Miller Lake Lamprey, *Lampetra (Entosphenus) minima,* Conservation Plan Implementation Strategy

Planning Context

The Miller Lake Lamprey Conservation Plan is intended to provide guidance for management actions and conservation of Miller Lake Lamprey. This conservation plan is made up of two components; the Oregon Administrative Rule (OAR) component, and the implementation strategy component. The OAR component is made up of the OAR adopted by the Oregon Fish and Wildlife Commission. This component provides policy direction for conservation and management of Miller Lake lamprey and is considered law. The implementation strategy component of the Miller Lake Lamprey Conservation Plan provides guidance to Oregon Department of Fish and Wildlife (ODFW) staff on implementation of management strategies for Miller Lake lamprey. This implementation strategy portion of the conservation plan is not considered law.

The following document includes both the implementation strategy and OAR portions of the Miller Lake Lamprey Conservation Plan to give the reader a better understanding of how the two work together as a conservation plan.

Executive summary – The Miller Lake Lamprey was believed extinct after a chemical treatment in 1958, targeting lamprey and tui chub, extirpated both from Miller Lake. The lamprey population was later recognized to be a distinct species, *Lampetra minima* (Bond and Kan 1973). It was the smallest lamprey species in the world (maturing at less than 4 in), and at that time was known only from Miller Lake, where it was extinct. In 1992, a small lamprey caught in the Upper Williamson River was identified as a Miller Lake Lamprey, and subsequent investigations have identified six local populations of this lamprey in two small subdrainages of the Upper Klamath Basin.

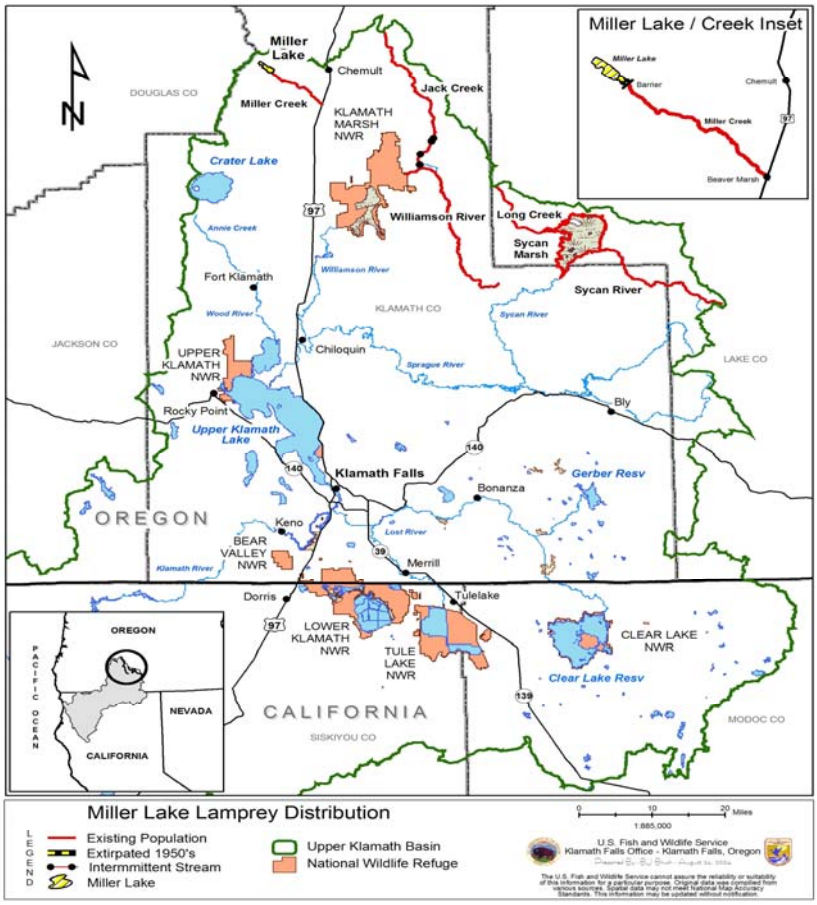
Management strategies to preserve this species include: conserving appropriate habitat conditions and availability within the natural range of the Miller Lake Lamprey, addressing potential impacts from stocking streams with hatchery fish, reducing entrainment, and establishing connectivity within and between local populations.

A man-made barrier built in 1959 still exists on Miller Creek. Originally created to prevent the re-establishment of lamprey in Miller Lake after the chemical treatment, the barrier currently prevents natural dispersal of the Miller Creek population and re-colonization of both extensive habitat in upper Miller Creek and Miller Lake itself. Removal of the barrier, which is in disrepair but continues to exclude lamprey, is feasible and will eliminate the only man-made feature obstructing natural connectivity within the Miller Lake drainage, the species' type locality.

Introduction

The Miller Lake Lamprey, *Lampetra* (*Entosphenus*) *minima*, is the world's smallest predatory lamprey, reaching a size of only 3-6", and is endemic to the Klamath Basin (Bond and Kan 1973, Gill et al. 2003, Lorion et al. 2000). It is also one of the few species to have "recovered" from extinction. Miller Lake was chemically treated with toxaphene by the Oregon Game Commission on September 16,1958 to eliminate Tui Chub (*Siphateles bicolor*) and a population of unidentified lamprey (Gerlach 1958, Gerlach and Borovicka 1964). The lamprey in Miller Lake was later discovered to have been a unique species, apparently restricted in range to the Miller Lake drainage (a small, disjunct tributary to the Upper Williamson River), and was scientifically described by Bond and Kan (1973) fifteen years subsequent to its presumed extirpation.

Figure 1. Map of the Upper Klamath Basin showing current known distribution of the Miller Lake Lamprey, *Lampetra* (*Entosphenus*) *minima*.



In 1992, researchers from Oregon State University tentatively identified a small lamprey caught during fish surveys of the upper Williamson River as a Miller Lake Lamprey, and in 1996 U.S. Forest Service personnel collected two small lampreys in the lower reaches of Miller Creek (Lorion et al. 2000). Concern for the tenuous status and apparently low abundance of this unique species, once thought extinct, prompted consideration of emergency listing under the federal Endangered Species Act. The immediate need to list was avoided by extensive surveys by staff from U.S. Fish and Wildlife Service and Oregon State University, which found relatively numerous populations in Miller Creek, the upper Williamson River drainage and the upper Sycan River drainage above Sycan Marsh (Lorion et al. 2000). Unfortunately, the species could not be found in Miller Lake itself, which is isolated from the surviving Miller Creek population by a lamprey barrier installed in 1959 as part of the original eradication effort (Gerlach 1959). This barrier still prevents re-colonization of the lake.

Although there appear to be no immediate threats to the Miller Lake Lamprey (Kostow 2002), the species is of considerable conservation concern due to: 1) its relatively limited range in two small sub drainages of the Klamath Basin, 2) its continued absence in the ecologically unique setting of Miller Lake (type locality) and 3) its evolutionary distinctiveness as the smallest known predatory lamprey in the world, maturing at less than four inches.

Life History

Distribution - The Miller Lake Lamprey is currently known from only two small sub-drainages of the Upper Klamath Basin, the upper Williamson River and the upper Sycan River above Sycan Marsh (Lorion et al. 2000). The upper Williamson River contains four known populations (Miller Creek, Jack Creek, Klamath Marsh, and mainstem Williamson River above the marsh). Miller Creek, which drains Miller Lake, is within the upper Williamson Watershed, but it goes sub-surface in the pumice soils and does not reach the Klamath Marsh or Williamson River. Miller Lake has presumably been isolated from the rest of the drainage since the eruption of Mt. Mazama (Crater Lake) over 6,000 years ago. Jack Creek, a small northern tributary to the upper Williamson River, is also generally disjunct from the mainstem Williamson River due to low, intermittent surface flows in its lower reaches. The Upper Sycan drainage (a northern tributary of the Sprague River) contains two principal populations, Long Creek drainage and the upper Sycan River drainage above Sycan Marsh. Lamprey have been documented in Coyote Creek and Shake Creek above Sycan Marsh by Nature Conservancy. Lamprey in Shake Creek have not been identified to species.

Geographic Variability - In general, individuals from the modern Williamson and Sycan sub-drainages are morphologically similar (Lorion et al. 2000). However, there are indications of geographic differences between populations. The Sycan populations exhibit significantly higher variability in the number of bicuspid posterial teeth, and the Miller Creek population generally tend to be darker on their ventral surface. Specimens from the original Miller Lake population (pre-1958) had, on average, fewer anterial teeth. They also tended to have larger eyes and oral disks relative to total length when compared to modern populations; however, this appears to be due to their slightly smaller size.

The available genetic information also indicates that there are geographic differences in the mitochondrial genome (mtDNA) between Sycan (Sprague) and Williamson lamprey populations, with one haplotype found only in the Upper Sycan and another limited to lamprey populations in the Sprague River drainage (Lorion et al. 2000). Continued genetic work on the Klamath lamprey fauna, examining additional genes, indicates that the population of lamprey in Miller Creek may be genetically different than both the other upper Williamson and Sycan populations (Docker pers. com. 2004).

Habitat - Miller Lake Lampreys currently occupy relatively cool, clear streams (Gunckel and Reid 2004, Kan and Bond 1981, Lorion et al. 2000, Reid pers. com. 2004). Adults are generally associated with structural cover, including loose rocks and woody debris. In lower Miller Creek, where rocky habitat is limited, adult lampreys were consistently found in woody debris jams and even under seat boards from an old outhouse that had fallen into the creek (Reid pers. obs. 1998). Ammocoetes (a larval stage lasting about 5 years) live in the substrate and are generally associated with depositional environments. In streams, ammocoetes are frequently found in silty backwater areas, low energy stream edges, and in pool eddies where leaf litter and other organics (including adult lamprey carcasses) tend to accumulate. At night ammocoetes may move into the water column to disperse downstream or into more favorable habitat. In Miller Lake ammocoetes were found in organic detritus all along the shoreline but rarely in the extremely cold tributaries flowing into the lake (Kan and Bond 1981). Recent extensive collections of Pacific Lamprey ammocoetes along the coast indicate that ammocoetes do not occupy otherwise apparently suitable sediments if the upper layer is poorly oxygenated (Reid and Goodman pers. obs. 2004).

Reproduction - Miller Lake Lampreys spawn in shallow redds in clean gravels and sand, which are moved out of the redd by lamprey sucking onto small rocks and actively moving them out of the way (Markle pers. com. 2004, Reid pers. com. 2004). In streams, redds are generally made in shallow water, often at the tail of a pool or run, and are roughly 10 cm in diameter and a few centimeters deep. In Miller Lake, lampreys were observed spawning in water as deep as 20 feet (Cochrun 1951b, Kan and Bond 1981). Males attach to the female's head and wrap around her body, aligning genitals and allowing fertilization of the eggs as they emerge. Eggs are heavier than water and are mixed into the bottom of the redd by spawning actions. Kan and Bond (1981) found that female lampreys from Miller Lake contained an average of about 600 eggs. Time to hatching is not known, but is probably on the order of a few weeks. Larvae (ammocoetes) emerge at about 8 mm and move into fine sediments. Adults die after spawning.

Feeding - Miller Lake Lampreys feed on fish only as adults. Ammocoetes have no eyes or teeth and are purely filter feeders, burrowing in the sediment and feeding on suspended microorganisms and algae. The ammocoete phase lasts about five years, during which time the ammocoetes grow to around 150 mm. After transformation, adults enter a predatory phase before spawning that generally lasts for less than a year (from transformation in the summer/fall to spawning in summer of the following year). Adults feed primarily on flesh that is gouged and rasped out of a small wound (<= 11 mm) under the sucking disk (Cochran 1994, Kan and Bond 1981). Adults apparently show little selectivity for prey. The adult lampreys in Miller Lake historically fed on both tui chubs and available salmonids (rainbow, brook and juvenile brown

trout) in Miller Lake (Kan and Bond 1981). They also scavenged dead tui chubs and trout, as well as cannibalizing other lampreys. In Miller Creek, most recent observations found occasional lamprey wounds on brook trout, which were the most abundant species in the creek, but it is probable that lampreys also feed on both rainbows and young brown trout in the creek (S. Reid pers. obs. 1998). In Jack Creek lampreys feed on speckled dace, the only other fish present in the stream, and in the Upper Sycan they feed on both trout and dace. Unlike other predatory lampreys, but similar to non-feeding brook lampreys, adult Miller Lake Lampreys loose body length and mass between the time they transform and actual spawning, indicating that energetic needs and gonadal development are not compensated for by the amount of food they consume (Hubbs 1971, Kan and Bond 1981, Lorion et al. 2000).

Lamprey / Trout Interaction - Although there have been no direct studies of the ecological interaction between lampreys and trout in the Klamath Basin, it is notable that healthy trout and lamprey populations coexist throughout the basin. Lampreys certainly prey on trout, and both adult lampreys and ammocoetes may represent a significant food resource to piscivorous adult trout. Native redband trout co-exist with much larger predatory lampreys ("Klamath Lake Lamprey", *Lampetra* (*Entosphenus*) sp., and Klamath River Lamprey, *L*. (*E*.) *similis*) in Upper Klamath Lake. A large percentage of the trophy redband trout in Upper Klamath Lake, as well as both redband and brown trout in the Wood and Williamson Rivers, exhibit recent or healed lamprey scars. In smaller streams where Miller Lake Lampreys (length 3-6 in) co-exist with native and introduced trout (redband, bull, brook and brown trout), there appears to be little impact to adult trout, and local fishermen are rarely even aware of the presence of the lamprey (S. Reid, pers. comm. 2004, R. Smith, pers. comm. 2004). Surveys by USFWS and USFS in 1998-1999 found that very few of the trout in Miller Creek, the Williamson or upper Sycan Rivers had scars, and during extensive snorkeling surveys, only a few trout were actually observed with lampreys attached (S. Reid USFWS pers. com., 2004).

Historical reports from Miller Lake prior to the extirpation of lampreys indicate that tui chubs were the principal prey, and dead tui chubs were often reported (Cochrun 1951a,b, Gerlach 1958, Kan 1975, Kan and Bond 1981). Some cannibalism on other lampreys, as well as scavenging of dead fish carcasses, was also observed (Kan and Bond 1981). Specific mortality of adult trout was not reported, although large trout were noted to have collections of scars and some mortality of fingerlings was observed. Recent observations of occasional fingerling trout mortality and much more frequent lethal predation on speckled dace (<10 cm TL) in the Sycan River and Jack Creek, as well as the observation of apparently healthy adult trout with healed wounds, suggests that lethal predation on trout is generally limited to fingerlings (Markle pers. com. 2004, Reid pers. com. 2004, Smith pers. com. 2004).

It is not believed that predation on Miller Lake lamprey by piscivorous adult trout has been a threat to the sustainability of lamprey populations. These populations have co-evolved with native trout and appear to be productive enough to withstand some level of predation. The Jack Creek population is an exception. Jack Creek is believed to only support populations of Miller Lake lamprey and speckled dace. Since this lamprey population evolved absent predation from trout, there is a concern that an introduction of piscivorous adult trout could upset the ecological balance in Jack Creek and present a threat to both the lamprey and dace populations. For this

reason, stocking of hatchery fish is prohibited by rule in Jack Creek or other streams containing Miller Lake lamprey.

Miller Lake Fisheries - Miller Lake currently supports a recreational trout fishery of entirely introduced species. Miller Lake's one notable native species, the Miller Lake Lamprey, was thought extinct when the Oregon Department of Fish and Wildlife Commission approved the current Klamath Basin Fish Management Plan (ODFW 1997). Today, Miller Lake provides a popular "catchable" and fingerling rainbow trout program, a trophy brown trout fishery, and an under-utilized kokanee population of small-sized individuals (Smith pers. com. 2004). Due to the role of Miller Lake as a recreational fishery and concerns over the potential impact of lampreys on introduced trout populations in the lake, the history and status of Miller Lake fisheries are summarized below by species.

Rainbow trout fingerlings (2-4 inches) were planted in Miller Lake until 1948, when stocking was discontinued due to poor returns. At that time, the poor rainbow fishery was believed to have been due to lamprey predation and competition with resident tui chubs (Cochrun 1950, 1951a). However, based on the reported poor performance of stocked fingerling rainbows post-treatment (see below), without either lampreys or tui chubs, it appears that local habitat conditions, and not trophic competition with tui chub or parasitism by lamprey, were driving the poor rainbow population dynamics. Recent observations by ODFW biologists have indicated that while the rainbow trout in Miller Lake are surviving, growing and being harvested by anglers, survival and growth have been, at best, marginal (Smith pers. com. 2004). Trapnet samples in Miller Lake have been very inefficient at capturing older age class rainbow trout so the average size of sampled trout is not representative of the fish that are available for angler harvest. While trapnet sets typically made in the fall are not particularly good indicators of the rainbow population in Miller Lake, Trapnet sampling of rainbow trout documented an average length of approximately 8 inches in 1988 and approximately 4 inches in 1997. The release of catchable-sized rainbow trout into Miller Lake was initiated in 2001 to supplement the ongoing fingerling stocking program.

Brown trout were first introduced into Miller Lake in 1981 and have been stocked annually since. Although small numbers may have been present prior to treatment. Survival and growth of brown trout has been excellent (Smith pers. com. 2004). Brown trout averaged approximately 17 inches in length in 1998 and approximately 16 inches in 2001. Larger fish captured in trap net sets exceed 10 pounds. Miller Lake was identified by sport-fishing author Denny Rickards as one of the top ten brown trout producing lakes in the western United States. Lampreys themselves, as well as their impaired prey, might in turn serve as additional prey for the large, highly piscivorous brown trout.

Stocks of kokanee were introduced to Miller Lake from several states between 1964 and 1971 (all post-treatment). Kokanee have been very successful reproducing and stocking has not been necessary since 1971. The average size of maturing adults have remained relatively small. Miller Lake is an oligotrophic lake with very low productivity (Johnson et al. 1985). The length of maturing female kokanee ranged between 7.5-10 inches between 1965 to1972, and the average size of kokanee females in 2001 was approximately 8 inches. Based on the relatively

small length of maturing kokanee females, it appears that environmental conditions or interspecific competition with other trout are driving the kokanee population dynamics.

Brook trout were stocked in Miller Lake from the 1930's until 1948. Brook trout were present in Miller Creek and apparently survived in tributaries during the 1958 treatment, since seven brook trout (6-14 in) were gill-netted from the lake in 1964, prior to introduction of 85,000 kokanee and 150,000 rainbow fingerlings. No brook trout are currently stocked into the lake or tributaries of the lake. A healthy self-sustaining population of brook trout is currently present in Miller Creek, below the lamprey barrier, where they have apparently coexisted with lampreys since both recovered from the 1958 treatment.

Tui chubs were present in Miller Lake prior to the 1958 treatment. It is not known whether tui chub were a native or introduced population. However, based on the elevation and atypical tui chub habitat in the lake, it is believed to have been an un-authorized introduction, most probably as a baitfish. Trophic competition between tui chub and rainbow trout has been consistently demonstrated in several Oregon lakes, including Diamond Lake in Douglas County. Tui chub or "roach" problems in Miller Lake were identified by Ken Cochrun (Fisheries Agent, Oregon State game Comm.) in his 1950 and 1951 annual reports (Cochrun 1950, 1951a). However, Mr. Cochrun felt that the "large population" of tui chub would be relatively easy to control compared to the lamprey and hence the need for the radical chemical treatment with toxaphene, which would eliminate both species, rather than rotenone, which would have limited effect on the lamprey ammocoetes in the substrate. In the 1950's, as is still the case, considerable amount of time was expended by fishery districts controlling tui chub ("roach"), as noted in Mr. Cochrun's annual reports. Tui chubs were never restocked after the treatment and are no longer present in the Miller Lake drainage.

One of the goals of this conservation plan for the Miller Lake Lamprey is to re-establish a lamprey population in Miller Lake itself. Historical reports from Miller Lake prior to the extirpation of lampreys nowhere mention specific mortality of adult trout, even when lamprey were abundant, although large trout were noted to have collections of scars (see above - Lamprey/ Trout Interaction). Based on historical accounts and recent observations from the Upper Sycan drainages, mortality when observed has been on small fish (<10cm TL). Observations from Miller Lake in the past and recent observations of trophy redband trout fisheries in Upper Klamath Lake indicate that little to no effect is experienced by the fish based on the occurrence of healed lamprey scars. Self-sustaining populations of brown and brook trout (unstocked) currently coexist with lampreys in Miller Creek below the lamprey barrier. Were lamprey to become reestablished in Miller Lake, they would probably feed primarily on juvenile kokanee, which are abundant in the lake. Although lamprey predation on adult trout may result in some stress and condition loss, the principal effect on adult kokanee and trout fisheries in Miller Lake is likely to be aesthetic, with small round wounds (<1/2 in), or scars, on the side of fish.

Future Recreational Fish Management

The recreational trout and kokanee salmon fisheries in Miller Lake are an extremely valuable fish resource to local community and anglers. All efforts will be made by the Oregon Department of Fish and Wildlife to continue to offer angling recreation at current harvestable levels. In the unlikely event that the re-establishment of the Miller Lake lamprey adversely impacts the trout and kokanee population abundance, then additional fish stocking or other compatible management actions will be initiated as necessary to meet recreational fishery management objectives.

Conservation Plan

Note: Underlined, bold text in italics represents those portions of the conservation plan that are proposed to be adopted into Oregon Administrative Rule by the Oregon Fish and Wildlife Commission. As discussed previously, these underlined, bold text in italics are the OAR component of the Conservation Plan.

Purpose

This conservation plan is intended to provide guidance for management actions and conservation of the Miller Lake lamprey, *Lampetra* (*Entosphenus*) *minima*. This is the first step in securing populations that currently exist in the Klamath Basin and in determining their status, abundance, distribution, and life history needs. As new information on the lamprey becomes available it is expected that this document will be modified and updated to reflect the current state of our knowledge.

Species Management Unit and Population Description

The Miller Lake Lamprey species management unit is comprised of six documented populations and one uncertain population. They are:

- ***Mainstem Upper Williamson River above Klamath Marsh***
- ***Miller Creek***
- ***Jack Creek***

- ***Sycan River above Sycan Marsh***
- ***Long Creek***
- ***Coyote Creek***
- ***Shake Creek (lamprey species uncertain)***

Desired Status

The desired status of the Miller Lake lamprey is for the species to be distributed widely throughout its historic range, with populations robust enough to withstand stochastic environmental events, and with both the populations and their habitat secure from anthropogenic threats.

Current Status

The Miller Lake Lamprey is endemic to the Klamath Basin and was recently re-described (Lorion et al 2000). It is currently known from two sub-drainages. The Williamson River sub-drainage includes populations in Miller Creek, Jack Creek, Klamath Marsh and the mainstem upper Williamson River. In the Sycan sub-drainage the lamprey exists in Long Creek and in the upper Sycan River above the Sycan Marsh. Information regarding the abundance and population structure of Miller Lake lamprey in these systems is not available, and only anecdotal information is available for the life history or habitat requirements of the species. For detailed information on the current information available for the species see Life History section. No immediate threats to the Miller Lake Lamprey are known to currently exist, except for the barrier to connectivity between Miller Creek and Miller Lake.

Management Strategies

The short- and long-term management strategies for the Miller Lake Lamprey species management unit are:

Short-term Strategy

a) ***Re-establish connectivity to Miller Lake.***

Long-term Strategies

b) ***Ensure appropriate habitat conditions and availability within the natural range of Miller Lake lamprey.***
c) ***Reduce entrainment or the potential for entrainment of adult and larval lampreys into water diversions.***
d) ***Reduce stranding or the potential for stranding of larval lampreys in dewatered segments of streams below water diversions.***
e) ***Maintain unobstructed opportunities, within and among populations for genetic exchange, natural dispersal or migration activities, and re-colonization of unoccupied portions of historical habitat.***
f) ***No hatchery fish shall be stocked in streams that support Miller Lake lamprey.***

Management strategies are those general conditions relevant to the conservation of the species that are considered essential to ensure its long-term survival within its natural

range. Although there are many aspects of a species life-history and management that may play a role in the species' biology, the management strategies include those aspects that are currently considered to be both essential for its long-term survival and that are potentially at risk.

Conservation Actions

Conservation actions are those specific activities or projects that have been identified as appropriate for the realization of the above conservation goals.

General - Due to the general lack of information about the life-history, habitat requirements, and distribution of the Miller Lake Lamprey, any studies which increase our understanding of the species will contribute to future conservation planning and should be supported.

Habitat - At this time, the general habitat requirements of the Miller Lake Lamprey populations in the upper Williamson and upper Sycan drainages appear to be similar to those of the native trout populations, and habitat restoration or enhancement projects that benefit the trout populations should be beneficial to the lamprey as well. However, there may be specific differences between these species that should be considered in future projects as our understanding of the lamprey's life-history increases.

Entrainment - At this time there has been no evaluation of potential entrainment risks to the Miller Lake Lamprey. Unscreened or improperly screened irrigation diversions currently exist on the upper Sycan and upper Williamson River systems. Private irrigator participation into the screening program should continue to be encouraged and supported.

Stranding - At this time there has been no evaluation of potential stranding risks to the Miller Lake Lamprey. Current water diversions reduce the stream flow in segments of the streams directly below the diversion point. Minimum stream flows or gradual ramping strategies should be encouraged where practicable.

Connectivity - The Miller Lake Lamprey is not known to carry out extensive spawning migrations. However, due to the tendency for ammocoetes to drift downstream during the multi-year larval stage, it is essential that local populations have free upstream passage opportunities during the period when adults are residing in the stream. The swimming characteristics and passage capabilities of trout (for whom many fish ladders are designed) and lamprey are very different. Lamprey-friendly ladders or passage corridors should be encouraged in the design phase of new projects, and occupied lamprey streams should be evaluated for the presence of older fish ladders, as well as other artificial barriers.

Re-establishment of the Miller Lake population - Miller Lake itself, the type locality for the species, remains the only known historical habitat from which the Miller Lake Lamprey is known to have been extirpated. It also represents both an ecologically unique

habitat and a crucial component in the evolutionary legacy of the species. Following the extirpation of lampreys from Miller Lake in 1958, a lamprey barrier was constructed in Miller Creek to prevent recolonization of the lake from Miller Creek. The barrier remains in place today. Removal of this barrier should have a high priority in order to meet the conservation goals for the Miller Lake Lamprey and is discussed in more detail below.

The barrier was constructed by the State of Oregon Game Commission in 1959 at the upstream extent of a short, high-gradient cascade in Miller Creek approximately ½ mile downstream from the outlet of Miller Lake and forest road 9772. It consists of a low stonework dam (about 2 ft high) constructed of mortared native rocks, with a metal plate and lip bolted on top. The configuration is very effective as a man-made barrier to fish passage. However, the current condition of the concrete and rock structure is substantially deteriorated. A recent examination by ODFW, USFWS and USFS personnel indicates that the structure would be relatively easy to remove using hand tools without adverse instream impacts (evaluated by R. Smith et al., September 2003).

Recent baseline surveys (August 2004) of lamprey ammocoetes in the Miller drainage indicate that they are apparently limited to less than two miles of low-gradient stream in lower Miller Creek (Gunckel and Reid 2004). Allowing lampreys to re-establish a population above the cascade in Miller Creek and Miller Lake will aid in creating an additional buffer against stochastic events that could otherwise eradicate this geographically limited population. Additional surveys should be scheduled on a five-year basis to evaluate status of the population and the success of re-colonization efforts. Removal of the barrier should allow natural expansion of the population and recolonization of the lake from the Miller Creek population, which survived the original extirpation.

Potential Impacts to Other Species

The conservation actions identified above are not anticipated to have any negative impacts to native fish species in the Klamath Basin. Any unanticipated impacts to native fish species from these actions would be unlikely to threaten the population health of that species.

Information Gaps

1) Life history – very little quantitative information is available on the life history and habitat requirements of either ammocoetes or adults with which to guide management decisions.
2) Distribution – current understanding of distribution is based on surveys in the 1990's that primarily focused on the Williamson and Sprague River drainages. Other potential areas in the Klamath Basin outside these drainages have not been properly surveyed.

3) No specific population or fine-scale distributional surveys have been undertaken for any populations outside of the Miller Lake drainage.
4) Preliminary morphological and genetic information suggests that there are regional differences between the various populations of Miller Lake Lamprey in the Klamath Basin. However, the available information is not yet sufficient for making management decisions relative to population independence or uniqueness.

Strategies to Address Gaps

1) A Miller Lake Lamprey Technical Management Team has been formed to promote investigation, management and conservation of the Miller Lake Lamprey. This team currently consists of biologists from ODFW (Roger Smith and Stephanie Gunckel), Oregon State University (Douglas Markle), the Western Lamprey Project (Stewart Reid), and the Great Lakes Inst. Environmental Research (Margaret Docker - lamprey genetics).

2) ODFW will, where appropriate, incorporate lampreys into their fish survey protocols in the Klamath Basin and will seek to collaborate with other researchers carrying out lamprey surveys in the Basin.

3) ODFW and the Miller Lake Lamprey Technical Management Team will promote the investigation of morphological and genetic information informative to resolving regional differences between the various populations of Miller Lake Lamprey.

Research, Monitoring and Evaluation

Research
Promote scientific studies of the Miller Lake Lamprey to aid in the conservation of the species.

Monitoring
Where appropriate, incorporate lampreys into fish survey protocols in the Klamath Basin and seek to collaborate with other researchers carrying out lamprey surveys in the Basin.

Evaluation
Periodically evaluate the status of Miller Lake lamprey and the success of the conservation plan management strategies.

Research – Due to the paucity of available quantitative information on the distribution, life history, habitat requirements of either ammocoetes or adults, ODFW will promote scientific studies of the Miller Lake Lamprey to aid in the conservation of the species.

Monitoring - ODFW, in collaboration with USFWS, has documented baseline distribution of the fish in Miller Creek with the lamprey barrier in place (Gunckel and Reid 2004). Monitoring of the population will continue to evaluate upstream movement, distribution, abundance, and re-colonization of the lake through the cooperative effort of ODFW and the Miller Lake Lamprey Technical Management Team. The ODFW and the Technical Management Team, will meet and discuss progress after the barrier has been removed, and the lampreys have had unobstructed passage to Miller Lake for five years.

Adaptive Management

a) The Klamath Watershed District Manager shall assemble a group of scientists with experience or interest in lamprey biology to serve as the Miller Lake Lamprey Technical Management Team.

b) The Miller Lake Lamprey Technical Management Team shall meet periodically to review the success of the management actions identified in the Miller Lake Lamprey Conservation Plan and identify modifications to management actions that are needed to achieve the desired status for Miller Lake lamprey.

No immediate threats to the Miller Lake Lamprey are known to currently exist, except for the barrier in Miller Creek. The Miller Lake Lamprey Technical Management Team (see under Strategies to Address Gaps) has been formed to promote investigation, management and conservation of the Miller Lake Lamprey. The team will meet periodically to evaluate current status and management strategies in light of new information.

Current management action is proposed for removal of the Miller Creek Barrier. The lamprey population in Miller Creek will continue to be monitored by ODFW following the 2004 baseline surveys. After five years the Miller Lake Lamprey Technical Management Team will evaluate the status of the Miller Creek population and the success of natural re-colonization of Miller Lake. If sufficient progress has not been made, then discussions regarding active re-introduction of lampreys to the lake will be initiated.

Trigger for Plan Modification

Substantial negative changes in the distribution or abundance of the Miller Lake lamprey, or the recognition of new threats to the species, shall prompt a review of the species management unit's status and all Miller Lake Lamprey Conservation Plan management strategies by the Miller Lake Lamprey Technical Management Team. Appropriate modifications to the Miller Lake Lamprey Conservation Plan intended to better achieve the desired status identified in the Plan shall be proposed by the Miller Lake Lamprey Technical Management Team.

Reporting

a) ***The Miller Lake Lamprey Technical Management Team shall periodically report on the status of Miller Lake lamprey and the effectiveness of the management strategies identified in the Miller lake Lamprey Conservation Plan.***
b) ***Annual Miller Lake Lamprey data collected and any reports on the status of Miller Lake Lamprey or evaluations of the Miller Lake Lamprey Conservation Plan shall be made available to the public.***

The staff of the ODFW's Klamath Watershed District and Native Fish Research Project will periodically report monitoring and research results through native fish conservation strategy stock status reviews.

Citations

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