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PROJECT TITLE: **2013 Warner Sucker Investigations (Lower Honey Creek)**

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Photograph of an aging irrigation diversion structure on lower Honey Creek.

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CONTENTS

INTRODUCTION

The Warner sucker (*Catostomus warnerensis*) is endemic to the Warner Valley, an endorheic subbasin of the Great Basin in southeastern Oregon and northwestern Nevada. Historically, this species was abundant and its range included three permanent lakes (Hart, Crump, and Pelican), several ephemeral lakes, a network of sloughs and diversion canals, and three major tributary drainages (Honey, Deep, and Twentymile Creeks) (U.S. Fish and Wildlife Service 1985). Warner sucker abundance and distribution has declined over the past century and it was federally listed as threatened in 1985 due to habitat fragmentation and threats posed by the proliferation of piscivorous non-native game fishes (U.S. Fish and Wildlife Service 1985).

The Warner sucker inhabits the lakes and low gradient stream reaches of the Warner Valley. The Warner sucker metapopulation is comprised of both lake and stream life history morphs. The lake suckers are lacustrine adfluvial fish that normally spawn in the streams. However, upstream migration may be blocked by low stream flows during low water years or by irrigation diversion dams. When this happens, spawning may occur in nearshore areas of the lakes (White et al. 1990). Large lake-dwelling populations of introduced fishes likely reduce recruitment by preying on young suckers (U.S. Fish and Wildlife Service 1998). The stream suckers inhabit and spawn in Honey, Deep, and Twentymile Creeks.

The Recovery Plan for the Threatened and Rare Native Fishes of the Warner Basin and Alkali Subbasin (U.S. Fish and Wildlife Service 1998) sets recovery criteria for delisting the species. These criteria require that: 1) a self-sustaining metapopulation is distributed throughout the Twentymile, Honey, and Deep Creek (below the falls) drainages, and in Pelican, Crump, and Hart Lakes, 2) passage is restored within and among the Twentymile, Honey, and Deep Creek (below the falls) drainages so that the individual populations of Warner suckers can function as a metapopulation, and 3) no threats exist that would likely threaten the survival of the species over a significant portion of its range.

To inform progress towards criteria two, our objective in 2013 was to obtain a population estimate for suckers in the lower Honey Creek drainage and describe their current distribution. The last time surveys were conducted in lower Honey Creek was prior to their listing (Coombs and Bond 1980).

METHODS

In the summer of 2013, we surveyed the entire 3.9 km lower portion of the mainstem of Honey Creek, starting at the confluence with Hart Lake and ending at the bridge crossing at County Road 3-13 (Figure 1). This portion (sample frame) was divided into ~500 m long, contiguous survey reaches. Reach breaks coincided with habitat breaks (i.e., we did not end a site in the middle of a pool) and thus were often slightly greater or less than 500 m. We marked the lower boundary of each reach by placing a metal-staked flag on the right bank, just above the water’s edge, and recorded both the upper and lower boundary coordinates using a hand held Global Positioning System (GPS).

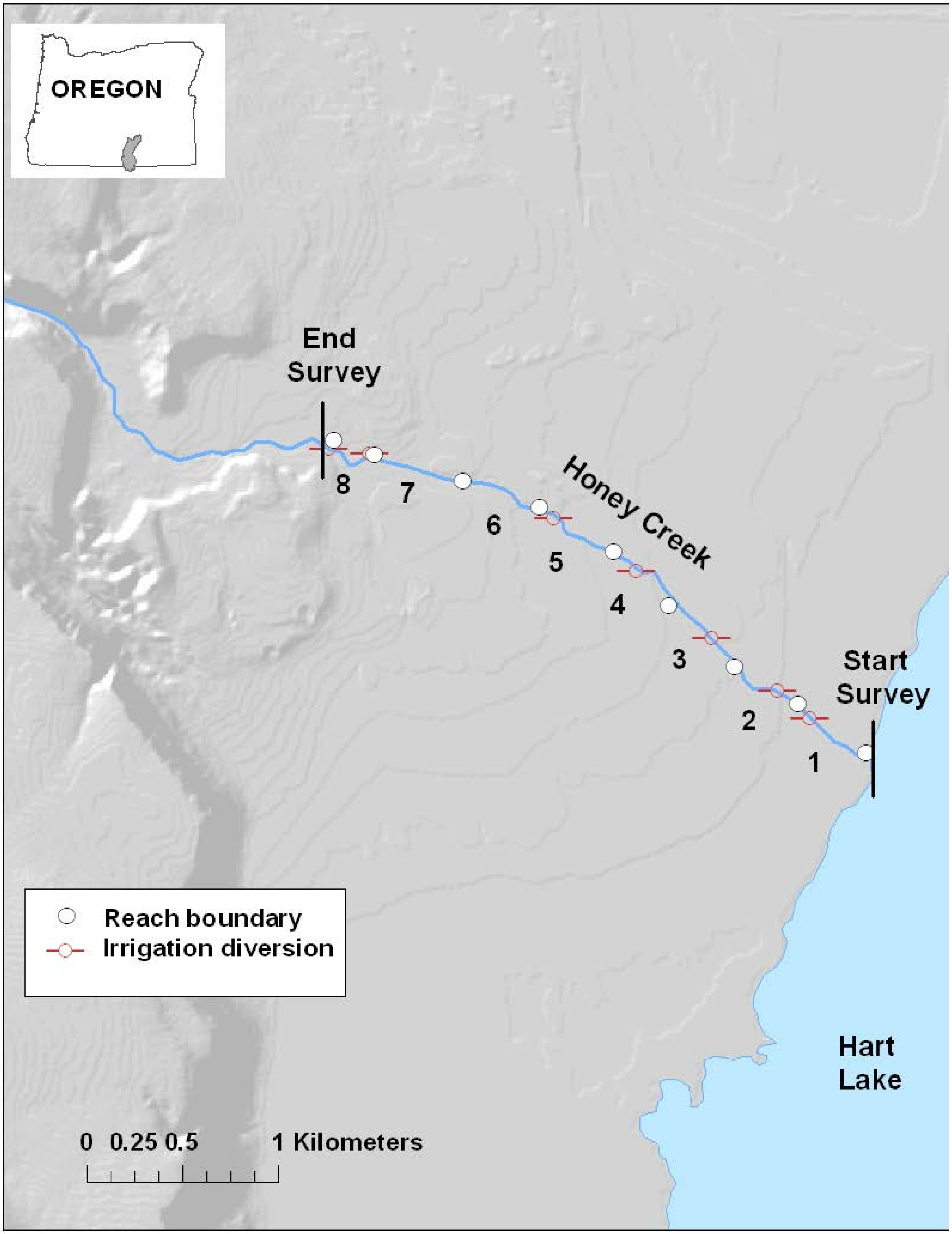

Figure 1. Study area sampled in lower Honey Creek in 2013. Reach boundaries are marked with white circles and reaches are numbered. Irrigation diversions are marked with open red circles with horizontal wings.

We surveyed for fish using three gear types/combinations. During a previous study (Scheerer et al. 2012), we found Warner sucker capture probabilities using backpack electrofishing were low. In this study, we included alternate capture methods (PIT antenna and the combination of hoop nets and electrofishing) to compare capture efficiencies with those using electrofishing alone. We conducted eight passes in which we surveyed the entire sample frame (downstream to upstream). Each pass took 3-4 days to complete. We first surveyed with a backpack electrofisher (four consecutive passes). Then we conducted mobile tracking with a passive integrated transponder (PIT) antenna (four consecutive passes). We systematically sampled each section with the same approximate effort on each pass. During the mobile PIT tracking, we detected several marked fish in two deep pools in reach 7 where we had been ineffective in capturing and recapturing suckers using electrofishing. To assess whether we could improve sucker capture efficiencies in these pools, compared to electrofishing alone, we set 6-panel hoop nets measuring 0.92 m in diameter with 13 mm mesh (2 nets per pool) overnight. The following morning, we conducted sweeping passes with the electrofisher to herd additional fish into the nets. We then pulled the nets and processed the fish (see below). We completed our sampling with another pass of these two pools with the mobile PIT antenna.

During each electrofishing pass, we divided each stream reach into 100 m sections and conducted a single upstream pass in each section. All fish were netted and placed in a bucket until processing. At the upstream end of each 100 m section, we anesthetized all suckers using methyl sulfonate (MS-222), measured fork length (FL) to the nearest 1 mm, scanned each sucker for previously-implanted PIT tags using a hand held PIT reader, and recorded PIT detections of tags when observed. We marked all un-tagged suckers ≥60 mm with half-duplex PIT tags in the anterior ventral side of the body cavity. We installed a 12 mm PIT tag in 60-99 mm suckers and a 23 mm PIT tag in suckers ≥100 mm. We double marked each sucker with a partial caudal fin clip and preserved the clips in 95% ethanol for future genetic analysis. We recorded the approximate numbers of other fish species collected. After processing, the fish were then released back to the 100 m stream section from which they were captured. During subsequent electrofishing passes, we scanned each fish for an existing PIT tag, looked for fin clips, recorded the number of marked and unmarked suckers, and recorded the PIT-tag number when one was detected. If no PIT tag was detected, we installed one as described above. When we sampled using the mobile PIT antenna, we recorded the tag number and location when one was detected. Using test tags, we found the typical tag read range using this mobile PIT antenna was approximately 0.75 m for the 23 mm tags and 0.5 m for the 12 mm tags. We recorded stream temperatures at the beginning, middle, and end of each sampling day. We did not deploy block nets during the survey; however, we installed a PIT-tag antenna at the downstream boundary of the survey (mouth of creek where it enters Hart Lake) to estimate the magnitude of downstream movement of fish out of the creek during our study. We tested the antenna weekly and verified that it was functioning during these visits. An impassable irrigation dam at the county road crossing prevented upstream fish movement from lower Honey Creek during the study period. Many of the other irrigation diversion dams within the sample frame were barriers to fish movement during the study period.

Following the fourth electrofishing pass, we collected habitat data in each 500 m stream reach including: wetted width (m), average depth (m), maximum depth (m), aquatic vegetation (as a percentage of total surface area), dominant substrate type, percent pools, and number of pools. Width, depth, substrate, and aquatic vegetation measurements were taken at transects located 50, 150, 250, 350, and 450 m from the downstream boundary of each reach. We calculated average depth at each transect by summing depth measurements collected at 25, 50, and 75% of the wetted width and dividing by four, to account for zero depth at the stream margins. We waded through each 100 m stream section and recorded the single deepest water depth (maximum depth). We determined the dominant substrate from seven equally-spaced points along each transect. At each point (100 mm circle), we recorded whether the majority of the substrate was fines (<0.063 mm), sand (0.063-2 mm), gravel (3-64 mm), cobble (65-256 mm), boulder (>256 mm), bedrock (native consolidated rock), or embedded. We recorded stream temperature at the beginning and end of the 500 m reach, recorded Universal Transverse Mercator (UTM) coordinates, and took photographs.

Previous mark and recapture models that we used to estimate Warner sucker abundance suggested that there may be substantial heterogeneity in capture probabilities among individual suckers (Scheerer et al. 2011; 2012). In addition, we captured and recaptured fish using multiple gears, one of which (mobile PIT antenna) was clearly biased towards detection of marked fish (i.e., no detection of unmarked fish). To analyze this complex data, we used a Bayesian closed-capture population estimator. This approach was used to model capture probability using covariates and because it can incorporate additional variation (heterogeneity) in capture probabilities using random effects (Link and Barker 2009). The random effects in our model represented unique effects associated with each capture occasion (including different gear types) and each individual fish on the capture probabilities, respectively. We estimated abundance during model fitting using data augmentation. We fit all models with Markov Chain Monte Carlo methods in WinBUGS version 1.4 (Lunn et al. 2000) with 400,000 iterations and 50,000 burn in samples, as determined by a Gibbsit analysis (Raftery and Lewis 1996).

We were primarily interested in obtaining the best predicting model of capture probability and population size. Therefore, we fit a global capture probability model containing sampling method, with nets and antenna binary coded (0,1) and electrofishing as the baseline, fish fork length, and two random effects corresponding to sample occasion and individual fish. We then fit all subsets of the global model and determined the best approximating model using Deviance Information Criteria (DIC; Spiegelhalter et al. 2002). We report the parameter estimates and random effects, expressed as variance components, from the best approximating model and expressed precision of the estimates using 95% credible intervals, which are equivalent to 95% confidence intervals.

RESULTS

Lower Honey Creek is a low gradient stream (0.3% gradient) flowing through private agricultural hay fields and pasture lands. During the winter and spring of 2013, the Warner basin experienced below average precipitation, snow pack, and stream flows (Oregon Climate Service 2014; Oregon Water Resources Department 2013). Over the course of our surveys (17 June – 18 July 2013), stream flows declined even further, the lower 1.0 km of the creek became puddled, and the creek was disconnected from Hart Lake.

Warner suckers were concentrated in deep pools that were located approximately 3.0–3.5 km upstream from the confluence with Hart Lake (upper end of reach 6 and reach 7). We estimated there was a total of 410 suckers (95% CI: 169-721) in lower Honey Creek. These fish ranged in size from 77-266 mm FL (Figure 2), though the majority (76%) were <150 mm, which is the approximate size-at-maturity for stream dwelling Warner suckers (Scheerer et al. 2011). The best approximating population model included fork length as a fixed effect and sampling occasion (pass) and variability in capture probabilities of individual fish as random effects (Table 1). Sucker capture probabilities were low (range: 0.5 to 10.9%), with the highest detection (recapture) probability using the mobile PIT antenna (7.8%) and the lowest using backpack electrofishing (mean 1.5%). Capture probabilities improved when we used a combination of hoop nets and electrofishing (3.6%), likely because we targeted this sampling in deep pools that were difficult to sample effectively with the electrofisher and where we detected suckers using the PIT antenna. Sixteen percent of the suckers we marked during the initial four electrofishing sampling passes were never recaptured or detected. Thirty-six percent were recaptured or detected on three or more occasions (**APPENDIX A**). None of the recaptured suckers were missing their PIT tag, i.e., there was no PIT tag loss of double tagged fish.

Table 1. Model parameters and estimated capture probabilities for Warner suckers in lower Honey Creek, 2013. Gear types for each sampling occasion: EF=backpack electrofishing, PIT=mobile PIT tag antenna, and EF/HN= combination of hoop nets and backpack electrofishing.

		95% Credible intervals	
Parameter	Mean	Lower 95%	Upper 95%
Fixed effects			
Intercept	-4.920	-7.419	-1.659
Fork length (mm)	0.030	0.020	0.040
Random effects			
Sample occasion[1]	3.131	0.605	5.864
Individual fish	0.311	0.062	0.932
Estimated average capture probability[2]			
Capture probability occasion 1 (EF)	0.028	0.007	0.070
Capture probability occasion 2 (EF)	0.016	0.003	0.046
Capture probability occasion 3 (EF)	0.011	0.002	0.033
Capture probability occasion 4 (EF)	0.005	0.000	0.021
Capture probability occasion 5 (PIT)	0.109	0.000	0.777
Capture probability occasion 6 (PIT)	0.078	0.000	0.616
Capture probability occasion 7 (PIT)	0.070	0.000	0.570
Capture probability occasion 8 (PIT)	0.081	0.000	0.642
Capture probability occasion 9 (EF/HN)	0.036	0.011	0.087
Capture probability occasion 10 (PIT)	0.050	0.000	0.415

[1]This reflects, in part, differences due to sampling method.

[2]Estimates are averaged across individual fish.

Table 2. Habitat characteristics of the reaches sampled in lower Honey Creek in 2013. Reach 1 started at the confluence of Honey Creek with Hart Lake and reach 8 ended at the bridge crossing on County Road 3-13. Stream flows were defined as puddled (series of isolated pools connected by subsurface flow), low (surface water flowing across 50-75% of the active channel width), or moderate (surface water flowing across 75-90% of the active channel width) (ODFW 2013).

Reach	Length	Average width	Average depth	Maximum depth	Dominant substrate	Number of pools	Percent pools	Percent aquatic vegetation	Stream flow
1	511	1.6	0.26	0.8	fines	30	62%	16%	puddled
2	493	2.0	0.11	1.4	fines	32	75%	54%	puddled
3	563	2.7	0.26	0.9	fines	27	75%	0%	low
4	492	4.4	0.26	1.2	fines	14	87%	2%	low
5	523	4.9	0.25	1.5	gravel	10	38%	12%	low
6	495	5.0	0.26	1.2	gravel	7	88%	2%	moderate
7	567	4.4	0.28	1.1	gravel	9	50%	24%	moderate
8	205	6.6	0.26	1.0	gravel	2	35%	0%	moderate

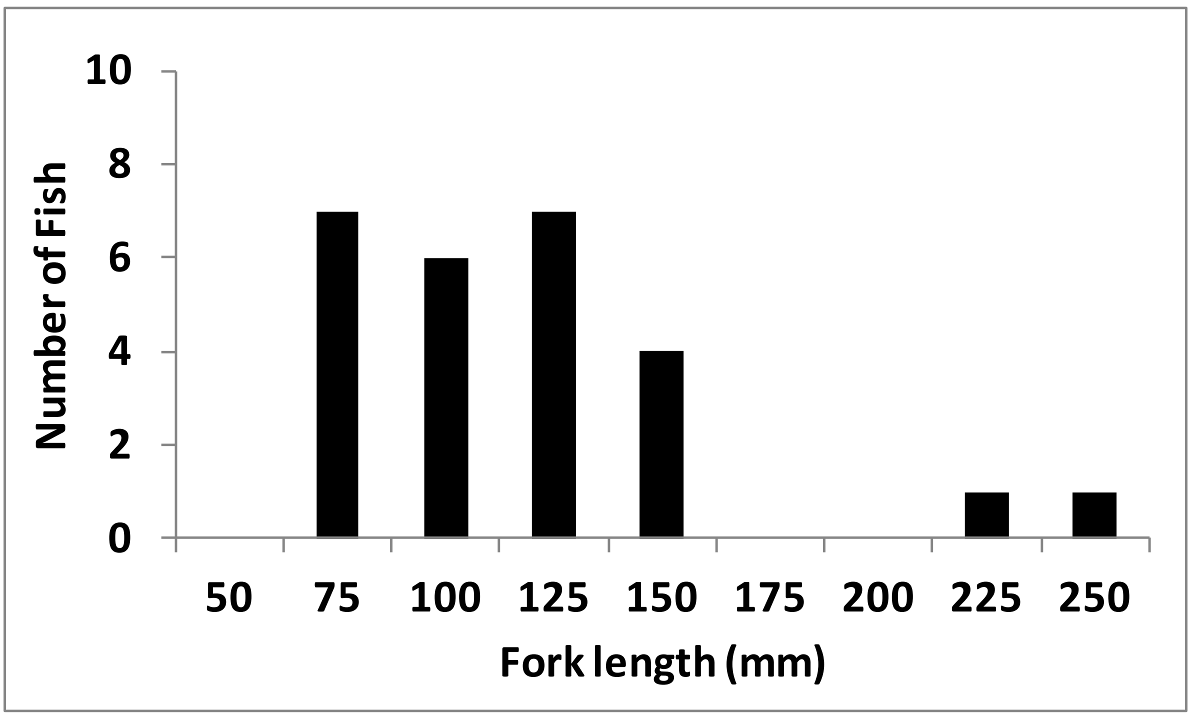

Figure 2. Length-frequency histogram for suckers captured in lower Honey Creek, 2013.

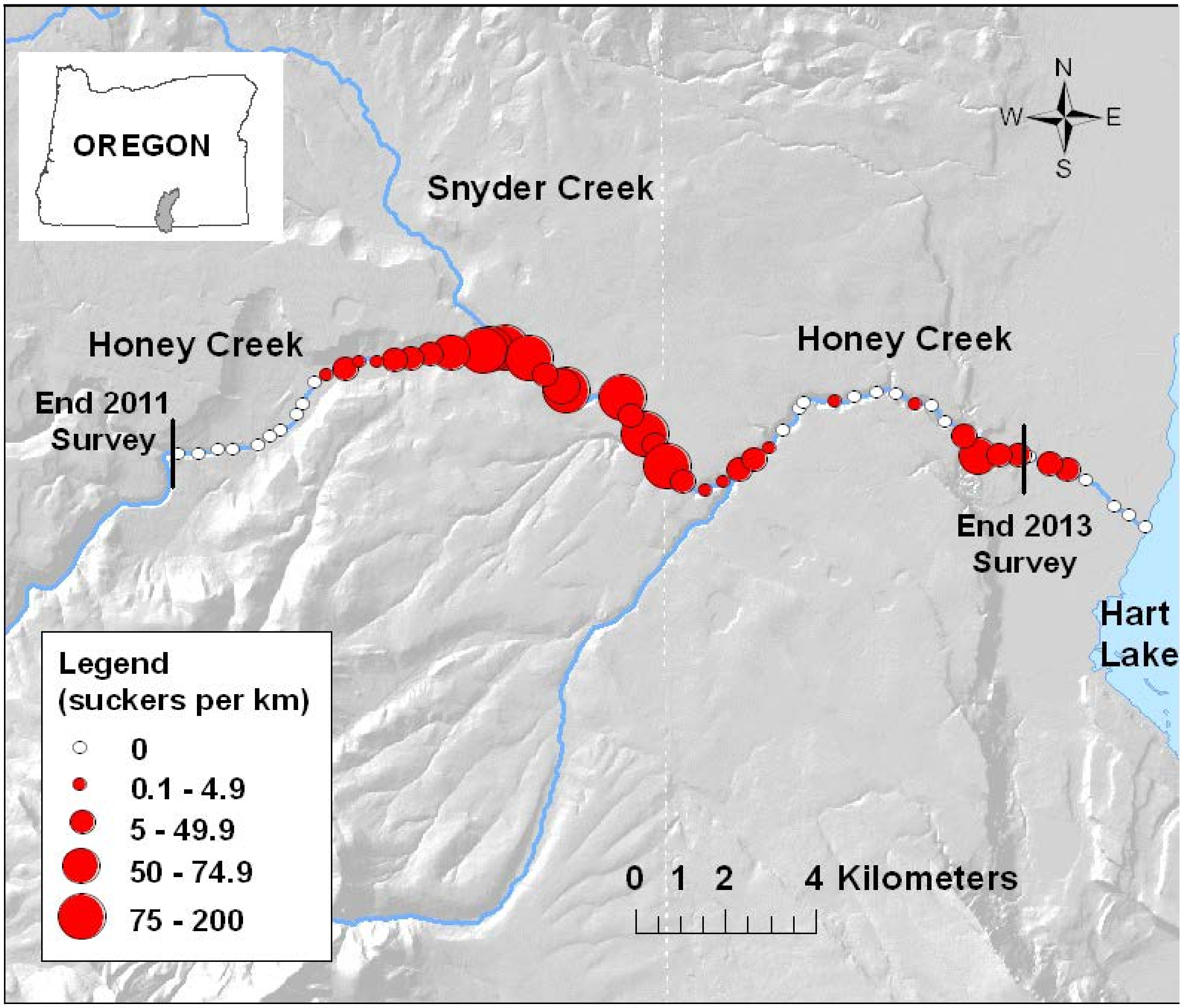

Figure 2. Distribution of Warner suckers in Honey Creek, from surveys conducted in 2011 (middle and upper Honey Creek) and 2013 (lower Honey Creek). Density values represent the total number of suckers captured in each 500 m sample reach (multiplied by two to get fish/km).

We captured very few fish (several juvenile redband trout *Oncorhynchus mykiss* and one tui chub *Siphateles thalassinus*) in the lower 1.6 km (reaches 1-3) of the stream. Upstream of this, we first started to capture speckled dace *Rhinichthys osculus* and adult redband trout, then later Warner suckers. It appeared that this lower stream segment may have desiccated in the early summer prior to our surveys, presumably due to the combination of low stream flows and upstream irrigation withdrawals. The lower three reaches (1.6 km) had reduced stream flow during our surveys, compared to the upper reaches (Table 2). The stream segment that supported Warner suckers, which consisted of the upper 100 m of reach six and reach seven (Figure 3), was characterized by gravel substrates and large, deep pools with abundant submerged aquatic vegetation (Table 2). The downstream reaches were characterized by smaller, often shallower pools, fine substrates, and sparse submerged aquatic vegetation. The large proportion of aquatic vegetation in reach two was comprised almost entirely of nonnative, emergent reed canary grass (*Phalaris arundinacea)*.

Thirty-six percent of the suckers we handled had external parasites or lesions. The most common parasites were fish lice (*Lernaea* sp.) and an unidentified trematode (black spots). Some lesions also had secondary fungal infections.

DISCUSSION

The Warner sucker was federally listed as threatened in 1985. Reasons for the listing included watershed degradation, irrigation diversion practices, and predation and competition from introduced fishes (U.S. Fish and Wildlife Service 1998). Irrigation dams and diversions limit movement and genetic exchange between lake and stream suckers by impeding both the upstream sucker spawning migration from the lakes into the streams and the downstream migration of fish into the lakes. There are seven irrigation diversion dams on lower Honey Creek. Recent recovery actions have focused on improving passage by replacing aging irrigation withdrawal structures which were constructed decades ago, often without fish ladders or screening. In May 2013, we evaluated the swimming performance of Warner suckers to inform future passage design (Scheerer and Clements 2013). In the fall of 2013, the downstream-most diversion on Honey Creek, the Rookery Diversion, was replaced with a new structure that included upstream passage.

At the time of our survey, Lower Honey Creek supported a relatively low number of Warner suckers (estimate 410; 95% CI: 169-721) compared to upper Honey Creek (estimate 4,495; 95% CI: 3,668-5,448) (Scheerer et al. 2011). Sucker densities were moderate (5-50 fish/km) in the upstream reaches (6 and 7) of lower Honey Creek and comparable to areas near the Twentymile Creek confluence in middle Honey Creek and in Taylor meadows (upstream end sucker distribution) in upper Honey Creek. Large beaver dams, which support the majority of the suckers in upper Honey Creek, are absent from lower Honey Creek.

Sucker distribution in lower Honey Creek is determined in part by stream flows and irrigation withdrawals. The high concentration of irrigation diversions in lower Honey Creek can result in partial or complete dewatering of stream segments at low stream flows. When irrigation water is diverted from upper Honey Creek, downstream flows in lower Honey Creek can be further reduced. During dry years, lower Honey Creek can desiccate completely. In addition, the stream channel in lower Honey Creek has been straightened and diked to reduce flooding and facilitate irrigation, resulting in a loss of off-channel rearing habitat.

During our surveys, we captured no suckers in the lower 3 km of the creek. Stream flow in the lower 5 reaches (lower 2.5 km) was substantially influenced by irrigation withdrawals; the lower 1.2 km of stream (downstream of the third diversion dam) nearly desiccated by mid-July. There was indication (low catch of all fishes and submerged terrestrial vegetation) that this lower stream section may have desiccated, either partially or in whole, prior to the beginning of our survey. The 2013 conditions were typical of drought years in the Warner valley when irrigation water is in short supply; no irrigation water was supplied to the hay fields adjacent to the lower 1-1.5 km of the stream. We also found little spawning gravel in the lower 2 km of the creek and most of the limited gravel was covered in thin layers of silt. This suggests that suckers may need to navigate upstream past at least four diversion dams to access suitable spawning habitat in the creek. The conditions we described in lower Honey Creek can serve as a baseline, at least during years with low precipitation during the winter and spring months, to evaluate the effectiveness of proposed passage improvements. Unfortunately, this was our first survey of lower Honey Creek, so we haven't quantified the variability in sucker distribution and abundance that occurs among drought years, much less between drought years and those with abundant winter and spring precipitation. However, we can compare the 2013 distribution and abundance of suckers in lower Honey Creek with that during future drought years, to assess whether proposed passage improvements affect resident sucker densities in lower Honey Creek and in the 2 km of middle Honey Creek downstream of the canyon.

In 2011, we found that abundance estimates from Lincoln-Petersen models, when compared to Huggins closed capture and Bayesian models, underestimated sucker abundance by as much as 50% due to heterogeneity in capture probabilities across size classes and between electrofishing passes (Scheerer et al. 2012). We also found that capture probabilities for Warner suckers using backpack electrofishing were low (0.5-11.2%) and varied substantially among fish size classes (Scheerer et al. 2012; this study). Price and Peterson (2010) estimated similar capture efficiencies for eastern suckers (3.1-12.7%) and found evidence that previous sampling efforts lowered capture efficiency during subsequent sampling periods. Warner suckers appear to show a similar behavioral response, where previously shocked fish avoid capture on subsequent occasions. We speculate that they may sense the electrical current and flee before becoming immobilized. Because we saw improved capture probabilities using hoop nets in combination with electrofishing, we plan to use this combination of gears for future sampling in deep pools to increase the number of suckers captured and PIT tagged. This will allow us to increase the sample size of PIT-tagged fish, whose movement we can track to monitor passage effectiveness, as additional structures are replaced in future years.

From 2006-2011, drought conditions in the Warner Valley resulted in near desiccation of the Warner Lakes. During this period, few suckers were captured in the lakes and even fewer migrated upstream into the tributaries (Scheerer et al. 2011). After a wet winter, the Warner Lakes refilled in 2012 and both Warner sucker recruitment and abundance increased (Scheerer et al. 2012). In 2012, we documented large numbers of suckers migrating into Honey Creek. As additional irrigation diversion structures are replaced in Honey Creek and passage is restored, suckers will have access to additional spawning and rearing habitat and recruitment of young suckers should improve.

In 2014, we plan to begin monitoring Warner sucker passage effectiveness at the recently replaced Rookery Diversion in lower Honey Creek. We will trap suckers in Hart Lake, implant PIT-tags, monitor the spawning migration into Honey Creek, and assess passage success at this diversion. We will install PIT antennas at various locations in the diversion to assess whether modifications in the design of this and future passage structures is warranted. In addition, our lake sampling will allow us to assess whether there has been recent recruitment of Warner suckers in the lake.

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REFERENCES

Coombs, C. I., and C. E. Bond. 1980. Report on investigations of *Catostomus warnerensis,* Fall 1979 and Spring 1980. Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR. 28 p.

Link, W. A. and R. J. Barker. 2010. Bayesian Inference: with ecological applications**.** Elsevier/Academic, Boston, MA. 339 p.

Lunn, D.J., Thomas, A., Best, N., and Spiegelhalter, D. 2000. WinBUGS -- a Bayesian modeling framework: concepts, structure, and extensibility. Statistics and Computing 10:325-337.

Mock, K. E., E. K. Latch, and O. E. Rhodes. 2004. Assessing losses of genetic diversity due to translocation: long-term case histories in Merriam's turkey (Meleagris gallopavo merriami). Conservation Genetics 5(5):631-645.

O'Hara, R. B., and D. J. Kotze. 2010. Do not log-transform count data. Methods in Ecology and Evolution 1:118-122.

Oregon Climate Service. 2014. Oregon climate data. Retrieved on 8 January 2014. http://www.ocs.orst.edu/oregon-climate-data.

Oregon Department of Fish and Wildlife. 2013. Aquatic Inventories Project methods for stream habitat surveys. Conservation and Recovery Program, Corvallis, OR. 75 p.

Oregon Water Resources Department. 2014. Oregon Water Resources Department hydrographics database. Retrieved on 8 January 2014. http://apps.wrd.state.or.us/apps/sw/hydro_report/gage_data_request.aspx?station_nbr=10378500.

Price, A. L., and J. T. Peterson. 2010. Estimation and modeling of electrofishing and seining capture efficiency for fishes in wadeable warmwater streams. North American Journal of Fisheries Management 30: 481-498.

Raftery, A. E., and S. M. Lewis. 1996. Implementing MCMC. Pages 115-130 *in* W. R. Gilks, S. Richardson, and D. J. Spiegelhalter, eds. Markov Chain Monte Carlo in practice. Chapman and Hall/CRC, Boca Raton, Florida.

Scheerer, P. D., S. E. Jacobs, M. Terwilliger, S. A. Miller, S. Gunckel, S. E. Richardson, and M. Heck. 2011. Status, distribution, and life history investigations of Warner suckers, 2006-2010. Oregon Department of Fish and Wildlife, Information Report #2011-02, Salem. 78 p.

Scheerer, P. D., S. Clements, and J. T. Peterson. 2012. 2012 Warner Valley fish investigations- Warner suckers. USFWS contracts F11AC00095 and F12AC01064, BLM contracts L10AC20356 and L12AC20619, and Ruby Pipeline funds. Annual Progress Report, Corvallis. 23 p.

Scheerer, P. D., and S. Clements. 2013. Evaluating Warner sucker swimming performance to inform passage design in the Warner Basin, Oregon. Oregon Department of Fish and Wildlife, Information Report, Salem. 12 p.

Spiegelhalter, D.J., N. G. Best, B. P. Carlin, and A. Van der Linde. 2002. Bayesian measures of model complexity and fit (with discussion). Journal of the Royal Statistical Society, Series B 64:583-616.

U.S. Fish and Wildlife Service. 1985. Endangered and threatened wildlife and plants; Determination that the Warner Sucker is a threatened species and designation of critical habitat. Federal Register 50(188):39117-39123.

U.S. Fish and Wildlife Service. 1998. Recovery Plan for the Native Fishes of the Warner Basin and Alkali Subbasin. Portland, Oregon. 86 p.

White, R. K., T. R. Hoitsma, M. A. Stern, and A. V. Munhall. 1990. Final report of investigations of the range and status of the Warner Sucker, *Catostomus warnerensis*, during spring and summer 1990. Report to U.S. Bureau of Land Management, Oregon Department of Fish and Wildlife, and U.S. Fish and Wildlife Service. 66 p.

APPENDIX A. Details of Warner sucker catch in lower Honey Creek, 2013. Sampling methods: EF= backpack electrofishing, PIT= mobile PIT tag antenna, and EF/HN= combination of backpack electrofishing and hoop nets.

		Pass									
	Fork	EF				PIT				EF/HN	PIT
PIT tag	length	1	2	3	4	5	6	7	8	9	10
360936834	89	0	1	0	0	1	1	0	0	0	0
360936846	82	1	0	1	0	0	0	0	1	0	0
360936851	89	1	0	0	0	1	0	0	0	0	0
360936852	77	0	1	0	0	0	0	0	0	0	0
361679037	138	1	0	0	0	0	0	0	0	1	1
361679047	119	1	0	0	0	1	0	1	0	0	0
361679049	115	0	1	0	0	1	1	1	1	0	1
361679052	119	1	0	0	0	1	0	0	0	0	0
361679054	130	1	0	0	0	0	0	0	0	0	0
361679056	119	0	0	1	0	1	1	1	1	0	1
361679061	230	0	1	0	0	0	0	0	0	0	0
361679071	137	0	1	0	0	0	0	0	0	1	0
361679072	266	1	0	0	0	0	1	1	0	1	0
361679087	119	0	0	1	0	1	1	1	1	0	1
361679088	141	1	0	0	0	0	0	1	0	0	0
361679101	129	0	0	0	1	0	0	0	0	1	0
361679102	145	1	0	0	0	0	1	0	1	0	0
152378421	94									1	0
360936845	82									1	0
361679018	129									1	1
361679039	142									1	1
361679046	157									1	0
361679064	154									1	0
361679074	163									1	1
361679075	151									1	1
	total	9	5	3	1	7	6	6	5	12	8
	recap			1		7	6	6	5	4	8