

> "the riparian areas on the South Fork Blitzen River and tribs are still being blitzed

Bowers (1997, personal communication) stated that degradation of riparian habitat by livestock along the South Fork of the Blitzen River had been a sore spot, but that livestock have been removed following a recent court injunction.

Dewatering for irrigation: Irrigation is having a negative impact on redband populations (Moskowitz and Rahr 1994).

Fragmentation and Genetic isolation: The ability of redband trout to migrate between Harney and Malheur Lakes and among surrounding streams is severely limited due to irrigation diversions, channelization, draining of marshlands, and high streamwater alkalinities (Kostow 1995, Moskowitz and Rahr 1994). Bowers and Perkins (1995) stated that the fish screens on Malheur Refuge are not being maintained or operated properly, and that the fish ladder at Page Springs Dam needs to be rebuilt to improve fish passage. Loss of habitat in this basin from irrigation and livestock grazing has significantly restricted redbands to a fraction of their historic range, causing reductions in their population sizes and increasing the opportunity for random genetic drift (Currens 1996). Allele frequencies reported in a recent genetic analysis (Currens 1996) suggested that the potentially catastrophic effects of genetic drift exist in many sub-basins. The habitat fragmentation and genetic isolation currently present in the Harney Basin is increasing the risk of extinction of these unique redband trout.

Channel Manipulation: Kunkel (1976) observed that insertion of a culvert associated with construction of a road that crosses Rattlesnake Creek resulted in fewer trout in that stream segment. Channel manipulation is likely impacting redband trout life cycles in

other Harney Basin streams as well, especially where streams have been fragmented by culverts associated with road construction.

Timber harvest: Populations in the Harney Basin have been and continue to be threatened by timber harvest (Kunkel 1976, Bowers and Perkins 1995).

Introgression and Competition With Exotic Hatchery Stocks or Translocated Species: Behnke (1992) found that specimens he examined looked surprisingly similar to fish collected before any stocking had occurred. Bowers and Perkins (1995) noted that in 1982-3, few hatchery rainbows survived past July. Therefore, most likely did not spawn, and their genetic characteristics did not enter the redband gene pool. However, the analysis of genetic variation of Harney Basin trout conducted by Currens (1996) found evidence of genetic drift. This, along with mitochondrial DNA analysis conducted by Rick Williams (noted in Bowers and Perkins 1995), suggests that introgression may have occurred in some creeks. Krumbo Creek trout, in particular, are likely all hatchery stocks. Other populations, however, including those in the Silvies River system (Currens 1997), Silver Creek system (Berg 1987), and those sampled by Phelps et al (1996)--McCoy Creek in the Blitzen River system and Riddle Creek--may be genetically pure.

An exotic carp population present in Malheur Lake has caused habitat damage so extensive as to render recolonization by native trout a virtual impossibility (Kostow 1995). Carp also cause loss of redband trout in the Blitzen system by increasing turbidity, by competing for food, and by being the target of poisoning projects that also eliminate native trout (Hosford and Pribyl 1983). A hatchery program in the Donner and Blitzen River was discontinued after 1992, and all other hatchery programs are currently restricted to reservoirs that do not contain native redband trout (Kostow 1995). In the Silvies River Basin, numerous exotic species, including smallmouth bass, yellow perch, brown bullhead, carp, and pumpkinseed sunfish compete with redband trout for space and food, and degrade trout habitat (Bowers and Perkins 1995). No actions are being taken at this time to address the problems caused by introduced exotic species.

Inadequacy of existing regulatory mechanisms: The policies of state and federal agencies have continued to result in severely depressed populations and degraded habitat conditions. All but the Donner and Blitzen River population are now isolated and small, and natural recolonization would not be possible should redbands of one or more of the streams be subjected to a random or stressful disturbance or climatic event.

XVII. CRITICAL HABITAT DESIGNATION REQUESTED TO PROTECT DISTINCT POPULATION SEGMENTS OF REDBAND TROUT

Petitioners request the designation of critical habitat for *Oncorhynchus mykiss* concurrent with its listing. The habitat of Great Basin redband trout continues to be fragmented and degraded. In addition, it continues to be subjected to other human impacts and naturally

stochastic environmental conditions, including randomly occurring drought. Nehlsen et al. (1992) emphasized the danger that:

> "A drought…that caused substantial mortality to eggs or juvenile salmonids would result in a much smaller number of adult fish returning to spawn the next generation. The smaller number of spawning adults might then be vulnerable to increases in genetic drift or inbreeding, or depensatory mortality."

Drought acts synergistically with the impacts of habitat fragmentation and loss as well as with introgression and competition with hatchery fish, all of which exacerbate the impacts of drought. As a result of this continuing feedback loop, or "extinction vortex" (Gilpin and Soule 1986), Great Basin redband trout populations and range continue to decline. Therefore, critical habitat should be designated in all areas where redband trout currently exist. If additional populations, including those currently thought to be extinct, are discovered, those areas should also be designated as critical habitat. Failure to protect all of the distinct population segments of Great Basin redband trout would be imprudent and negligent because if redband populations and their habitat continue to decline, "available options for present and future generations will diminish or disappear" (Nehlsen et al. 1992). If the petition is not granted, it may be technically impossible and economically prohibitive to recover Great Basin redband trout after further declines in population and range and continued deterioration of habitat. None of its populations would never be naturally recolonized should the indigenous populations go extinct.

XVIII. CONCLUSION

This petition seeks listing pursuant to the ESA for a grouping that petitioners believe qualifies as a "distinct population segment" in accord with the joint FWS/NMFS policy defining this term and in light of the biology of redband trout. However, petitioners are aware that, particularly in recent years, FWS and NMFS have often not agreed with the groupings identified in listing petitions as constituting DPSs. In some cases, such as the ferruginous pygmy owl in the southwest United States, FWS has listed distinct population segments smaller than requested by petitioners. Here, petitioners would not object to identifying as a DPS each of the populations in the six basins specified in this petition. In fact, Currens (pers. comm. 1997) stated his belief that each one of the populations in the basins identified in this petition is sufficiently genetically unique to constitute a distinct grouping.

In general, petitioners hope and anticipate the US Fish and Wildlife Service's consideration of this petition will be a cooperative rather than an adversarial process. Indeed, a federal court recently criticized the agency for failing to communicate with petitioners regarding ambiguities over what should constitute a DPS (see *Southwest Center for Biological Diversity v. Babbitt*, no. 94-2036, Dist. Of Arizona). To avoid such a situation here, we respectfully request that FWS personnel communicate with petitioners prior to making a 90 day finding if the agency anticipates any difficulty in identifying a DPS of redband trout.

XIX. SUMMARY

From the information presented above, the petitioners believe that the only reasonable conclusion is that Great Basin redband trout is ***biologically threatened*** throughout its range and that it is ***in imminent danger of extinction***. Classification of most of the populations of redband in all six basins within the northern Great Basin as "depressed", "greatly depressed" or "extinct" (Table 11) clearly illustrates the ***high degree of risk*** to this group. Conservation efforts by federal and state agencies have proven to be inadequate; and due to the closed nature of the six basins, natural recolonization is impossible. Since all past artificial introductions of trout to these basins have proven unsuccessful, the extinction of Great Basin redband trout will result in the permanent loss of trout to the Catlow, Harney, Warner, Fort Rock, Goose Lake, and Chewaucan Basins.

Great Basin redband trout are a distinct and significant population segment of *O. mykiss* in that they are the only redbands that exist in desert watersheds that have been physically isolated from other watersheds for thousands of years (Behnke 1992, Kostow 1995). **No other form** of *O. mykiss* exists in closed basins in such an arid, extreme environment. Great Basin redband populations are considered to be especially significant in that they represent a group that diverged early in the evolution of *O. mykiss*, and have been present in the northern Great Basin for at least 32,000 years (Behnke 1992) and possibly over a million years (Gerald Smith, pers. comm.). Therefore, Great Basin redband trout represent a significant portion of the evolutionary history of the entire species. Consequently, Great Basin redband trout are a distinct population segment that deserve and require immediate protection by being listed as threatened and endangered pursuant to the Endangered Species Act.

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