



Klamath Watershed District Stock Status Review of Native Fish



January 2016

Klamath Fish District



Kamkaun Springs redband trout spawner, Long Creek bull trout, Rock Creek redband, Upper Klamath Lake lamprey (USFS photo)

January 2016

Bruce Eddy- Regional Manager

Chip Dale – Watershed Manager

Elizabeth Osier Moats – Acting District Fish Biologist

William Tinniswood – Assistant District Biologist

Policy Direction for Fish Management in Klamath Basin

Wildlife Policy (ORS 496.012)

- Prevent serious depletion of any indigenous species (Manage for Sustainability)
- Provide the optimum recreational and aesthetic benefits for present and future generations of the citizens of this state (Manage for Utilization consistent with Sustainability)

and

- (1) Maintain all species of ~~wildlife~~ fish at optimum levels.
- (2) Develop and manage ~~the lands and~~ waters of this state in a manner that will enhance the production and public enjoyment of ~~wildlife~~ fish.
- (3) Permit an orderly and equitable utilization of available ~~wildlife~~ fish.
- (4) Develop and maintain public access to ~~the lands and~~ waters of the state and the ~~wildlife~~ fish resources thereon.
- (5) Regulate ~~wildlife~~ fish populations and the public enjoyment of ~~wildlife~~ fish in a manner that is compatible with primary uses of the ~~lands and~~ waters of the state.
- (6) Provide optimum recreational benefits.
- (7) Make decisions that affect ~~wildlife~~ fish resources of the state for the benefit of the ~~wildlife~~ fish resources and to make decisions that allow for the best social, economic and recreational utilization of ~~wildlife~~ fish resources by all user groups. [1973 c.723 §6; 1993 c.659 §2; 2001 c.762 §6]

Klamath Basin Anadromous Fish Reintroduction Plan (2008) (OAR 635-500-3890, 635-500-3895, 635-500-3900, 635-500-3905, 635-500-3910)

Miller Lake Lamprey Conservation Plan (2005) (635-500-3885)

Native Fish Conservation Policy (2003) (OAR 635-007-0502)

Klamath River Basin Fish Management Plan (1997) (OAR 635-500-3600, 635-500-3885, 635-500-3890)

Oregon's Trout Plan (1988) (OAR 635-500-0100)

Oregon's Warmwater Plan (1988) (OAR 635-500-0045)

Klamath Basin Fisheries

Note:

Management for all fish species in the Klamath Basin streams and standing waters is directed under the *Klamath River Basin Fish Management Plan* (OAR 635-500-3600 through 635-500-3880) adopted by the Oregon Fish and Wildlife Commission (Commission) in 1997, and as amended by the Commission in 2005 to revise management of Miller Lake Lamprey (OAR 635-500-3885) and amended in 2008 to address re-introduction of anadromous fish (OAR 635-500-3890 through 635-500-3910).

Manage for Sustainability

The following species indigenous to Klamath Basin are Strategy Species in the East Cascades Ecoregion under the *Oregon Conservation Strategy* (ODFW 2006)

- Bull trout (*Salvelinus confluentus*)
- Jenny Creek sucker (*Catostomus rimiculus*)
- Lost River sucker (*Deltistes luxatus*)
- Miller Lake lamprey (*Entosphenus minimus*)
- Oregon Basins redband trout (*Oncorhynchus mykiss newberrii*)
- Pit-Klamath brook lamprey (*Entosphenus lethophagus*)
- Shortnose sucker (*Chasmistes brevirostris*)
- Slender sculpin (*Cottus tenuis*)
- Upper Klamath Lake lamprey (*Entosphenus sp.*)

Table 1. Threatened and Endangered Fish Species of Klamath River Basin, Oregon.
(T=threatened, E=endangered)

| Common Name | Scientific Name | State status | Federal status |
|-------------------|--------------------------------|--------------|----------------|
| FISH | | | |
| Lost River Sucker | <i>Deltistes luxatus</i> | E | E |
| Shortnose Sucker | <i>Chasmistes brevirostris</i> | E | E |
| Bull Trout | <i>Salvelinus confluentus</i> | | T |

Table 2. Updated Oregon State Sensitive Fish Species List in the Klamath Basin.

| | SENSITIVE – CRITICAL AND VULNERABLE | |
|---|--|---|
| Common Name | Scientific Name | USGS HUC distribution (current) |
| FISH | | |
| Bull Trout (CRITICAL) (Klamath Lake Bull Trout SMU)* | <i>Salvelinus confluentus</i> | Upper Klamath Lake (18010203), Sprague (18010202) |
| Miller Lake Lamprey (VULNERABLE) | <i>Entosphenus minima</i> (<i>Entosphenus minimus</i>) | Williamson (18010201), Sprague (18010202) |
| Great Basin Redband Trout (Upper Klamath Basin Redband Trout SMU, VULNERABLE) | <i>Oncorhynchus mykiss newberrii</i> (Behnke 2002) | Sprague (18010202), Upper Klamath Lake (18010203), Williamson (18010201), Lost River (18010204), Upper Klamath River (18010206) |

Data Sources for Sustainability

- **Outline**
 - 1) **Fish Population**
 - 2) *Specific Stream Fish Population*
 - Life History Type
 - Fish Species Status
 - Population Trend (5-10 years)
 - Distribution
 - Recent Findings
 - Preferred Management Actions

Bull Trout (*Salvelinus confluentus*)



Figure 1. Long Creek fluvial bull trout above 400-00 road (USFS photo August 2012)

Life History Type: Primarily isolated resident with limited fluvial expression.

Status: Federal ESA Threatened (1998), ODFW State Sensitive Critical, Conservation Strategy Species and Native Migratory Fish.

Population Trend: Likely downward due to extreme drought and higher than normal water temperatures however good adult age class from mild year in 2011.

Distribution: Bull trout populations in the Klamath Basin represent a valuable biological resource. The Klamath Basin is at the southern range of the species distribution and the population is genetically distinct. Klamath Basin bull trout are presently found as stream resident forms in eight isolated headwater streams within six small drainage basins (Sun, Threemile, Long, Boulder, Brownworth and Deming creeks). Long Creek continues to maintain a small component of the fluvial form and the Sun Creek population is also showing migratory patterns. Bull trout occupied streams occur in three general locations: tributaries of the Sprague and Sycan Rivers and tributaries of Agency Lake.

1: Tributaries of the Sprague River Watershed:

- Brownworth Creek
- Leonard/Hammond Creeks

- Deming Creek
- Boulder/Dixon Creeks
- North Fork Sprague River (NF Sprague)

2: Tributaries of the Sycan River Watershed

- Long Creek

3: Tributaries of Agency Lake Watershed:

- Sun Creek
- Threemile Creek

Streams presently inhabited by bull trout are typically small and spring-fed with steep gradients. With the exception of Long Creek all bull trout streams originate in the higher elevations of mountains within the Wilderness areas of Gearhart and Sky Lakes or Crater Lake National Park. Bull trout streams continue to flow through forests where land use range from commercial forestry and grazing. The water from the streams eventually reach the mainstem of the river, leave the forest, and flow through sagebrush-covered valleys or marshes where they widen and flatten. Livestock grazing and agriculture are the dominant use in the broad, low gradient meadow reaches of rivers and streams.

Bull trout are currently found in eight headwater streams. Klamath basin bull trout populations are numerically small and have little connection between populations. Bull trout are subject to hybridization and interspecific competition from brook trout and brown trout (except Deming Creek and portions of Threemile and Sun creeks above man made barriers). All populations have limited geographic distribution and limited reproductive potential due to low abundance and low fecundity of spawners. In addition, habitat quantity and quality has been affected to some degree by land use in all currently occupied bull trout streams except upper Sun Creek. Seven of the eight bull trout populations (Brownsworth, Leonard/Hammond, Boulder/Dixon, Long, Sun, and Threemile creeks) are designated as having a high risk of extinction. The remaining population (Deming Creek) is designated as having a moderate risk of extinction. Bull trout populations in Coyote (Sycan) and Sheepy (NF Sprague) creeks are thought to have been extirpated with bull trout last documented in 1998. The Sun Creek population has experienced an increase in population size and distribution in recent years which may result in reduction in risk of extinction. The Brownsworth and Leonard populations may also be considered for a reduction in risk due to a recent expansion of the distribution and indications of increased genetic exchange.

USGS (Dunham and Heck in press, Corvallis) collected water temperature data in all streams within designated critical habitat in 2012 and 2013. However, the coldest water in the basin in the Sevenmile Creek tributaries Crane, Short, Cocoon, and Blue Springs was not sampled due to those streams not being listed as critical habitat. A final recovery and implementation plan was completed in 2015 by USFWS, on which ODFW commented extensively.

Tributaries of the Sprague River Bull Trout Populations

Brownsworth and Leonard (Hammond) Creeks Bull Trout Population:

Life History Type: Resident. Fluvial life history has never been documented in South Fork Sprague River.

Population Trend: No recent population estimate exists but likely recent downward trend due to four years of extensive drought (2010, 2012-2015) in conjunction with higher than average air temperatures. However, bull trout survival likely very high in 2011 due to above average flow and lower than average summer air temperatures.

Brownsworth and Leonard Creek bull trout populations are small and tenuous, but thought to be relatively stable with cyclical swings in abundance depending on water year. Both native redband trout and non-native brown trout are present in bull trout occupied habitat. Population surveys conducted in 1989 and 1995 estimated the bull trout abundance for Brownsworth Creek to be 964 and Leonard Creek to be 834, respectively. The last population estimate in Brownsworth Creek, conducted in 2000 by ODFW Klamath District, was 1290 bull trout. The current population is likely lower than 1290 bull trout due to extended drought. The larger population size in 2000 was likely due to greater precipitation and milder air temperatures in the late 1990's.

Leonard Creek was surveyed in 2005 and 2006 by ODFW Native Fish Investigations with a population estimate of 828 in 1989, 679 +/- 65% in 2005 (two pass electrofishing), and 363 +/- 37% (mark/recapture) in 2006.

Distribution: In 2000 bull trout were present in the summer from headwaters downstream to the confluence of Brownsworth Creek with South Fork Sprague River. A snorkel survey in 2009 from the mouth to approximately 0.5 miles upstream observed no bull trout. Redband trout dominated observations (100+) with only five brown trout observed.

Recent findings: Genetics of the Klamath bull trout populations were examined by Dehan *et al.* in 2008.

Bull trout were documented in Hammond Creek for the first time on August 28, 2012 at coordinates 42.41900°N, 120.86814°W. A total of 62 brown trout, 9 redband trout, 3 lamprey ammocetes and 1 bull trout were captured in 2107 seconds of electrofishing.

Currently, USFW, USFS, and USGS are investigating redband trout/brown trout/bull trout habitat interactions and habitat preferences in Leonard and Brownsworth Creeks utilizing Passive Integrated Transponder (PIT) tags. Sampling in Upper Brownsworth and Leonard creeks above the NF 34 road crossing shows bull trout dominate the species assemblage with redband trout rare and brown trout least common. A total of 327 bull trout were PIT tagged in 2013 and an additional 156 bull trout were captured in Leonard and Brownsworth in 2014.

Five fish passage partial barrier culverts on Leonard and Brownsworth Creeks were replaced from 2012 to 2014 at:

1. Lower Brownsworth (replaced -stream simulation)

2. Brownsworth Creek culvert at northern road closure (culvert to bridge)
3. Uppermost Brownsworth Creek (culvert removal)
4. Leonard Creek at FR34 (culvert modification --habitat based)
5. Upper Leonard (replaced -- stream simulation)

USFWS/ODFW is currently working on a monitoring plan for bull trout in the Klamath Basin which should be finalized in 2016.

Factors impacting bull trout populations include competition from non-native brown trout, sediment and other impacts from roads, lack of pool habitat from reductions in large wood input and road prisms located within the riparian corridor.

Preferred Management Actions:

- 1) Remove brown trout.
- 2) Estimate effective population size.
- 3) Add large wood throughout system.
- 4) Improve overwintering habitat in SF Sprague River.
- 5) Increase number of fluvial bull trout or understand what is limiting that life history expression.

Deming Creek Bull Trout Population:

Life History Type: Resident

Population Trend: No recent population estimate but likely upward trend despite climate due to extensive screening, passage, instream flow and habitat restoration projects.

Population appears stable with no significant population changes. Deming Creek is one of the healthiest bull trout populations within the Klamath Basin. This might be due to overlap with adfluvial redband trout from Campbell Reservoir and the lack of competition and hybridization with brook trout and brown trout. The last population estimate, conducted in 2005, was 1,316. Fish species present in Deming Creek include bull trout, redband trout, speckled dace and Pit-Klamath brook lamprey.

Distribution: Currently bull trout have been documented from the head waters of Deming Creek downstream to just below the Deming Creek diversion. One bull trout diverted from Deming Creek through the irrigation diversion was found in the ditch to Campbell Reservoir. Bull trout distribution has shifted downstream when comparing 2006 results with those of 1997. Under the current Deming Creek Ranch water management, bull trout distribution has expanded downstream with the ability to begin expressing a fluvial life history.

Recent findings: In 2007 adfluvial adult redband trout from Campbell Reservoir were found in the bull trout reach. Young of the year bull trout were found with young of the year redband trout.

Deming Creek fish passage was improved in 2012 with the addition of a bottomless culvert on Forest Service property at the uppermost crossing.

The property directly downstream of Forest Service property, Deming Creek Ranch, was purchased by Dan Kominek founder of Wildlands in California in 2009. Changes in management on Deming Creek Ranch include abiding by the water right, two fish screens, riparian fencing, off stream watering, large wood addition, culvert barrier removal, instream flow acquisition of 1.8 cfs up to 6 cfs in spring, channel reconnection to South Fork Sprague, and one mile of new South Fork Sprague River channel.

In 2014, bull trout were found lower than ever documented, below a culvert barrier on the Deming Creek Ranch, which was subsequently removed in 2015. One adult and one juvenile bull trout were captured.

Factors impacting Deming Creek bull trout include reduced flows from irrigation and the lack of large wood and associated pool habitats. One of the prior limiting factors was unrestricted livestock grazing. Deming Creek Ranch has fenced most of Deming Creek from cattle use.

Preferred Management Actions:

- 1) Monitor lower section of Deming Creek on Deming Creek Ranch for presence of bull trout and abundance of redband trout.
- 2) Add additional large wood on Deming Creek on the USFS and Green Diamond properties.
- 3) Screen irrigation diversion at Campbell Road.
- 4) Limit brown trout invasion into Deming Creek.
- 5) Increase number of fluvial bull trout or understand what is limiting that life history expression.

Boulder/Dixon Creeks Bull Trout Population

Life History Type: Resident with limited expression of fluvial life history in North Fork Sprague River.

Population Trend: No recent population estimate but smallest known bull trout population in Klamath Basin.

Boulder/Dixon bull trout populations are small and tenuous. The bull trout population in Boulder Creek was estimated at 219 in 1989 and 362 +/- 62% in 2006. A population estimate on Dixon Creek (tributary to Boulder Creek) was not conducted due to low numbers of bull trout in the stream and habitat complexity. Both native redband trout and non-native brown trout are present in bull trout occupied habitat but the core of the bull trout population is allopatric in Boulder Creek.

Distribution: In 2012, bull trout were found 0.5 km upstream of the mouth of Boulder Creek, indicating a downstream expansion of the Boulder Creek population. . The Dixon Creek population appears to exist only in the South Fork and North Fork. Brown trout dominate the fish assemblage in mainstem Dixon Creek.

Recent findings: Five bull trout were captured in South Fork (SF) Dixon Creek during an electrofishing effort in 2006; however brown trout dominated the sample. The better habitat of North Fork Dixon Creek was not sampled in 2006 due to beaver dam complexes and extreme habitat complexity but bull trout were subsequently found in North Fork Dixon in 2007.

Boulder Creek was sampled on August 24, 2012, by electrofishing from the confluence of Dixon Creek to the perched culvert crossing on NF-3595 road. A total of 127 brown trout, five redband trout and eight bull trout were captured in 4459 seconds of electrofishing. Redband trout were measured up to 275 mm and in excellent condition. Numerous large brown trout were captured up to 375 mm. The pool below the NF-019 road culvert contained five brown trout over 200 mm. Bull trout were more numerous progressing upstream towards the culvert. The largest bull trout captured was 130 mm. Surprisingly, in the summer of 2013 fish salvage by USFS at the NF-019 road culvert resulted in the capture of only eight bull trout.

Boulder Creek was electrofished for 2089 seconds from the confluence to gps coordinates 42.51607°N, -120.9842°W on August 27, 2012. While brown trout were numerically more abundant (n=28) than redband (n=21), redband exceed brown trout in biomass due to their larger size (maximum length 320mm versus 60 mm of browns). This section is high gradient with large substrate. One 130 mm bull trout was captured below the confluence of Dixon Creek at gps coordinates 42.51694°N, -120.94021°W.

Dixon Creek was also sampled on August 27, 2012, from the mouth upstream through a long, steep cascade. Only redband trout were found near the confluence and no fish were found in the cascade in 437 seconds of electrofishing. This is the first documentation of redband trout in Dixon Creek.

In lower Dixon and Boulder Creeks, brown trout displace bull trout. Fish passage is impaired at culvert crossings on North Fork Dixon Creek but all other culverts have been replaced. The NF-019 road culvert was replaced by a fish friendly culvert in 2013 on Boulder Creek and 2012 on SF Dixon Creek.

Changes in timber and livestock management practices within occupied bull trout habitat has improved riparian and instream habitat. Sediment input from roads is excessive. The development of methods to begin addressing interspecific competition with non-native brown trout should be a high priority.

Preferred Management Actions:

- 1) Consider removing brown trout from Dixon Creek and constructing barrier at existing steep cascade at mouth.
- 2) Remove brown trout from Boulder Creek.
- 3) Replace culvert at North Fork Dixon Creek at NF-019 road crossing.
- 4) Estimate effective population size.
- 5) Monitor distribution and abundance response of brown trout population above NF-019 road culvert.
- 6) Increase number of fluvial bull trout or understand what is limiting that life history expression.

North Fork Sprague River Bull Trout Population

Life History Type: Likely fluvial fish that spawn in Boulder and Dixon Creeks

Population Trend: Bull trout in the North Fork of the Sprague River are extremely rare.

Critical habitat was finalized on North Fork Sprague in 2010 to include the North Fork Sprague above the NF-3411 road and tributaries Boulder, Dixon, Gearhart, Nottin, Hole, School, Deadcow and Gold Creeks.

Distribution: Bull trout have been found by snorkeling below the mouth of Boulder Creek in 1998 and by angling above Boulder Creek in 2014.

Recent findings: Bull trout were not observed during snorkel surveys in 2006 and 2014. ODFW Klamath District staff snorkeled from the mouth of Boulder Creek to the North Fork Sprague hydroelectric dam (RM 14) in 2014. Electrofishing efforts at mouth of Sheepy Creek in 2014 only resulted in capture of brown, brook and redband trout. However, anglers have reported capturing bull trout in the North Fork Sprague River at the elbow on numerous occasions (May 22, 2010 pers.com. Randy Rigdon). One angler catch report in the North Fork Sprague River was verified, by photo, in 2014, just above the confluence with Boulder Creek (Jared Botcher Fish Biologist BOR photo). The “elbow” is located below the Boulder Creek confluence on the North Fork of the Sprague River. Bull trout in the North Fork Sprague River likely spawn in Boulder or Dixon Creeks.

In 2010 and 2011 District staff surveyed tributaries to North Fork Sprague River including School Creek and tributaries, Gearhart Creek, Nottin Creek, Hole Creek, Gold Creek, Deadcow Creek and tributaries and Cold Creek. All these streams were dominated by brook trout. Brook trout have likely completely displaced bull trout populations in School Creek, Deadcow Creek, Gold Creek, Upper North Fork Sprague, Gearhart Creek, Nottin Creek, Cold and Meryl Creeks. Brown trout populations are robust in the North Fork Sprague, Meryl, Boulder/Dixon and Fivemile Creek. The NF Sprague is a stronghold for brown trout and has one of the highest densities in the Klamath Basin.

The North Fork Sprague River at the elbow (NF-3411 Road) had an undersized culvert which limited upstream movement of bull trout. In 2012 OWEB funds were utilized, in partnership with the USFS, to remove the culvert and replace with a bridge.

The ODFW Central Point Screen shop screened the largest diversion on NF Sprague at the elbow (RM 12) in 2014. This diversion can divert up to 60 cfs. Most instream flow in the summer is diverted.

Preferred Management Actions:

- 1) Improve passage at the hydroelectric dam in summer.
- 2) Improve riparian and instream habitat conditions and water temperature regime in North Fork Sprague River above Gearhart Creek by better grazing management and large wood additions.
- 3) Acquire instream flows below the NF-3411 road crossing irrigation diversion (North Ditch).

- 4) Identify a reach of the mainstem North Fork Sprague River and tributaries to remove brook trout, construct barrier and reintroduce bull trout.

Sheepy Creek Bull Trout Population

Life History Type: Unknown

Population Trend: Likely extirpated or fish only stray into stream during high water years. This stream was not listed as critical habitat by USFWS in 2010.

Sheepy Creek is a very small and steep stream at the mouth. Habitat conditions range from fair to good. Brown trout, redband trout and bull trout were present in 1998 surveys but these surveys are suspect and might have sampled North Fork Dixon Creek instead of Sheepy Creek. Surveys by ODFW Native Fish Investigations in 2006 found no fish present.

Distribution: No fish found in last sampling effort in 2014.

Recent Findings: District staff sampled Sheepy Creek by electrofishing from the mouth to the end of water in 2014. No fish were found.

Passage at mouth, stream size, lack of pools, and culvert crossings with poor fish passage might reduce fish residence in the stream. Water temperatures are very cold in the Sheepy Creek below the NF-019 road. A large spring occurs just below the NF-019 road that supplies much of the flow in Sheepy Creek. Sheepy Creek should support fish. An improvement in large wood density and improved fish passage at the NF-019 road and upstream could improve the potential for this stream to support fish. The lower section of Sheepy Creek is very steep and likely not fish habitat

Preferred Management Actions:

- 1) Improve fish passage at the two culverts at NF-019 road and the perched culvert on the 710-40 road.
- 2) Add large wood to the stream.
- 3) Extensively monitor for fish. If no fish found work with landowner, Green Diamond to reintroduce bull trout.

Tributaries of the Sycan River Bull Trout Populations:

Long Creek Bull Trout Population:

Life History Type: Isolated Resident above manmade waterfall barrier and limited fluvial expression below waterfall.

Population Trend: Likely declining due to brook trout interactions and a warmer climate however recent surveys have shown a steep decline in brook trout and hybrid density above the barrier waterfall in 2013 and 2014.

Habitat conditions in Long Creek are relatively good. Long Creek bull trout management activities should focus on brook trout eradication efforts. Critical habitat is designated along the entire length of Long Creek to confluence with Sycan River in the Sycan Marsh.

Distribution: Bull trout are found in good numbers downstream to the 400-00 road crossing. Bull trout have been found to enter the Sycan Marsh area by radio telemetry in 1999. Nature Conservancy fish staff captured small juvenile bull trout in weir traps below the NF-27 road in the early 2000's. The use of lower Long Creek (below confluence of Calahan Creek) by bull trout likely only occurs seasonally from October to June.

Recent findings: In 2008 a mark-recapture population estimate was performed from the water falls downstream to the 400-00 road. The mark-recapture method calculated 288 +/- 32% (>100 mm) bull trout in this 1.2 mile reach. Eleven fluvial bull trout ranging in length from 230-360 mm. Five fluvial hybrids (brook/bull) over 220 mm were also captured.

In general, brook trout dominated the reach as 253 were captured and euthanized. Brook trout abundance increased moving downstream to the 400-00 road. At the 400-00 road Long Creek was dominated by brook trout. A few bull trout were captured downstream of the 400-00 road approximately 400 meters.

Mark-resight and recapture population estimates for adult bull trout (>140mm) were also conducted in 2013 and 2014 from the 400-00 road upstream to the end of bull trout distribution (Table 3). The total expanded population estimate for adult bull trout from the 400-00 road crossing to the end of distribution was 507 +/- 33% in 2013 and 445 +/-13.2% in 2014. During sampling most, if not all, adult bull trout were found in the reach from 400-00 road crossing upstream. For comparison, Native Fish investigations and District staff collected age 0+ (25-60mm) and 1+ (60-100mm) bull trout for genetic analysis from above the 400-00 road crossing in 2013 (110 samples) and at randomly selected sites from the NF-27 road crossing upstream to the end of bull trout distribution in 2014 (247 samples). Only one bull trout was found below the 400-00 road in 2014 sampling. The genetic analysis was used to estimate effective population size. A very early preliminary estimate of the bull trout effective population size by ODFW Native Fish Investigations ranged from 17-35 adult bull trout. Past effective population size estimates above the falls were 36-119 using a different protocol (ODFW 2000). The estimate of effective population size is alarmingly low and assumptions of the model might not be met.

Bull trout spawning surveys were completed on Long Creek on October 7-8, 2015 from the 400-00 road crossing to the end of distribution. A total of 49 redds were observed from the falls to the

end of distribution. An additional 22 redds were observed from the 400-00 road to the falls. Brook trout were observed on redds below the falls and were especially abundant just upstream and downstream of the 400-00 road. A night snorkel survey was conducted from 0.5 mile upstream of 400-00 road to waterfalls. Redds marked by flagging of previous spawning surveys were snorkeled as well as all pools. Number of bull trout observed was surprisingly low of 34 whereas 50 brook trout, 8 hybrids and 4 redband trout were observed. Bull trout were not observed to be paired on any flagged redd sites. Bull trout appeared to be potentially paired with brook trout and/or hybrids on 7 redds with one fluvial bull trout (300 mm) with brook trout and hybrids.

Table 3. Long Creek adult bull trout mark-resight (recapture) population estimate at four randomly selected sites from 400-00 road to end of distribution in the years 2013 and 2014.

| Year | <i>n2</i> | <i>n1</i> | <i>m</i> | N | SE | +/- | %(+/-) | Adults/ m² |
|--------------------|--|-----------|----------|----------|-----------|------------|---------------|------------------------------|
| 2013 all sites | 87 | 88 | 19 | 391 | 66 | 130 | 33.2 | 0.03 |
| 2014 all sites | 193 | 140 | 69 | 390 | 26 | 52 | 13.2 | 0.02 |
| <i>n1</i> = | number marked in first capture event | | | | | | | |
| <i>n2</i> = | total number resight(unmarked +resight) in second capture event | | | | | | | |
| <i>m</i> = | number resight during second capture event | | | | | | | |
| <i>N</i> = | Bull trout adult estimate greater than 140 mm at four sites (not expanded) | | | | | | | |

Water samples were taken at 11 sites (10 Long and 1 Calahan) to monitor for brook trout and bull trout eDNA in 2014 (Figure 2). Brook trout eDNA were found at all eDNA sample sites including the upper-most site just above the West Fork tributary on Long Creek. Only one brook trout has ever been documented above this site and that was in 2013. However, large hybrids (220 mm) were found during electrofishing in 2013 and 2014 above this site. Bull trout eDNA was found downstream to the confluence of Calahan Creek but was not found in areas further downstream of Calahan Creek (Figure 2).

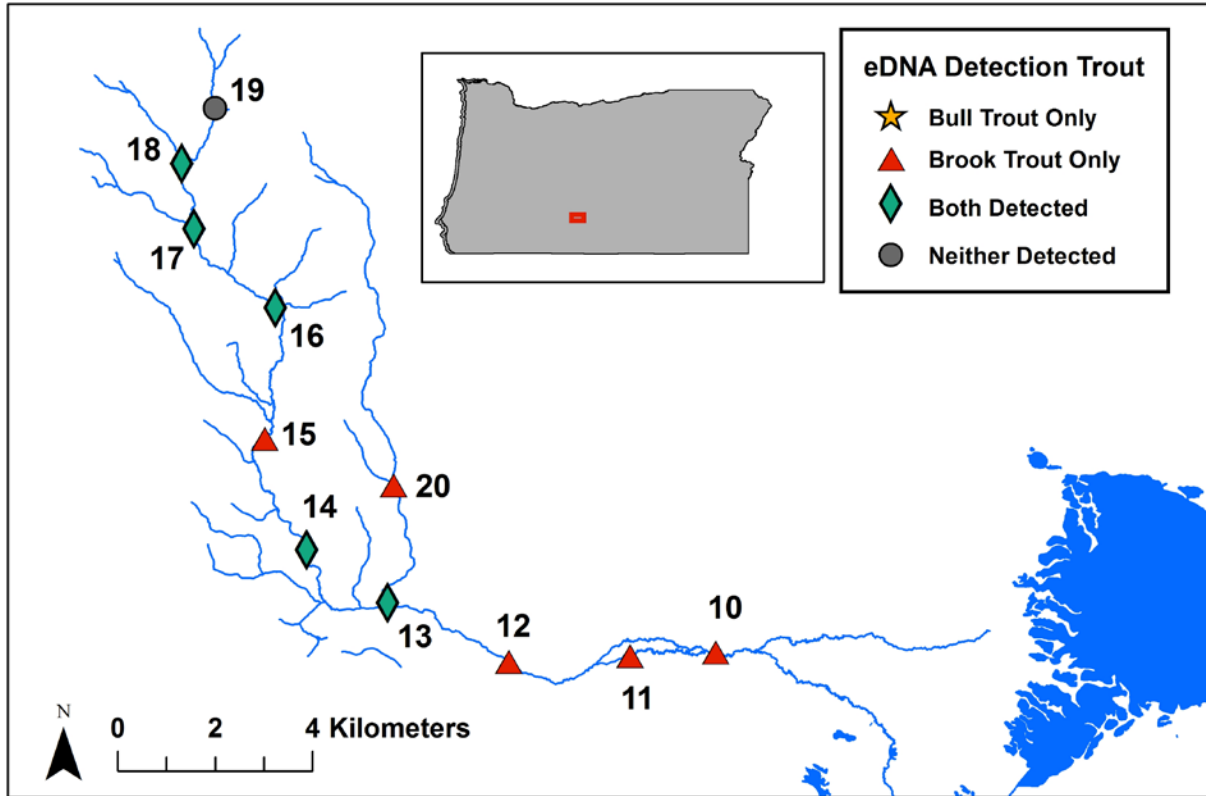


Figure 2. Sampling locations for brook trout and bull trout eDNA in Long (sites 10-19) and Calahan Creeks (site 20) in September 2014 (Carim et al. 2015).

Brook trout are the primary limiting factor for bull trout in Long Creek and tributaries. Fluvial brook trout have exceeded the size of documented fluvial bull trout. The lack of anadromous fish nutrient inputs further limits the population. The high density of roads in the watershed likely affects habitat and sediment inputs.

Preferred Management Actions:

- 1) The ODFW Klamath District has proposed constructing a barrier, which would include passing fluvial bull trout, and treating a section of Long Creek with rotenone. District staff is awaiting the results of the OSU decision support model to be completed in January 2016. The decision support model is looking at two different management scenarios 1) isolate bull trout population with barrier and remove brook trout (ODFW preferred option) vs. 2) manage bull trout population as is with brook trout and supposedly with fluvial bull trout (USFWS preferred option).
- 2) Screen the diversion immediately below the NF-27 road.
- 3) Increase number of fluvial bull trout by removing brook trout.

Coyote Creek Bull Trout Population:

Life History Type: Historically isolated resident

Population Trend: Extirpated. Designated as critical habitat but dominated by brook trout

Distribution: No bull trout have been documented in recent surveys of Coyote Creek.

Recent Findings: Brook trout are the most abundant fish in Coyote Creek and likely caused extirpation of bull trout. Current habitat conditions are excellent including numerous beaver dam complexes.

Preferred Management Actions:

- 1) Coyote Creek would be challenging to treat with rotenone due to the number of native fish species (speckled dace, redband trout and Miller Lake lamprey), beaver dams and likelihood of recolonization of brook trout from Long Creek through the Smalls ditch.

Calahan Creek Bull Trout Population:

Life History Type: Unknown?

Population Trend: Extirpated. Designated as critical habitat but dominated by brook trout.

Distribution: No bull trout were documented in 2013-2014 surveys of Calahan Creek.

Recent Findings: Calahan Creek was sampled from the headwater springs to the mouth in the summer of 2013 and 2014. Brook trout were the most abundant fish found and likely caused extirpation of bull trout. A few redband trout were found at the mouth. No other fish species occur in the stream. Feasibility of treating the stream with a successful rotenone project is high. Water samples from Calahan Creek show no presence of bull trout eDNA in the stream (Figure 2).

Preferred Management Actions:

- 1) The Klamath District has proposed constructing a barrier, treating the creek with rotenone and reintroducing bull trout to the stream in 2016 or 2017. District staff is awaiting the results of the Oregon State University decision support model to be completed in January 2016.
- 2) After successful rotenone treatment beavers should be encouraged to reestablish in the meadow section of Calahan Creek. Meetings with the landowner Green Diamond to discuss riparian management on the creek should occur.

Tributaries of Agency Lake Bull Trout Populations

Threemile Creek Bull Trout Population

Life History Type: Isolated resident above man-made barriers.

Population Trend: Population is significantly increasing in abundance.

The Threemile Creek bull trout population is small and tenuous. Occupied bull trout habitat is approximately 3.3 km in length. Habitat conditions in the occupied reach range from good to fair. In 2000, brook trout were successfully removed from the reach above the NF-34-110 culvert. Threemile Creek was treated below the NF-34-110 culvert in August 2010 to the lowermost barrier. Monitoring from 2011 to 2015 indicates no fish are present in this reach.

Distribution/location: In 2010, summer-time distribution of bull trout expanded 1 mile downstream to 150 m above the 110 culvert. Distribution has remained constant since 2010 with no movement below the NF 34-110 culvert.

Recent findings: A mark-resight population estimate was conducted during night snorkeling in August 2012. The total population of age 1+ and older bull trout was 577 +/-102 in the reach from 150 m above the 3519 bridge to the forks. The population has expanded from the original estimate of 50 in 1997 to likely over 600 bull trout distributed to the NF-110 road culvert in 2012. Population sampling has not been conducted since 2012.

Table 4. Mark-resight juvenile-adult bull trout population estimate with 95% confidence interval on Threemile Creek from 150 m above NF-3419 road crossing to forks in August 2012.

| Year | n2 | n1 | m | N | SE | +/- | %(+/-) |
|-------------|---|-----------|----------|----------|-----------|------------|---------------|
| 2012 | 291 | 98 | 49 | 577 | 52 | 102 | 17.6 |
| n1= | number marked in first capture event | | | | | | |
| n2= | total number resight(unmarked +resight) in second capture event | | | | | | |
| m= | number resight during second capture event | | | | | | |
| N= | Bull trout estimate age 1+ to adult | | | | | | |

The reach below the culvert barrier has been sampled annually since rotenone treatment in 2010. No fish have been found in this reach. In past brook trout removals, such as Upper Threemile and Sun creeks, bull trout were found to recolonize very slowly. Therefore, the lack of distribution expansion is not entirely surprising. Habitat conditions in the reach below the culvert should improve with the placement of 155 pieces of large wood in 2015. The lowermost barrier was also replaced in 2015 by a more stable concrete structure. As part of the annual surveys, the sampling will occur in the reach above the NF-110 road culvert until bull trout are found. In all surveys from 2010 to 2015, bull trout have been found a short distance upstream of the culvert.

Preferred Management Actions:

- 1) Restore the channelized section of Threemile Creek to a sinuous channel improving fish passage at the irrigation structures.
- 2) Restore Fourmile Creek to a sinuous channel.
- 3) Restore fish passage at the 34-110 culvert.

- 4) Develop a plan for the Crane Creek ditch. Potentially disconnect from Threemile as large source of brook and brown trout.
- 5) Remove brook trout if possible in Crane Creek and Threemile Creek
- 6) Restore adfluvial redband trout or fluvial bull trout to stream and pass over barriers

Sun Creek Bull Trout Population:

Life History Type: Isolated resident above manmade barriers but fish trap exists to transport fluvial bull trout once reestablished. However, bull trout have been found below the barriers and movement of bull trout is increasing.

Population Trend: Upward trend. The population continues to increase in size and distribution.

The Sun Creek bull trout population exceeds 2000 individuals and is the largest in the Klamath Basin. Most bull trout are located within the boundaries Crater Lake National Park though bull trout have recently been found within the Sun Pass State Forest on Oregon Department of Forestry (ODF) land. Impacts from non-native brook trout and brown trout limit this bull trout population. Historically, Sun Creek was diverted and re-routed into Annie Creek. Annie Creek substrate is dominated by glacial till and considered fair habitat for bull trout. In 2011 two barriers were constructed on ODF land, with the lowermost barrier equipped with a fish trap to pass native fish. PIT tag arrays were placed on the two new barriers and both bull trout and brook trout were tagged to monitor their movement.

Distribution: Bull trout distribution has increased since 2010. Bull trout are now located throughout Sun Creek on Crater Lake National Park and most of Sun Pass State Forest to the lower-most barrier. In 2012 and 2013, bull trout were also found below the lower-most barrier during an antimycin treatment. Recent anecdotal reports of bull trout have been reported by anglers in Annie Creek and Wood River.

Recent Findings:

Sun Creek was treated with antimycin from the barrier on Crater Lake National Park to the bridge crossing on Sun Pass State Forest in August 2012. Bull trout were more numerous in this reach than anticipated and more than 40 mortalities were observed. Most bull trout were in the size range of 90 to 120 mm. No adult bull trout were observed. Bull trout were encountered as far downstream as the private property boundary.

Sun Creek was treated with antimycin again in 2013 on Sun Pass State Forest from the Crater Lake boundary downstream to the bridge crossing. Prior to the treatment, Crater Lake Park staff and ODFW salvaged 88 bull trout and transferred them above the treatment. Forty-seven bull trout mortalities were observed as the result of the 2013 treatment. Bull trout were more numerous in the treatment reach than anticipated which bodes well for the future but the loss of bull trout during the treatment was unfortunate. Bull trout mortalities ranged from 107 to 260 mm in length. Most bull trout were of adult size greater than 160 mm but were immature with only three out of the 47 being mature males. Bull trout were in excellent condition with an average relative weight of 130. The 260 mm bull trout was the largest ever bull trout observed in Sun Creek. A total of three brook trout mortalities were found in the treatment reach. These brook trout had apparently survived the treatment in 2012.

On September 17, 2013 Lost Creek on Crater Lake Park was electrofished to recapture six bull trout placed there in 2012 prior to the Sun Creek antimycin treatment. Twelve bull trout were captured in 1850 seconds of electrofishing, ranging in size from 75 mm to 200 mm. Two bull trout (ca. 160 mm) that appeared paired for spawning were missed. Three of six PIT tagged bull trout from Sun Creek were captured. A total of six bull trout were transferred to Sun Creek below the Crater Lake Park boundary.

Klamath Basin Rangeland Trust, USFWS and Trout Unlimited are creating a new Sun Creek channel to reconnect with the Wood River near the headwaters. The channel is expected to be activated in late June 2016. Additionally, Trout Unlimited is investigating the acquisition of 2 cfs of instream flow for the new Sun Creek channel

Preferred Management Actions:

- 1) Treat Sun Creek in 2016 with rotenone from lowermost barrier to start of new channel.
- 2) Improve rearing habitat in the Wood River from headwaters to Annie Creek.
- 3) Improve number of adfluvial redband trout spawners in the Wood River (food for bull trout).
- 4) Screen the Melhase Ditch in 2016 and Wood River Canal in 2017.
- 5) Reintroduce chinook salmon to Wood River (food for bull trout)
- 6) Increase number of fluvial bull trout or understand what is limiting that life history expression.
- 7) Operate Sun Creek trap on the lowermost barrier more frequently (May-October).
- 8) Work with Crater Lake Park to reduce number of brook and brown trout that will reinvade lower Sun Creek.
- 9) Assist Crater Lake Park with monitoring fish populations in Sun Creek from mouth to Crater Lake Park boundary using video weir monitoring and electrofishing.

Lost River Sucker: (*Deltistes luxatus*)



Figure 3. Lost River sucker captured in Agency Lake by trap net in 2011.

Life History Type: Adfluvial with spawning timing from late February-May peaking in April.

Status: Federal and State ESA Endangered and declining.

Distribution: Currently occupy Upper Klamath and Agency Lakes, Link River, Lake Ewauna, Klamath River, Lost River, Sprague River, Sycan River, Wood River, Sevenmile Creek?, and Williamson River. Upper Klamath Lake contains the largest remaining population of Lost River suckers.

Recent findings: USGS continues to monitor Lost River sucker survival and population growth (Hewitt et al. 2015). PIT tag receiver arrays in Upper Klamath Lake, Williamson River and Sprague River are used to detect spawning migrations of tagged fish and to estimate annual survival probabilities using the Cormack-Jolly-Seber (CJS) open population capture-recapture model. A reverse time analog of the CJS model is used to estimate recruitment of new individuals into the spawning population. Length-frequency corroborates the recruitment into the adult population. The model estimates of survival and recruitment are then used to estimate the change in population abundance over time (Hewitt et al. 2015).

In 2014, 1,466 Lost River suckers were captured in Upper Klamath Lake during spawning, 970 of which had been tagged in previous years (Hewitt et al. 2015). In the Williamson River, 3,800 Lost River suckers were captured, of which 762 had been tagged in previous years. In Upper Klamath Lake 6,370 Lost River suckers were detected by PIT arrays during the spawning season at springs utilized for spawning along the east shoreline. In the Williamson River, 3,038 Lost River suckers were captured and an additional 762 that had been tagged in previous years. In the Williamson and Sprague rivers, a total of 23,446 Lost River suckers were detected at PIT arrays.

An additional 375 Lost River suckers were captured during pre-spawn staging in Upper Klamath Lake, of which 111 had been previously tagged (Hewitt et al. 2015).

Based on 13,200 individual encounter histories of lakeshore spawners and 36,400 encounter histories of river spawners, the survival of males and females of both sub-populations is estimated to be greater than 0.88 between 1999 and 2012 (Hewitt et al. 2015). However, between 2001 and 2013 the abundance of male and female lakeshore spawners has decreased by 55 and 42 percent, respectively. This could be due to poor survival for both sexes in 2000, for male shoreline spawners in 2002 and male river spawners from 2006 to 2012. In the river spawning sub-population, the abundance of females declined by approximately 52 percent and males decreased by 61 percent (Hewitt et al. 2015).

However, despite relatively high survival in most years, USGS concludes that both Lost River and shortnose suckers “have experienced substantial decreases in abundance of spawning adults because losses from mortality have not been balanced by recruitment of new individuals (Hewitt et al. 2015).” While the capture-recapture data indicate recruitment of new individuals into the spawning populations, the size composition data do not corroborate estimates. USGS concludes that “the status of the endangered sucker population remains worrisome, especially for shortnose suckers (Hewitt et al. 2015).”

The USFWS released the Recovery Plan and critical habitat designation in 2012 for Lost River and shortnose suckers (USFWS 2012). USFWS also updated their 5-Year Status Review of Lost River and shortnose suckers in 2013 (USFWS 2013).

Two major improvements in habitat connectivity and availability have occurred in recent years. The first major improvement to habitat connectivity was the removal of the Chiloquin Dam in 2008, which allows migrating adults and larvae access to approximately 75 miles of potential spawning habitat and migration corridor. The second major improvement was the restoration of the freshwater marsh where the Williamson River entered Upper Klamath Lake, known as the Williamson River delta. Approximately 6,000 acres of potential rearing habitat for larvae and juveniles were reconnected to the lake and river when levees were breached in 2008 and 2009. However, because these efforts are relatively recent, population-level responses by Lost River sucker are not yet apparent.

Water quality in Upper Klamath Lake is poor due to excessive nutrients and algae growth which can increase the pH and cause fluctuations in dissolved oxygen, as well as produce toxins (USFWS 2013). All Lost River sucker life stages (larvae, juveniles, and adults) in the Upper Klamath Lake watershed are almost entirely confined to the lake during the summer when water quality is poor, the entire population in the watershed is vulnerable to alterations of the habitat due to poor water quality. Keno Reservoir also frequently and persistently experiences extremely poor water quality conditions due to the considerable amounts of organic materials passing from Upper Klamath Lake to Keno Reservoir through the Link River (USFWS 2013).

Microcystin is a toxin produced by algae, *Microcystis aeruginosa*, that primarily affects the liver causing a variety of symptoms, but it can also affect the intestines, kidneys, heart, spleen, and gills. In a 2007 survey, 49 percent of a sample of juvenile suckers (all species) from Upper Klamath Lake exhibited indications of microcystin exposure (USFWS 2013). One hypothesis is that the toxin is secondarily ingested when suckers consume midge larvae (Chironomidae),

which feed on the algae (Vanderkooi et al. 2010). Further investigations are required to better understand the degree to which these toxins threaten the Lost River sucker within Upper Klamath Lake.

The Klamath Indian Tribe collected approximately 1,066,175 sucker eggs from late March to May 2015. Out of these, approximately 400,000 to 600,000 larvae were produced at Crooked Creek springs at hatchery and Harriman Springs. No attempts were made to count or measure mortality or survival during the incubation period. Fungus was expected to be the primary cause of mortality and was estimated to cause 5-10% mortality in Lost River sucker gametes (personal communication, R. Leary, The Klamath Tribes).

Movement of fish into irrigation systems through unscreened diversions was identified as a threat to the suckers at the time of listing (USFWS 1988). Bureau of Reclamation's (BOR) A-Canal has been fitted with a fish exclusion screen but PacifiCorp's hydroelectric and BOR's irrigation intakes at the Link River Dam and elsewhere in Upper Klamath Lake have no structures to prevent fish entrainment. Seven hundred fifty-two (752) juvenile suckers, age 1-3, (both Lost River and shortnose) were salvaged in BOR's A-Canal forebay in 2015 (personal communication, T. Tyler, BOR). Sucker numbers salvaged from the A-Canal forebay has ranged from 12 to 250 in the previous 12 years. Suckers are also salvaged annually from BOR's other irrigation canals when they are drained at the end of the irrigation season. The total number of suckers salvaged from BOR canals in 2015 was 1013. The number of salvaged suckers has ranged from 96 to 1202 and does not appear to be related to the A-Canal salvage abundance or population estimates. Salvaged suckers are PIT tagged and transported to Hagelstein Park (personal communication, T. Tyler, BOR).

Shortnose Sucker: (*Chasmistes brevirostris*)



Figure 4. Shortnose Sucker from Upper Klamath Lake (USGS Photo)

Life History Type: Adfluvial with spawning timing from March-June peaking in May.

Status: Federal and State ESA Endangered and declining rapidly

Distribution: Currently occupy Upper Klamath and Agency Lake, Link River, Lake Ewauna, Klamath River, Lost River, Sprague River, Wood River, Sevenmile Canal?, Williamson River, Gerber Reservoir, and Miller Creek. Upper Klamath Lake contains one of the largest remaining populations of shortnose suckers.

Recent Findings: USGS continues to monitor shortnose sucker survival and population growth (Hewitt et al. 2015). PIT tag receiver arrays in Upper Klamath Lake, Williamson River and Sprague River are used to detect spawning migrations of tagged fish and to estimate annual survival probabilities using the Cormack-Jolly-Seber (CJS) open population capture-recapture model. A reverse time analog of the CJS model is used to estimate recruitment of new individuals into the spawning population. Length-frequency is used to corroborate recruitment into the adult population. The model estimates of survival and recruitment are then used to estimate the change in population abundance over time (Hewitt *et al.* 2015).

In 2014, 423 shortnose suckers were captured in the Williamson River during spawning, 156 of which had been tagged in previous years (Hewitt et al. 2015). Only one (1) shortnose sucker, a female, was captured at the springs in Upper Klamath Lake in 2014. Thirty five (35) shortnose suckers were detected by PIT arrays at shoreline spawning areas in Upper Klamath Lake during the spawning season. Thirty one (31) of the 35 (89%) were also detected in the Williamson River. An additional 884 shortnose suckers were captured during pre-spawn staging in Upper

Klamath Lake, of which 390 had been previously tagged (Hewitt et al. 2015). Total tagged individuals detected in spring 2014 was approximately 6,200 (D. Hewitt, personal comm.).

Based on encounter histories of more than 19,200 individuals, the annual survival estimates between 2001 and 2012 were high (greater than 0.80; Hewitt et al. 2015). However, shortnose suckers experienced more years of low survival than Lost River suckers. In 2004, 2010 and 2012, annual survival of both sexes was low, as well as for males in 2002. Between 2001 and 2013 the abundance of male and female shortnose suckers is estimated to have decreased by 77 and 73 percent, respectively (Hewitt et al. 2015).

Despite relatively high survival in most years between 2001 and 2012, USGS concludes that both Lost River and shortnose suckers “have experienced substantial decreases in abundance of spawning adults because losses from mortality have not been balanced by recruitment of new individuals (Hewitt et al. 2015).” While the capture-recapture data indicate recruitment of new individuals into the spawning populations, the size composition data do not corroborate estimates. Based on length data from the past 16 years, the population “consists almost entirely of similarly sized individuals growing through time with little evidence of recruitment (Hewitt et al. 2015).” USGS concludes that “the status of the endangered sucker population remains worrisome, especially for shortnose suckers (Hewitt et al. 2015).”

As the shortnose sucker population continues to be made up of older age individuals the risk for extinction is more dire for shortnose than Lost River suckers. However, the population in Gerber Reservoir is robust with a healthy age class distribution. Systematics of the Gerber Reservoir population is currently under review as the population in the reservoir has diagnostic traits of both largescale and shortnose suckers.

Recent efforts have been under taken that have focused on the poor water quality in Upper Klamath Lake and the lack of survival of juvenile suckers from age 0 to age 1. Efforts to improve habitat include the restoration of the Williamson River Delta by levee removal in 2008 and 2009.

Nearly all shortnose sucker adults from Upper Klamath Lake exclusively utilize the lower Williamson and Sprague Rivers to spawn (USFWS 2013). The population in Gerber Reservoir is known to spawn in Ben Hall Creek and Barnes Valley Creek, which includes several tributaries as well. No other substantial spawning congregations are known to occur, but some minimal spawning may also occur throughout the Lost River, including the Big Springs area (near Bonanza, Klamath Co., Oregon).

Fish passage on the Sprague River has been improved through the removal of Chiloquin dam in 2008. While most Lost River and shortnose suckers are still spawning in the Williamson and lower Sprague Rivers, researchers have observed an increase in the numbers of fish moving into the reach upstream of the dam site. In the spring of 2008 with the dam still in, USGS researchers detected approximately 100 of the endangered suckers on a PIT tag array located 2.5 km upstream of the dam. In 2009 with the dam out, USGS researchers detected approximately 1300 endangered suckers on the same array. In 2014, USGS detected 390 endangered suckers at the array above the old dam.

Fish passage at the Link River Dam has been improved with the addition of a vertical slot fish ladder. However, sucker use of the ladder is very low. In 2015 USFWS has installed a pit tag array in the Link River to better understand sucker life history in Lake Ewauna and Link River. In May 2008 ODFW District staff observed spawning behavior of suckers in the Link River. No one has studied whether sucker spawning in the Link River is successful.

Klamath Largescale Sucker: (*Catostomus snyderi*)



Figure 5. Largescale sucker radio tagged at Chiloquin Dam on Sprague River (USGS Photo)

Life History Type: Resident (including above barriers), fluvial and adfluvial (rare) with spawning from March-May with peak in April.

Status: Federal Species of Concern, Native Migratory Fish and Tribal Trust species.

Population Trend: No data but likely downward as many tributaries were dry in 2015 (i.e. Sycan River)

Distribution: Williamson River, Upper Williamson River, South Fork and North Fork Sprague, Fishhole Creek, Sprague River, Fivemile Creek, Whiskey Creek, Sycan River, Wood River, Crooked Creek, Agency Lake, Upper Klamath Lake, Lake Ewauna, Link River, Klamath River, J.C. Boyle Reservoir (Moyle 2002) and Lost River watershed.

Recent findings: Electrofishing surveys typically do not find suckers. In 2006 one largescale sucker (175 mm) was found in Whiskey Creek (RM 6.2) above passage barriers adjacent to highway 140. Several juvenile largescale suckers were captured while electrofishing in NF Sprague River and Fivemile Creek in 2007. Klamath largescale suckers were found up to rivermile 84 on the Upper Williamson in electrofishing surveys

Monitoring last occurred in 2008 when the Chiloquin Dam on the Sprague River (RM 2) was removed. Radio tagged suckers at Chiloquin Dam made long migrations to the Upper Sprague River and the Coyote Bucket area of the Sycan River. Klamath largescale suckers were found in Agency Lake and the Wood River in 2011 during sampling for redband trout. Their numbers appeared low in these systems.

USGS continues to capture largescale sucker while sampling for endangered suckers in Upper Klamath Lake and the Williamson River. USGS reports between 2010-2015, USGS captured or detected 1533 (1020 Female, 470 Male, 43 Unk), individual Klamath Largescale suckers (KLS) throughout Upper Klamath Lake and the Williamson, Wood and Sprague rivers. Of the KLS captured or detected between 2010-2015 close to 70% were originally tagged between 1995-

2009 at the Chiloquin Dam fish ladder. In recent years, the majority of KLS are captured and tagged around Modoc Point and Goose Bay in early spring. Throughout the spawning season, the largest numbers of KLS are detected migrating up the Williamson River and into the Sprague River system. Some individuals are also detected at remote PIT tag locations on the Wood River as well but to a much lower extent. Since the operation of the PIT tag readers on the Wood River in 2012, only 9 individual tagged KLS have been detected in that system (3 in 2012, 2 in 2013, and 4 in 2015).

Preferred Management Actions

- 1) Improve habitat and water quality/quantity conditions in the Sprague River including North and South Forks.
- 2) Restore the Whiskey Creek system.
- 3) Reduce predation and competition with nonnative fish such as largemouth bass, brown bullhead, yellow perch and fat head minnow especially the mainstem Sprague River.

Smallscale Sucker: (*Catostomus rimiculus*)



Figure 6. Smallscale sucker in spawning colors from Spencer Creek in May 2004.

Life History Type: Resident, fluvial and artificial adfluvial in J.C. Boyle Reservoir (rare)

Status: Native Migratory Fish

Population Trend: Unknown but the Klamath Hydroelectric project has limited population productivity, distribution and diversity.

Distribution/location: Klamath River below Keno Dam and Spencer Creek

Recent findings: Smallscale suckers were the dominant fish in drift boat electrofishing sampling in 2003 in the Klamath River below the powerhouse from BLM Campground (RM 216) to Frain Ranch (RM 214). Good numbers of smallscale suckers were observed spawning in Spencer Creek near the 400-00 road crossing in May 2012.

Preferred Management Options

- 1) Provide fish passage at JC Boyle Dam either by breaching or a new fish ladder.
- 2) Reduce flow fluctuations below the powerhouse on the Klamath River and designate ramp rate to 1-2 inches per hour.
- 3) Increase minimum flow in the bypass reach of the Klamath River.
- 4) Reduce predation by largemouth bass, yellow perch, crappie, fat head minnow
- 5) Reduce competition with goldfish, pumpkinseed and aforementioned fish in J. C. Boyle Reservoir either by returning the reservoir to a lotic state or increasing harvest of these species.

Jenny Creek Sucker (*Catostomus rimiculus*)



Figure 7. Jenny Creek suckers (Photo Credit: BLM)

Life History Type: Resident and fluvial above impassable waterfall.

Status: Federal Species of Concern, Oregon Conservation Strategy Species and Native Migratory Fish.

Population Trend: Upward trend when compared to numbers in 1992-1993 and 2003-2004.

Distribution: Jenny Creek suckers are an isolated population of Klamath smallscale suckers separated from the Klamath River by a large, natural waterfall. Jenny Creek suckers are located from the falls on Jenny Creek, located approximately 3.5 km upstream from the confluence with Iron Gate Reservoir on the Klamath River, upstream to rkm 33 downstream of Howard Prairie Reservoir including tributaries Johnson Creek, lower Beaver Creek, lower Coral Creek, lower Keene Creek and Oregon Gulch Creek.

Recent findings: The Medford BLM conducted snorkel surveys in 1992, 1993, 2003 and 2004 which indicated that the abundance had declined in the 2000's with older age classes missing (Figure 8, Rossa and Parker 2007). The snorkel surveys were repeated in 2010 and found an increase in overall abundance (Figure 8) and a higher abundance of older fish, though Age 4 still appears to be missing (Figure 9, personal communication, C. Volpe (BLM Fish Biologist)). Very preliminary population estimates have been calculated for 33.8 km of mainstem habitat in Jenny Creek. A total population estimate of 6,520 suckers were estimated by sampling 23 habitat units which totals 2,382 m and 13,659m² of habitat area with 193 suckers/km in six reaches with a range of 107-264 at a density of 0.04 sucker/m² (C. Volpe (BLM Fish Biologist)).

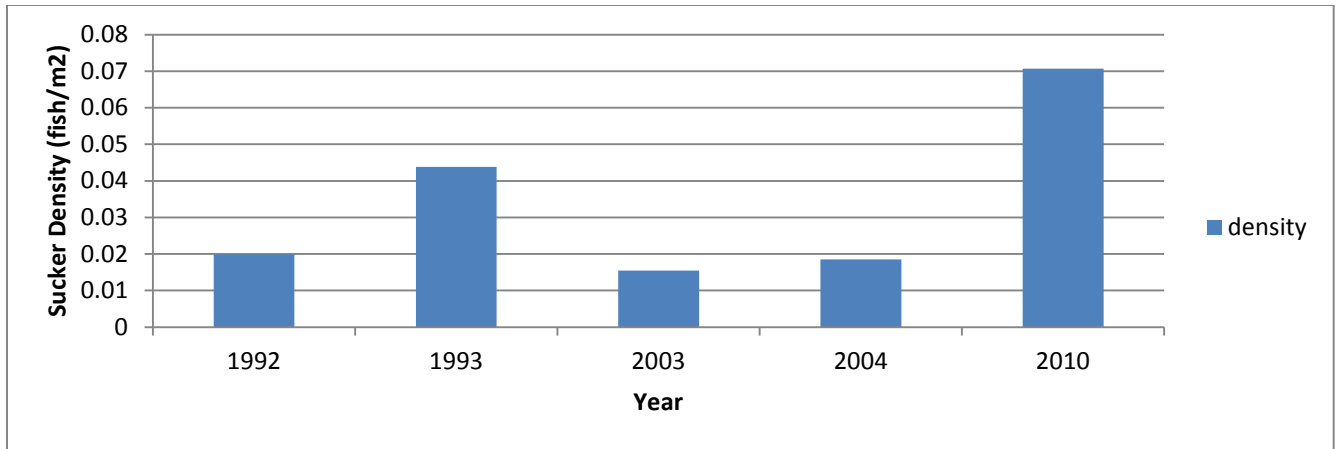


Figure 8. Total average sucker density in Jenny Creek sucker monitoring sites in Jenny Creek (Medford BLM data).



Figure 9. Total average sucker density by age classes in Jenny Creek sucker monitoring sites (Medford BLM Data).

In 2004 ODFW cooperated with BLM to complete an aging study to compare age and growth of Klamath smallscale suckers in Jenny Creek (i.e. Jenny Creek suckers) and Klamath River (RM 214-216) below Powerhouse. Jenny Creek suckers reached age 5 (141mm, though >141 mm SL not collected) while Klamath River suckers reached age 17 (341 mm SL) (Rossa and Parker 2007). The fish population appears to fluctuate based on water years.

Preferred Management Actions

- 1) Work with Medford BLM office with monitoring suckers in Jenny Creek and tributaries.
- 2) Collect five Jenny Creek suckers and send to ODFW Pathology for Native Fish Health Examination.
- 3) Determine other limiting factors of the population.

Klamath River Lamprey: (*Entosphenus similis*)

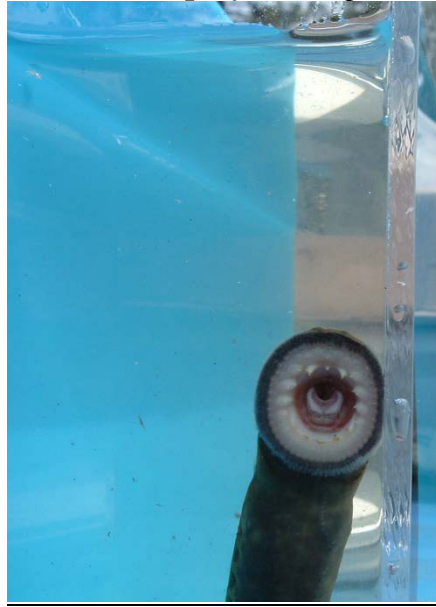


Figure 10. Klamath River lamprey from Spencer Creek in 2004.

Life History Type: Resident, fluvial and artificial adfluvial in J.C. Boyle Reservoir

Status: Native Migratory Fish and ODFW Data Gap Species

Population Trend: No data.

Distribution: Klamath River below Keno Dam and Spencer Creek

Recent Findings: Large numbers of ammocetes were documented in a downstream weir juvenile trap in Spencer Creek in 2004 by ODFW Native Fish Investigations. Adult lamprey found to parasitize spawned out redband trout in Spencer Creek and fish in the Klamath River.

Preferred Management Actions

- 1) Provide fish passage at JC Boyle Dam either by breaching or a new fish ladder.
- 2) Reduce flow fluctuations below the powerhouse on the Klamath River and designate ramp rate to 1-2 inches per hour.
- 3) Increase minimum flow in the bypass reach of the Klamath River below J.C. Boyle Dam.
- 4) Reduce predation by largemouth bass, yellow perch, and crappie in J.C. Boyle Reservoir

Miller Lake Lamprey (*Entosphenus minima*)



Figure 11. Miller Lake lamprey top to bottom eye-spot ammocoete 26.2 mm, ammocoete 39 mm, immature transformed adult 152 mm (Doug Markle (OSU) photos).

Life History Type: Currently all resident with potential for adfluvial to reestablish in Miller Lake

Status: Oregon State Sensitive Vulnerable, Conservation Strategy Species, and Native Migratory Fish.

Population Trend: Upward trend in Miller Creek and Evening Creek but likely declining trend in rest of distribution due to extended drought.

Distribution: Evening Creek, Miller Creek, Upper Williamson River and tributary Jack Creek, Long Creek, Upper Sycan River, Coyote Creek, Crazy Creek, Paradise Creek, South Fork Sycan. The first Williamson River specimens were collected by Dave Simon and Dan Logan (OSU) in 1992. Todd Forbes (BLM Wildlife Biologist) found lamprey in Miller Creek in 1996, which initiated discussion of emergency federal endangered species listing. Scott Peets (USFS Fish Biologist) found Miller Lake lamprey on the Sycan River in 1997. OSU and partners received funding to conduct surveys in early 1998. As a result of the surveys distribution was expanded and included the development of the Miller Lake lamprey Management Unit which is comprised of six documented populations and one uncertain population (ODFW 2005). They are:

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

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

The Miller Lake lamprey barrier was installed by the State of Oregon Game Commission in 1959 during the Toxaphene treatment to remove lamprey from Miller Lake. The barrier was

constructed in Miller Creek approximately ½ mile downstream from the outlet of Miller Lake and forest road 9772. The artificial obstruction has been very effective as a man-made barrier to fish passage and was removed in 2005. No upstream movement of lamprey was observed in five years. In 2010 the Miller Lake Lamprey Working Group developed a plan to reintroduce Miller Lake lamprey to Miller Lake and tributaries for five years.

Recent Findings: A total of 2558 lamprey (ranging in size from “eyelash” to adult, but mostly ammocete) have been reintroduced into Evening Creek, Miller Creek and Miller Lake from 2010-2013. In 2015 USFS and Stewart Reid, PhD, of Western Fishes, reintroduced a total of 400 lamprey (>35 mm) into Evening Creek and Miller Creek at the NF-9972 road culvert crossing. Reintroduced Miller Lake lamprey have been immediately found in subsequent electrofishing surveys every year in Evening Creek and Miller Creek (NF-9972 road culvert) below Miller Lake. Survival of reintroduced lamprey appears to be high in Evening Creek and has likely resulted in the establishment of a seventh population of Miller Lake Lamprey. Lamprey have not been found in the Miller Lake reintroduction site. Sampling of Miller Lake tributaries of Tipsoo and Gideon Creeks did not find any lamprey in 2014 and 2015. A spawned out female lamprey was observed on Evening Creek in summer 2015.

Sampling of brook, brown, rainbow trout and kokanee in Miller Lake from 2010-2015 has not identified any lamprey parasitism.

Preferred Management Actions:

- 1) Provide fish passage and screening through the Upper Williamson River Klamath Marsh on USFWS Refuge.
- 2) Organize a meeting of the Miller Lake Lamprey Working Group to discuss future reintroduction efforts into Miller Lake and tributaries.
- 3) Continue monitoring of Miller Lake lamprey in Miller Lake and tributaries specifically looking for successful reproduction in Evening Creek in summer of 2016.
- 4) Look at options to reduce embeddedness in Long Creek due to high road density.
- 5) Screen Small Ditch on Long Creek below NF-27 road.
- 6) Evaluate other potential entrainment and stranding risks specifically in the Sycan River at weir 2 and Upper Williamson River at Yamsi Ranch.

Pit-Klamath Brook Lamprey (*Entosphenus lethophagus*)



Figure 12. Pit-Klamath Brook Lamprey from Barkley Springs (Photo by Ron Larson (USFWS Retired))

Life History Type: Stream Resident

Status: Oregon Conservation Strategy Species, ODFW Data Gap Species, and Native Migratory Fish.

Population Trend: Overall habitat has improved and ammocetes locally abundant especially in Crooked Creek system.

Distribution: Wood River and tributaries excluding Sun Creek, Lower Williamson River and tributaries, Sprague River and tributaries. Unidentified lamprey ammocetes have been documented in electrofishing surveys by ODFW, USFS and others in Annie Creek, Agency Creek, Brownsworth Creek, Crooked Creek, Corral Creek (SF Sprague) Long and Bond 1979), Coyote Creek, Crazy Creek (Sycan), Deming Creek, Fort Creek, Fourmile and Harriman Creek (Walkley 2010), Hammond Creek, Larkin Creek, Leonard Creek Long Creek(Sycan), Fivemile Creek, Fort Creek, Sevenmile Creek, Sprague River including NF and SF, Sunnybrook Creek, Upper and Lower Sycan River, South Fork Sycan, Lower Threemile, Trout Creek, Whitworth Creek, Williamson River, Upper Williamson River, and Wood River.

Lamprey have not been found in the Lost River Basin in Oregon however a dead lamprey was found on a boat chair in Boggs Lake (Pronghorn Lake) near Miller Creek by landowner Mike Tyrholm in 2015. This lamprey was suspected of being dropped by a bird but the closest lamprey populations are quite a distance from this location. Stewart Reid found lamprey in NF Willow Creek (Tributary to Clear Lake Reservoir) in 2008 at the 48N70 bridge in California. These lamprey might be considered *Entosphenus folleti*.

No lamprey have ever been found in the Jenny Creek system above the waterfalls.

Recent findings: Lamprey been observed spawning near dusk in several spring fed systems and mortalities of spawned out adults have been observed from November through February in Sunnybrook Creek, Williamson River at Kirk Springs, Agency Creek, Crooked Creek at hatchery, Tecumseh Springs and Sprague River unnamed springs at RM 74.5.

Video weir observations of adult lamprey (130-150 mm) in Wood River, Fort Creek, Agency Creek and Ranch during 2011-12 show an upstream movement by adults in September and November and one lamprey moving upstream in Ranch Creek in February (ODFW Native Fish Investigations).

Upper Klamath Lake lamprey (*Entosphenus sp.*)



Figure 13. Upper Klamath Lake lamprey captured by trap net in 2011 in Agency Lake.

Life History Type: Adfluvial in Upper Klamath and Agency Lakes

Status: Conservation Strategy Species, ODFW Data Gap Species, and Native Migratory Fish.

Population Trend: No data but likely improving trend due to Chiloquin Dam removal and culvert replacement on the NF Sprague River at 3411 road.

The Upper Klamath Lake lamprey was originally thought to be a landlocked Pacific lamprey. The individual specimen currently in the University of California's collection is small, approximately five inches in length, was parasitizing a fish when collected, and not anadromous. Currently, ichthyologists are working on the taxonomy and systematics of this unique lamprey (Lorion et al. 2000). Current genetics of the Klamath Basin lamprey species are uncertain (personal communication, Stewart Reid, PhD.) Morphological differences have been identified in the Upper Klamath Lake population (Kan 1975, Lorion et al 2000.). While some have treated this species as a "landlocked" Pacific lamprey (Moyle 2002), genetics separate all Klamath Basin endemic taxa of *Entosphenus* from Pacific lamprey (pers. comm. Stewart Reid, PhD.)

Distribution: Largely unknown but occur in the Sprague River system and parasitize fish in Upper Klamath and Agency Lakes. Likely spawn in North Fork Sprague River, Trout Creek and mainstem Sprague River near Beatty. Removal of Chiloquin Dam on the Sprague River likely improved fish passage to spawning grounds. Adult lamprey were captured in Agency Lake at the Wood River delta in the spring of 2011 by trap net. A small parasitic lamprey occurs in Sevenmile Creek of unknown species and might occur in the Wood River system.

Recent Findings: Larger lamprey (350-400mm) were documented by video weir (ODFW Native Fish Investigations) in late November 2011 in Ranch Creek and December 11, 2010 in Agency Creek. Other lamprey estimated at 250 mm were observed moving upstream in almost all months in Crooked Creek, Agency Creek, Wood River and Fort Creek.

The culvert at the NF-3411 road on the North Fork Sprague River was replaced with a bridge in 2011 allowing passage of Upper Klamath Lake lamprey to significant habitat. Upper Klamath Lake lamprey were found below the NF-3411 culvert on several occasions including the USFS fish salvage during the culvert removal. Upper Klamath Lake lamprey have not been found above the NF 3411 culvert suggesting the culvert was completely impassable to lamprey. In

addition, a lamprey ramp was constructed on the hydroelectric plant on the NF Sprague River (RM 13.3) in summer of 2015.

Upper Klamath Lake lamprey were observed in June 2015 in Trout Creek (Sprague River). Lamprey were likely migrating to spawning grounds.

Preferred Management Actions

- 1) Determine distribution and spawning areas of Upper Klamath Lake lamprey.
- 2) Investigate fish passage on Trout Creek where lamprey were concentrated in June 2015.
- 3) Monitor effectiveness of fish passage on the North Fork Sprague River at the NF-3411 road and at the Hydroelectric Dam (RM 14).

Klamath Speckled Dace (*Rhinichthys osculus klamathensis*)

Life History Type: Mostly stream residents but occasionally found in lakes

Status: None.

Population Trend: No data

Recent Findings: ODFW Klamath District staff worked with Humboldt State University in collecting genetic samples from speckled dace in 2012 from Spencer, Link River and Sevenmile Creek. Speckled dace were also collected from the Sprague River, Jenny Creek and mainstem Klamath River just below the State Line. Other samples were taken throughout the Trinity River and lower Klamath River systems (Wiesenfeld 2014). The Jenny Creek population showed reduced values of genetic diversity (Ar =Allelic richness and H_o =observed heterozygosity) ($Ar=7.58$, $H_o=0.41$) compared to adjacent Klamath populations Sprague River ($H_o=0.67$), Sevenmile Creek ($H_o=0.65$), Link River ($H_o=0.70$), Spencer Creek ($H_o=0.65$) and Klamath River (0.66) (Wiesenfeld 2014). Jenny Creek population shows a strong divergence from other populations (Wiesenfeld 2014). One Sevenmile Creek speckled dace sample showed a highly divergent unique haplotype whereas the majority of the speckled dace samples were monophyletic with closest relationships with Sacramento River populations (Sacramento, Pit, Goose and Warner Basins) (Wiesenfeld 2014)

ODFW Klamath District staff assisted Erin Petersen from OSU collect speckled dace from a spring area and flowing streams to compare meristics and morphometrics. Her study questions were: 1) are speckled dace in streams and springs morphologically distinct across study range 2) within each basin are fish in streams morphological different. In summer of 2013 speckled dace were collected in the Lost River system from Duncan Springs on Antelope Creek, below Gerber Reservoir in Miller Creek and Rock Creek (tributary to Clear Lake). Specked dace from Duncan Springs were found to be statistically different ($p<0.001$) than stream populations in Rock and Miller Creek based on morphology (Premaxilla to dorsal origin length, head length and body depth). The Duncan Springs speckled dace had shorter head and shallower bodies than stream dace (Miller and Rock Creek). No difference was found in the 10 different scale counts conducted (Petersen 2014).

Slender sculpin (*Cottus tenuis*)



Figure 14. Slender sculpin capture in Upper Klamath Lake (USGS photo)

Life History Type: Resident

Status: Federal Species of Concern (SOC), Conservation Strategy and ODFW Data Gap Species

Population Trend: Unknown due to small sample sizes during OSU sampling.

Distribution: Sprague River, Crooked Creek, Fourmile (Lake) Creek (Walkley 2010) and springs along Upper Klamath Lake

This unique sculpin species is associated with spring habitat in Upper Klamath Lake and tributaries. Individuals are locally abundant and widely distributed within spring areas. Catch of sculpin by OSU the past three years has declined (Figure 15).

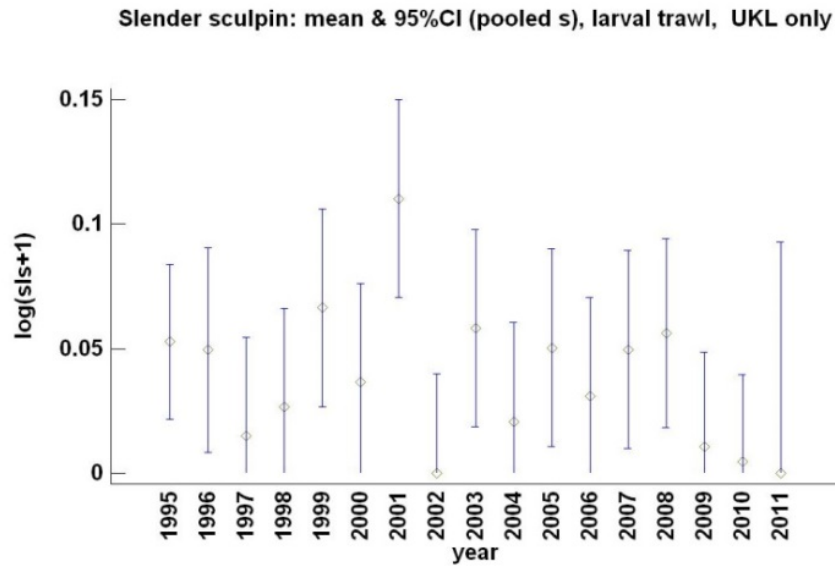


Figure 15. Mean catch of slender sculpin by larval trawl in Upper Klamath Lake from 1995-2011 (Markle OSU 2015)

Preferred Management Objectives:

- 1) Determine limiting factors which could include water quality as they are typically found in areas of groundwater influx.

Klamath Basin Redband Trout (*Oncorhynchus mykiss newberrii*)



Figure 16. Redband trout from Upper Klamath Lake in 2015 (Photo: W. Tinniswood)

Life History Type: Resident, Fluvial, Adfluvial, Anadromous extirpated

Status: ODFW State Sensitive Vulnerable and Native Migratory Fish

Factors affecting redband trout survival are unique to specific reaches of streams, rivers or lakes. Many irrigation diversions remain unscreened and divert a majority of stream or river flow. Juvenile rearing habitat, water quality in Upper Klamath-Agency Lakes and Sprague River, fish passage, brown and brook trout interactions, warm water species interactions (yellow perch, brown bullhead, largemouth bass), lack of spawning habitat and thermal refuge are all major limiting factors to redband trout. Generally redband trout respond very positively to good water years suggesting instream flow is an important limiting factor for redband trout populations.

Distribution: Redband trout occupy most accessible waterbodies, however they have been found to be displaced by brook trout in streams that lack fish passage or where fish passage and screening is limited. Further, the headwaters of the SF Sprague, NF Sprague, Upper Sycan River, Upper Williamson River, Denny Creek, Fourmile Lake Creek, Fourmile Creek, Cherry Creek, Sevenmile Creek, Annie Creek and Sun Creek including most of their tributaries are dominated by brook trout and in most occasions brook trout are the only fish that occur in the upper part of these streams. A new documented redband trout distribution GIS layer was created by fish division GIS staff in 2012. Current distribution has been reduced compared to historical due to fish passage barriers, lack of instream flow and the dominance of brook trout and occasionally brown trout in headwater and cold streams.

Recent Findings and Monitoring: Adfluvial redband trout populations are primarily monitored through fortnightly (every 14 days) spawning surveys conducted throughout spawning timing. A near census spawning survey protocol developed from 2010-2013 continues to be refined to monitor adfluvial redband trout escapement in the Williamson River, Wood River, Crystal Creek watersheds and Kamkaun Springs on the Sprague River (Tinniswood and Harrington 2013). The protocol requires enumeration of redds and redband trout in all surveys. ODFW will continue to improve monitoring of adfluvial redband trout by improving protocol to estimate escapement.

Rough escapement estimates in each population are based on redd counts (1 to 1.6 redds per female with 1:1 sex ratio and/or Area Under the Curve (AUC) live and dead redband counts based on a residence time of 10-14 days and 69-75% observer efficiency) The following areas of the current spawning survey monitoring protocol for adfluvial redband trout need improvement:

- 1) Redd life and superimposition.
How long are redds observable? Redd surveys are currently conducted every two weeks. If all redd surveys could be reduced to once every month or once every two months that would save time. Further, enumerating all redds on the each survey instead of marking each one with colored rocks or flagging would save time and money as well. A rate of superimposition would also need to be calculated based on available spawning habitat.
- 2) Incorporating uncertainty into area under the curve counts
How accurate are fish counts and what is an acceptable correction factor? Snorkel surveys should be conducted to compare to fish counts from boat in order to determine accuracy. Video weirs could also be used to compare to AUC counts. Multiple surveys should be conducted by different surveyors on same days in order to determine precision.
- 3) Residence time
How long do redband trout stay in the spawning area? This would improve estimates of escapement and also assist with developing improved protocol.
- 4) Brown trout redds
Determine difference in brown trout redds, potentially either by size or spawning location. Studies in 2011 by Native Fish Investigations showed brown trout are significantly smaller than redband in the Wood River system. Also, ODFW District staff observations indicate that brown trout in Spring Creek spawn in areas of higher water velocity than preferred by redband trout.
- 5) Creel surveys should be conducted once every three weeks on Upper Klamath Lake, Agency Lake and Williamson River to calculate catch rates to determine catch per unit of effort (i.e. Redband/hr).
- 6) Investigate the potential for conducting effective population size estimates on all spawning populations of redband trout and compare to spawning escapement estimates.

Redband trout distribution surveys continues in areas where fish habitat restoration, screening, fish passage, instream flow acquisition and rotenone treatment has occurred or will occur in the near future. Priority streams are Deming Creek, Sun Creek, Annie Creek, Short Creek (Fort Creek), Upper Crooked Creek, Rock Creek(Crystal Creek) and Calahan Creek. Additionally, electrofishing surveys (two pass with blocknets) have continued (data back to 1995) as part of long term index sites on Cherry, Spencer, Long and Brownsworth creeks.

Monitoring of habitat restoration and gravel placement for adfluvial redband trout has been conducted annually in Spring Creek, Williamson River, Sunnybrook Creek, Wood River, Crooked Creek, Tecumseh Springs, Agency Creek, Wood River, Ranch Creek, and Sevenmile Creek from 2005-2015. Relative abundance monitoring of redband trout has continued in Sevenmile Creek and tributaries Crane and Short creeks. Extensive Wetland Reserve Program

(WRP) enrollment, habitat restoration, screening, fish passage and instream flow acquisition has occurred in Sevenmile, Crane and Short creeks. Water temperature continues to be monitored annually on new and some current adfluvial redband trout spawning areas and also in areas not used by adfluvial redband trout

The following recent findings are organized by the redband trout populations identified in the Western Native Trout Initiative Rangelwide Redband Trout Assessment in 2012 with identifying Conservation Population Number (Muhlfeld et al. 2014). Populations were developed using genetic information from Pearse (2011) and Currens (1994, 1999, 2007), unique life history traits (spawning timing, adfluvial, resident, size at spawning, *C.shasta* resistance), isolation, and/or morphology (Behnke 1992). Conservation populations are identified by the HUC number (i.e. 18010202 is Sprague River watershed) and then divided into currently occupied stream reaches (cd) under the HUC number (see maps in appendix figure 1-4). The 11 Conservation Redband Trout Assessment populations (cp) identified include:

Cascade Mountain Tributaries Redband Trout Conservation Population 18010203cp001:

Denny Creek, Moss Creek, Short Creek, Odessa Creek, Harriman Creek, Fourmile (Lake) Creek, Rock Creek, Crystal Creek, Cherry Creek, Fourmile Creek, Threemile Creek, Crane Creek, Sevenmile Creek, Short Creek, and Cocoon Creek (Appendix Figure 1)

Wood River Redband Trout Conservation Population 18010203cp002: Wood River, Crooked Creek, Fort Creek, Short Creek, Annie Creek, and Sun Creek (Appendix Figure 1)

Lower Williamson River Redband Trout Conservation Population 18010201cp004: Barkley Springs, Williamson River, Spring Creek, Sunnybrook Creek, Larkin Creek, and Kirk Springs (Appendix Figure 2)

Upper Williamson River Redband Trout Conservation Population 18010201cp002: Upper Williamson River (Appendix Figure 2).

Sprague and Lower Sycan River Redband Trout Conservation Population 18010202cp004:

Sprague River Kamkaun Springs, Rock Creek, Sprague River (Spring Creek Complex to River Springs), Spring Creek, Lower Sycan River to confluence of Shake Creek, Snake Creek, Brown Springs Creek (Appendix Figure 3)

Trout Creek (Lower Sprague River) Redband Trout Conservation Population 18010202cp005: Trout Creek, MF Trout Creek, NF Trout Creek, and SF Trout Creek (Appendix Figure 3).

NF Sprague River Redband Trout Conservation Population 18010202cp001: NF Sprague River, Fivemile Creek, Meryl Creek, Long Creek, Boulder Creek, Dixon Creek, Gearhart Creek, Cold Creek, and School Creek (Appendix Figure 3).

SF Sprague River Redband Trout Conservation Population 18010202cp002: SF Sprague River, Fishhole Creek, Robinson Spring Creek, Paradise Creek, Brownsworth Creek, Leonard Creek, Hammond Creek, Whitworth Creek, Pothole Creek, Buckboard Creek, and Camp Creek (Appendix Figure 3) .

Deming Creek Redband Trout Conservation Population 18010202cp003: Deming Creek and Campbell Reservoir (Appendix Figure 3).

Upper Sycan River Redband Trout Conservation Population 18010202cp006: Upper Sycan River, Long Creek, Coyote Creek, Long Creek (RM 51), Paradise Creek, Crazy Creek, Watson Creek, Skull Creek, and Rifle Creek (Appendix Figure 3).

Lost River Redband Trout Conservation Population 18010204cp001: Lost River, Miller Creek and Gerber Reservoir (Appendix Figure 4)

An additional three redband trout populations and one current steelhead population were not evaluated during the Rangewide Redband Trout Assessment in 2012. These include:

Klamath River Redband Trout Conservation Population : Klamath River above JC Boyle Dam to Lake Ewauna, Spencer Creek, Clover Creek, Miners Creeks, Klamath River Below JC Boyle Dam.

Jenny Creek Redband Trout Conservation Population: Jenny Creek, Skookum Creek, Spring Creek, Keene Creek, Beaver Creek, Coral Creek, Johnson Creek, Sheepy Creek, and Cold Creek

Fall Creek and Lower Klamath River Redband Trout Conservation Population: Fall Creek and tributaries, Beaver Creek, Camp Creek, Scotch Creek and Hutton Creek

Klamath River Tributaries Summer Run Steelhead Population: Cottonwood Creek, EF Cottonwood Creek, Mill Creek Grouse Creek, Cow Creek, Long John Creek, Red Mtn. Creek

Cascade Mountain Tributaries Redband Trout Population 18010203cp001

Denny Creek redband trout population (cd003)

Life History Type: Currently likely all adfluvial.

Population Trend: Nearly extirpated. Population abundance is below 500 adults and nearly undetectable.

Recent Findings: A short section of Denny Creek was restored in 2006 below the hydroelectric powerhouse. The hydroelectric diversion was screened in 2012.

The headwaters are dominated by brook trout with only one redband trout found in sampling in 2004.

Preferred Management Actions Denny Creek Redband Trout Population:

- 1) Restore channelized section of Denny Creek from just upstream of highway 140 to Upper Klamath Lake.
- 2) Perform redband trout density estimate in restored section of Denny Creek.
- 3) Screen irrigation diversions.

Moss Creek Redband Trout Population (cd 004):

Life History Type: Likely isolated resident with an occasional adfluvial redband trout in good water years.

Population Trend: Likely downward trend with less than 500 adults.

Recent Findings: Redband trout in Moss Creek have unique appearance. Genetics indicate that this small, isolated population has closer relationships to Klamath River redband/rainbow trout instead of the Klamath Lake redband trout (Pearse et al. 2011). Moss Creek was last sampled in 2010.

Preferred Management Actions Moss Creek Redband Trout Population:

- 1) Investigate presence of adfluvial redband trout.
- 2) Improve fish passage at highway 140 crossing and downstream if necessary.

Short Creek, Odessa Creek (cd005) and Harriman Creek

Life History Type: Adfluvial

Population Trend: No apparent spawning population or very limited.

These short, spring fed stream channels to Upper Klamath Lake are vital for thermal refuge during the summer. Harriman Creek is the largest and supports hundreds, if not thousands, of redband trout rearing the creek in the summer. In the summer of 2015, more than 1,000 redband trout were estimated rearing in Harriman Creek. Spawning has not been documented in Harriman

Springs by redband trout despite adequate substrate. Kokanee spawning has been observed by landowners at the mouth of the Harriman Creek. Odessa and Short creeks also have small areas of spawning substrate, but no spawning has not been documented. Odessa has large numbers of redband trout (likely hundreds) rearing through the summer. The smaller springs of Short Creek likely hold less than 100 redband trout in the summer months.

Fourmile (Lake) Creek Redband Trout Population (cd 006-008):

Life History Type: Adfluvial with likely late spring spawning (April-June)

Population Trend: Nearly extirpated with population well below 500 adults and nearly undetectable.

Recent Findings: Fourmile Creek was sampled in the summer of 2014 at confluence of Lost Creek where the only perennial flow occurs in Fourmile Creek. Only brook trout were found. Habitat restoration by USFWS occurred from mouth at Harriman Creek upstream to meadow above Westside road in 2012.

Preferred Management Actions Fourmile (Lake) Creek Redband Trout Population:

- 1) Acquire instream flow from Fourmile Lake (Reservoir).

Crystal (cd010) and Recreation Creeks (cd009) Redband Trout Population

Life History Type: Adfluvial with spawning from October-March with peak late November.

Population Trend: Likely recent decline due to drought but population likely exceeds 500 adults in most years.

Recent Findings: Area under the curve spawning surveys from boat were completed from 2011-2015 at the spawning area at Crystal Springs. Since these surveys were inadequate to estimate escapement due to lack of data peak counts were used to assess status (Table 5). Surveys were conducted by drift boat with one observer and one rower in November and by kayak with one observer once snow or ice prohibited launching drift boats. Two counts are conducted by drift boat with the rower and observer changing duties.

Table 5. Peak number of adfluvial redband trout observed at the spawning area on Crystal Creek at Crystal Springs from 2011-2015.

| Year | Peak # Redband observed |
|------|-------------------------|
| 2011 | 168 |
| 2012 | 217 |
| 2013 | 332 |
| 2014 | 172 |
| 2015 | 119 |

Redband trout spawning timing at Crystal Creek appears to be earlier than other sites. For example, 245 redband trout were observed on the spawning grounds on October 30, 2013. In 2015 redds, were observed during the first survey on October 22. However, when other areas are peaking, in early January, the Crystal Creek count can be zero. The Crystal Creek spawning population is significant with a high count of 332 redband trout observed on November 21, 2013. Since these surveys tend to reflect abundance and there is little variation between surveyors more surveys will be conducted in this area in the future. A larger sample size will provide more significance to these surveys.

Crystal Creek and Recreation Creek have numerous unnamed springs that have limited spawning. This large groundwater influx results in large numbers of redband trout entering the creeks in the summer. One volunteer counted over 1000 redband trout utilizing the creeks in summer.

Management Actions Crystal/Recreation Creek Redband Population:

- 1) Restore the stream channel at the historic landing site for logging operations on the Redband Ranch owned by the Wenner Family.
- 2) Continue to monitor redband trout escapement at Crystal Springs.
- 3) Develop minimum escapement goals. A draft number to maintain could be a minimum peak count of 100 redband trout or an escapement estimate greater than 500 as determined by AUC surveys.
- 4) Research the interactions with yellow perch as yellow perch are extremely abundant in lower Crystal Creek in summer.

Rock Creek (Crystal Creek) Redband Trout Population (cd011)

Life History Type: Resident male redband trout have been documented with a very small adfluvial population likely.

Population Trend: Nearly extirpated with total number of redband captured in three pass electrofishing was 130 (age 0 and older) in 2015.

Redband trout were salvaged from Rock Creek in July 2015. A total of 130 redband trout were transferred to Klamath Hatchery while Rock Creek was treated with rotenone to remove brook trout. Redband trout ranged in size from 40 mm to 190 mm. Rock Creek was treated with rotenone from late July to mid-August. After the treatment, brook trout were found in side channel areas and in areas where the stream subbed out, which resulted in another treatment in mid-August. A total of 113 redband trout were reintroduced in Rock Creek on September 30, 2015.

Preferred Management Actions Rock Creek Redband Population:

- 1) Continue to monitor Rock Creek to ensure successful rotenone treatment and removal of brook trout. Treat again if necessary.
- 2) Perform spawning surveys for adfluvial redband trout in May.

Life History Type: Currently all adfluvial with spawning in late fall-winter at small area of spawning habitat at Fourmile Springs.

One juvenile redband trout was captured during two electrofishing efforts in 2008. Spawning brook trout were the only fish documented during a spawning survey on 21 December 2011 at Fourmile Springs, Jack Springs and unnamed springs. A few redband trout redds and one redband trout were observed in February 2005 at Fourmile Springs. Stream dominated by brook trout and brown trout. An adfluvial redband trout was reported captured at the mouth of Fourmile Creek with Fourmile Canal in the summer of 2015.

Management Actions Fourmile Creek (Agency Lake) Redband Population:

- 1) Restore Fourmile Canal to a sinuous channel.
- 2) Screen the irrigation ditch at top end of Agency Ranch (if necessary).
- 3) Work with The Nature Conservancy to restore recently purchased property adjacent to Fourmile Canal.
- 4) Improve fish passage on two irrigation structures on Fourmile Canal or bypass with newly constructed channel.

Threemile Creek (Crane Creek Ditch-Fourmile Canal)

Life History Type: Likely historically resident and adfluvial

Population Trend: Extirpated.

Extensive electrofishing efforts from 2005-2010 did not document any redband trout. The stream is dominated by brook trout below barriers. Threemile Creek was treated in 2010 with rotenone from 110 culvert downstream to lowermost barrier. Bull trout are the only fish above barriers with the exception of two miles of habitat that has been fishless since 2010. A new barrier was constructed in fall of 2015.

A major flood occurred on December 21, 2014. The stream clogged the culverts at the gravel pit road and Westside road.

Preferred Management Actions Threemile Creek Redband Population:

- 1) Restore the channelized section of Threemile Creek to a sinuous channel and reconnect with Fourmile Creek
- 2) Screen the irrigation ditches
- 3) Remove brook trout if feasible

Cherry Creek (Fourmile Creek) Redband Trout Population (cd013)

Life History Type: Resident but likely some adfluvial redband trout present but have not been documented. Spawning occurs from April-June with peak in May.

Population Trend: Downward trend. Adfluvial life history nearly extirpated but moderate abundance of resident form likely exceeding 500 adults.

Cherry Creek is dominated by brook trout but at a ratio of 60/40. No redds or adfluvial fish have been observed during spawning surveys conducted in the spring. Fish passage is difficult due to

channelization and head-cuts on private property. In 2004 and 2012 two pass electrofishing was conducted. Abundance of redband trout was .1072 and .0678 m² in a small index section in 2004 and 2012, respectively. The 2012 estimate was almost 50% lower than the 2004 estimate. Reasons for the decline are unknown as habitat and flow have not changed significantly. The drought of 2010 could have reduced the number of age 2+ individuals.

A spawning survey conducted in the spring of 2015 observed no large adfluvial redband trout nor any large redds. One redband trout at 200 mm was observed. Cherry Creek was sampled above two barrier waterfalls in 2015. Brook trout were the only fish found above the falls. Brook trout occupied the stream from high lake stocking of lakes that feed Cherry Creek. No brook trout have been stocked in the high lakes since 2013. Redband trout were found to 1/5 of the abundance of brook trout in sampling just below the uppermost trailhead crossing. An unnamed tributary was sampled with no fish present.

Nannie Creek (Cherry Creek)

Life History Type: Unknown

Population Trend: Extirpated

Stream is dominated by brook trout and is very small with less than 1 cfs in summer and becoming intermittent. Nannie Creek was nearly dry in 2014 with no fish found.

Preferred Management Actions Cherry Creek Redband Population:

- 1) Restore the channelized section of Cherry Creek to a sinuous channel to allow for improved fish passage of adfluvial redband trout from Fourmile Creek.
- 2) Screen the two irrigation ditches (Fourth highest priority in Klamath Basin for screening)
- 3) Remove brook trout if feasible

Sevenmile Creek Redband Trout Population (cd 014-017)

Life History Type: Currently all adfluvial with spawning in March.

Population Trend: Upward Trend from nearly extirpated but total adult population much less than 500.

Recent Findings: The last documented redband trout spawner was found in Sevenmile Creek in the late 1970's. Extensive electrofishing and snorkeling efforts occurred in 2002, 2005, 2010 and 2012 throughout Sevenmile Creek which captured a total of 11 juvenile redband trout and observed three adult redband trout. Sevenmile Creek was sampled above an impassable water fall in August 2012. Only brook trout were found. Sevenmile Creek dominated by brook and brown trout.

Spawning adfluvial redband trout were documented for the first time in March of 2015. In addition, limited sampling in October and November 2015 of an irrigation ditch at Sevenmile Road found 36 age 0 and 1 redband trout. Work completed by Klamath Basin Rangeland Trust which included transferring water right instream, improving fish passage, screening irrigation diversions and cattle enclosure through WRP is the reason redband trout are returning to Sevenmile Creek.

Crane Creek (Sevenmile)

Life History Type: Currently all adfluvial

Population Trend: Nearly extirpated and undetectable

Recent Findings: The stream is dominated by brook and brown trout. Crane Creek was electrofished in 2014 and only brook trout, brown trout, speckled dace and marbled sculpin were found. Four electrofishing and snorkeling efforts have observed one juvenile redband trout. Five small redds were observed in March 2008 and appeared unusual due to their size which make them suspect whether these redds were constructed by adfluvial redband trout. During irrigation season fish passage is blocked at the fish ladder/irrigation control structure. Fish passage blockage at this site needs to be remedied in the near future.

Short Creek (Sevenmile)

Population Trend: Extirpated

Short Creek is one the coldest tributaries in the Klamath Basin with temperatures rarely exceeding 4°C. Six electrofishing and snorkeling efforts from 2005-2015 have not documented any redband trout. Brook trout and brown trout dominate. Spawning surveys in the spring have not documented redds. Redds have been observed in fall, which are assumed to belong to brook and brown trout, rather than redband.

Cocoon Creek

Population Trend: Extirpated

Cocoon Creek rivals Short Creek for the coldest creek in the Klamath Basin with spring discharge at 2°C. Cocoon Creek is spring fed. Only brook trout were found in Cocoon Creek in electrofishing surveys.

Management Actions Sevenmile Creek Redband Trout Population:

- 1) Screen the diversion just upstream of diversion dam at RM 6 on Sevenmile Canal.
- 2) Work with The Nature Conservancy to restore recently purchased property adjacent to Fourmile Canal.
- 3) Improve fish passage at the Crane Creek diversion.
- 4) Continue to perform spawning surveys and presence/absence electrofishing surveys.
- 5) Screen the upper-most diversion on Sevenmile Creek (RM17). (Scheduled for 2016)
- 4) Restore Sevenmile Canal to a sinuous channel.
- 5) Screen the east- and west-side diversion at Sevenmile Road (Temporary screen in 2016 with permanent screen likely in 2018).
- 6) Reduce Blue Springs diversion water from going down irrigation ditch during winter and provide fish passage.

Wood River Conservation Population 18010203cp002

Wood River Redband Trout Population (cd18-20)

Life History Type: Adfluvial

Population Trend: Downward trend and spawning population usually exceeds 500 adults. Spawner escapement likely ranges from 300-1700 adults.

Spawning escapement of adfluvial redband trout into the Wood River has been monitored since 1994. Due to lack of data to calculate AUC estimates, peak counts are utilized to reflect abundance. Peak counts of adfluvial redband trout are on a downward trend (Figure 17). This downward trend might be attributed to lack of screening at diversions which total nearly 300 cfs.

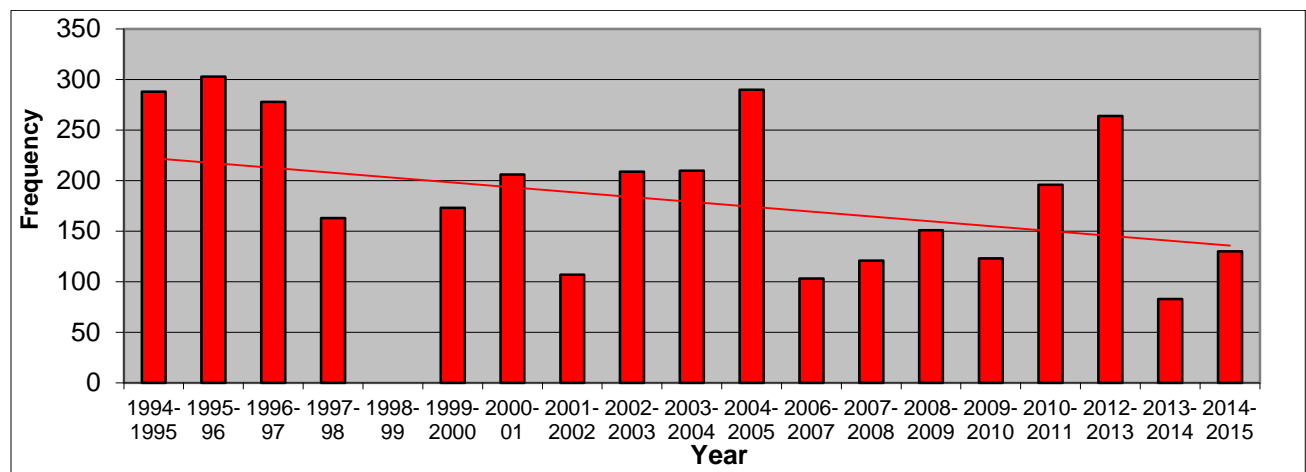


Figure 17. Annual peak redband trout enumeration from boat beginning at Kimball State Park to Melhase Canal on the Wood River during the years 1994-2015 (no data 1998-1999).

Management Actions Wood River (Wood River Redband Population)

- 1) Work with project partners KBRT to screen the Melhase Canal (40 cfs)
- 2) Work with USFWS and KBRT to screen the Hawkins Diversion (250 cfs)
- 3) Continue to monitor redband trout spawning escapement. Minimum escapement could be peak count of 100.

Crooked Creek Redband Trout Population (cd026)

Life History Type: Primarily adfluvial but resident and fluvial redband are observed with spawning from October-April with peak in early December.

Population Trend: Ten year upward trend with adult spawning population ranging from 200-600.

Standardized spawning surveys have been completed by the same staff in the same locations since 2005. In 2005 significant habitat restoration occurred at the spawning survey sites. These three sites make up approximately 99% of the spawning habitat in the mainstem Crooked Creek. Number of redd and redband trout observed have shown an upward trend (Figure 18).

Redband trout spawning timing at Crystal Creek appears to be earlier than other sites. For example, 245 redband trout were observed on the spawning grounds on October 30, 2013. In 2015 redds, were observed during the first survey on October 22. However, when other areas are peaking, in early January, the Crystal Creek count can be zero. The Crystal Creek spawning population is significant with a high count of 332 redband trout observed on November 21, 2013. Since these surveys tend to reflect abundance and there is little variation between surveyors more surveys will be conducted in this area in the future. A larger sample size will provide more significance to these surveys.

Crystal Creek and Recreation Creek have numerous unnamed springs that have limited spawning. This large groundwater influx results in large numbers of redband trout entering the creeks in the summer. One volunteer counted over 1000 redband trout utilizing the creeks in summer.

Management Actions Crystal/Recreation Creek Redband Population:

- 1) Restore the stream channel at the historic landing site for logging operations on the Redband Ranch owned by the Wenner Family.
- 2) Continue to monitor redband trout escapement at Crystal Springs.
- 3) Develop minimum escapement goals. A draft number to maintain could be a minimum peak count of 100 redband trout or an escapement estimate greater than 500 as determined by AUC surveys.
- 4) Research the interactions with yellow perch as yellow perch are extremely abundant in lower Crystal Creek in summer.

Rock Creek (Crystal Creek) Redband Trout Population (cd011)

Life History Type: Resident male redband trout have been documented with a very small adfluvial population likely.

Population Trend: Nearly extirpated with total number of redband captured in three pass electrofishing was 130 (age 0 and older) in 2015.

Redband trout were salvaged from Rock Creek in July 2015. A total of 130 redband trout were transferred to Klamath Hatchery while Rock Creek was treated with rotenone to remove brook trout. Redband trout ranged in size from 40 mm to 190 mm. Rock Creek was treated with rotenone from late July to mid-August. After the treatment, brook trout were found in side channel areas and in areas where the stream subbed out, which resulted in another treatment in mid-August. A total of 113 redband trout were reintroduced in Rock Creek on September 30, 2015.

Preferred Management Actions Rock Creek Redband Population:

- 1) Continue to monitor Rock Creek to ensure successful rotenone treatment and removal of brook trout. Treat again if necessary.
- 2) Perform spawning surveys for adfluvial redband trout in May.

Table 6. A comparison of redband trout redd surveys completed in Agency Creek in 2003-2004 and 2010-2015 (note: 2010 and 2011 surveys completed by ODFW Native Fish Investigations).

| Year | Total Redds | Total Redband trout |
|-----------|-------------|---------------------|
| 2003-2004 | 186 | 158 |
| 2010-2011 | 70 | 15 |
| 2011-2012 | 83 | 27 |
| 2012-2013 | 192 | 149 |
| 2013-2014 | 109 | 32 |
| 2014-2015 | 126 | 26 |

Management Actions Agency Creek (Crooked Creek Redband Population):

- 1) Work with KBRT and landowners to maintain beaver dams (beaver deceivers construction) while at the same time providing fish passage and not significantly altering the project area spawning habitat.
- 2) Continue to monitor redband trout escapement at Agency Creek.
- 3) Develop minimum escapement goals. A draft number to maintain could be a minimum 100 redds.

Ranch Creek Redband Trout Population (cd none)(Crooked Creek)

Life History Type: Primarily adfluvial but resident and fluvial redband are observed with spawning from October-April with peak in early December.

Population Trend: Downward trend with adult spawning population ranging from 80-400.

Recent Findings: Ranch Creek is a manmade spawning channel with flows from Agency Creek. Surveys in Ranch Creek have shown a similar trend to Agency Creek except spawning escapement has significantly declined with most of the recent spawning by redband trout spawners smaller in size (Table 7). Reduced flows in Ranch Creek are the likely reason for reduced number of spawning redband trout. Reduction in Ranch Creek flows is likely due to a decline in groundwater discharge from Agency Springs.

Table 7. A comparison of redband trout redd surveys completed in Ranch Creek (Crooked Creek) Klamath County, OR in 2003-2004 and 2010-2014 (note: 2010 and 2011 surveys completed by NFI).

| Year | Total # Redds | Total # redband trout |
|-----------|---------------|-----------------------|
| 2003-2004 | 187 | 68 |
| 2010-2011 | 76 | No count |
| 2011-2012 | 110 | No Count |
| 2012-2013 | 103 | 8 |
| 2013-2014 | 23 | 4 |
| 2014-2015 | 43 | 0 |

Redband trout were found above the standpipe headgate structure in Ranch Creek ditch on USFS while electrofishing in July 2012.

Management Actions Ranch Creek (Crooked Creek Redband Population)

- 1) Work with KBRT and landowners to improve flow management for attraction flow and habitat to restore the historic use by adfluvial redband trout
- 2) Continue to monitor redband trout escapement at Ranch Creek.
- 3) Develop minimum escapement goals. A draft number to maintain could be a minimum 50 redds.

Tecumseh Springs Redband Trout Population (cd030) (Crooked Creek)

Life History Type: Primarily adfluvial but fluvial redband are observed with spawning from October-April with peak in early December.

Population Trend: Ten year upward trend with adult spawning population ranging from 100 to 350.

Recent Findings: Tecumseh Springs spawning channel has been monitored since construction in 2006. Redband trout and redd observations are on an upward trend (Figure 19). However, results should be viewed with caution as passage into Agency Creek has been difficult from 2013-2015 due to beaver dams. Additional spawning gravel has been added to the site in 2014. The 2014-2015 spawning season was the highest on record.

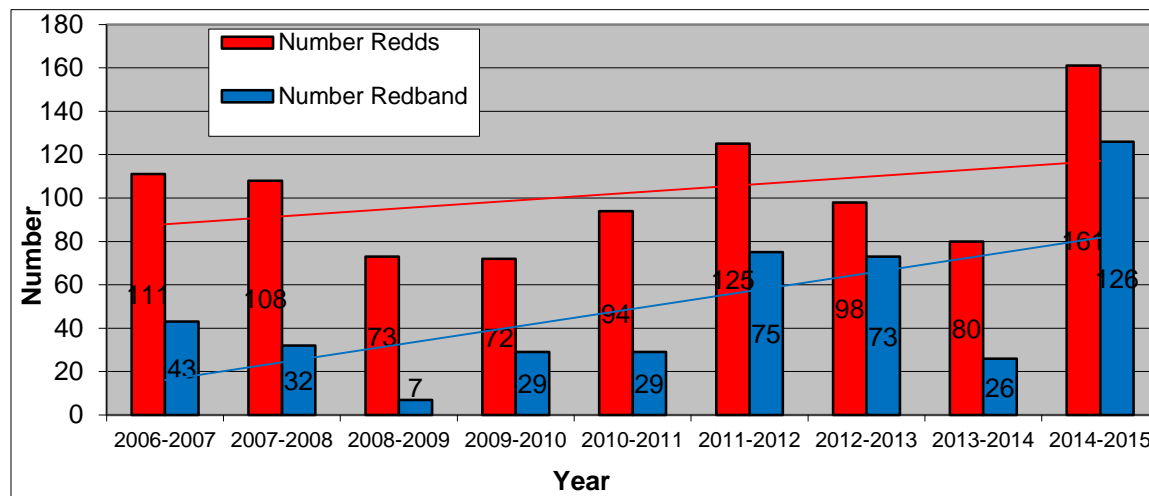


Figure 19. Redd and redband trout observations in Tecumseh Springs by spawning year (Crooked Creek) from 2006-2015.

Management Actions Tecumseh Springs (Crooked Creek Redband Population)

- 1) Continue to monitor redband trout spawning escapement.
- 2) Develop minimum escapement goals (likely 70 redds and 10 redband).
- 3) Add spawning gravel as needed

Fort Creek Redband Trout Population (cd 24):

Life History Type: Primarily adfluvial but resident redband are extremely rare with spawning from October-April with peak in January.

Population Trend: Ten and twenty year upward trend with adult spawning population ranging from 150 to 450.

Recent Findings: The population of adfluvial redband trout has been monitored by redd counts since 1995 from a bridge crossing on private land to the headwaters at Reservation Springs. An overall upward trend in escapement has been observed (Figure 20). Video weir monitoring in 2010-2011 recorded 559 adfluvial adult redband moving upstream. The video weir was located at the start of this redd survey. The video weir count does not likely reflect a true census due to the high probability of individual redband trout moving through the video weir on several occasions.

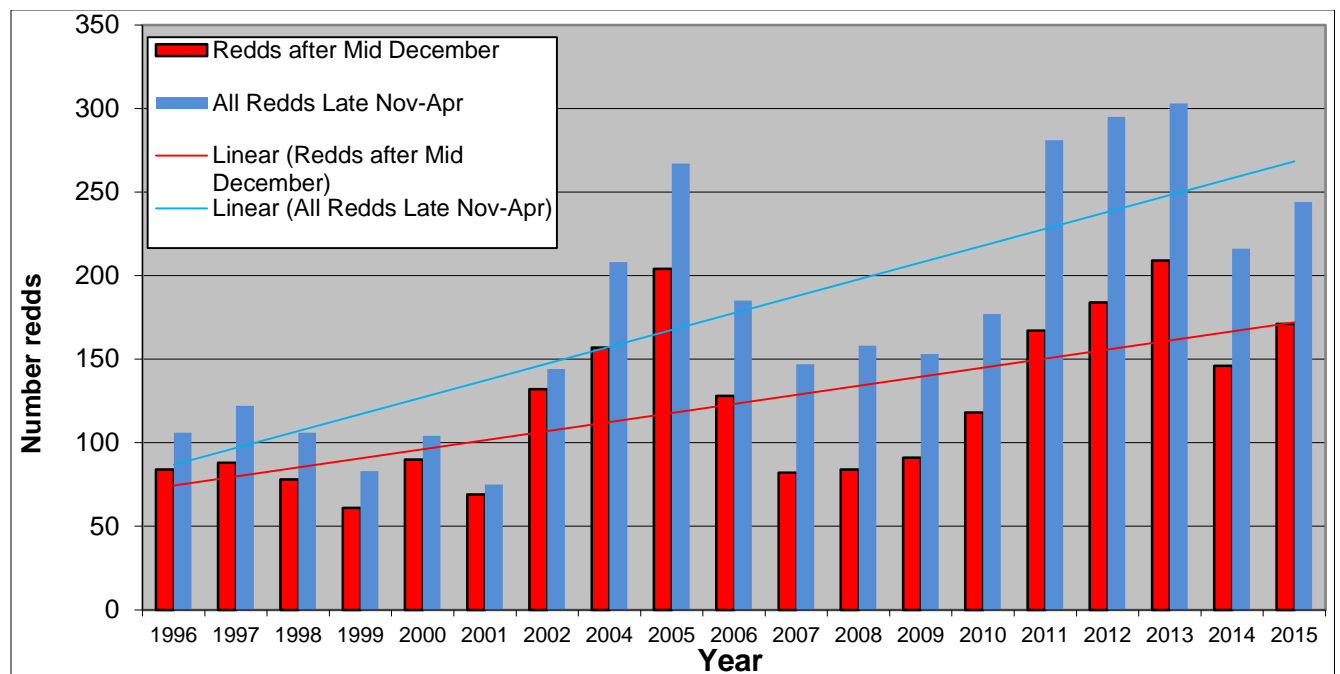


Figure 20. Redd counts in Fort Creek (Rivers of Light bridge to headwaters) from 1995-2015 from mid-December thru April (red bars) and all redds from November-April (blue bars). (Note: the red bars represent mostly redband trout after mid-December and prior to mid-December is primarily brown trout spawning).

Management Actions Fort Creek (Fort Creek Redband Population)

- 1) Continue to monitor redband trout spawning escapement.
- 2) Develop minimum escapement goals (likely 80 redds) and screen irrigation diversions.
- 3) Ensure development of Anadromous fish hatchery does not significantly affect spawning of redband trout and incubation water temperatures.

Short Creek Redband Trout Population (cd025) (Fort Creek)

Life History Type: Primarily adfluvial but resident redband are extremely rare

Population Trend: Nearly extirpated

Recent Findings: Large wood was added to Short Creek in 2013 to improve spawning habitat. These large wood additions appear to have had little effect on improving the spawning habitat in the creek due to the size and placement of the wood in small, single structures. The creek is dominated by fines due to a rock dam breach in the 1980's. Some redband spawning does occur in the stream as indicated by the detection of young of the year redband trout in 2013 and large redds observed after January. Also, a small precocial male mortality was observed in 2013. The creek is dominated by resident brook trout.

Management Actions Short Creek (Fort Creek Redband Population)

- 1) Add wood to existing wood structure to increase scour of sediments to improve spawning habitat.
- 2) Continue to periodically monitor redband trout spawning escapement.

Sun Creek redband trout population (cd none) (Wood River)

Population Trend: Extirpated

Recent Findings: Redband trout were last documented in Sun Creek in the 1940's. No redband trout were found by extensive sampling by Crater Lake Park and ODFW in Sun Creek on Sun Pass State Forest from 2010-2015. Brook trout dominated the samples with a few brown trout. A few bull trout were found. No other fish species exist in Sun Creek.

District staff did not find any redband trout in Sun Creek near the mouth in 2013. Two fish passage barriers occur on Sun Creek have limited recolonization of redband trout into Sun Creek.

A new channel will be activated in 2016 which will allow for fish passage into Sun Creek.

Management Actions Sun Creek (Wood River Redband Population)

- 1) Work with Crater Lake National Park to treat the remaining section of Sun Creek with rotenone in 2016.
- 2) Work with project partners KBRT to screen the new point of diversion and construction of new channel on Sun Creek in 2016.
- 3) Reintroduce redband trout fry (from Wood River ditch systems) to Sun Creek at the location of the lowermost barrier in 2016.

Annie Creek Redband Trout Population (cd 021-022) (Wood River)

Life History Type: Adfluvial with unknown spawning timing but likely April-June or early fall October-November.

Population Trend: Nearly extirpated

Recent Findings: Young of the year redband trout have been found in Annie Creek in 2013 and 2015 above Sun Creek. The abundance is very low possibly suggesting these fish are coming from the Wood River.

Management Actions Annie Creek (Wood River Redband Population)

- 1) Work with Crater Lake National Park to determine if redband trout are spawning in Annie Creek.
- 2) Work with project partners and KBRT to begin to screen the major irrigation diversions
- 3) Work with KBRT to improve stream channel conditions and riparian habitat in the first four miles of Annie Creek.

Lower Williamson River Conservation Population 18010201cp004

Fourteen redband trout scales were readable from redband trout collected from the Williamson River from the mouth to the spawning grounds at Kirk Springs from 2003-2010. Lisa Borgerson from the ODFW Fish Life History Lab read redband trout scales in 2014. Metrics calculated from redband trout scales were age, spawning age, migration age to more productive habitat, back calculated length at age and length at age when scale collected.

Redband trout ranged from age 2 to age 7. The most common age was age 2. Average size of all redband trout was 456 mm and size ranged from 329-588 mm. Size at outmigration ranged from 76-177mm (N=6). Age at outmigration to more productive habitat (ie. Upper Klamath Lake) ranged from age 0+ to age 2+.

Spring Creek redband trout population (cd003)

Life History Type: Primarily adfluvial with fluvial and resident life histories rare with spawning timing from October-August with peak in late December or January (Figure).

Population Trend: Five year upward trend with likely 1000-3000 adult spawning escapement.

Recent Findings: Index spawning surveys have been conducted on Spring Creek at Collier State Park from the gabion site to above highway 97 since 1972. Effort was minimal early on with only two to three surveys conducted a year until 1975 (Figure 21). Spawning habitat at the gabion has been significantly reduced due to failure of the gabion since 2010.

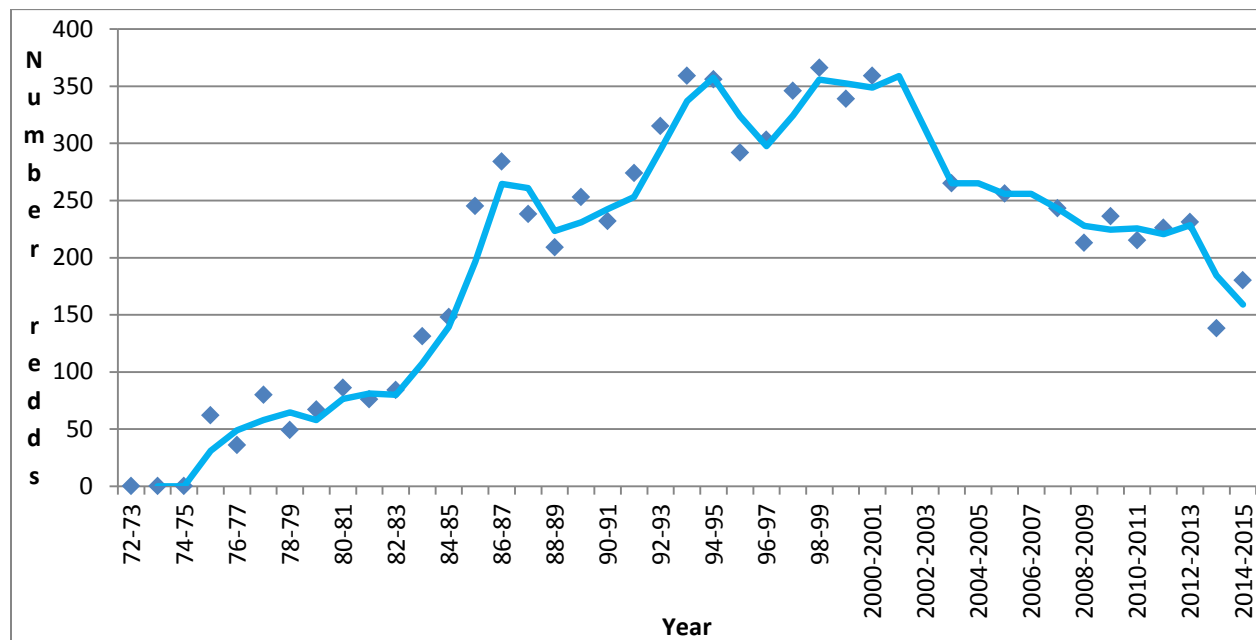


Figure 21. Redd counts at the gabion on Spring Creek (Collier State Park) from 1972-2015. (note: Gabion constructed in 1975 and gabion began to fail in 2009 reducing spawning habitat area)

The stocking of 15,000 legal rainbow trout into Spring Creek was discontinued after September 2010. Beginning in 2010 nearly all the spawning habitat was surveyed with redd counts and AUC surveys every 14 days. Recently, redband trout were observed spawning from October

through July which corroborates findings of Buchanan et al (1989) which observed spawning 11 months out of the year. No surveys were completed in August or September. Estimates of redband trout escapement in Spring Creek on the spawning grounds in Collier State Park was calculated since 2010 from AUC surveys using an observer efficiency of 75% (Table 8). Spawning gravel was added to Spring Creek in 2010-2012, 2014-2015.

Table 8. Spring Creek adfluvial redband trout area under the curve spawning escapement estimates and survey statistics at Collier State Park from 2010-2016 (Note: residence time calculated as 14 days with an observer efficiency of 75%).

| Year | Escapement Estimate | Sample size | Mean count | Peak count | Date of Peak |
|-----------|---------------------|-------------|------------|------------|--------------|
| 2010-2011 | 669 | 19 | 24 | 82 | 12/23 |
| 2011-2012 | 1470 | 15 | 59 | 130 | 1/11 |
| 2012-2013 | 1970 | 14 | 76 | 185 | 1/9 |
| 2013-2014 | 1124 | 18 | 51 | 108 | 1/6 |
| 2014-2015 | 2197 | 20 | 95 | 294 | 1/26 |
| 2015-2016 | | | | 244 | 2/4 |

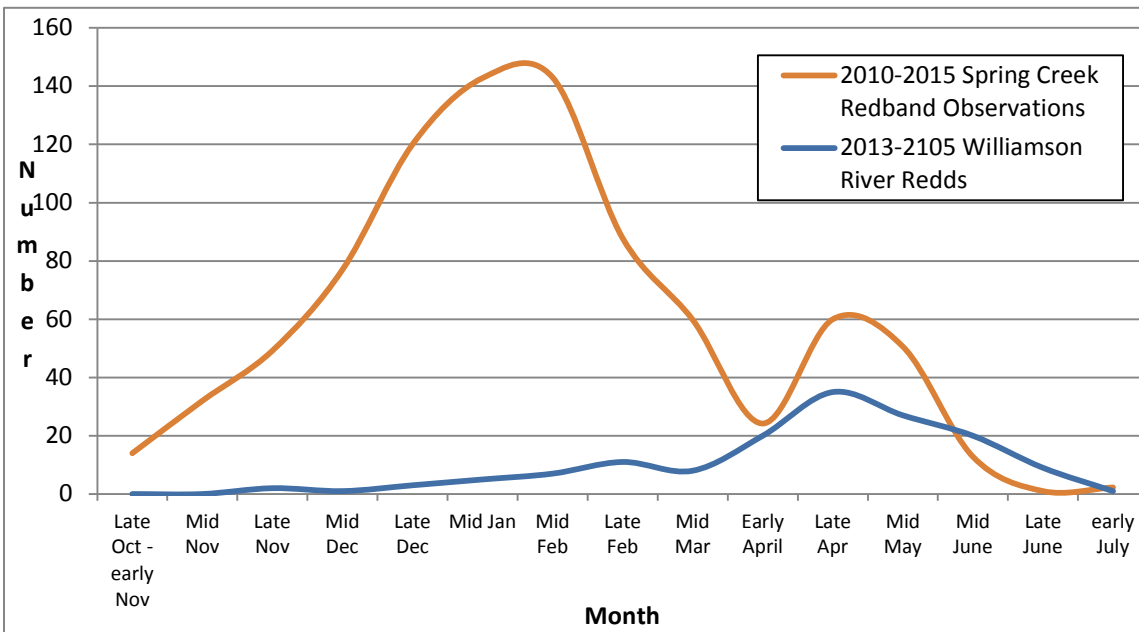


Figure 22. Average monthly count of redband trout observed on spawning grounds on Spring Creek in Collier State Park from October-July from 2010-2015 and average number of Williamson River redds at RM 16 from 2013-2015.

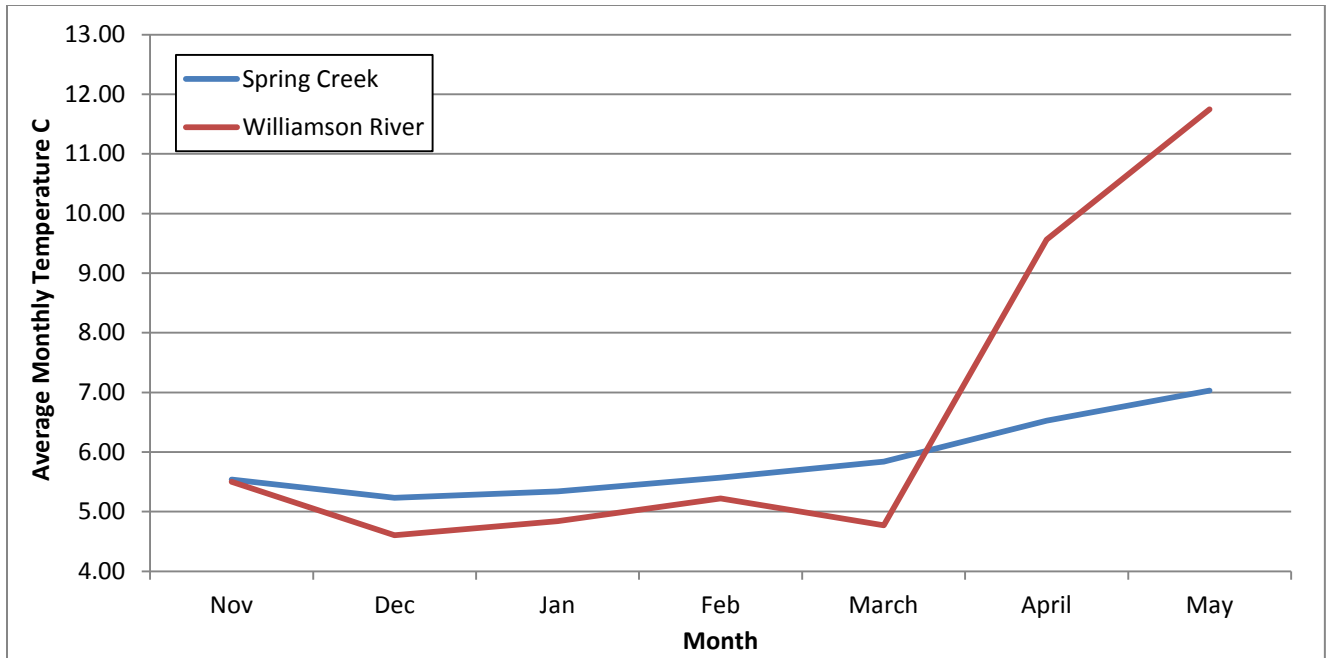


Figure 23. Average monthly water temperature in 2011-2012 on Spring Creek at Collier State Park and Williamson River at RM 15.9.

Spawning timing of the Spring Creek redband trout depends on water temperature and has a bimodal peak (Figure 22). When water temperatures start to increase in the spring a secondary pulse of redband trout enter Spring Creek to spawn (Figure 22 and 23). Redband trout in the Williamson River below the confluence of Spring Creek also respond to the spring water temperature increase but their peak spawning occurs during this time (Figure 22 and 23). Water temperatures in the winter in the Williamson River downstream have declined to a point where little spawning occurs in the winter where conversely Spring Creek spawning is peaking (Figure 23).

Preferred Management Actions:

- 1) Continue to collaborate with State Parks and Klamath Tribes on placement of large wood.
- 2) Investigate feasibility of adding wood and spawning gravel on private property immediately upstream of Collier State Park.
- 3) Contact largest private landowner regarding riparian and habitat restoration on their property.
- 4) Continue to monitor redband trout escapement utilizing redd and redband trout counts.
- 5) Collaborate with Fish Division Biometrician on improving redd survey protocol and developing creel protocol on the Williamson River.
- 6) Develop new catch rate management objective for Williamson River

Lower Williamson River Redband Trout Population (cd002)

Life History Type: Primarily adfluvial with fluvial and resident life histories rare with spawning timing of November-July with peak in April-June (Figure 22).

Population Trend: Only two years of data but likely follows Spring Creek trends.

Redband trout spawn in this reach from the mouth of Spring Creek downstream almost to Chiloquin bridge. Spawning areas are secondary to areas of spawning at Spring, Sunnybrook, Kirk Springs and the river above Larkin Creek. The highest density of spawning occurs in the area at river mile 14 above the old homestead and just downstream of the one of the deepest holes on the river. Redband trout spawning is monitored at the downstream boundary of Collier State Park downstream to the pump site on the Tuttle Ranch.

Williamson River (Kirk Springs Area) Redband Trout Population (cd005)

Life History Type: Primarily adfluvial with fluvial and resident life histories rare with spawning timing of November-February with peak in late December.

Population Trend: No apparent trend but downward compared to years 2003 and 2004. Spawning escapement range 150-2000.

Recent Findings: Redband trout in Kirk Springs were collected as broodstock from 1988 to 1993. This was the beginning of the Klamath Rainbow (Stock 28) that was stocked in Diamond Lake and Davis Lake as an experiment to produce a fishery when tui chub are present. Concerns by the Klamath Tribes (TKT) in 1996 resulted in the cessation of collecting redband trout at this site. TKT believed there was a decline of the population.

The Williamson River Kirk Springs population (above Spring Creek) has been monitored since 2003 by peak counts of adult redband trout on the spawning grounds (Table 9). Counts were also conducted prior to 2003 but not specifically as a monitoring tool. Beginning in 2010 an AUC protocol has been conducted. Counts are conducted bimonthly through spawning. Abundance peaked in the 2003-2004 and 2004-2005 spawning season (Table 9). Abundance might have approached these numbers in 2014-2015 but redband appear to be utilizing the natural and introduced gravel below Kirk Springs. A total of 423 and 516 redband trout were observed from drift boat on December 17, 2014 and January 2, 2015 respectively from the start of the Kirk Springs survey downstream to the boat ramp just above Knapp's Dam. More study is needed in this reach to develop an effective monitoring protocol. The complete failure of spawning in 2013-2014 and 2015-2016 is concerning and few reasons could be postulated why the run did not show up. For instance, the weather was extremely cold in December 2013 with some days setting record lows. However, in 2015-2016 spawning at the USFS boundary at end of survey was the most ever observed at this site. This suggests redband trout did not pass the cascade just upstream.

Kirk Springs was also monitored by redd counts in 2010-2011 where 180 redds were enumerated from November 15-January 7. High flows after January 7 reduced visibility and ability to discern redds. In 2014-2015 all visible redds were counted on all surveys conducted in Kirk Springs Reach. Redd counts have been conducted from 2010-2015 just downstream of Kirk Springs at USFS campground Reach (RM 19.5- 20.5) on the Williamson River.

Redd surveys have been conducted downstream of Kirk Springs since 2010. Similar to Spring Creek, Sunnybrook and Kirk Springs numbers peaked in the 2014-2015 spawning season (Table 10).

Table 9. Summary of peak adfluvial redband trout counts at Kirk Springs on the Williamson River in the years 1980,1996,1997, 2003-2016.

| Year | Peak Number Redband | Total Number Mortalities | Sample Size | Date of Peak | Comments |
|-----------|---------------------|--------------------------|-------------|--------------|-----------------|
| 1980-1981 | 300 | 0 | 2 | 12/10 | |
| 1994-1995 | 300 | 0 | 1 | 12/21 | |
| 1995-1996 | 20 | | | | Poor Visibility |
| 1996-1997 | 70 | 1 | 3 | 12/18 | Poor Visibility |
| 2003-2004 | 500 | 15 | 1 | 12/18 | |
| 2004-2005 | 400 | 8 | 1 | 12/22 | |
| 2005-2006 | 50 | 1 | 1 | 12/16 | |
| 2006-2007 | 41 | 1 | 1 | 12/14 | |
| 2007-2008 | >100 | 3 | 1 | 1/3 | Poor Visibility |
| 2008-2009 | 280 | 0 | 5 | 1/9 | |
| 2009-2010 | 300 | 0 | 1 | 12/26 | |
| 2010-2011 | 157 | 0 | 4 | 12/21 | |
| 2011-2012 | 209 | 1 | 6 | 1/8 | |
| 2012-2013 | 272 | 5 | 5 | 12/6 | |
| 2013-2014 | 6 | 1 | 7 | 1/6 | |
| 2014-2015 | 199 | 2 | 13 | 12/27 | |
| 2015-2016 | 12 | | | 1/15 | |

Redd counts have been conducted from 2010-2015 just downstream of Kirk Springs at USFS campground Reach (RM 19.5- 20.5) on the Williamson River (Table 10).

Table 10. Redd survey results on the Williamson River from Larkin Creek upstream to private property from 2010-2015 (USFS Campground Reach).

| Dates | Spawning Year | Number Surveys | Total Redds |
|---------------|---------------|----------------|-------------|
| 11/15 to 1/7 | 2010-2011 | 3 | 192 |
| 11/7 to 12/14 | 2011-2012 | 3 | 99 |
| 10/30 to 2/14 | 2012-2013 | 7 | 143 |
| 11/18 to 3/13 | 2013-2014 | 6 | 113 |
| 11/17 to 2/20 | 2014-2015 | 7 | 204 |

Extensive habitat restoration has occurred in this reach from 2011-2012. Forty cubic yards of spawning gravel was placed in just below Kirk Spring in August 2011. Redband trout were utilizing all sections of introduced gravel placed in 2011. An additional 100 cubic yards was added from Kirk Springs to the second major springs downstream in 2012. A total of 645 trees were placed in the Williamson River from just below Kirk Springs to Sunnybrook Creek in October 2011 and 2012. An additional 26 cubic yards of spawning gravel was added to the Williamson River immediately downstream of the USFS campground in September 2015. However, for the first time in historical record no flow occurred in this reach from the Upper Klamath Marsh in 2015.

Preferred Management Actions:

- 1) Instream flow from the Upper Klamath Marsh is the biggest limiting factor in this reach. Work with Klamath Watermaster to ensure adequate flows are being released downstream from the Upper Klamath Marsh.
- 2) Continue to monitor redband trout escapement utilizing redd and redband trout counts.
- 3) Collaborate with Fish Division Biometrician with improving redd survey protocol.
- 4) Develop a creel protocol to determine catch rate. Management objectives for catch rates should be developed.
- 5) Add spawning gravel in locations below Kirk Springs.

Upper Williamson Redband Trout Conservation Population 18010201cp002

Population Trend: Likely stable with recent decline but large upward trend since 1980's

Life History Type: Resident above natural impassable waterfalls. Spawning timing March-April

Recent Findings: Redband trout are only found in the mainstem Upper Williamson and have not been found in any of the tributaries Aspen, Sand, Jackson, Jack, Big Springs, Sand (Hwy 97), Scott and Hog Creeks. Brook trout dominate all these tributaries except Hog and Jack. Hog Creek is likely fishless and Jack Creek has only speckled dace and Miller Lake lamprey. The Klamath Tribes monitored the Upper Williamson in the 1990's and found complete year class failures in some years. This might be attributed to the lack of spawning habitat in the mainstem Upper Williamson River.

Hook and line sampling in June 2011 during the black drake hatch showed an abundant redband trout population with good age class diversity ranging from 150-475 mm at rivermile 66.

Habitat conditions on the Royce Tract (RM 66) were showing signs of recovery since the area were excluded from cattle grazing in the early 1980's. Habitat conditions in this area have evolved from very poor to very good. Habitat conditions through most of the Upper Williamson have shown tremendous improvement resulting in an improved fishery throughout. The continuation of four years of drought has reduced the redband population but lack of flow has been somewhat ameliorated by improved habitat and fish passage. The Yamsi and Sand Creek Ranches have performed significant large wood, gravel addition projects, and fish passage improvements from 2010-2015 in the Upper Williamson from rivermile 75-86.

Preferred Management Actions:

- 1) Provide fish passage and screening on the USFWS Upper Klamath Marsh Refuge.
- 2) Sample areas in the Klamath Marsh Refuge including Big Springs Creek for redband trout presence.
- 3) Reintroduce redband trout to tributaries.

Upper Klamath Lake Mixed Redband Trout Populations

Anecdotally the redband trout fishery has been good in some locations but poor in others. Good fishing was reported by bank anglers in the fall of 2014 at Eagle Ridge shoreline. Catch rates continued to be good for anglers fishing from a boat along Eagle Ridge in the spring of 2014 and 2015. Both Fish Division and District staff hooked 20 and 15 redband trout in one day along the Eagle Ridge shoreline in 2014 and 2015, respectively. Fisherman continued to have good success in Pelican Bay in the summer of 2015. The boat ramp at Pelican Bay was the busiest observed. Most fisherman state that catch rate is good for smaller redband trout but few larger fish (>28 in) are being caught. Fishing has been poor at Putnams Point both in the spring and fall of 2015. This might be attributed to the turbidity of the lake or lack of flows. Anglers consistently complain about the lake turning brown in the early spring and again in early November. The turbidity of the lake is due to a large brown algae diatom bloom. Extensive diatom blooms appear to be a new phenomenon.

USGS has PIT tagged adfluvial redband trout from 2010-2015 in Upper Klamath Lake and Williamson River. The preliminary objective was to determine relative abundance and proportion of redband trout migrating into the three large river systems (Wood River, Williamson River, and Sprague River) from Upper Klamath and Agency Lakes and obtain timing of movements out of Upper Klamath and Agency Lakes.

In 2011 length frequency of redband trout captured by USGS studies shows median (Figure 24-25) and mean fork length (Figure 25) as the highest recorded since the data set began in 1999. In 2011 there was a possible year class failure of smaller redband trout in Upper Klamath Lake. The 2012 data shows a stronger younger age class. The data appears to show a strong recruitment class in 2001 that lacks larger individuals. This year class appears to progress and dominate to 2005. Another recruitment event appears to have occurred in 2010. Most fish captured in 2010 were likely 3-4 year old fish coming from the 2006 or 2007 brood year. Redband trout appear to recruit to the sample gear at age 2 or age 3. The smaller box-whisker boxes might suggest a less diverse age structure in 2001 in Agency Lake and 2014 in Upper Klamath Lake. Table 12 shows a comparison of all the fork length data available on redband trout from Agency and Upper Klamath Lake. Data suggests redband trout were larger in the lake in the late 1950's and 1960's.

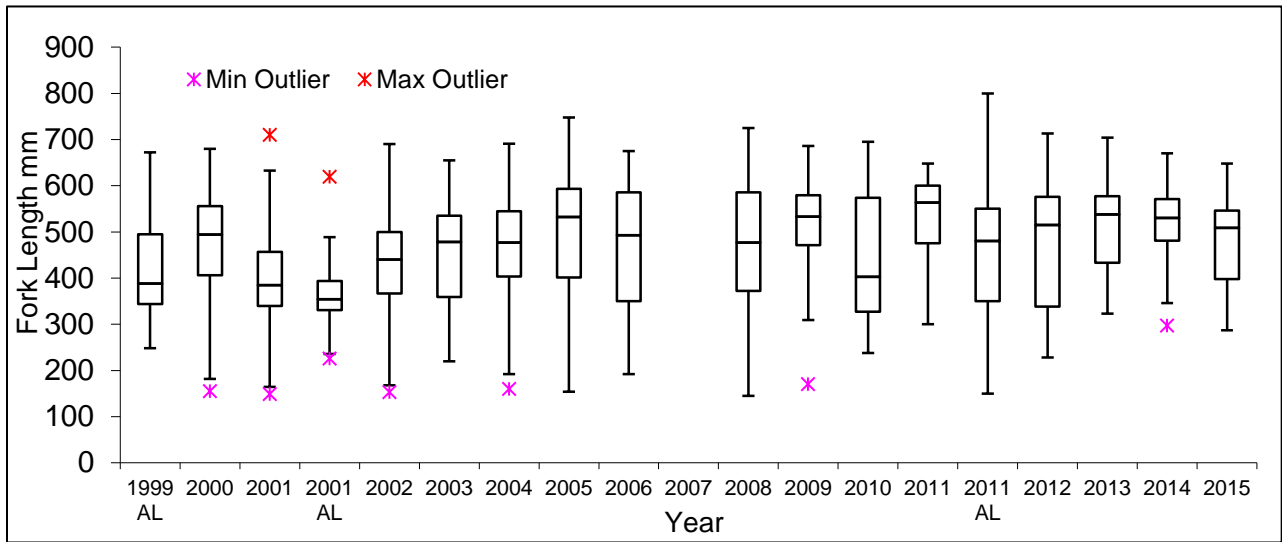


Figure 24. Box-Whisker Plot of fork length of adfluvial redband trout captured by USGS and ODFW from 1999-2015 in Upper Klamath Lake, Williamson and Sprague Rivers. AL is Agency Lake. The 2011 Agency Lake data are redband captured using (boat electrofishing, hook and line and trap net)

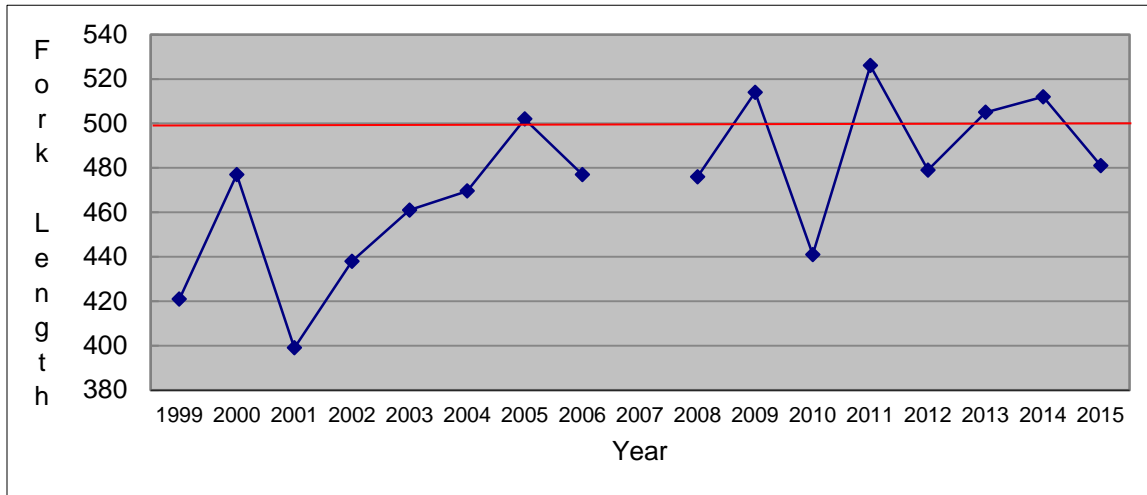


Figure 25. Mean fork length (mm) of adfluvial redband trout captured by USGS in spring in Upper Klamath, Williamson River and Sprague River by trammel net, weir and fish ladder. Red line is fishery management objective of average redband greater than 20 inches.

Table 12. Comparison of all adfluvial redband trout fork length data in Agency Lake (AL) and Upper Klamath Lake (UKL) from 1958-2015 (in 1958 only fish greater than 20” could be retained).

| Avg length | Max FL | Min FL | N | Year | Location |
|------------|--------|--------|-----|-------|-------------------------|
| 481 | 648 | 287 | 155 | 2015 | UKL |
| 512 | 670 | 297 | 105 | 2014 | UKL |
| 505 | 704 | 323 | 92 | 2013 | UKL |
| 479 | 713 | 228 | 135 | 2012 | UKL |
| 526 | 648 | 300 | 78 | 2011 | UKL |
| 449 | 800 | 150 | 302 | 2011 | AL |
| 441 | 695 | 238 | 63 | 2010 | UKL |
| 514 | 686 | 170 | 178 | 2009 | UKL |
| 476 | 725 | 145 | 123 | 2008 | UKL |
| | | | 40 | 2007 | UKL |
| 477 | 675 | 192 | 48 | 2006 | UKL |
| 502 | 748 | 154 | 219 | 2005 | UKL |
| 470 | 691 | 160 | 228 | 2004 | UKL |
| 461 | 655 | 220 | 199 | 2003 | UKL |
| 438 | 690 | 153 | 302 | 2002 | UKL |
| 399 | 710 | 149 | 400 | 2001 | UKL |
| 374 | 619 | 226 | 112 | 2001 | AL |
| 477 | 680 | 155 | 198 | 2000 | UKL |
| 398 | 545 | 248 | 40 | 1999 | AL |
| 569 | 780 | 387 | 294 | 92-93 | Spring Creek spawners |
| 544 | 670 | 403 | 122 | 92-93 | Williamson River (Kirk) |
| 546 | 725 | 403 | 50 | 91 | Spring Creek spawners |
| 499 | 619 | 344 | 50 | 90 | Williamson River (Kirk) |
| 526 | 670 | 365 | 45 | 1989 | Sprague River spawners |
| 550 | 727 | 398 | 78 | 1990 | Spring Creek spawners |
| 632 | 775 | 521 | 158 | 1958 | UKL Creel |

Klamath Lake Redband Trout Scale Analysis

Scales were collected from harvested redband trout primarily during the 2009 and 2010 statistical creel conducted on Upper Klamath Lake. In addition scales were collected from 2003 to 2013 in various locations around Upper Klamath Lake.

Lisa Borgerson from the ODFW Fish Life History Lab in Corvallis, Oregon read 125 redband trout scales in 2014. Metrics calculated from redband trout scales were age, spawning age, migration age to the lakes, back calculated length at age and length at age when scale collected.

Redband Trout Size at Age and Size at Back Calculated Age

Redband trout ranged in age from age 2 to age 7. The most common age was age 4 which encompassed 41% of the sample (Table 13), with an average age of 4.15 years old. Average size of all redband trout was 555 mm and size ranged from 342-788 mm.

Table 13. Scale analysis of redband trout captured from Upper Klamath Lake and tributaries in 2009-2010 Klamath County, Oregon.

| | <i>Age 2</i> | <i>Age 3</i> | <i>Age 4</i> | <i>Age 5</i> | <i>Age 6</i> | <i>Age 7</i> |
|---------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Average Length (mm) | 363 | 487 | 559 | 611 | 629 | 674 |
| N | 5 | 25 | 48 | 27 | 8 | 3 |
| % Sample | 0.04 | 0.22 | 0.41 | 0.23 | 0.07 | 0.03 |

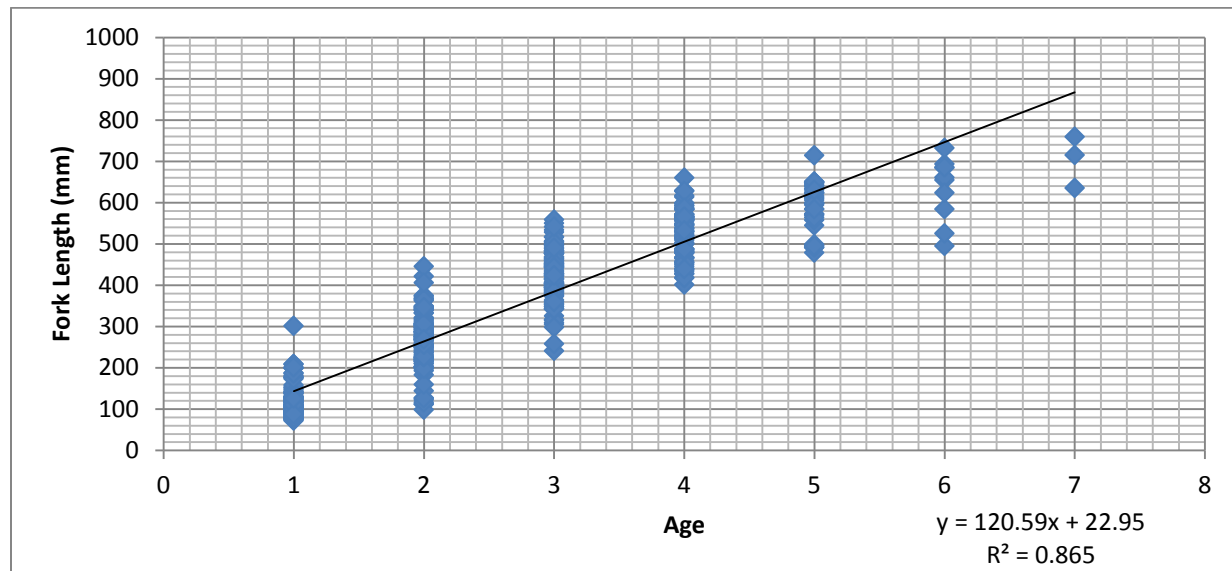


Figure 26. Back calculated age versus back calculated fork length of redband trout from Upper Klamath Lake from 2003-2013. (Klamath County, Oregon).

Table 14. Average fork length (mm) of redband trout at age by scale back calculation and determination of size at migration into Upper Klamath or Agency Lakes

| Scale Annulus Age or Check | Average Length (mm) | +/- 95%CI (mm) | Size Range (mm) | Sample Size |
|----------------------------|---------------------|----------------|-----------------|-------------|
| Migration Check | 119 | 9 | 25-233 | 112 |
| A1 | 116 | 7 | 72-301 | 115 |
| A2 | 266 | 12 | 99-445 | 113 |
| A3 | 423 | 12 | 241-558 | 109 |
| A4 | 519 | 17 | 401-660 | 85 |
| A5 | 593 | 18 | 478-714 | 37 |
| A6 | 634 | 48 | 495-732 | 10 |
| A7 | 703 | 71 | 635-759 | 3 |

Redband Trout Outmigration Age

A total of 110 redband trout scales showed readable patterns to estimate age at outmigration. Most juvenile redband trout appear to migrate to more productive habitat at age 1 (71%) (Age 0, 20% and age 2, 12%). Redband trout potentially migrate to more productive habitat near their first year of life as back calculated average size at outmigration is similar to back calculated size at age 1 (Table 14). Back calculated size at outmigration for juvenile redband trout into more productive habitat (ie. Upper Klamath Lake) ranged from 25-233mm. The Upper Klamath Lake redband trout showed a higher percentage of juveniles outmigrating at age 0 and age 2 than Agency Lake redband. Screw trap monitoring on the Sprague and Williamson Rivers show similar size classes moving downstream.

Redband Trout Spawning Age

Age at first spawning was age 2 but age 3 was the most common age to first spawn and nearly all the redband trout showed a spawning check at age 3. Repeat spawning was common and 95% of redband trout age 4 and older had spawned at least twice or more. Two seven year old redband trout appeared to spawn five times with four spawning checks observed on scales. A total of 104 out of 115 redband trout had at least one spawning check on the scale (Table 15).

Table 15. Number of spawning checks observed on scales and percentage of sample of redband trout in Klamath Lake from scales collected in the years 2003-2013.

| Number of Spawning Checks | % of Sample |
|---------------------------|-------------|
| 0 | 10 |
| 1 | 16 |
| 2 | 40 |
| 3 | 27 |
| 4 | 6 |
| 5 | 2 |

Agency Lake Watershed Scale Analysis

A total of 72 scales were analyzed from redband trout in Agency Lake watershed. Scales were collected from harvested redband trout primarily during the 2009 and 2010 statistical creel conducted on the lakes. In addition six redband trout scale samples were mortalities found on the spawning grounds of the Wood River and tributaries. Metrics calculated were the same as those reported from Upper Klamath Lake. Six of these redband were collected on the Wood River (3), Tecumseh Springs, Crooked Creek, and Fort Creek spawning areas. Sixty six redband trout scales were collected from harvested redband trout from Agency Lake in 2009 and 2010.

Redband Trout Size at Age and Size at Back Calculated Age

Redband trout from Agency Lake watershed ranged from age 2 to age 6. The most common age was age 4 which encompassed 48% of the sample (Table 16) with an average age of 4.19 years old. Average size of all redband trout was 551 mm and size ranged from 343-762 mm (Figure 24).

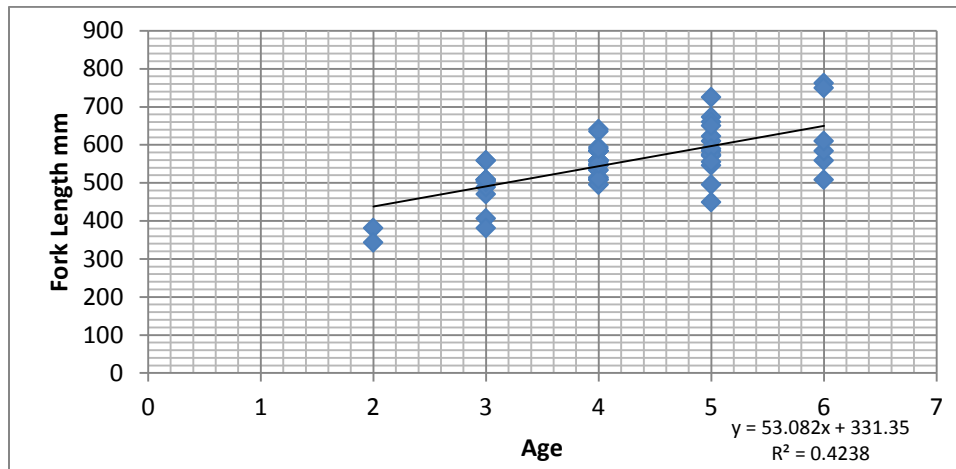


Figure 24. Measured length at age of redband trout in Agency Lake and tributaries (Klamath County, OR) in 2009-2010 as calculated by scale analysis.

Table 16. Scale analysis of redband trout captured from Agency Lake and tributaries in 2009-2010 Klamath, County, Oregon

| | <i>age 2</i> | <i>age 3</i> | <i>age 4</i> | <i>age 5</i> | <i>age 6</i> |
|-------------------|--------------|--------------|--------------|--------------|--------------|
| Average size (mm) | 362 | 491 | 553 | 593 | 629 |
| N | 2 | 12 | 34 | 17 | 6 |
| % Sample | 0.03 | 0.17 | 0.48 | 0.24 | 0.08 |

Table 17. Average fork length of redband trout at age by scale back calculation and determination of size at migration into Agency or Upper Klamath Lake.

| Scale Annulus Age or Check | Average Length (mm) | +/- 95%CI (mm) | Size Range (mm) | Sample Size |
|----------------------------|---------------------|----------------|-----------------|-------------|
| Migration Check | 132 | 8 | 74-189 | 60 |
| A1 | 119 | 8 | 25-222 | 67 |
| A2 | 281 | 12 | 184-377 | 67 |
| A3 | 421 | 12 | 297-500 | 65 |
| A4 | 514 | 13 | 381-637 | 54 |
| A5 | 568 | 33 | 448-714 | 21 |
| A6 | 617 | 90 | 488-759 | 6 |

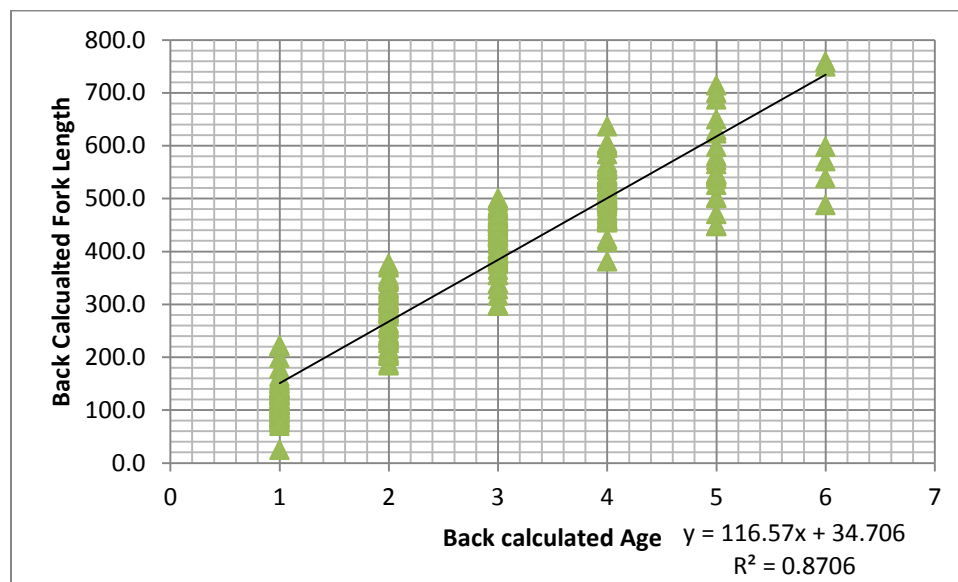


Figure 27. Back calculated age versus back calculated fork length of redband trout from Agency Lake and Tributaries in 2009-2010 (Klamath County, Oregon).

Redband Trout Outmigration Age

Most juvenile redband trout appear to migrate to more productive habitat such as Upper Klamath Lake at age 1+ (88%). Redband trout potentially migrate to more productive habitat after their first year of life as back calculated average size at outmigration is larger than back calculated size at age 1 (Table 17). One redband trout appeared, at 188mm, to be age 2 upon outmigration. Outmigration of redband trout at age 1 was validated in 2011 trap netting at the Wood River delta where 35 redband trout were captured ranging in size from 75-200mm. Young of the year redband trout less than 75 mm would likely not be captured in the trap net.

Redband Trout Spawning Age

Similar to Upper Klamath Lake age at first spawning was age 2 but age 3 was the most common age to first spawn and nearly all the redband trout showed a spawning check at age 3. Repeat spawning was common and 95% of redband trout age 4 and older had spawned at least twice or more. Three six year old redband trout appeared to spawn four times with four spawning checks observed on scales. A total of 68 out of 70 redband trout had at least one spawning check on the

scale (Table 18). The other two scales were from smaller redband trout of 343 and 381 mm. Small redband trout rarely enter the fishery and are even less rare in the harvested creel.

Table 18. Number of spawning check observed on scales and percentage of sample of redband trout in Agency Lake and Tributaries in 2009-2010

| Number of Spawning Checks | % of Sample |
|----------------------------------|--------------------|
| 0 | 2 |
| 1 | 16 |
| 2 | 47 |
| 3 | 29 |
| 4 | 6 |

Management Actions Upper Klamath and Agency Lakes (Mixed Redband Population)

- 1) ODFW Fish District continues to support breaching the levees along Barnes, Agency and BLM wetlands to increase sucker and redband trout habitat, restore the cold water stream channels of Sevenmile and Fourmile Creeks, reduce entrainment and improve water quality in the lake.
- 2) Determine catch rate by creel surveys performed every three weeks.
- 3) Management objective for catch rate based on 2009-2010 statistical creel should be 6 hours per redband trout from boat anglers and 20 hours per redband trout from bank anglers. Historic management objective was no more than 17 hours per angler per fish (1981 Upper Klamath Lake Management Plan).
- 4) Maintain average size of redband trout captured as greater than 20 inches.
- 5) Further studies should document the habitat conditions juvenile redband trout are utilizing and if possible the preference of habitat types.
- 6) Management actions should take place to reduce the likelihood of competition, exclusion and predation by warmwater fish species such as yellow perch, brown bullhead and pumpkinseed sunfish.
- 7) Management should consider the age at which redband trout produce trophy redband trout. To reach the true trophy size of 31 inches redband trout are 7-8 years old and have spawned 5-6 times. Management actions should consider protecting larger, older fish especially on spawning grounds, in staging habitat and in thermal refuge areas to potentially increase the likelihood of catching true trophy redband trout
- 8) Radio tag redband trout with water temperature tags to determine multiple objectives of improving the trout fishery.

Sprague River and Lower Sycan River Conservation Population 18010202cp004

Sprague River (Chiloquin Dam) Redband Trout Scale Analysis

A total of 27 scales were analyzed from redband trout in the Sprague River. While the scales were collected from redband trout captured in the fish ladder trap on Chiloquin Dam on the Sprague River on March 1, 1989, they were analyzed by the ODFW Fish Life History Lab (Corvallis) in 2014. Metrics calculated from redband trout scales were age, spawning age, migration age to the lakes, back calculated length at age and length at age when scale collected. Redband trout ranged from age three to age seven, with an average age of 4.7 years. The most common age was age 5 which encompassed 37% of the sample. Average size of all redband trout was 529 mm and size ranged from 382-615 mm.

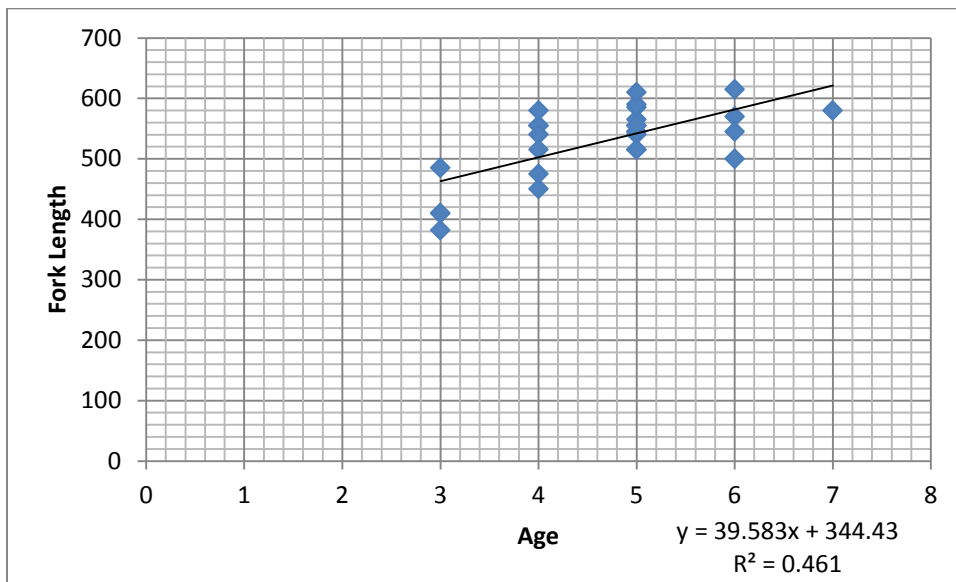


Figure 28. Measured length at age of redband trout in Sprague River (RM 1) (Klamath County, OR) in 1989 as calculated by scale analysis.

Most juvenile redband trout appear to migrate to more productive habitat such as Upper Klamath Lake at age 1+ (64%) (Age 0+, 25% and age 2+, 11%). Twenty five-percent of redband trout appear to migrate into Agency and Upper Klamath Lake during their first year of life at age 0+. Redband trout potentially migrate to more productive habitat (i.e. Agency Lake or Upper Klamath Lake) near their first year of life as back calculated average size at outmigration is similar to back calculated size at age 1. Back calculated size at outmigration ranged from 84-200mm with an average of 133 mm. The Sprague River redband trout showed the highest percentage of juveniles outmigrating at age 0+ when compared to Upper Klamath and Agency Lake redband. Screw trap monitoring on the Sprague River and Williamson River have shown similar size classes moving downstream.

Age at first spawning and the most common age to first spawn was age 3. Repeat spawning was common (Table 19). One seven year old redband and two six year old trout appeared to spawn four times with four spawning checks observed on scales. All redband trout had at least one spawning check on the scale (Table 1).

Table 19. Number of spawning checks observed on scales and percentage of redband trout from Sprague River in the year March 1989

| <i>Number of Spawning Checks</i> | <i>% of Sample</i> |
|----------------------------------|--------------------|
| 1 | 11 |
| 2 | 36 |
| 3 | 42 |
| 4 | 11 |

Preferred Management Actions

- 1) Habitat conditions conducive to rearing of redband trout to age 1+ should be enhanced and rehabilitated to benefit the productivity of the population and improve the Upper Klamath Lake and Williamson River trophy trout fishery.
- 2) Further studies should document the habitat conditions juvenile redband trout are utilizing and if possible the preference of habitat types.
- 3) Management actions to reduce the likelihood of competition, exclusion and predation for habitat by yellow perch and largemouth bass should occur. This includes the continuation of the no limits on all warmwater species.
- 4) Predation of young of the year redband trout by yellow perch and largemouth bass should be studied especially around spring areas of Lalo, Kamkaun and Gold Springs (RM 77).
- 5) Habitat, water quality and instream flow improvements in the Sprague River could result in a larger number of outmigrants into Upper Klamath Lake.

Sprague River redband trout population at Kamkaun Springs (cd 01)(RM 24):

Life History Type: Primarily adfluvial with fluvial life histories with spawning timing from October-April with peak in January

Population Trend: Unknown with recent excellent returns. Spawning population easily exceeds 500 adults with likely adult escapement 600-2500.

Recent Findings: AUC redband trout counts began in the 2013-2014 spawning season. Kamkaun Springs has one of the largest spawning escapements of adfluvial redband trout in the Klamath Basin (Table 20). Peak counts reached 570 redband trout in 2014-15 spawning season. Observer efficiency is likely low at this site due to a large area that fish can elude observation. The landowner who lives on the springs reported in the 2014-2015 spawning this was the most redband he had observed at the springs since early 2000's. Six of twelve redband trout radio tagged at Chiloquin Dam on Sprague River in late December of 2005 were found at Kamkaun Springs.

Past sampling has shown the importance of the Kamkaun Spring spawning area. Large numbers of adfluvial redband trout were observed in December 2008 while snorkeling. Large numbers of trophy bass were also observed and outnumbered the trout. However, during the 2014 snorkeling survey, few largemouth bass were observed and this population appears in steep decline District and USFWS staff night snorkeled the springs in winter 2014. Redband trout behavior was not typical. Redband trout swam away rapidly downstream and then rushed all at once making enumeration impossible.

Table 20. Number of redband trout observed at Kamkaun Springs (Sprague River) and outlet channel to Sprague River in three spawning seasons from 2013-2016.

| <i>Date</i> | <i>Number redband</i> |
|-------------|-----------------------|
| 1/4/2014 | 292 |
| 1/20/2014 | 211 |
| 1/28/2014 | 146 |
| 11/11/2014 | 213 |
| 11/20/2014 | 204 |
| 1/4/2015 | 570 |
| 1/15/2015 | 550 |
| 1/27/2015 | 347 |
| 3/3/2015 | 42 |
| 4/25/2015 | 0 |
| 10/26/2015 | 90 |
| 11/10/2015 | 203 |
| 12/8/2015 | 332 |
| 12/31/2015 | 433 |

The population likely benefitted from improved fish passage from the removal of Chiloquin Dam in 2008. Extensive habitat restoration and enrollment of several large properties in NRCS CREP and WRP easements has improved habitat conditions in the Sprague River. Recent call of senior water rights by the Klamath Tribes in 2013 and 2014 likely improved water quality in summer due to the lack of return flow from flood irrigation. However, water temperatures in the river reached lethal levels for redband trout in 2013-2015. All three years water temperatures reached 29-30 degrees at the USGS gage station near mouth.

Preferred Management Actions:

- 1) Work with project partners (NRCS, Klamath Tribes, KBRT and USFWS) to improve water quality in Sprague River by reducing water temperatures and reducing nutrient loading especially from floodplain habitats.
- 2) Work with (USFWS and KBRT) to restore any spring fed systems to the Sprague River particularly Lalo Spring (RM 19) and McCready (RM 25.5), and others.
- 3) Restore fish passage, remove levees if feasible and potentially improve spawning habitat at Lalo Springs (RM 19).
- 4) Increase harvest or physically remove largemouth bass and yellow perch from Kamkaun Springs and Sprague River.

Sprague River redband trout population from Spring Creek (RM 75) to River Springs (RM 80) (cd23):

Life History Type: Primarily adfluvial with fluvial life histories with spawning timing from November-March with peak in January.

Population Trend: Unknown but likely a recent upward trend likely due to the 2010 and 2011 year class. Expect crash in near future due to numerous drought years with low flow and above average water temperatures.

Preferred Management Actions:

- 1) Improve water quality by reducing water temperatures and reducing nutrient loading.

- 2) Restore any spring fed systems to the Sprague River particularly Whiskey Creek, Whitehorse Springs and headwaters of Spring Creek.
- 3) Restore River Springs (RM 80) with USFWS.
- 4) If feasible restore spawning habitat and fish passage in spring areas (unnamed springs RM 76, etc.)

Rock Creek (Sprague) redband trout population (cd 009-012):

Life History Type: Very small, isolated resident population less than 500 adults. Spawning timing likely from March-May.

Population Trend: Likely downward trend

Rock Creek was last sampled in 2010. Redband trout are restricted to the extreme headwaters as the creek is mostly dry in the summer. The lower portion of the stream channel is channelized and passage is likely blocked at the mouth by a levee on the Sprague River. A few redband trout were found on this lower channelized section upstream of Sprague River highway. Genetic samples analyzed by Pearse in 2010 showed interesting relationship of this population and also showed that the population has limited heterozygosity. This population might have historically experienced a more anadromous life history type due to closer genetic relationships with Klamath River redband/rainbow trout.

Preferred Management Actions:

- 1) If necessary provide fish passage at the mouth of Rock Creek.
- 2) Improve fish habitat on private land with potential to increase sinuosity.

Lower Sycan River Redband Trout Population (cd 014,016-017,019,044)

Life History Type: Resident, fluvial, and adfluvial with spawning timing from December-February at Drews Road (RM 2) and unknown at Torrent Springs.

Population Trend: Significant downward trend

Recent Findings: Extensive drought in 2012-2015 caused the Sycan River to go dry for most of the River. The river was dry at the Blue Creek confluence in summer of 2015. This might be the first time the river went dry in this location.

Hook and line sampling in April 2014 captured three redband trout from 6 to 14". No redband trout were captured on opening day April 23, 2015 (RM 11). No fish of any species were observed on the Sycan River on opening day of trout season in 2015. Two small juvenile bullfrogs were observed.

Redband trout were likely able to survive in low numbers immediately below Brown Springs Creek, Snake Creek and Torrent Springs. Besides these locations trout survival is minimal.

Snake Creek (cd 015)

Recent Findings: Sampling by USFWS in 2012 found redband trout in Snake Creek above a permanent irrigation dam barrier at confluence of the Sycan River (RM 3). In 2015 USFWS and Klamath Partnership provided fish passage into this small spring fed stream for the first time in decades.

**Trout Creek (Lower Sprague River) Redband Trout Conservation Population
18010202cp005**

Trout Creek Redband Trout Population (Sprague River RM 38.2)

Life History Type: Fluvial, resident, adfluvial with spawning likely from March-May

Population Trend: Likely downward trend

Recent Findings: Trout Creek is the most productive redband trout stream in the Klamath Basin as far as fish per meter squared utilizing two pass electrofishing with block nets. Trout Creek redband trout populations have interesting genetic relationships with an intermediate correlation between Klamath River redband and Klamath Lake redband. They also have an intermediate resistance to the parasite *C. shasta*. Redband trout in Trout Creek might have experienced a stronger run of anadromous redband than the lake populations spawning in Williamson and Wood River systems.

Upper Sycan River Redband Trout Conservation Population 18010202cp006

Upper Sycan River Redband Trout Population (cd 018,056-057)

Life History Type: Primarily resident or fluvial with spawning from April-June.

Population Trend: Likely Downward trend; Extensive drought the past four years has likely decreased abundance and habitat.

Recent Findings: Hook and line sampling at Rock Creek campground in May 8, 2015 captured six redband trout in two hours. Redband trout were also observed spawning upstream of the campground. Brook trout outnumbered redband trout 3.3 to 1.

Hook and line sampling on the Sycan River from Paradise Creek confluence upstream did not observe or catch any redband trout in May 2015. One redd was observed in this reach. Extensive beaver activity has occurred in this reach with large, full spanning beaver dams.

The Nature Conservancy is continuing work on improving fish passage through the Sycan Marsh especially at weir 2 where The Nature Conservancy and ZX Ranch divert water and restoring the historic sinuous channel.

Long Creek Redband Trout Population (cd 20-21)

Life History Type: Resident, fluvial and adfluvial to Upper Klamath Lake with spawning likely from April-June.

Population Trend: Likely Downward Trend; The redband trout long term index site has not been monitored since 2007.

Recent Findings: Redband trout were found while night snorkeling at the barrier waterfalls on Long Creek in 2013, 2014 and 2015. This increase in distribution might be related to lower flows and warmer water temperatures. Four redband trout were observed from the falls downstream to the 400-00 road in 2014 sampling. One redband trout was observed immediately below the falls in October 2015. All redband were 150 mm or less.

Calahan Creek Redband Trout Population (not listed)

Population Trend: Likely downward trend

Life History Type: Likely fluvial into Long Creek

Life History Type: Resident, fluvial and adfluvial to Upper Klamath Lake with spawning likely from April-June. Redband trout were found in Calahan Creek electrofishing in 2014. Redband trout distribution was limited to the first mile of creek.

Preferred Management Actions:

- 1) Screen Smalls Ditch irrigation diversion below NF-27 road on Long Creek.
- 2) Remove brook trout in Calahan Creek and reintroduce redband trout.

Coyote Creek redband trout population (cd 022)

Population Trend: Likely Downward Trend

Life History Type: Isolated Resident with spawning likely from April-June

Long and Bond (OSU 1979) only found redband trout at the two sampling locations. Brook trout dominated sampling by ODFW in all sections of the Coyote Creek.

The culvert at the 2700-019 road was replaced in 2008.

Extensive recent beaver activity has created numerous large beaver complexes. Beaver dam complexes tend to favor brook trout over redband trout.

Preferred Management Actions:

- 1) Remove brook trout in Coyote Creek.

Skull Creek redband trout population (cd 063)

Population Trend: Nearly Extirpated

Life History Type: Primarily fluvial into Sycan River with likely spawning in the spring.

Recent Findings: Fortune captured 70 redband trout to six brook trout at the NF-2913 road crossing in 1968. Long and Bond (OSU 1979) found only brook trout to be very abundant in the upper watershed sampling whereas ODFW in 2006 found a sparse population of redband trout at the lowermost culvert crossing. Fortune (1968) found brook trout to be sparse at this location and redband trout dominate while ODFW in 2006 found the converse. District staff electrofished briefly at the 3272 road crossing in September 2006. Brook trout were more abundant than redband trout at this site by approximately margin of 10 to 1.

Fish passage was improved on Skull Creek by replacing the culvert at the NF-3380 crossing in section 24 in 2012.

Preferred Management Actions:

- 1) Remove brook trout in Skull Creek

Crazy Creek redband trout population (cd 061)

Population Trend: Nearly Extirpated

Life History Type: Primarily fluvial into Sycan River with likely spawning in spring.

Recent Findings: A survey by Fortune et al. (1968) found only 88 redband trout electrofishing at the NF-2913 road crossing on October 8, 1968. Klamath District staff electrofished briefly at the NF-3272 road crossing in September of 2006. Brook trout were more abundant than redband trout at this site by approximate margin of 3 to 1. The culvert was perched and could use improvement. The culvert at the NF-3372 road was replaced in 2008. A 200 m section was sampled in November 2008 by the USFS and captured 218 brook trout and 4 redband trout.

Preferred Management Actions:

- 1) Remove brook trout in Crazy Creek

Paradise Creek redband trout population (cd 58 and 60)

Population Trend: Likely Downward trend

Life History Type: Primarily fluvial and resident

Recent Findings: Fortune et al. (1968) found only redband trout and dace at the NF-2913 road crossing. District staff electrofished briefly at the NF-3272 road crossing in September of 2006. Redband trout were more abundant than brook trout at this site by approximately 10 to 1. Speckled dace were common. Crayfish were observed. The culvert at this crossing is perched and could use improvement. USFS found 19 redband trout, 15 brook trout, 29 speckled dace and 27 lamprey at the NF-3372 road fish salvage on 8-28-2007 for the culvert replacement.

Hook and line sampling at the mouth of Paradise Creek in May 2015 only captured brook trout. Silt load and incision is high in this reach.

Watson Creek redband trout population (cd 059)

Population Trend: Likely extirpated

District staff surveyed Watson Creek above the 3372 road crossing culvert on 11 July 2012. Brook trout were abundant and the only fish found in this section despite the water temperature of 23.5 C.

Long Creek (RM 51) Redband Trout Population (cd 064-065)

Life History Type: Primarily fluvial and resident

Population Trend: Likely downward due to flow reduction. Less than 500 adults

Recent Findings: Redband trout were documented below the 28 road crossing by electrofishing in July 2014. Redband trout were surprisingly the only fish found in the creek. Redband trout ranged in size from 40 mm young of the year to adult 180 mm. Habitat was significantly affected by cattle grazing with a large amount of fines instream.

In the spring of 2015 district staff surveyed for upper distribution in Long Creek and found no fish from the 36 road crossings downstream to the 31 crossing. Water levels and habitat appeared suitable to fish but the stream in the summer likely desiccates throughout this section. A healthy stand of willow occurred throughout and beaver reintroduction might assist with development of perennial water in some locations.

Rifle Creek Redband Trout Population (cd 062):

Life History Type: Primarily fluvial and resident

Population Trend: Nearly extirpated and nearly undetectable

Extensive electrofishing by the USFS in 2005 found 222 brook trout and 2 redband trout in 3086 seconds of electrofishing. No redband trout were found above the 3380-11 culvert. District staff

sampled above the culvert in July 2014 and found only brook trout. The 3380-11 culvert was replaced in September 2014 with a stream simulation designed bottomless arch culvert.

Preferred Management Actions:

- 1) Remove brook trout
- 2) Reintroduce bull trout and redband trout

NF Sprague River Conservation Population 18010202cp001

North Fork Sprague River Redband Trout Population (cd 066,070-073)

Life History Type: Resident, fluvial and adfluvial with spawning likely March-June

Population Trend: Likely upward trend last five years due to extensive habitat and fish screening projects but expect a significant decline in the future due to drought.

Recent Findings: Snorkel surveys have occurred in 2006 and 2014 (Figure 30). District staff snorkeled from the mouth of Boulder Creek to the NF Sprague Hydroelectric dam in August 2014 (Figure 30). District staff and Jared Botcher snorkeled the NF Sprague during the day on August, 2014 from Boulder Creek downstream to the hydroelectric dam for 2.1 km. Redband trout dominated observations throughout the reach. A total of 213 redband and 34 brown trout were observed. Three brook trout were observed to nearly the end of the survey. No other fish species were observed. Fish density at this site was higher (119 fish/km) than any other site snorkel sites surveyed in 2006 (Table 21).

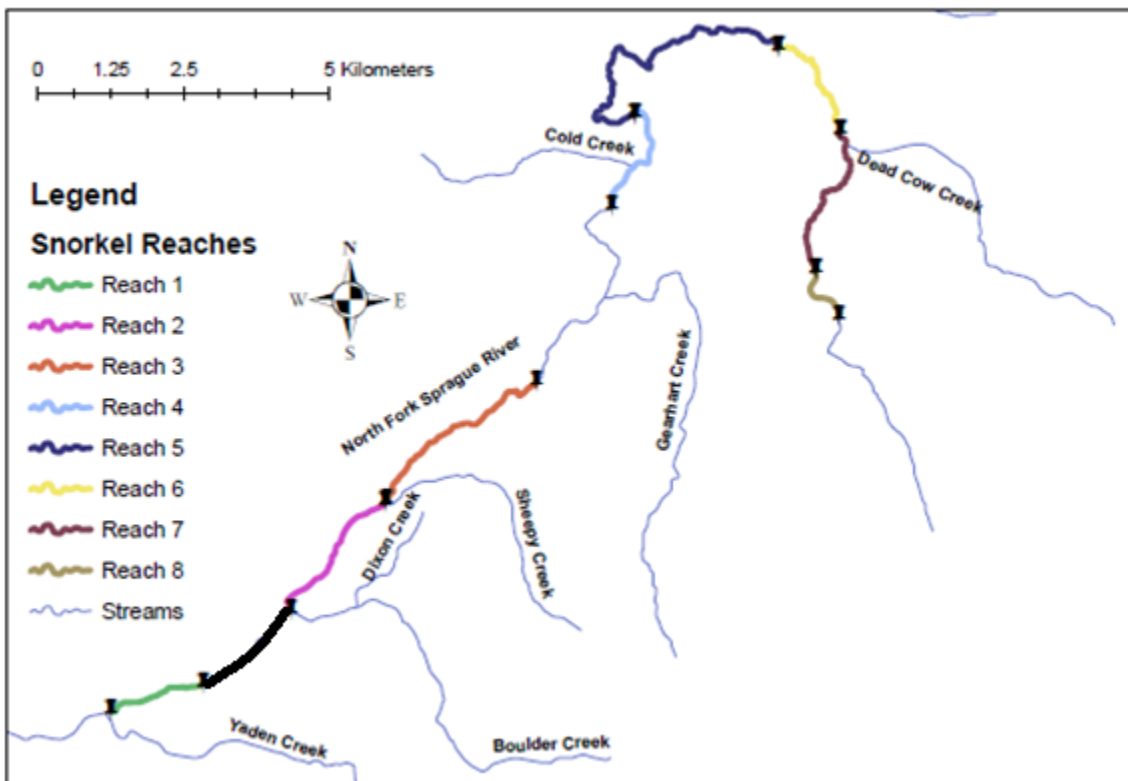


Figure 30. Map of snorkel reaches on the North Sprague River in the years 2006 to 2014 (Reach 1.5 is in black).

Table 21. Observed salmonid density (fish/km) while day snorkeling in the North Fork Sprague River from North Ditch upstream to RM 30.

| Survey Reach | Year | Reach Length (km) | Observed Density (Fish/km) | | | |
|--------------|------|-------------------|----------------------------|---------------|-------------|-------------|
| | | | All Salmonids | Redband Trout | Brown Trout | Brook Trout |
| 0.5 | 2004 | 0.28 | 82.1 | 71 | 10.7 | 0 |
| 0.5 | 2014 | 0.28 | 153.57 | 114.28 | 39.2 | 0 |
| 1 | 2006 | 1.72 | 12.21 | 7.6 | 4.6 | 0 |
| 1.5 | 2014 | 2.1 | 119 | 101.43 | 16.2 | 1.42 |
| 2 | 2006 | 2.73 | 32.25 | 26 | 5.9 | 0.4 |
| 3 | 2006 | 3.72 | 51.62 | 45.2 | 6.4 | 0 |
| 4 | 2006 | 2.17 | 2.3 | 0 | 0.9 | 1.4 |
| 5 | 2006 | 5.93 | 0.67 | 0.3 | 0 | 0.3 |
| 6 | 2006 | 2.16 | 0.46 | 0 | 0.5 | 0 |
| 7 | 2006 | 3.02 | 0.33 | 0 | 0 | 0.3 |
| 8 | 2006 | 1.12 | 9.79 | 0 | 0 | 9.8 |

Note: Reach 0.5 is from North Ditch to 3411 culvert before (2004) and after (2014) NF-3411 culvert (2014) was removed and replaced with bridge.

District staff and USFWS hydrologist followed up the 2014 snorkel survey above the hydro dam diversion with a hook and line survey on August 27, 2014 from 16:30 to 20:15. A total of 21 redband trout, 8 brown trout and 2 brook trout were captured above the hydroelectric dam.

The only documentation of adfluvial redband trout occurred in 2005 from a redband trout that was tagged with an acoustic tag at Chiloquin Dam on the Sprague River and picked up in January at Ivory Pine Road Crossing proceeding upstream and again in March proceeding downstream. This redband trout likely spawned somewhere above Ivory Pine Road

In 2010 and 2011 District staff surveyed tributaries to North Fork Sprague River including School Creek and tributaries, Gearhart Creek, Nottin Creek, Hole Creek, Gold Creek, Deadcow Creek and tributaries and Cold Creek. All these streams were dominated by brook trout. Brook trout have likely completely displaced redband trout populations in School Creek, Deadcow Creek, Gold Creek, Upper North Fork Sprague, and Nottin Creek. Brown trout populations are robust in the North Fork Sprague, Meryl, Boulder/Dixon and Fivemile Creek and exceed redband trout abundance in Boulder and Dixon and Upper Meryl Creek. The North Fork Sprague is a stronghold for brown trout and has one of the highest densities in the Klamath Basin.

FERC has determined the owner of the hydroelectric dam no longer needs to operate a real time stream gage in the bypass reach of the North Fork Sprague River. Water was being diverted during the day of the survey. The minimum flow in the bypass channel is 25 cfs. The flow of NF Sprague River at the OWRD gage on the day of the survey was 27 cfs. Therefore the flow through the turbines is 2 cfs. The flow through the turbines looks more like 10 cfs. The hydroelectric dam was also a barrier to fish passage in August 2014 due to velocity and a jump height exceeding six inches.

The ODFW Central Point Screen shop screened the largest diversion on NF Sprague at the elbow (RM 12) in 2014. This diversion can divert up to 60 cfs. Most instream flow in the summer is

diverted. Fish salvage of the ditch found numerous fish including brown trout and redband including young of the year. This irrigation diversion likely entrained a significant number of out-migrating redband trout.

The North Fork Sprague River at the elbow (FS 3411 Road) had an undersized culvert which limits upstream movement of redband trout. In 2012 OWEB funds were utilized in partnership with the USFS to remove the culvert and replace with a bridge.

Preferred Management Actions:

- 1) Improve passage at the hydroelectric dam in summer.
- 2) Improve riparian and instream habitat conditions and water temperature regime in NF Sprague River above Gearhart Creek by better grazing management and large wood additions.
- 3) Acquire instream flows from the North Ditch which is below the 3411 road crossing.
- 4) Identify a reach of the mainstem NF Sprague and tributaries to remove brook trout, construct barrier and reintroduce bull trout.
- 5) Determine spawning area of adfluvial redband trout above Ivory Pine Road
- 6) Further restore excellent potential spawning and rearing habitat from USFS boundary to Ivory Pine Road.

Cold Creek Redband Trout Population (cd078)

Life History Type: Fluvial into North Fork Sprague River

Population Trend: Nearly Extirpated

Recent Findings: Long and Bond (OSU 1979) reported redband trout abundant at the 3323 road crossing on Cold Creek. In 2011 district staff only found brook trout at this location. At the 3411 road crossing all Long and Bond (1979) found were brown trout. In 2011 District staff found brook trout to dominate at this site with redband trout sparse.

School Creek Redband Trout Population (cd 075)

Life History Type: Fluvial into North Fork Sprague River

Population Trend: Nearly Extirpated; The USFS found one redband trout near the mouth in 2014.

Recent Findings: Long and Bond (OSU 1979) found only redband trout in upper School Creek and found that brook trout dominate a spring fed tributary to School Creek with redband trout sparse. In 2011 District staff spent significant time sampling near the confluence of School Creek to find brook trout dominate with brown trout sparse. Additionally, district staff sampled the exact locations as Bond and Long and found numerous brook trout but no redband trout. Habitat conditions throughout School Creek are good to excellent. Redband trout are virtually extirpated in this stream despite ideal habitat conditions.

Deadcow Creek redband trout population

Life History Type: Fluvial into North Fork Sprague River

Population Trend: Nearly Extirpated

Recent Findings: Long and Bond (OSU 1979) found only redband trout in upper Deadcow Creek. District staff found numerous brook trout at the location Long and Bond sampled. Brook trout were the only fish documented. Further, district staff found brook trout dominated with brown trout sparse at the confluence of Deadcow Creek with NF Sprague River.

Gold Creek Redband Trout Population

Population Trend: Likely Extirpated; District staff in 2011 and Long and Bond (OSU 1979) found only brook trout.

Fivemile Creek redband trout population (cd 67-69)

Life History Type: Resident, fluvial and (adfluvial?) with spawning observed from January-March and maybe earlier.

Population Trend: Likely upward trend

Recent Findings: Improvements in fish passage, riparian management, screening, and permanent instream flow has likely increased abundance of redband trout.

KBRT has secured funding to permanently place a 5 cfs water right instream on Fivemile Creek at Greg Bulkley's property (RM 2). The five cfs will further provide additional cold water to the North Fork Sprague River.

Fivemile Creek has been sampled in 2000, 2007, 2009 and 2012 from just upstream of the mouth to double wide (RM 2). Electrofishing sampling in 2007 was ineffective due water depth but redband trout were captured. In all surveys except in 2000 redband trout were the most abundant fish observed. District staff snorkeled Fivemile Creek on 29 October 2012 with USFWS staff from below the sill logs to the bridge at the mobile home. The snorkel survey in 2012 observed almost three times (116) as many redband trout as 2009 (42) from bridge crossing to double wide trailer. Another 145 redband trout were observed in step pools (juniper sill logs) below the bridge with redband trout up to 22" observed. Screening, fish passage and habitat improvements might be responsible. However, the 2009 survey was completed at night. In most literature night snorkeling is more efficient at observing fish.

During these surveys in 2012 three redband trout and two brown trout were collected and sent to fish pathology for examination. The results show healthy fish with few parasites. The brown trout had spawned. Fish were consuming ants and beetles.

Meryl Creek redband trout population (cd 080)

Life History Type: Resident, fluvial and adfluvial(?) with spawning timing likely March-May

Population Trend: Likely Downward Trend due to drought

Recent Findings: Electrofishing sampling below and above the Cain Creek confluence also only found brook and brown trout. Sampling in Cain Creek only found brook trout. Redband trout were found on Meryl Creek in hook and line sampling on Green Diamond property. Lower Meryl Creek is excessively incised above the irrigation dam structure and below Ivory Pine Road.

Habitat on Meryl Creek is extensively damaged by a road wash out in 2006 due to a plugged culvert failure. A very high silt load still occurs in Meryl Creek. Additionally the system is heavily grazed especially at Meryl Springs. Surveys were conducted at Meryl Springs in 2014. Brown trout dominated the sample with brook trout rare. No redband trout were found.

Long Creek (Meryl Creek) redband trout population (cd 081)

Recent Findings: Long Creek is a small intermittent tributary to Meryl Creek. Redband trout were first discovered in July 2010 at a new beaver dam complex and spring adjacent to the NF-3411 road to Sandhill Crossing on NF Sprague at 42.52578°N, 120.96553°W. Perennial habitat is limited and few redband trout exist in the Creek.

Boulder and Dixon Creek redband trout population (cd 079)

Life History Type: Resident and fluvial with spawning likely form April-May

Population Trend: Likely downward Trend due to drought and population much less than 500 adults.

Recent Findings: Boulder Creek was sampled on August 24, 2012 by electrofishing from the confluence of Dixon Creek to the perched culvert crossing on the 3595 (019) road. A total of 127 brown trout, five redband trout and eight bull trout were captured in 4459 seconds of electrofishing. Redband trout were measured up to 275 mm and in excellent condition. Numerous large brown trout were captured up to 375 mm. The pool below the 019 culvert contained five brown trout over 200 mm. Bull trout were more numerous progressing upstream towards the culvert. The largest bull trout captured was 130 mm. In the summer of 2013, fish salvage by USFS at the NF-019 culvert captured only eight bull trout. No redband trout have been observed immediately below or above the 019 road culvert.

Boulder Creek was sampled from the confluence to 42.51607 -120.9842 on August 27, 2012. This reach was dominated by redband trout biomass with length up to 320 mm. A total of 21 redband and 28 brown trout were captured with most brown trout at 60 mm in 2089 seconds of electrofishing. This section is high gradient with large substrate.

Dixon Creek was sampled on August 27, 2012, at the mouth upstream through a long, steep cascade. Only redband trout were found near the confluence and no fish were found in the cascade in 437 seconds of electrofishing. This is the first documentation of redband trout in Dixon Creek.

Preferred Management Actions

- 1) Remove brown trout.
- 2) Monitor distribution of redband trout to determine if they pass the new culvert at the 019 road crossing.

Gearhart Creek redband trout population

Life History Type: Fluvial with likely spawning from April-June.

Population Trend: Unknown; The Gearhart Creek redband trout population is small likely due to a high abundance of brook trout in Gearhart and Nottin Creeks. Extensive beaver dam activity occurs in these streams and most habitat is in the wilderness area. Habitat is in excellent condition with little disturbance.

South Fork Sprague River Redband Trout Populations 18010202 cp002

South Fork Sprague River Redband Trout Population (cd 025,034,046,045,055):

Life History Type: Resident, Fluvial, adfluvial with spawning likely from March-June.

Population Trend: Significant downward trend due to low flows

Recent Findings: Angling on the South Fork Sprague River in the year 2013-2015 has been very poor. In 2015 numerous anglers did not catch any fish at the USFS day use area off highway 140.

USFWS electrofished this area in summer of 2015 and did not capture any redband trout

USFWS and Deming Creek ranch restored a mile of South Fork Sprague River by creating a new sinuous channel. USFWS sampled this area in 2015 by electrofishing and only captured three redband trout less than 150 mm.

Paradise Creek Redband Trout Population (SF Sprague River (Map incorrect cd032-033)

Life History Type: Isolated Resident above manmade reservoirs

Population Trend: Likely downward trend

Recent Findings: Redband trout were documented for the first time at the headwaters of Paradise Creek a tributary to the South Fork Sprague River. The population is above impassable reservoirs on Paradise Creek on private property. Below these reservoirs the creek is dewatered and habitat conditions are extremely poor. Paradise Creek below the reservoir flows for approximately two months out of the year.

No further studies have occurred since finding this population in 2010.

Whitworth Creek and unnamed tributaries Redband Trout Population (cd 048-52)

Life History Type: Resident and fluvial into South Fork Sprague River

Population Trend: Likely Downward Trend; No data since ODFW Native Fish Investigations sampled in 1995.

Pothole Creek Redband Trout Population (cd 047 distribution wrong on map)

Life History Type: Fluvial into Whitworth and South Fork Sprague River

Population Trend: Likely Downward Trend; No sampling since 1995.

Buckboard Redband Trout Population (cd 053 distribution wrong on map)

Life History Type: Fluvial into South Fork Sprague River

Population Trend: Likely Downward Trend

Recent Findings: Redband trout were found in an intermittent pool below the culvert crossing in 2011.

Camp Creek Redband Trout Population (cd 054)

Life History Type: Fluvial into South Fork Sprague River

Population Trend: Likely Downward Trend with only a few fish present in stream

Recent Findings: Stream dominated by brook trout. Only one redband trout has ever been found in the creek.

Deming Creek Redband Trout Population 18010202cp003

Deming Creek Redband Population (cd 26-29)

Life History Type: Resident and artificial adfluvial (Campbell Reservoir) with spawning run from Campbell Reservoir in April and May

Population Trend: Upward Trend

Recent Findings: ODFW and KBRT performed a distribution survey for redband trout on Deming Creek Ranch on August 11, 2014 to monitor project effectiveness relative to the NFWF objective of increasing redband trout summer distribution.

ODFW found redband trout in Deming Creek in moderate abundance at the property boundary of Deming Creek Ranch in Anderson Field on August 11, 2014. This contrasts with a September 11, 2009 survey in which ODFW did not find redband trout while electrofishing in Anderson Field. Only speckled dace were encountered. Water temperature in Deming Creek was 19.9° C on September 11, 2009 while 14.4° C on August 11, 2014.

ODFW calculates that redband trout summer distribution has increased by 1.4 km on the Deming Creek Ranch since 2009 when management changes began to occur. Redband trout abundance in 2014 in Deming Creek at Anderson Field was in the range of moderate population abundance of 0.12 redband/m².

Additionally, ODFW estimates that redband trout summer distribution has increased downstream from the property boundary at Deming Creek Ranch at Anderson Field to the irrigation diversions below Campbell Road crossing for an additional 3.5 km. Total likely increase in summer distribution of redband trout in Deming Creek is 4.9 km.

Habitat conditions have improved on Deming Creek in Anderson Field due to increased instream flows, riparian fencing, off-site watering for livestock, vegetation planting, instream structures, and juniper removal. Additionally, the uppermost culvert that impeded passage at the uppermost diversion from Deming Creek has been removed and replaced with a roughened channel and fish screen in 2015. This fish screen will block most juvenile redband trout from reaching Campbell Reservoir and inhibit upstream passage of adult redband spawners from Campbell Reservoir.

OWRD has issued the Preliminary Determination for the instream transfer of the Deming Creek Ranch's water rights from Deming Creek within the next two weeks or so, permanently protecting minimum flows of 1.8 cfs and up to 6 cfs during periods of the year.

For the first time in 100 years Deming Creek was reconnected to the South Fork Sprague River with the construction of a 4000 foot channel and a fish screen is nearly complete at the irrigation diversion.

Preferred Management Actions

- 1) Monitor Campbell Reservoir for redband trout presence and the irrigation ditch for redband trout spawning.

- 2) Meet with Deming Creek Ranch and BLM to discuss management of Campbell Reservoir (i.e. warm water fishery, redband trout, or stock with fingerling, legal or trophy rainbow trout).

Lost River Redband Trout Conservation Population 18010204cp001

Miller Creek Redband Trout Population (cd 007-008)

Population Trend: Likely extirpated

Life History Type: Resident and historically March-May spawners

Recent Findings: Miller Creek supported an excellent redband trout (up to 40 redband per angler trip) fishery from 1999-2001. Catch rates significantly declined until 2005 when redband trout were nearly uncatchable. In 2010 flows in the winter were accidentally shutoff at Gerber Reservoir. Since cracks in Gerber Dam had been repaired this left little flow in Miller Creek. Redband trout have not been documented since.

The Miller Creek redband trout population below Gerber Reservoir might be extirpated. Surveys in May 2012 from North Canal upstream over two miles found no redband trout. The entire Lost River redband trout population is possibly extirpated. Purchasing instream water rights for Miller Creek remains a high priority for endangered suckers and redband trout if they still occur.

Gerber Reservoir Tributaries Redband Trout Population (cd 009-010)

Life History Type: Artificial adfluvial and historically March-May spawners

Population Trend: Likely extirpated; Historically, redband trout juveniles were found in Barnes Valley Creek just upstream from the lower road crossing. Adult redband trout were last found in 2001 in Gerber Reservoir by USGS sampling

Jenny Creek Redband Trout Population

Jenny Creek and Tributaries redband trout populations

Population Trend: Likely downward trend

Life History Type: Isolated Resident above natural waterfall barrier with spawning from March-June

Recent Findings: Extensive drought in this watershed has affected all redband trout populations. Keene Creek redband trout numbers have declined sharply (Figure 31) Anecdotal landowner accounts in certain sections of lower Jenny Creek report no redband trout.

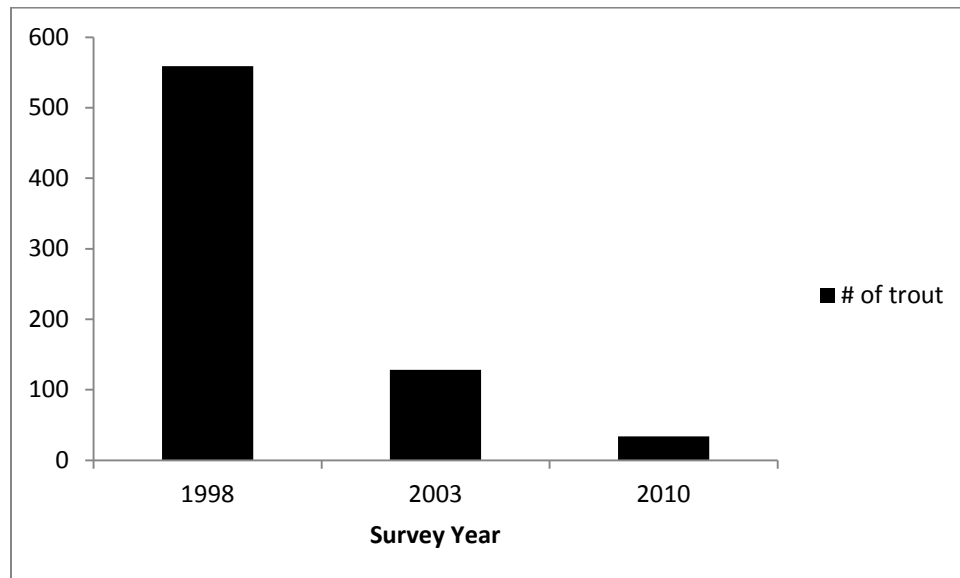


Figure 31. Redband trout enumerated in Keene Creek while Snorkeling in the years 1998, 2003 and 2010 (Data Source Medford BLM).

The genetics of Jenny Creek redband trout appear to be quite diverse due to the stocking of hatchery rainbow trout. The most recent genetic analyses using microsatellites of DNA show Jenny Creek more closely related to Lower Klamath River steelhead (Pearse et al. 2011). In the past Curren's (Buchanan et al. 1994) found redband trout in Jenny Creek and Johnson Creek that were closely related to Wood River redband. Further, Curren's found tributaries Cold Creek and Beaver Creek clustered with the Upper Williamson River group. Additionally, Curren's found that populations in lower Johnson Creek, Willow Creek (Tributary to Howard Prairie Reservoir), lower Jenny Creek, Fall Creek and Shoat Springs clustered with typical coastal hatchery rainbow trout. Further investigation is needed for possible conservation actions for redband trout in areas not impacted by introduced hatchery fish.

Jenny Creek redband trout are located throughout the Jenny Creek systems but have likely have been mostly extirpated or highly introgressed above Keene Creek Reservoir, Hyatt Reservoirs, and above Howard Prairie Reservoir and near private hatchery on Spring Creek. Redband trout have been found in Johnson Creek and tributaries Cold and Sheepy Creek, Beaver Creek and tributary Corral Creek, Keene Creek and tributary Lincoln Creek, and Skookum Creek.

Spring Creek (Shoat Springs) redband trout population

Population Trend: Likely downward trend

Life History Type: Isolated resident above natural potential barrier

Recent Findings: A small isolated population of redband trout occurs at the headwaters of Spring Creek at Shoat Springs. This population is above a likely cascade barrier. A rainbow trout fish hatchery has been operated on Spring Creek near the confluence with Jenny Creek for years. When Ken Currens performed genetic analysis of these fish in 1994 they appeared to cluster with populations of potential introgression with coastal hatchery rainbow trout.

PacifiCorp is intending to install this new weir structure on Spring Creek to allow additional flow from the upper Spring Creek spring to make its way down past their diversion pipe to Taylor's diversion and lower Spring Creek and Jenny Creek. Taylor's hydroelectric diversion, which is downstream is required to maintain a minimum instream flow of 1.56 cfs and includes provisions for fish screens on his three diversion intakes. He is also required to maintain habitat for aquatic and riparian species and provide access for upstream and downstream migrating trout to Jenny Creek. PacifiCorp's diversion is unscreened to their hydroelectric facility and any work on the project is delayed as part of the KHSA and KBRA.

Preferred Management Actions:

- 1) Perform a thorough genetic analyses of Jenny Creek and all tributaries.
- 2) Continue to work with ODFW Central Point Fish District with selection of rainbow trout stocks for stocking in Hyatt and Howard Prairie that will not affect the uniqueness of certain redband trout in tributaries.
- 3) Assist Medford BLM with monitoring activities.

Klamath River Redband Trout Population

Klamath River Redband Trout Population

Population Trend: Likely downward trend

Life History Type: Resident, fluvial, and artificial adfluvial (Keno Reservoir, J.C. Boyle Reservoir, Copco Reservoir) with spawning from February-June in Bypass Reach near springs

Recent Findings: District staff sampled the Klamath River on 14 September 2009 at the Frain Ranch (RM 214) for a disease analysis by Scott Foote from USFWS. Condition and size of redband trout was slightly higher than observed in extensive sampling in 2003 and 2004 by ODFW (Figure 32).

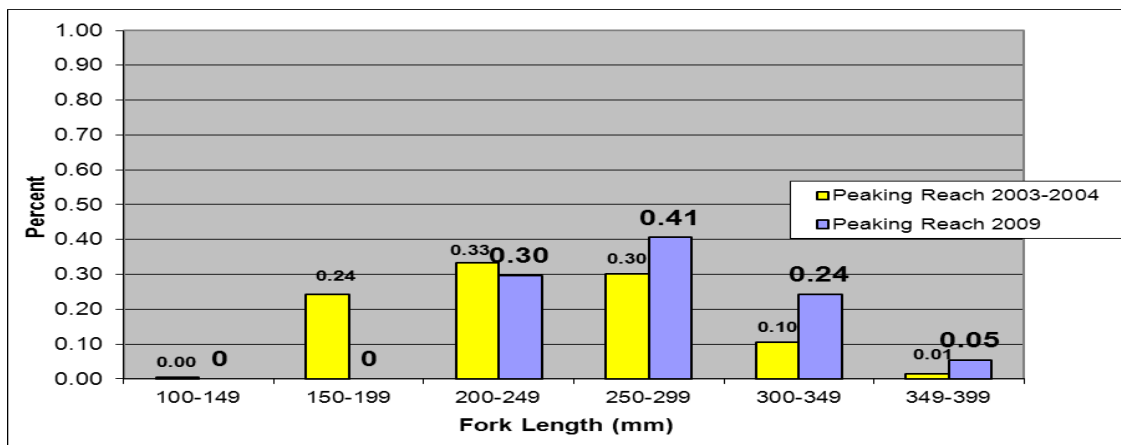


Figure 32. Fork length of redband trout captured by hook and line sampling on the Klamath River in the years 2003-2004 (RM 207-219) and 2009 (RM 214).

The redband trout population below Keno Dam continues to support a robust fishery and Roe Outfitters charges \$450 dollars a day to float and fly fish this section of river. Two other guides are known to guide on the river.

Gravel augmentation occurred in October-November of 2011-2015 at numerous locations below JC Boyle Dam from rivermile 215-220. Gravel ranged in size from 3/8 to 4". The gravel is being placed as an interim restoration measure agreement until the dams are breached in 2020.

Significant violations of ramping rates in the reach below JC Boyle Dam and Powerhouse likely continue to affect the redband trout population as well as other native fish.

The auxiliary water supply intake to the fish ladder at JC Boyle dam lacks ODFW approved screening and likely has developed a large hole in the existing trash rack. Large redband trout and suckers are getting stranded once they are entrained due to the trash racks-tailrace barrier. ODFW is working with PacifiCorp to develop a plan to salvage the fish out of that area.

District staff sampled the Klamath River during maintenance activities in October 2012. Thirty redband trout were captured at river mile 216 in four hours of hook and line sampling. Trout ranged from 4 to 14 inches. Many trout in the six to eight inch age class were captured. In 2015

two District staff and one USFWS biologist performed hook and line sampling at RM 214 at the Frain Ranch and just above the BLM campground near RM 217. Approximately 35 redband trout were landed in six hours of fishing. Trout ranged from 4-12 inches.

District staff sampled the Klamath River below Keno Dam in October 2012. Flows were 598 cfs and 388 cfs. Hook and line sampling was excellent with redband trout ranging from 12-23 inches. Redband trout were in very good condition. A total of 20 were captured in six hours of angling. Hook and line sampling in late May 2015 was the lowest catch rate on record for district staff. Three redband trout were landed in six hours of angling.

Spencer Creek redband trout population

Population Trend: Likely downward trend

Life History Type: Resident, fluvial, and artificial adfluvial (Keno Reservoir, J.C. Boyle Reservoir, Copco Reservoir) with spawning from late February-May.

Recent Findings: The redband trout index site on Spencer Creek was last monitored in 2008. Spawning surveys were discontinued as the survey was not an adequate assessment of abundance and flows were typically high and turbid during surveys.

Preferred Management Actions:

- 1) Restoration of the headwater springs area and the stream channel through Buck Lake remains the highest priority for Spencer Creek.

Fall Creek Redband Trout Population

Fall Creek redband trout

Population Trend: Likely downward trend

Life History Type: Isolated resident above natural waterfall

Recent Findings: The Medford BLM office has reported the Oregon Gulch fire in 2014 severely burned the riparian area up to the headwater springs. The Medford BLM office plans to fence sections of Fall Creek to protect sensitive vegetation from cattle grazing. Medford BLM Fishery Staff observed redband trout in Fall Creek after the fire.

Preferred Management Objectives

- 1) Perform fish distribution and abundance survey.

Lower Klamath River Tributaries Redband Population

Lower Klamath River Tributaries (Beaver Creek, Camp Creek, Scotch Creek and Hutton Creek)

Population Trend: Likely downward trend

Life History Type: Some are isolated resident between Iron Gate and Copco dams or lack of passage at mouth. The use of Iron Gate Reservoir by rainbow trout from Camp Creek, Scotch Creek and Hutton Creek is likely.

Recent Findings: All these tributaries flow into California before entering the Klamath River or Iron Gate Reservoir. In 1997 Klamath District ODFW determined Long Prairie, Edge and Hayden Creek were fishless in Oregon. Fish presence in Beaver Creek has not been confirmed.

Klamath River Tributaries Summer Run Steelhead Population

Klamath River Tributaries below Iron Gate Dam Steelhead Population
Population Trend: Likely downward trend

Life History Type: Resident, fluvial, anadromous

Recent Findings: All these tributaries enter California before entering the Klamath River. These tributaries have not been sampled since 2004.

Juvenile *Oncorhynchus mykiss* have been found in Cow, Long John, Red Mill, Grouse, Cottonwood Creek and East Fork Cottonwood Creek (USFS and Central Point ODFW). Juvenile *Oncorhynchus mykiss* were found in Cow Creek and Long John Creek by ODFW Klamath Staff in 2003.

A large redd was observed in EF Cottonwood Creek on April 15, 2003. The size of the redd suggests steelhead utilize the creek in Oregon for spawning. Fish passage (perched culvert to bridge) was improved by the nonprofit Lomakatsi at the Colestein Road crossing on a tributary to EF Cottonwood Creek in 2007. Large number of juvenile rainbow trout were found below the culvert in 2004. The creek at this location was dry in summer of 2015. Numerous fish passage barriers occur on the railroad grade on upper East Fork Cottonwood Creek.

Literature Cited and Klamath Based References

- Bentivoglio, A. 1998. Investigations into the endemic sculpins, (*Cottus princeps*, *Cottus tenuis*), in Oregon's Upper Klamath Lake watershed with information on other sculpins of interest (*C. evermanni*, *C. ssp.*, *C."pretendor"*). United States Geological Survey, Reston, Virginia
- Borgerson, L.A. 1991. Scale Analysis. Oregon Department of Fish and Wildlife. Fish Research Project F-144-R-4, Annual Progress Report, Portland.
- Buchanan, D.V., A.R. Hemmingsen, D.L. Bottom, R.A. French and K.P. Currens. 1989. Native Trout Project. Oregon Department of Fish and Wildlife. Fish Research Project F-136-R, Annual Progress Report, Portland.
- Buchanan, D.V., A.R. Hemmingsen, D.L. Bottom, P.J. Howell, R.A. French and K.P. Currens. 1990. Native Trout Project. Oregon Department of Fish and Wildlife. Fish Research Project F-136-R, Annual Progress Report, Portland.
- Buchanan, D.V., A.R. Hemmingsen, D.L. Bottom, P.J. Howell, R.A. French and K.P. Currens. 1991. Native Trout Project. Oregon Department of Fish and Wildlife. Fish Research Project F-136-R, Annual Progress Report, Portland.
- Buchanan, D.V., A.R. Hemmingsen, and K.P. Currens. 1994. Native Trout Project. Oregon Department of Fish and Wildlife. Fish Research Project F-136-R, Annual Progress Report, Portland
- Buchanan, D.V., M.L. Hanson and R.M. Hooton. 1997. Status Of Oregon's Bull Trout. Oregon Department of Fish and Wildlife, Portland
- Contreras, P.G. 1973. Distribution of the fishes of the Lost River system, California-Oregon with a key to the species present. Master's thesis, University of Nevada, Reno, Nevada.
- Currens, K.P. 1997. Evolution and risk in conservation of Pacific salmon. PHD Thesis, Oregon State University, Corvallis, Oregon.
- Currens, K.P., Carl B. Schreck, and Hiram W. Li. 2009. Evolutionary Ecology of Redband Trout. Transactions of the American Fisheries Society 138:797–817
- DeHaan, P, M.Diggs, and William Ardren. 2008. Genetic analysis of bull trout in the Upper Klamath River Basin, Oregon. USFWS Progress Report, Longview, WA. 26p.
- Doering, C.M. 2013 Restoring Oregon's Upper Klamath Lake Sub-basin: Guidance from Past- Project Evaluations. Masters Thesis. University of California, Berkeley. 164 pp.
- Fortune, J. 1968. Oregon State Game Commission Fish Species Distribution Survey.
- Gamperl, A. K., and coauthors. 2002. Metabolism, Swimming Performance, and Tissue Biochemistry of High Desert Redband Trout (*Oncorhynchus mykiss* ssp.): Evidence for Phenotypic Differences in Physiological Function. Physiology, Morphology, and Genetics of Redband Trout. Physiological & Biochemical Zoology. Dept. of Ecology & Evolutionary Biology. University of California, Irvine, CA.

- Gamperl, A. K., and coauthors. 2002. Metabolism, swimming performance, and tissue biochemistry of high desert redband trout (*Oncorhynchus mykiss* ssp.): evidence for phenotypic differences in physiological function. *Physiol Biochem Zool* 75(5):413-31.
- Gamperl, K. 2003. Metabolic and thermal physiology of Eastern Oregon Redband Trout: Recommendations for Appropriate Numeric Temperature Criteria. Final Report.
- Geiger, S., D. Caldwell, B. Hollen, D.J. Heffernan and C.O. Cogan. 2000. Potential water quality impacts of the Pelican Butte Ski Area Project Klamath Falls, Oregon, including potential impacts on Upper Klamath National Wildlife Refuge Marsh. Shapiro and Associates, Inc., SHAPIRO Project# 7971089, Portland, Oregon.
- Jacobs, S. E., S. J. Starceovich, and W. Tinniswood. 2007. Effects of Impoundments and Hydroelectric Facilities on the Movement and Life History of Redband Trout in the Upper Klamath River: A Summary and Synthesis of Past and Recent Studies. Pages 67-75 in R. F. Carline and C. LoSapio, editors. Sustaining wild trout in a changing world. Proceedings of the Wild Trout IX Symposium, Joseph Urbani & Associates, Bozeman, Montana Klamath River Basin. *Journal of Aquatic Animal Health* 18:194-202
- Jhingran, V.G. 1948. A contribution to the biology of the Klamath black dace, *Rhinichthys osculus klamathensis* (Evermann & Meek). Doctoral Dissertation. Stanford University, Palo Alto, California.
- Kan, T.T. 1975. Systematics, variation, distribution, and biology of lampreys of the genus *Lampetra* in Oregon. Ph.D. dissertation. Oregon State University, Corvallis, Oregon, U.S.A.
- Li, H. W., J. Dambacher, and D. V. Buchanan. 2007. Phenotypic Variation in Redband Trout. Pages 14-18 in R. K. Schroeder, and J. D. Hall, editors. Redband trout: resilience and challenge in a changing landscape. Oregon Chapter, American Fisheries Society, Corvallis
- Long, J.J., and C.E. Bond. 1979. Unique Fish Survey Fremont National Forest. Oregon State University Department of Fisheries and Wildlife. Cooperative Agreement No. 237. Corvallis, OR. 70p.
- Lorion, C. M., D. F. Markle, S. B. Reid, and M. F. Docker. 2000. Redescription of the presumed-extinct Miller Lake lamprey, *Lampetra minima*. *Copeia* 2000:1019-1028.
- Hemmingsen, A.R., R.A. French, D.V. Buchanan, D.L. Bottom, and K.Currens. 1992. Native Trout Project. Oregon Department of Fish and Wildlife. Fish Research Project F-136-R, Annual Progress Report, Portland, Oregon.
- Hemmingsen, A.R., and D.V. Buchanan. 1993. Native Trout Project. Oregon Department of Fish and Wildlife. Fish Research Project F-136-R-6, Annual Progress Report, Portland, Oregon.

- Hewitt, D.A., Janney, E.C., Hayes, B.S., and Harris, A.C., 2012. Demographics and run timing of adult Lost River (*Deltistes luxatus*) and shortnose (*Chasmistes brevirostris*) suckers in Upper Klamath Lake, Oregon, 2011: U.S. Geological Survey Open-File report 2012XXXX, 43p.
- Hewitt, D.A., Janney, E.C., Hayes, B.S., and Harris, A.C., 2015. Status and trends of adult Lost River (*Deltistes luxatus*) and shortnose (*Chasmistes brevirostris*) sucker populations in Upper Klamath Lake, Oregon, 2014: U.S. Geological Survey Open-File Report 2015-1189, 36 p., <http://dx.doi.org/10.3133/ofr20151189>.
- Messmer, R. T., and R. C. Smith. 2007. Adaptive Management for Klamath Lake Redband Trout. Pages 92-98 in R. K. Schroeder, and J. D. Hall, editors. Redband trout: resilience and challenge in a changing landscape. Oregon Chapter, American Fisheries Society, Corvallis
- Moyle, P.B. 2002. Inland fishes of California. University of California Press, Berkeley, California.
- Muhlfeld, Clint C., Shannon E. Albeke, Stephanie L. Gunckel, Benjamin J. Writer, Bradley B. Shepard & Bruce E. May (2015) Status and Conservation of Interior Redband Trout in the Western United States, North American Journal of Fisheries Management, 35:1, 31-53, DOI: 10.1080/02755947.2014.951807.
- Mulligan, T.J., H.L. Mulligan and J.E. Walkley. 2009. Final report: Habitat utilization and life history patterns of fishes in Upper Klamath National Wildlife Refuge Marsh; Fourmile Creek and Odessa Creek; Oregon. United States Fish and Wildlife Service, Klamath Falls, Oregon. Contract Number 11450-4-J519
- Oregon Department of Fish and Wildlife. 2005. Miller Lake Lamprey Management Plan.
- Pearse, D., S. Gunckel, and S. Jacobs. 2011. Population structure and genetic divergence of coastal rainbow trout and redband trout (*Oncorhynchus mykiss*) in the upper Klamath Basin. Trans. Am. Fish. Soc. 140:587-597.
- Petersen, E. 2014. Morphological diversity of speckled dace (*Rhinichthys osculus*) in Oregon's desert. American Fisheries Society, Oregon Chapter Meeting Paper.
- Reid, S.B., D.H. Goodman, D. Boguski, and M.F. Docker. 2007. Unparalleled diversity of lamprey species from the west coast of North America. 137th American Fisheries Society Annual Meeting, San Francisco, California, September 2007.
- Reid, S.B., D. Goodman, M. Docker, and D. Markle. 2005. The inland lampreys: diversity in the Klamath and Goose Basins. Oregon Chapter of the American Fisheries Society, Corvallis, Oregon, September 2005.
- Stocking, R. W., R. A. Holt, J. S. Foot, and J. L. Bartholomew. 2006. Spatial and Temporal Occurrence of the Salmonid Parasite *Ceratomyxa shasta* in the Oregon–California.

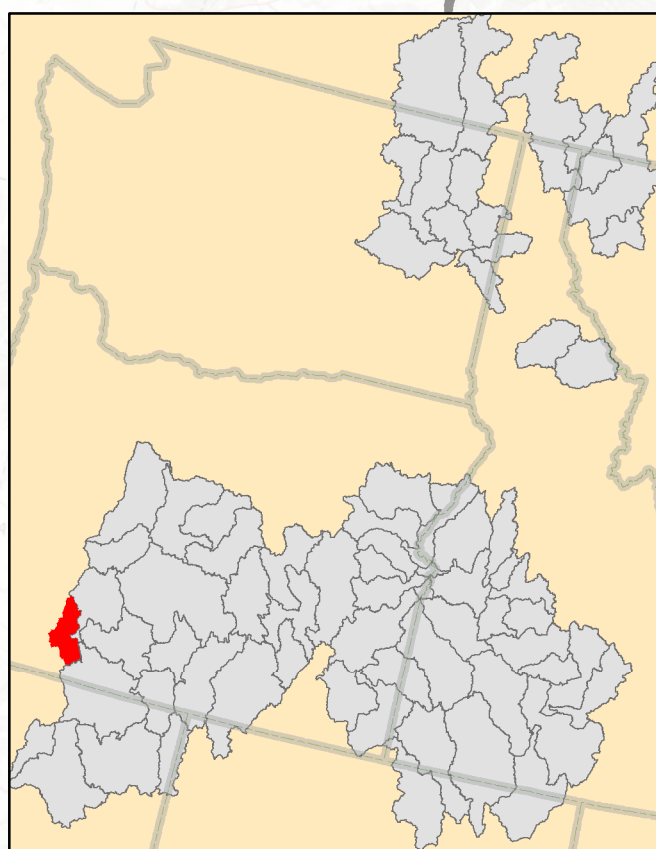
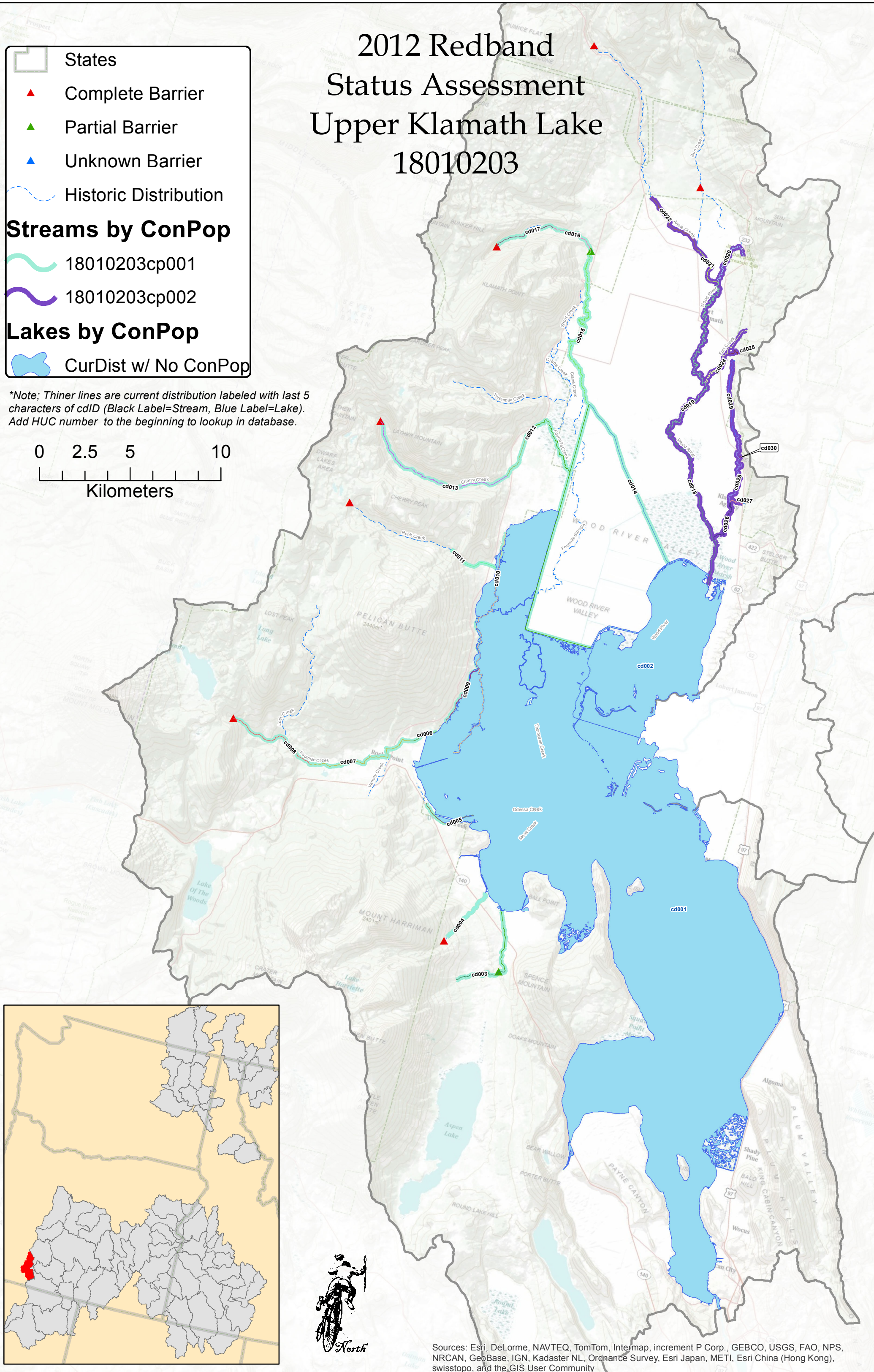
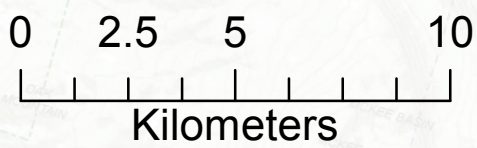
- Tinniswood W.R. and M. Harrington. 2013. Transition from index adfluvial redband trout redd counts in the Wood and Williamson watersheds to near census spawning surveys combining redd surveys and area under the curve methodologies. ODFW Klamath Watershed District Report. 112 pp.
- USFWS. 1988. Final Rule: Endangered and threatened wildlife and plants: determination of endangered status for the shortnose sucker and Lost River sucker. Federal Register 53:27130-27134.
- U.S. Fish and Wildlife Service. 2012. Revised recovery plan for the Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*). U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California. xviii + 122 pp.
- U.S. Fish and Wildlife Service. 2013. 5 Year Statue Update on Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*). U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California.
- Walkley, J.E. 2010. Seasonal Ecology of Fish and Macroinvertebrates inhabiting Fourmile Creek, Upper Klamath Lake, Oregon. Masters Thesis. Humboldt State University. 304pp.
- Wiesenfeld, J.C. 2014. Riverscape Genetics Identifies a Cryptic Lineage of Speckled Dace (*Rhinichthys Osculus*) in the Klamath-Trinity Basin. Masters Thesis. Humboldt State University. 76pp.

Appendix Figure 1. Cascade Tributaries (18010203cp001) and Wood River (18010203cp002) Redband Trout Conservation Populations. Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community map made by Jason Writer and Shannon Albeke at Wyoming Geographic Information Center, University of Wyoming for the maps and the Range-wide Redband Trout Assessment for the data.








2012 Redband Status Assessment Upper Klamath Lake 18010203

States
 Complete Barrier
 Partial Barrier
 Unknown Barrier
 Historic Distribution
Streams by ConPop
 18010203cp001
 18010203cp002
Lakes by ConPop
 CurDist w/ No ConPop

*Note; Thinner lines are current distribution labeled with last 5 characters of cdID (Black Label=Stream, Blue Label=Lake). Add HUC number to the beginning to lookup in database.

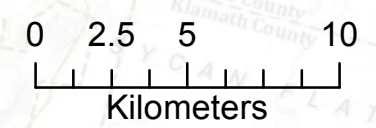


Appendix Figure 2. Lower Williamson (18010201cp004) and Upper Williamson (18010201cp002) Redband Trout Conservation Populations. Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community map made by Jason Writer and Shannon Albeke at Wyoming Geographic Information Center, University of Wyoming for the maps and the Range-wide Redband Trout Assessment for the data.

 States
 Complete Barrier
 Partial Barrier
 Unknown Barrier
 Historic Distribution
Streams by ConPop
 18010201cp002
 18010202cp004

**Note: Thiner lines are current distribution labeled with last 5 characters of cdID (Black Label=Stream, Blue Label=Lake). Add HUC number to the beginning to lookup in database.*

2012 Redband
 Status Assessment
 Williamson
 18010201



Appendix Figure 3. Lower Sprague River (18010202cp004), Trout Creek (18010202cp005), NF Sprague River(18010202cp001), SF Sprague River(18010202cp002), Deming Creek(18010202cp003) ,Upper Sycan (18010202cp006) Redband Trout Conservation Populations. Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community map made by Jason Writer and Shannon Albeke at Wyoming Geographic Information Center, University of Wyoming for the maps and the Range-wide Redband Trout Assessment for the data.

2012 Redband Status Assessment Sprague 18010202

States

▲ Complete Barrier

▲ Partial Barrier

▲ Unknown Barrier

Historic Distribution

Streams by ConPop

18010202cp001

18010202cp002

18010202cp003

18010202cp004

18010202cp005

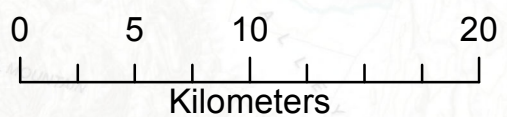
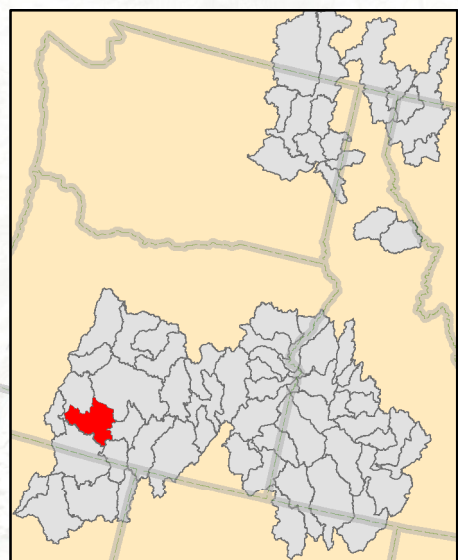
18010202cp006

Lakes by ConPop

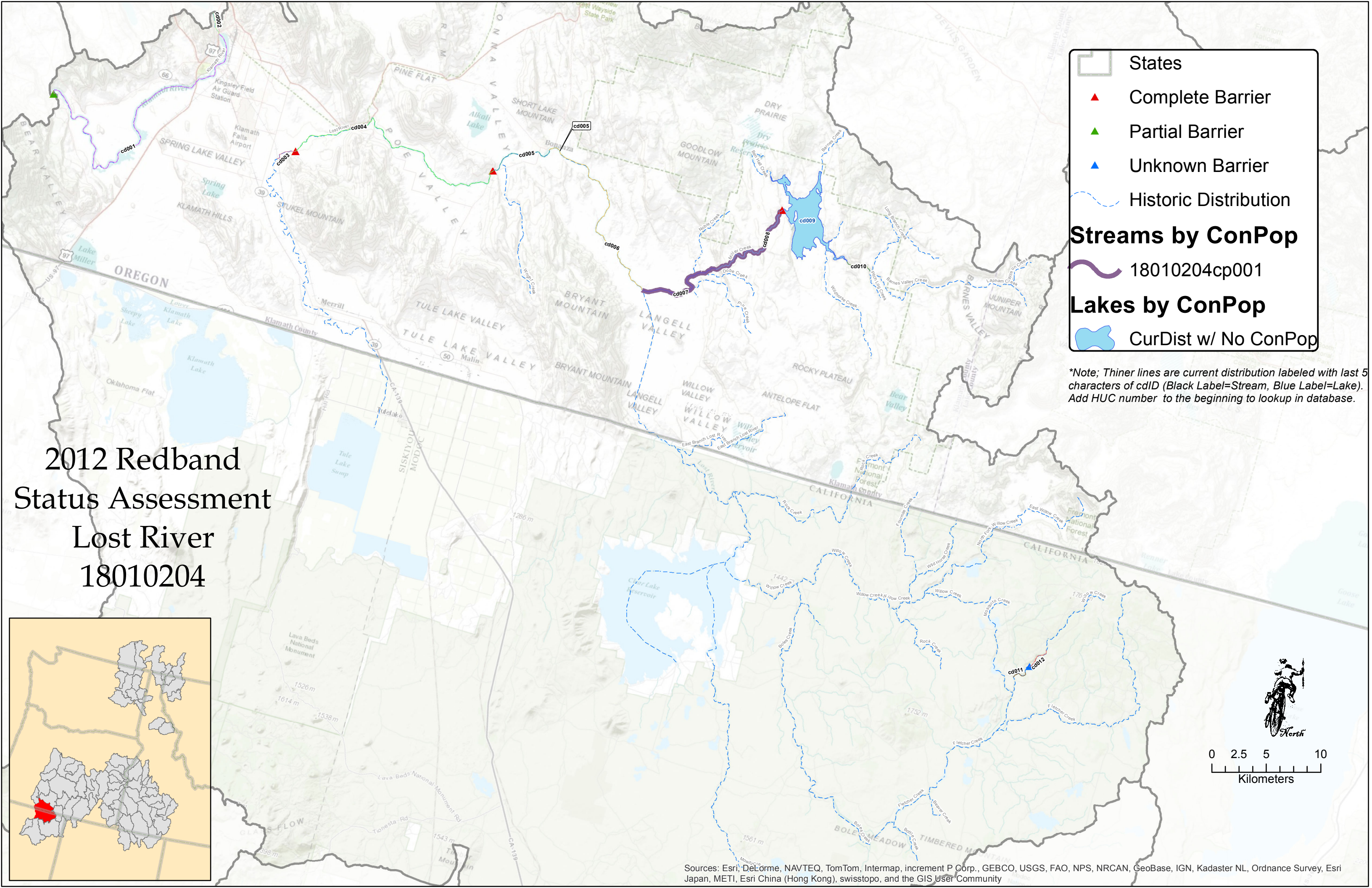
CurDist w/ No ConPop

18010202cp003

*Note; Thiner lines are current distribution labeled with last 5 characters of cdID (Black Label=Stream, Blue Label=Lake). Add HUC number to the beginning to lookup in database.



Appendix Figure 4. Lost River Redband Trout Conservation Population 18010204cp001 .
Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community map made by Jason Writer and Shannon Albeke at Wyoming Geographic Information Center, University of Wyoming for the maps and the Range-wide Redband Trout Assessment for the data.



States

- Complete Barrier
- Partial Barrier
- Unknown Barrier
- Historic Distribution

Streams by ConPop

- 18010204cp001

Lakes by ConPop

- CurDist w/ No ConPop

*Note; Thiner lines are current distribution labeled with last 5 characters of cdID (Black Label=Stream, Blue Label=Lake). Add HUC number to the beginning to lookup in database.

2012 Redband
Status Assessment
Lost River
18010204

