Jenny Creek Sucker PIT Tagging Study

Bureau of Land Management – Medford District – Ashland Resource Area

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Introduction

The Jenny Creek Sucker is a unique dwarfed population of Klamath small scale (KSS) suckers (*Catastomus rimiculous*) found only in the Jenny Creek Watershed in southwest Oregon. The population developed in genetic isolation above a series of large barrier falls located just upstream of the confluence of Jenny Creek with Iron Gate Reservoir on the mainstem of the Klamath River. KSS have a limited range in southwestern Oregon and northern California confined to the Klamath, Trinity, and Rogue River basins.

The population was first described in 1975 by Andreasen. Morphologically, the Jenny Creek sucker (JCS) differs substantially from the KSS of the Rogue River. Differences include the number of scales above the lateral line, number of pectoral fin rays, number of caudal vertebrae, number of post-Weberian vertebrae, and lip size. The only known morphological difference between Jenny Creek and Klamath River populations is the number of caudal vertebrae (Hohler 1981), which, along with genetic evidence, suggests that Jenny Creek was colonized by the Upper Klamath Lake Basin population via a headwater capture event (Harris and Currens 1993). Temperature tolerances have not been explicitly investigated, though based on their presence in high abundances in lower stream reaches during the summer they appear to be tolerant of temperatures which annually exceed 28° C.

Jenny Creek Suckers are thought to have a relatively short life span (Parker and Call 2006), rarely exceeding 5 years of age, and to mature at an early age (age 2+ vs. age 4+ for KSS) and small size (> 115 mm at maturity) and small maximum size (largest measured fish from this study was 246 mm) compared to KSS which may attain lengths exceeding 400 mm. They are assumed to spawn in low gradient tributaries in the spring (May-early June) based on previous observations (Hohler 1981, Rossa 1999), with downstream migrations to deeper pool habitats in the mainstem of Jenny Creek occurring after spawning. Though never observed spawning, they are most likely broadcast spawners like other KSS. They are not believed to widely use manistem habitats for spawning. Larval surveys (Parker and Ruhl 2005) have documented use in Johnson, Corral, and Beaver Creeks. Specific spawning sites have not been identified, and fecundity has not been described, though they are assumed to be highly fecund.

Previous studies (e.g. Hohler 1981, Rossa 1999) have sought to describe the population, behavior, and the habitats used by JCS. However, much remains unknown about the population, including migration patterns, seasonal habitat use of mainstem habitats and preference of spawning tributaries, and the overall current status of the population. In 2010, the Bureau of Land Management (BLM) completed a conservation plan specifically for the population (USDI 2011). This plan recommended research and monitoring to better understand the population and to help guide future management actions to ensure the health of the population. Specific recommendations included studying migratory patterns, with an emphasis on identifying high priority spawning streams, and monitoring to assess population and distribution trends. This project was developed in cooperation with Crater Lake National Park and was designed to address the recommendations specified in the conservation plan. The primary goal of this project was to determine which spawning streams were preferred by JCS, which could then help guide future management decisions such as prioritizing areas for acquisition and/or restoration. As a secondary goal, it was decided mid-project to include a recapture and population study as part of this effort.

Study Location

The 54,413 hectare Jenny Creek Watershed (figure 1) is located primarily in SW Oregon, just east of the Cascade crest. Its confluence with the mainstem of the Klamath River lies just south of the Oregon/California border. The watershed drains a low gradient flat bench in the north (the Dead Indian Plateau) which sits above 1500 m in elevation. The plateau contains several large impoundments, including Hyatt and Howard Prairie reservoirs. Roughly 30,000 acre feet of water, representing approximately one third the average yearly basin yield, is diverted out of the watershed annually, most of which is transferred into the Bear Creek Watershed in the Rogue River Basin. Watershed runoff peaks in the spring during the annual snow melt, but atmospheric river events can result in rapid stream flow rises and flood events any time from the late fall through late winter. Flood and runoff events have been attenuated by the reservoirs. Channel gradients are generally low in the upper and middle watershed and increase significantly downstream of the Oregon border, culminating in a series of barrier falls which are over 10m in vertical height. Major tributaries include perennial Keene, Spring, Corral, and Beaver Creeks, and seasonal Johnson and Skookum Creeks. Jenny Creek Suckers are known to be present in the mainstem of Jenny Creek from the waterfalls at approximately river km 4.0 to just downstream of Howard Prairie Reservoir at approximate river km 32. Previous studies have documented their presence seasonally in Keene, Beaver, Corral, and Johnson Creeks. Jenny Creek Suckers have not been detected in Keene Creek in over two decades, and they are now thought to be extirpated from Keene Creek due to an impassible diversion located on private lands just upstream of the Keene Creek mouth.

South of the Howard Prairie Reservoir, Jenny Creek flows through an alternating series of meadow and canyon reaches nested within the Cascade Siskiyou National Monument. For the purposes of this study, these reaches were delineated as follows, from downstream to upstream:

- The Lower Canyon begins at the series of barrier falls at river km 4.0 and continues ~ 5.6 km upstream to a private inholding nested within the Soda Mt Wilderness area just downstream of the Spring Creek confluence at river km 9.7. The lower half of the reach is in California, and includes a steep walled canyon and high stream gradients, very large boulder substrate, and numerous cascades and plunges. The upper half includes gentler gradients and smaller substrates, and large pools and long riffles are typical habitat features, with fewer plunges and cascades. Average wetted widths are 8.9 m during the late summer in this reach. Channel gradients range from 1.5% to over 5%.

- The Lower Meadow begins above the afore mentioned private inholding at approximate river km 11.8, and continues ~ 5 km upstream to the wilderness boundary with a private cattle ranch at approximate river km 16.8. The Keene Creek confluence is located on the private ranch at ~ river km 18.7. Habitat includes alcoves, pools of varying length, width and depth, and short riffles with many areas of exposed bedrock. Rushes and aquatic macrophytes are common in slow water habitats. Average wetted widths are 5.9 m. Channel gradient is less than 1% throughout most of this reach.

- The Middle Canyon begins above the private cattle ranch at river km 19.1 and continues ~ 2.6 km, ending at the BLM property line just south of HWY 66 at river km 21.7. Habitat is typified by numerous steep plunges, cascades, large substrate, and several large pools. Average wetted widths are 5.4 m, and channel gradients average 1.5%.

- The Middle Meadow (~ river km 21.7-24.1) is entirely on private lands and continues north of Hwy 66 for ~ 4.2 km, and includes the confluence of Beaver and Corral Creeks at river km 22.0. Permission was granted from a private landowner to survey one 100 m in the Middle Meadow. Average wetted width was 4.2 m in this reach, and channel gradient was less than 1%.

- The Upper Canyon reach (~ river km 27.8 - 29.9) is ~ 2.1 km long and lies within a very steep walled canyon, but the valley bottom itself is low gradient. Habitat consists of riffles and pools with few plunges, and numerous side channels and braids. Average wetted widths are 4.2 m, and channel gradients range from 1 to 2 %.

- The Upper Meadow (~ river km 29.9 – 32.0) is ~ 2.1 km long includes the confluence of Johnson Creek, the furthest upstream JCS spawning tributary, at river km 31.3. Gradients are very low, habitat consist of riffles and small pools, and most of the reach includes side channels and numerous braids. There are several active beaver dams present in the reach. Average wetted widths are 4.6 m, and channel gradient is less than 1%.

With the exception of one 100 m reach which was sampled on private lands in the Middle Meadow reach, all sampling for this study occurred on BLM managed lands.

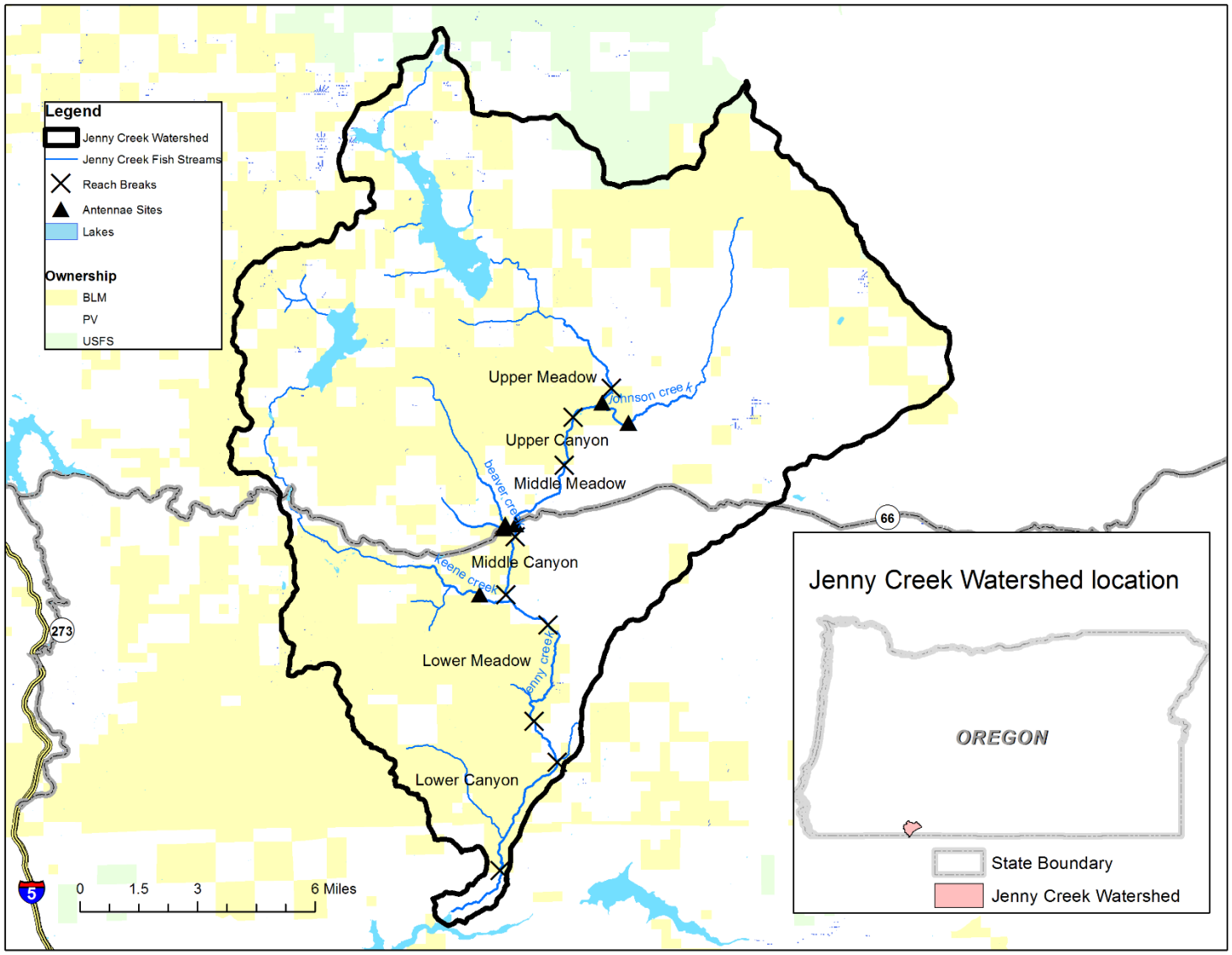

Figure 1: Jenny Creek Watershed, reach breaks, and antennae sites

Methods

During the first two weeks of September 2013, 469 suckers were captured by electro-fishing and tagged. Sampling occurred in four distinct reaches and included the upper half of the Lower Canyon, the Lower Meadow, the Middle Canyon, and in the Upper Meadow. Reaches were electro-fished in an upstream direction, with efforts focused on those habitats most likely to contain suckers. Medium to large pools, particularly those with reeds or aquatic macrophytes present, deep plunges, and cascades were found to be the most productive areas. In most cases, two back pack electro-fishers were utilized in tandem. All Jenny Creek Suckers captured were anesthetized with tricaine methanesulfonate (MS-222), measured, and weighed. The initial target length for tagging for this study was 130 mm fork length, as fish of this size were assumed likely to be mature adults based on previous length-age investigations (Hohler 1981, Rossa and Parker 2007). However, individuals of that size or greater proved difficult to find. We therefore decided to lower our length limit, and all suckers over 90 mm fork length were tagged with 12 mm half-duplex (HDX) passive integrated transponders (PIT) tags. Each tag was read with a hand-held PIT tag reader, recorded, and then surgically inserted into the body cavity of a fish via a small incision made by a razor blade posterior to the left pectoral fin on the fish's ventral axis. Fish were allowed to recover in buckets of oxygenated stream water for 15 minutes prior to release back into the stream. GPS coordinates were recorded at each tagging station.

PIT antennas were installed during September and October at five locations in the watershed, including at the furthest downstream point of BLM lands on Keene Creek, at the mouths of Beaver and Corral Creeks, at the lowest accessible location on Johnson Creek, and on the mainstem of Jenny Creek upstream of the Johnson Creek confluence. Each antenna consisted of two loop antennas constructed of heavy walled PVC pipe (for larger antennas) of flexible conduit, and anchored to the stream bed with angle aluminum and boulders. Antennas were installed perpendicular to flow and spanned the entire channel. The paired configuration of the antennas allowed for determination of direction of fish movement. Each antenna array was attached to a HDX transceiver and data-logger on the adjacent stream bank. Each transceiver was powered by two 12 volt deep cycle batteries that in turn were charged by solar panels. A test PIT tag was placed at each antenna and programmed to be detectable at 30 minute intervals to document time periods when the antennas were operational.

In 2014, an additional 360 suckers were tagged. Sampling was conducted in the same locations and followed the same methodology as in 2013. This additional tagging effort was implemented to increase the odds of detecting tagged fish. In both 2013 and 2014, the majority of fish captured and tagged (80 percent) came from the Lower Meadow reach (table 1). No large individuals were captured from the Upper Meadow, and hence none were tagged from this reach. In late fall of 2014, the Keene Creek antenna was relocated to the mainstem of Jenny Creek above the Beaver/Corral confluence. The antenna was moved from a stream where any detections were very unlikely to occur due to the diversion dam which is a suspected migration barrier, and placed in the middle watershed where the probability of detecting migrating fish would be higher.

year	Reach																	
	Lower Canyon			Lower Meadow			Mid Canyon			Mid Meadow			Upper Canyon			Upper Meadow		
	caught	tagged	recap	caught	tagged	recap	caught	tagged	recap	caught	tagged	recap	caught	tagged	recap	caught	tagged	recap
2013	93	91	0	356	344	0	34	34	0	0	0	0	0	0	0	11	0	0
2014	22	21	1	334	318	8	24	21	3	0	0	0	0	0	0	6	0	0
2015	33	0	0	158	0	7	95	0	7	19	0	0	96	0	0	18	0	0
Total	148	112	1	848	662	15	153	55	10	19	0	0	96	0	0	35	0	0

Table 1: Number of JCS captured, tagged, and recaptured by year and sample reach.

Antennas were initially operated 365 days a year, and visited as needed, depending on length of daylight and ability of the solar panels to re-charge the batteries. Batteries needed to be swapped out roughly every two weeks during the dark winter months, but during the summer the solar gain was generally great enough to keep the batteries sufficiently charged. Data were downloaded during each site visit. After the 2016 winter season, the emphasis on maintaining continuous operation of the antennas was shifted to the spring and summer months, which were the only times of year any detections have occurred to date.

After the 2014 field season, two of the primary project proponents left the project to pursue other careers, and the scope of the project was expanded to include a survey effort to estimate the population and describe the demographics of JCS, and to try and recapture tagged fish. This effort occurred during the first three weeks of September of 2015. Utilizing a stratified sample design, the large scale reaches were delineated based on geomorphology, in this case canyon vs. meadow, as previously described. Within these large scale canyon and meadow reaches, random points were generated and selected as sample reaches, with a general goal to sample twenty percent of each large scale reach. The lower portion of the Lower Canyon was not sampled due to concerns over access and ability to sample effectively given the nature of the stream and terrain, and only one reach was sampled in the Middle Meadow (private lands), as it was the only location we had landowner permission to access. This resulted in 24 distinct 100 m sample reaches. Each sample reach was measured for distance and average width. Sample reach start and end points were adjusted as necessary to allow for effective placement of block nets which resulted in a total length of 2,382 m that was surveyed. Sample reaches were sampled with electro-fishers, utilizing the multiple pass depletion methodology.

Sampling began at the lowest random sample reach in the watershed, at roughly the mid-point of the Lower Canyon reach, and proceeded upstream during the ensuing three weeks, ending in the Upper Meadow just downstream of the Johnson Creek confluence. Each sample reach was isolated with block nets. Two to four crews (two people per crew) shocked continuously from the lower block net upstream to the upper net, and every sucker encountered was netted. These fish were then anesthetized, weighed, measured, and then released well downstream of the lower block net. A second pass of equal effort was then undertaken, and if needed based on depletion rates, a third pass was completed. All fish were scanned with a hand held PIT tag reader, and any tagged fish were recorded.

Results/Discussion

Late fall and winter storms, falling trees, and bedload movement damaged many of the PIT antenna components in 2015, reducing the number of functional antennas to three, which were then concentrated in the middle of the watershed on Beaver, Corral, and the mainstem of Jenny Creek, to facilitate access and maintenance of the antennas. These antennas have continued to be operated to date, with an emphasis of ensuring they remain functional during the period that coincides with the spawning migration (spring to early summer). Because the antennas at the upper mainstem Jenny Creek and Johnson Creek sites were destroyed, detection data is not available to determine spawning use of those tributaries. Floods, inclement weather, and technical malfunctions have rendered the remaining antennas inoperable for varying lengths of time, resulting in incomplete tag interrogation throughout the year. A few detections have been recorded, however, providing some insight into seasonal use of potential spawning tributaries.

No detections occurred during the 2014 spawning season. During the 2015 spawning season, one detection of a migrating sucker occurred in April in Beaver Creek, and one detection occurred on the mainstem of Jenny Creek, which coincides with the hypothesized spawning season. Of note, even though there were two separate large flood events in Jenny Creek, 2015 was the lowest snowpack on record for the region, and there was no spring run-off from melting snow, possibly resulting in less upstream movement by fish. In late April and early May of 2016, one detection occurred as a single fish passed by the antenna arrays in Beaver, Corral, and the mainstem of Jenny Creek. In 2017, two fish were detected passing the mainstem Jenny antenna in May and July. Two other fish were detected passing through the Beaver and Corral antennas as well; both fish passed by both antennas, one in early May, the other in early June. Of the eight fish detected to date, seven were tagged in the Middle Canyon, which is very close (one and a half miles or less) spatially to the antenna locations. The other detection came from a fish tagged in the lower meadow, located roughly 6 miles downstream of the antennas. We remain hopeful that we will continue to get future detections, as we believe that a significant portion of the fish we tagged were not mature at the time. An analysis of the size class of tagged JCS shows that only 35% of the tagged fish were likely of spawning age. The bulk of the tagged fish have had up to an additional three years to mature to date, and perhaps we will begin to detect more fish passing our antennas.

For the population estimate, a total of 419 suckers were captured. Sucker abundance and density were estimated for each block-netted sample segment using a removal estimator in program MARK, and extrapolated to the entire sampling frame using a local neighborhood variance estimator (Stevens and Olsen 2003), yielding an overall JCS abundance estimate of 5,092 (95% CI 3415-6770), and an overall density estimate of 192.9 fish/km. It is assumed that our sample methodology would have significantly underestimated the population of Jenny Creek Suckers less than 1 year of age, as fish that small are difficult to capture by electrofishing.

Fish were found to be well distributed throughout the watershed (Figure 2), as sucker densities were estimated to be over 100 fish/km in each of the large scale reaches. The population was not well distributed by age class however, as most fish were estimated to be either in the one year of age class,

or in the five years and older class (Figure 3), perhaps an indication that the population experiences periods of good vs poor recruitment.

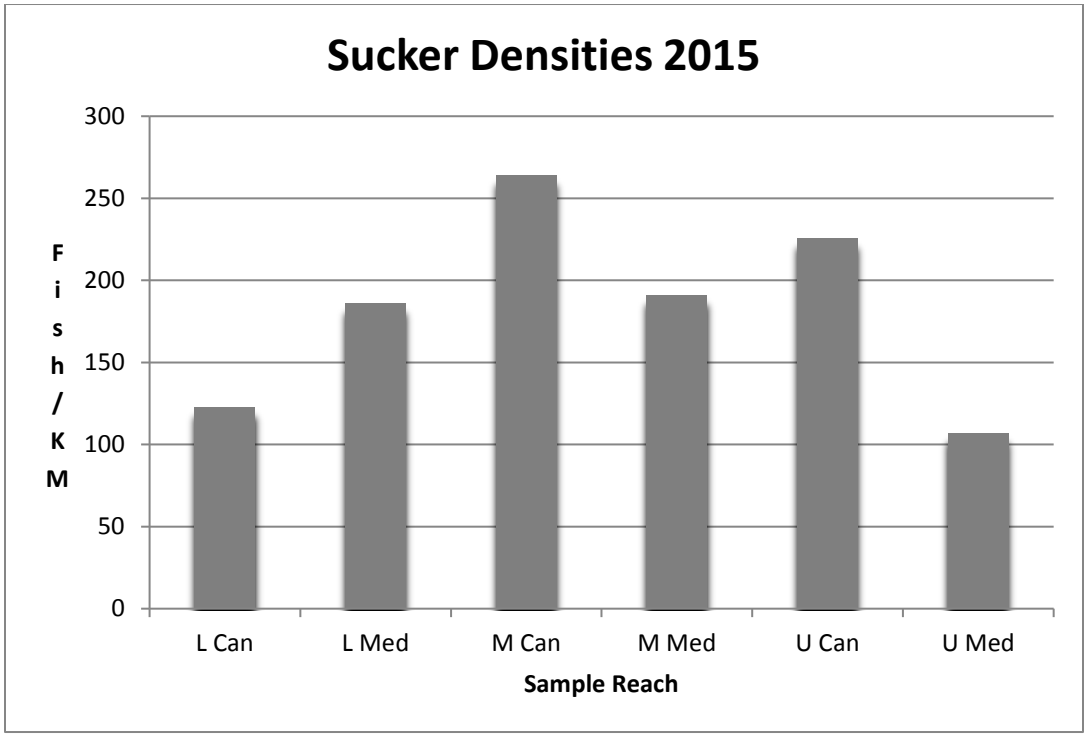

Figure 2: Jenny Creek Sucker Density by Sample Reach.

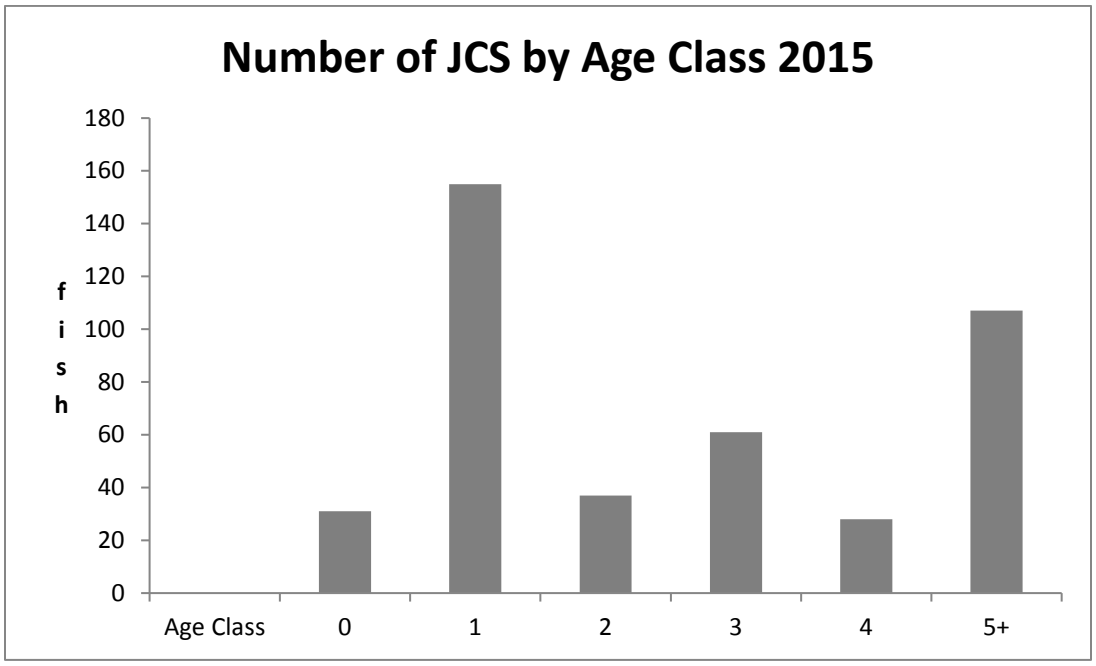

Figure 3: Jenny Creek Sucker Population Distribution by Age Class, based on assumed length-age relationships from previous studies.

During the three field sample seasons of this study a total of 26 tagged fish were recaptured including one individual that was recaptured twice (Table 2). An analysis of recapture data shows that only one fish was recaptured in a different reach than it was tagged in, and that most of the recaptured fish were found within 400 m of their initial capture location (Figure 4), suggesting either that JCS generally do not migrate far, and/or that they display high site fidelity during late summer/early fall. The recapture data also shows several fish growing through more than one age class based on previously reported length-age relationships in a single year, and a high degree of variability between growth rates (from 3mm/year up to 45 mm/year) of individual fish (Figures 5 and 6), which suggests that size class may not be a reliable proxy for age as was previously thought. If this is indeed the case, then perhaps the population is better distributed by age class than indicated by our analysis.

	Year		**Location (UTM)**		Distance from	**Length (mm)**		**Weight (g)**	
Tag #	Tag Year	Recap Year	Tag UTM	Recap UTM	tag to recap (m)	Tag L	Recap L	Tag W	Recap W
1683	2013	2014	552325 X 4662374	552282 X 4662032	350	134	143	28.3	34
1683	2013	2015	552325 X 4662374	552355 X 4662301	80	134	159	28.3	NT
9250	2013	2014	552325 X 4662374	552282 X 4662032	350	140	143	36	43
9190	2013	2014	552325 X 4662374	552282 X 4662032	350	174	180	64.4	66
1500	2013	2014	553340 X 4652784	552941 X 4652496	490	201	215	97.8	130
1600	2013	2014	UTL	553763 X 4656409	NA	?	158	?	43
9323	2013	2014	553946 X 4656699	553906 X 4656779	83	124	141	22.8	35
1390	2013	2014	553946 X 4656699	553906 X 4656779	83	120	146	24	44
1409	2013	2014	553902 X 4656608	553927 X 4656965	378	122	150	21.2	43
9308	2013	2014	553912 X 4656906	553927 X 4656965	60	96	136	9.4	31
9317	2013	2014	553912 X 4656906	553998 X 4657584	715	130	167	25.9	60
9212	2013	2014	554000 X 4657553	553998 X 4657584	29	130	134	28	33
9251	2013	2014	554000 X 4657553	553998 X 4657584	29	100	132	12.3	29
9335	2013	2015	553958 X 4657288	553945 X 4657188	114	110	154	15.6	40.6
1739	2013	2015	554068 X 4658105	554205 X 4658605	540	87	151	8.2	NT
1683	2013	2015	552325 X 4662374	552355 X 4662301	70	134	159	28.3	NT
1854	2014	2015	553763 X 4656409	553717 X 4656334	79	109	147	15	37.9
2088	2014	2015	553998 X 4657584	553921 X 4656970	636	86	130	10	28.1
2042	2014	2015	553998 X 4657584	553921 X 4656970	636	94	130	12	26.4
2020	2014	2015	554077 X 4658244	553967 x 4657553	686	120	38	20	32.4
2120	2014	2015	554077 X 4658244	554077 x 4658200	43	94	130	10	NT
1815	2014	2015	552338 X 4662271	552321 X 4662201	72	135	150	28	NT
1801	2014	2015	552338 X 4662271	552321 X 4662201	72	110	135	14	NT
1811	2014	2015	552249 X 4662085	552355 X 4662301	242	128	140	31	NT
1779	2014	2015	552340 X 4662266	552355 X 4662301	37	142	158	34	NT
1856	2014	2015	552340 X 4662266	552355 X 4662301	37	118	133	19	NT
2011	2014	2015	553998 X 4657584	552355 X 4662301	6,058	93	123	11	NT

Table 2: Tag and recapture year, locations, lengths, and weights. Recaptured tag # 1600 (Location = UTL) was not found in the 2013 database or field notes and is assumed to have been recorded incorrectly in the field. During field efforts in 2015, the scale broke, and hence not all recaptured fish were weighed (Recap W = NT).

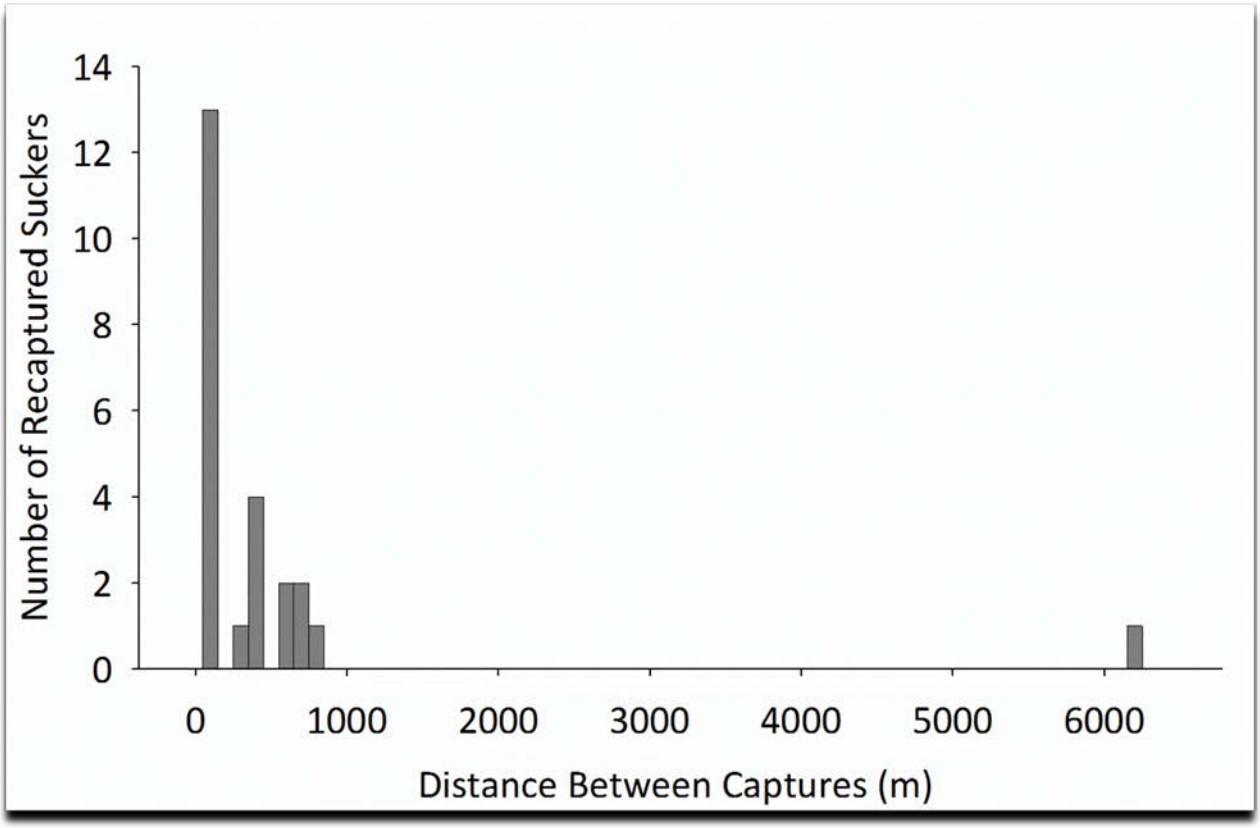

Figure 4: Stream channel distance between capture and recapture locations of individual JCS. Fish were recaptured one to two years after tagging. Most individuals were recaptured relatively close to their original tagging location.

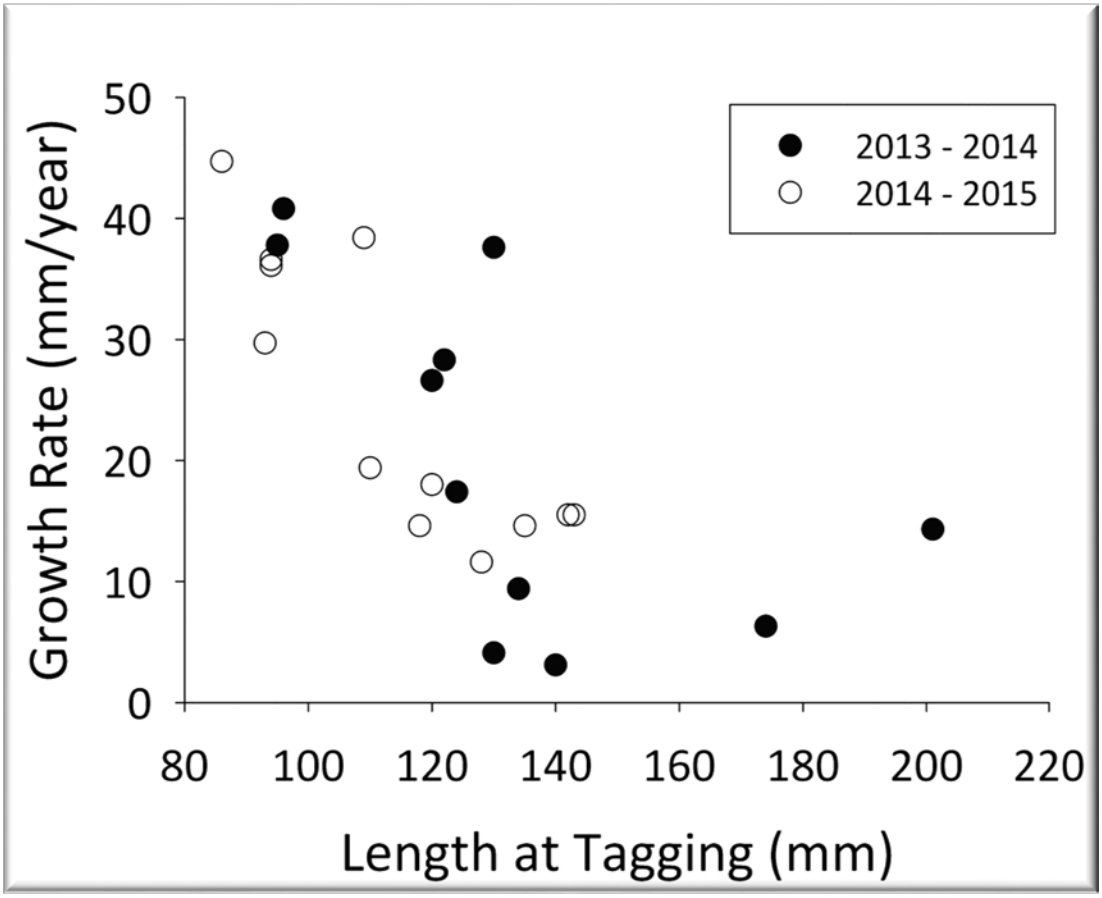

Figure 5: Growth rate of individual JCS recaptured one year after tagging.

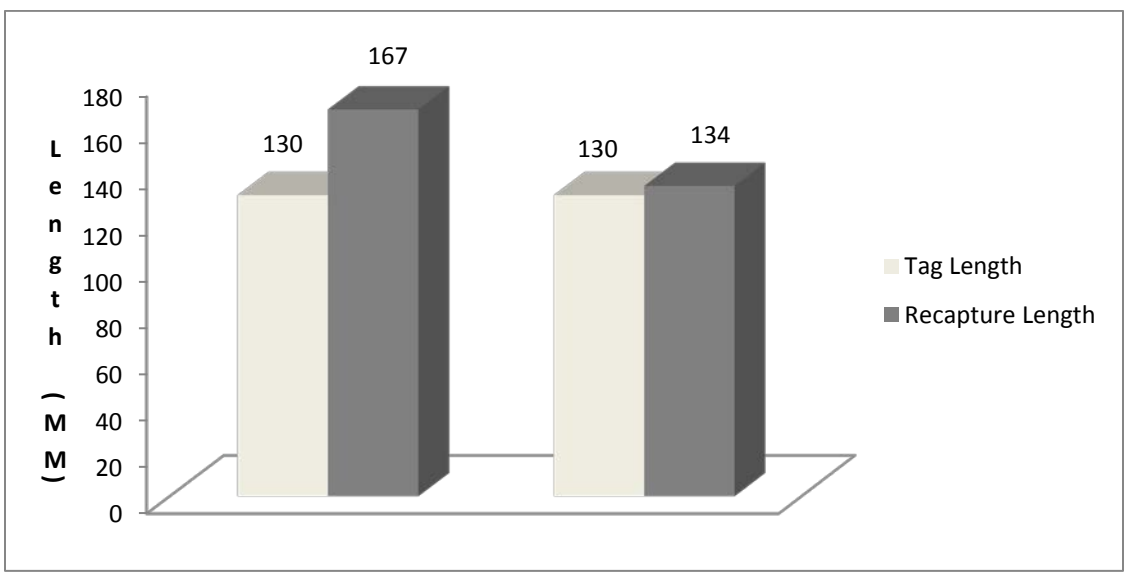

Figure 6: Growth rates of two individual fish caught of equal size and recaptured the following year, demonstrating markedly different growth rates.

In addition, several obviously disfigured (bloated stomachs) JCS and speckled dace (*Rhinichthys osculus*) were encountered during this study in two of the large scale reach areas, and investigative surgery revealed the presence of a parasite suspected and later confirmed by the Oregon Dept. of Fish and Wildlife research lab in Corvallis to be *Ligula intestinalis*, which was not previously known to be in Jenny Creek.

Overall, the primary objective of this study, to determine which spawning streams were of the most importance to JCS, was not realized. The challenges of maintaining antennas proved to be significantly greater than anticipated at the onset of the study. The logistics of swapping out batteries, which weighed over 80 pounds each, at the more remote antenna locations was also a challenge that we underestimated, particularly during the winter months when at times deep snow pack made an already difficult task even more arduous. Flood events were particularly problematic; not only did they damage and in some instances destroy critical antenna components, they also rendered the middle Jenny antenna inaccessible for weeks at a time. In hindsight, it would have been to our benefit to have "storm proofed" the antennas during the winter months by unplugging the transceivers/data loggers from the antennas and storing the sensitive and expensive electronic equipment in doors. This would have meant the antennas were un-operational for a portion of the season, but JCS are not likely migrating at these times. The antenna arrays themselves would have still been vulnerable to flood damage, but in most instances damage to the instream components of the antennas was reparable at relatively low financial costs. Every effort was made to ensure the antennas were functional during the spring to early summer, but there were still numerous periods when antennas were not continuously operational, which may have also contributed to the overall lack of detections.

With the addition of the population and recapture effort, we feel that some very useful data did come out of this project. The population estimate is only the second effort of its kind to have been undertaken for the population, since Hoehler's effort which occurred in 1979. And though not part of the original intent of this study, tagging fish allowed for examination of recapture data, which did lead to some interesting anecdotal observations, notably that individuals in the population appear to have high site fidelity, and that there was high variability in growth rates between individual fish. This calls into doubt the efficacy of relying on length solely as an indicator for age, and raises some interesting questions in and of itself. For instance, perhaps JCS are longer lived, and do not mature as young as was previously thought.

Furthermore, this project has helped lead to some renewed local interest in the unique sucker population, with presentations reaching several different groups, including three elementary schools, fisheries professionals, and science groups working within the Cascade Siskiyou National Monument.

Acknowledgements

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from Crater Lake Natl. Park provided technical and analytical support at every stage of this project, as well as lending much needed equipment and manpower. Oregon Dept. of Fish and Wildlife also lent us use of equipment, and helped positively identify a parasite detected during this project. And special thanks to all the fish and non-fish folk alike from the Medford BLM who lent a hand during the three busy field seasons, helping us schlep our gear into some remote places, and in particular Sean Anderson, who did much of the arduous battery exchanging and data downloading, on top of helping out with most of the sampling.

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Photo 1. Upper Falls on lower Jenny Creek

Photo 2. Each tag was read with a hand-held PIT tag reader, recorded, and then surgically inserted into the body cavity of a fish via a small incision made by a razor blade posterior to the left pectoral fin on the fish's ventral axis.

Photo 3. Two mid-sized Jenny Creek Suckers captured in the same pool demonstrate color variation in the population.

Photo 4. Each antenna consisted of two loop antennas constructed of heavy walled PVC pipe (for larger antennas) of flexible conduit, and anchored to the stream bed with angle aluminum and boulders. Antennas were installed perpendicular to flow and spanned the entire channel.

Photo 5. Sample reaches were sampled with electro-fishers, utilizing the multiple pass depletion methodology.

Photo 6. Electro-fishing to capture Jenny Creek Suckers.