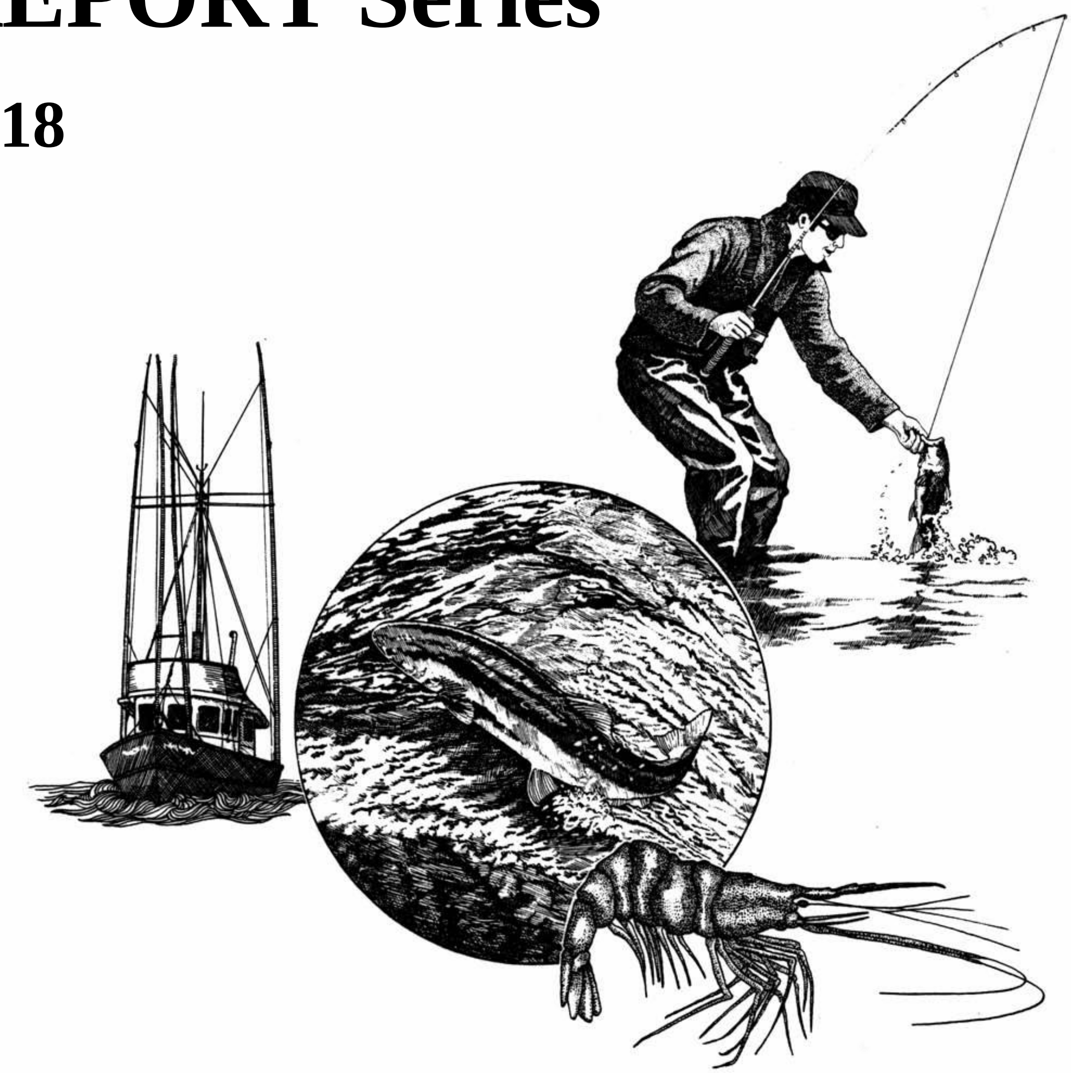
ODFW PROGRESS REPORT Series

2018



Oregon Department of Fish and Wildlife

2018 Foskett Speckled Dace Investigations at Dace Spring

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Photograph of the south pool at Dace Spring, Coleman Valley.

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ABSTRACT

Foskett Speckled Dace *Rhinichthys osculus* are small minnows endemic to the Coleman Lake subbasin in southeastern Oregon. Foskett Speckled Dace were listed as threatened by the U.S. Fish and Wildlife Service in 1985 because of their limited range and the threat of modification or destruction of their habitat to support cattle grazing. Over the past three decades, focused recovery actions have addressed the threats to Foskett Speckled Dace that were identified at the time of listing. The Foskett Speckled Dace is represented by a naturally-occurring population that inhabits Foskett Spring and an introduced population that inhabits Dace Spring in the Warner Basin. At Dace Spring, we documented a gradual increase in population abundance from a low of 34 fish in 2013 to 1,964 fish in 2016. The 2017 estimate of 15,729 fish was nearly an order of magnitude larger than previous estimates but was imprecise as demonstrated by a large 95% confidence interval. Our 2018 study objective was to obtain a more precise population estimate of Foskett Speckled Dace in Dace Spring. Additionally, we provide a general description of habitat conditions at Dace Spring. We estimated population size in Dace Spring with a Huggins closed-capture model in program MARK with three consecutive encounter occasions and three attribute (size) groups (small <35 mm, medium 35–59 mm, and large fish >59 mm fork length). Abundance estimates were calculated separately for each of the two excavated pools, the connecting channel, and the cattle trough. The springhead channel leading to the south pool was too shallow to sample in 2018. Dace abundance was estimated at 1,924 fish (95% CI 1,890–1,965) in Dace Spring in 2018. Most fish were found in the south pool (1,387 fish; 95% CI 1,369–1,411) followed by the north pool (454 fish; 95% CI 432–483). Both pools had the same maximum depth of 1.2 m, but the south pool contained the most open water habitat whereas the north pool was heavily choked with cattails and other aquatic vegetation. At least three age classes were observed in Dace Spring based on length-frequency distribution. An additional spring site located in the Coleman Lake subbasin that may be suitable habitat for Foskett Speckled Dace is also referenced.

INTRODUCTION

Speckled Dace *Rhinichthys osculus* are geographically widespread throughout the western United States, and occur in many isolated endorheic basins within the Great Basin. The Foskett Speckled Dace is represented by a naturally-occurring population that inhabits Foskett Spring and an introduced population that inhabits Dace Spring in the Warner Basin. Both springs are located on the west side of Coleman Lake in Lake County, Oregon (Figure 1). Foskett Spring is a natural spring that rises from a springhead pool, flows through a narrow spring brook into a series of shallow marshes, and then disappears into the soil of the normally dry Coleman Lake (Figure 1). Dace Spring consists of two pools excavated in a shallow spring brook.

The Foskett Speckled Dace became isolated in Foskett Spring at the end of the most recent pluvial period (9,000–10,000 years ago). Hoekzema and Sidlauskas (2012) found that Foskett Speckled Dace were genetically isolated relatively recently (10,000 years vs. millions of years) with no evidence for recent gene flow with other speckled dace populations in the basin.

Foskett Speckled Dace were listed as threatened under the federal Endangered Species Act (ESA) in 1985 because of their limited range and the threat of modification or destruction of their habitat to support cattle grazing (U.S. Fish and Wildlife Service 1985). The primary recovery objective for Foskett Speckled Dace is long-term persistence through preservation of its native ecosystem (U.S. Fish and Wildlife Service 1998). The recovery plan further states that the conservation and long-term sustainability of Foskett Speckled Dace will be met when:

> (1) long-term protection of its habitat, including spring source aquifers, spring pools and outflow channels, and surrounding lands is assured; (2) long-term habitat management guidelines are developed and implemented to ensure the continued persistence of important habitat features and guidelines will include monitoring of current habitat and investigation for and evaluation of new spring habitats; and (3) research into life-history, genetics, population trends, habitat use and preference, and other important parameters is conducted to assist in further developing and/or refining criteria (1) and (2), above.

Actions needed to meet these criteria include protecting the fish population and its habitat, conserving genetic diversity of the fish population, ensuring adequate water supplies are available, monitoring of the fish population and habitat conditions, and evaluating long-term effects of climatic trends on the health of this fish population.

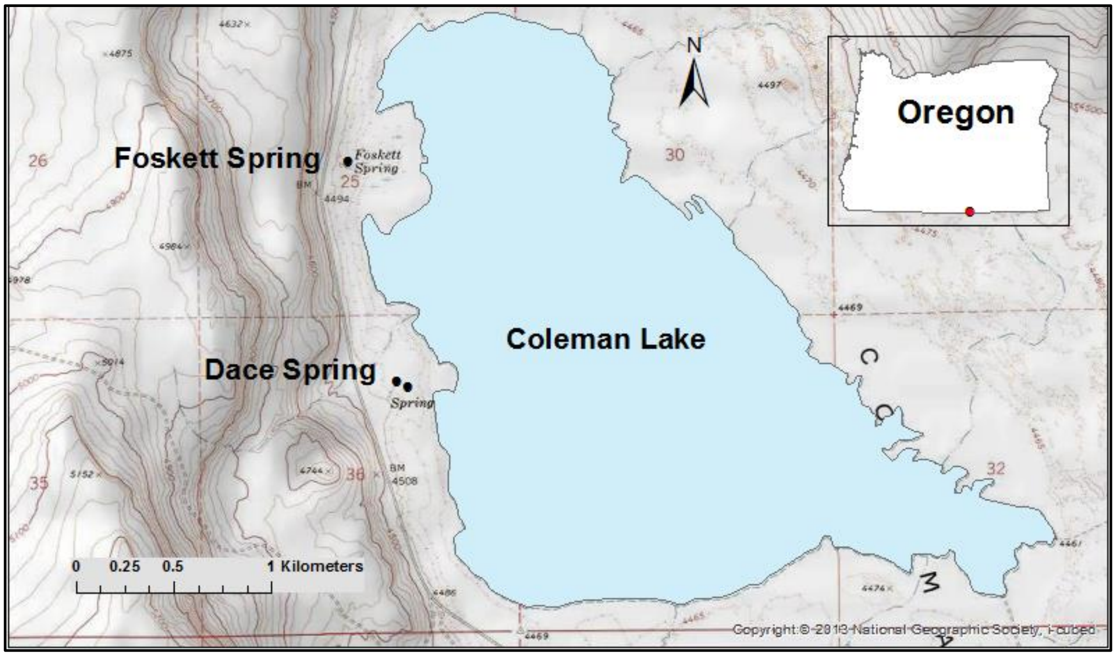

Figure 1. Map showing the locations of Foskett and Dace springs in the Coleman Lake subbasin of the Warner Basin in southeastern Oregon. Coleman Lake is a normally dry lake bed.

Substantial progress has been made towards the conservation and long-term sustainability of Foskett Speckled Dace. In 1987, the Bureau of Land Management (BLM) acquired the 65 hectare parcel of land containing Foskett and Dace springs and fenced 28 hectares to exclude cattle from the springs. Currently, the BLM manages the lands surrounding the springs consistent with the Lakeview Resource Management Plan (Bureau of Land Management 2003), which identifies Foskett Speckled Dace as a Special Status Species to be managed in accordance with the Recovery Plan (U.S. Fish and Wildlife Service 1998). In 2012, the BLM conducted a controlled burn in the tule and cattail marshes to reduce the vegetative biomass and hand-excavated 11 pools in 2013 – 2014, which substantially increased the amount of open water habitat suitable for Foskett Speckled Dace (Scheerer et al. 2014). In 2017, the BLM mechanically excavated eight pool in the spring brook and tule marsh and removed vegetation in the spring pool.

In 2009, the BLM and the U.S. Fish and Wildlife Service (USFWS) completed a habitat enhancement project creating two spring-fed pools at Dace Spring. A population of Foskett Speckled Dace in Dace Spring was initially established from an introduction of 100 fish from Foskett Spring in 1979–1980 (Williams et al. 1990; U.S. Fish and Wildlife Service 1998); however, this population failed due to habitat loss (vegetative succession) and lack of successful recruitment. Following the habitat enhancement project, the Oregon Department of Fish and Wildlife (ODFW) introduced 124 Foskett Speckled Dace from Foskett Spring into the pools in 2010–2011; however, survival of these fish was low due to frequent prolonged algal blooms and resultant anoxic conditions

(Scheerer et al. 2013). In 2013, the BLM excavated flow-through channels to improve water circulation in the Dace Spring pools and observed an immediate improvement in water clarity (algal bloom subsided) and water quality (Scheerer et al. 2013). In October 2013, the ODFW transferred an additional 200 Foskett Speckled Dace from Foskett Spring into the Dace Spring pools (100 fish each).

ODFW monitored the Foskett Speckled Dace population and habitat at Foskett Spring in 1997, 2005, 2007, 2009, and at Foskett and Dace springs from 2011–2017. A declining trend of open water habitat and Foskett Speckled Dace abundance at Foskett Spring was noted from 1997–2012 (Dambacher et al. 1997; Scheerer et al. 2016). Following the BLM's habitat enhancement activities, the Foskett Speckled Dace population increased in abundance from 1,728 individuals in 2011 to 24,888 individuals in 2014 (Scheerer et al. 2014). At Dace Spring, ODFW documented a gradual increase in population abundance from a low of 34 fish in 2013 to 1,964 fish in 2016 (Scheerer et al. 2016). The 2017 estimate of 15,729 fish was nearly an order of magnitude larger than previous estimates, but this abundance estimate was imprecise (95% CI; 3,470-58,479).

During all these surveys, valuable knowledge was gained on several key demographic parameters of Foskett Speckled Dace. We documented annual recruitment (presence of young-of-the-year fish) and a broad size range; indicative of multiple age groups. In 2013, we noted that Foskett Speckled Dace spawning occurs beginning in late-March and extends into July; as evidenced by the presence of larval fish. Also, young-of-the-year fish were more common in the shallow marsh habitats (unpublished data). In Dace Spring, we learned that individual recruits can grow to maturity in a single year, and we gained insight into the species longevity by noting that individuals from the 2010–2011 translocations were present in 2014 (4–5 years old).

The status of ESA listed species is reviewed every five years. This process reviews available data gathered and activities undertaken since the time of listing to determine if recovery actions have progressed, and reviews any new information regarding the status of the threats to the species and Recovery Plan criteria to make recommendations regarding potential changes to the species' listing status. The Foskett Speckled Dace 5-Year Review was completed in 2015, with a recommendation to propose removing the species from the federal list of threatened and endangered species (U.S. Fish and Wildlife Service 2015). At the time that this report was written, Foskett Speckled Dace have been removed from the Oregon State List of Threatened and Endangered Species, and have been proposed for removal from the federal list of threatened and endangered species (U.S Office of the Federal Register 2018).

This report provides results of monitoring conducted in 2018. Our objective was to obtain a more precise population estimate of Foskett Speckled Dace in Dace Spring. General habitat conditions at Dace Spring are described and an additional spring site located in the Coleman Lake subbasin that may be suitable for habitat for Foskett Speckled Dace is also referenced.

METHODS

We used baited minnow traps (1.6 mm mesh) to sample Foskett Speckled Dace over a three-day period from 07–09 August 2018 in Dace Spring. Minnow traps were distributed in the two pools (*n* = 5 traps in the south pool; *n*=6 traps in the north pool) and the connecting channel between the pools (*n* = 3). We also place traps (*n* = 3) in a buried cattle trough at the terminal end of the spring flow (Figure 2). The cattle trough is hydrologically connected to the spring flow by an underground pipe that extends to a well near the north pool. The spring brook leading to the south pool was too shallow for traps (maximum depth = 0.1 m). We deployed less traps in 2018 than in 2012–2017 in an effort to limit the number of fish handled.

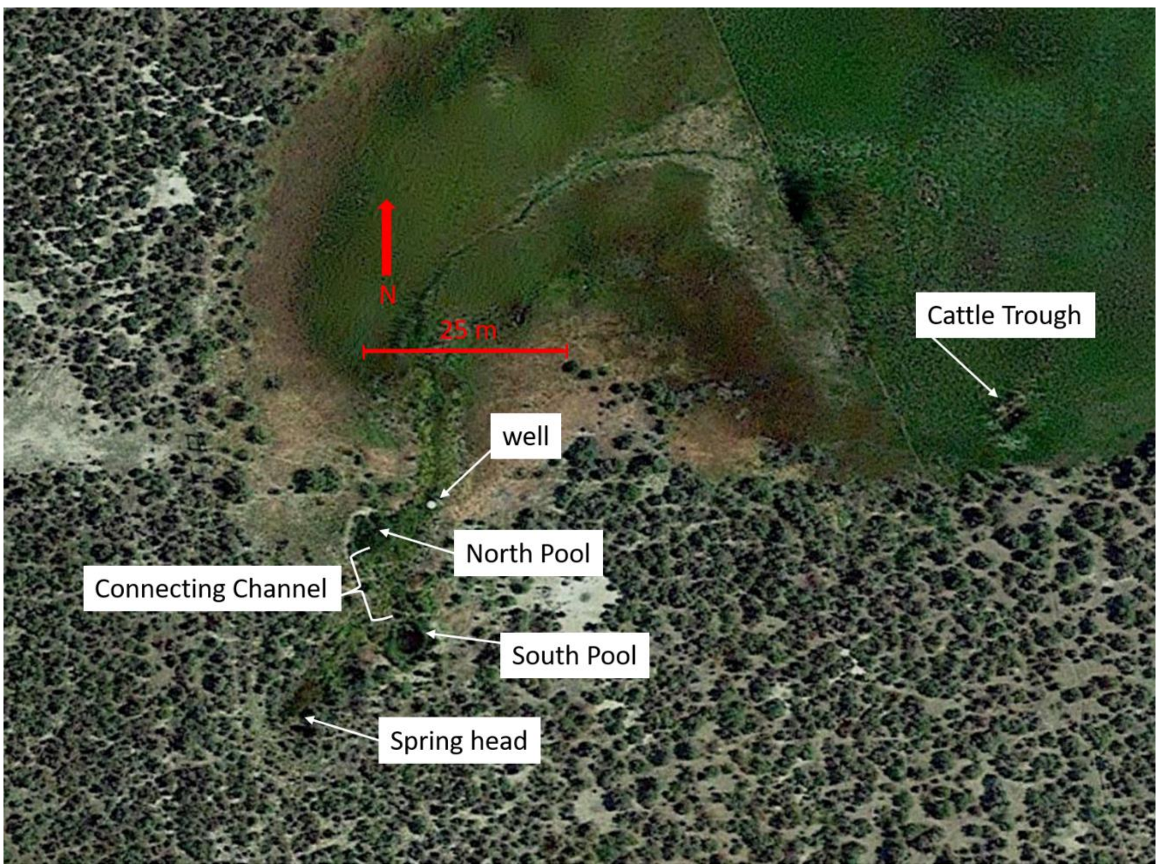

Figure 2. Aerial view of Dace Spring with habitat features.

Minnow traps were distributed on day one and left in place for 3–6 h (soak time). Afterwards, traps were collected and the number of Foskett Speckled Dace in each size group (small < 35 mm total length (TL), medium 35–59 mm TL, and large ≥ 60 mm TL) from each trap was recorded. We marked all fish that we captured in each trap with a partial upper caudal fin clip and recorded the number of fish in each of three size categories. After we marked the fish, they were returned to the water near the location of capture. The following morning (day 2), we set the traps at approximately the same locations, left them in place for 3–6 h to capture fish, recovered the traps, recorded the number of marked and unmarked fish in each size category in each trap, marked all fish with a partial lower caudal fin clip, and released them near the location of capture. On day 3, we pulled the traps, and recorded the total number of unmarked and marked fish (upper caudal, lower caudal, and both) in each size category in each trap.

Using the capture-recapture data, we estimated abundance at Dace Spring using the Huggins closed-capture model in program MARK (White and Burnham 1999) with three consecutive encounter occasions and three attribute groups (small <35 mm, medium 35–59 mm, and large fish >59 mm). This model requires a minimum of three sampling occasions to estimate capture probabilities and can include covariates that are known to affect capture probabilities (e.g., fish size and habitat characteristics) (Peterson and Paukert 2009). The Huggins model does not directly estimate abundance, but rather abundance (N) is derived using the following formula:

$$N = M_t / (1 – [(1-p_1)(1-p_2)(1-p_3)]),$$

where M_t is the total number of marks in the populations, p_1 is the probability of capture for occasion one, p_2 is the probability of capture for occasion two, and p_3 is the probability of capture for occasion 3. We estimated abundance for the entire Dace Spring population, and calculated separate abundance estimates for the south pool, the north pool, the connecting channel, and the cattle trough. We calculated 95 percent confidence intervals for the abundance estimates according to Chao (1987).

To evaluate which of the independent variables in our Huggins closed-capture model (sampling occasion, trap soak time, fish size, individual trap, and habitat location) had a greater effect on capture probability, we examined the parameter estimates for the best approximating capture probability model. The parameter estimates were on a logit scale, so to facilitate interpretation of the parameters we calculated the odds ratios by exponentiating the parameter estimates (Hosmer and Lemeshow 2000). Odds ratios are an estimate of the odds of an event occurring (e.g., capture of a fish) in response to increasing the predictor variable one unit, or the relative differences between two groups. An odds ratio of 1 is interpreted as no effect on the response or no differences between groups. An odds ratio estimate >1 is interpreted as a positive effect. For example, if the odds ratio is 1.24 for small vs. large fish, then small fish are 24% more likely to be captured than large fish. An odds ratio estimate of <1 is interpreted as a negative effect. For example, if the odds ratio is 0.333 for sampling occasion 1 versus 2, then fish are approximately 3 times (1/0.333) less likely to be captured on occasion 2, compared to occasion 1.

We systematically fit alternative capture probability models with various combinations of covariates and selected the best approximating model using Akaike's Information Criteria with a small sample bias adjustment (AICc; Burnham and Anderson 2002).

RESULTS

We estimated the Foskett Speckled Dace abundance in Dace Spring at 1,924 fish (95% CI 1,890–1,965) in 2018. The south pool contained the most dace at 1,387 fish (95% CI; 1,369–1,411) followed by the north pool with 454 fish (95% CI 432–483). Both pools had a maximum depth of 1.2 m but the south pool was all open water habitat whereas the north pool was heavily choked with cattails. Only 38 fish were estimated to be in the connecting channel (95% CI 32–54) and 45 in the cattle trough (95% CI 35–68).

The best approximating capture probability model included six parameters (Table 1). Large fish were 1.9 times less likely to be caught than small and medium fish. This differed from previous years were large fish were generally more likely to be caught than medium fish (Scheerer et al. 2014). We observed heterogeneity in capture probabilities among locations in the spring complex. For example, fish were 20 times more likely to be captured in the south pool, eight times more likely to be captured in the connecting channel, and 36 times more likely to be captured in the cattle trough than in the north pool. Details regarding the best model beta estimates, odds ratios, and their interpretations are shown in Table 2.

Very few small fish were observed in Dace Spring in 2018. The total number of small, medium, and large fish was 4 (95% CI 4–4), 1,707 (95% CI 1,677–1,745) and 213 (95% CI 200–232), respectively. This contrasts with the estimate in 2017 when small fish comprised the majority (89%) of the estimated total abundance. Although few fish in the small category were caught, at least three age groups were evident based on visual interpretation of length-frequency data (Figure 3).

Table 1. Huggins closed-capture best model beta coefficients, odds ratios, and their interpretations. See “Methods” for a description of these descriptive statistics.

Parameter	Estimate	Standard error	Lower 95%	Upper 95%	Odds ratio	Interpretation
Intercept	-5.468	0.487	-6.423	-4.513		
Large	-0.632	0.126	-0.880	-0.384	0.53	Large fish were 1.9 (1/0.53) times less likely to be caught than medium and small fish combined.
Soak time	0.163	0.015	0.133	0.192	1.18	Fish were 1.2 times more likely to be caught with each trap hour.
South pool	3.012	0.210	2.600	3.424	20.33	Fish were 20 times more likely to be caught in south pool relative to north pool.
Connecting channel	2.062	0.388	1.302	2.823	7.86	Fish were 7.9 times more likely to be caught in connecting channel relative to north pool.
Cattle trough	3.582	0.522	2.559	4.604	35.94	Fish were 36 times more likely to be caught in the cattle trough relative to north pool.
Third sample occasion	0.204	0.093	0.021	0.387	1.23	Fish were 1.2 times more likely to be caught on the third occasion after accounting for soak time.

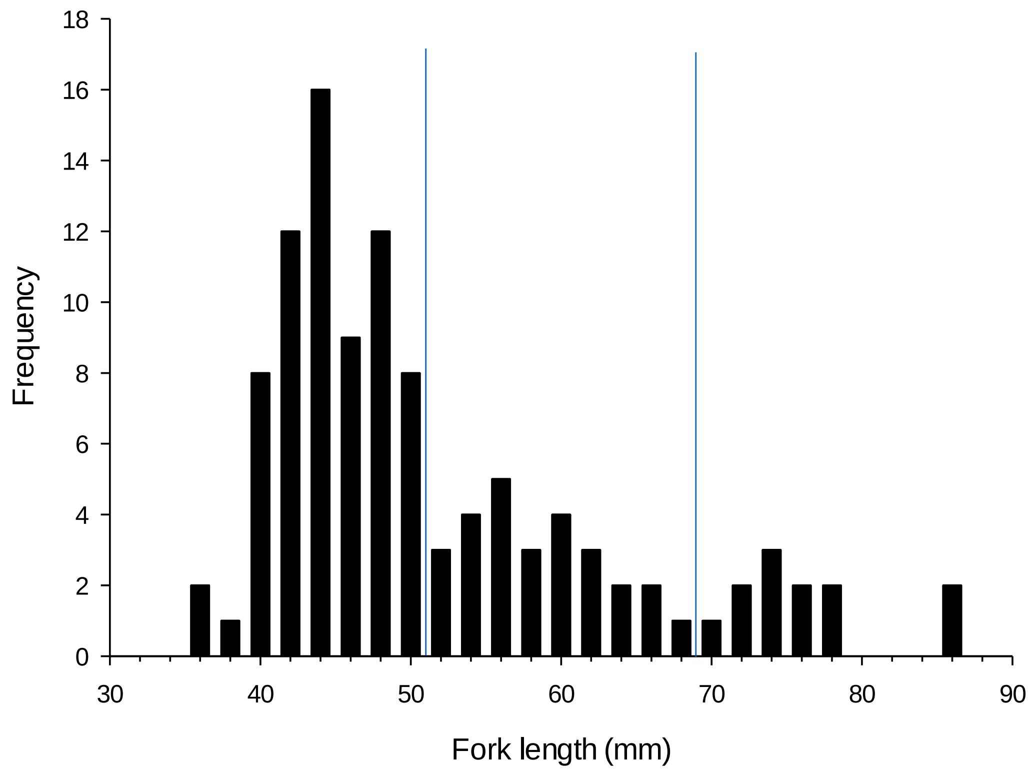

Figure 3. Length-frequency of Foskett Speckled Dace in Dace Spring, 2018. Vertical lines demarcate putative year-classes.

DISCUSSION

The 2018 estimate of Foskett Speckled Dace in Dace Spring was nearly an order of magnitude lower than the 2017 estimate, but similar to the 2016 estimate (Table 2). The 2017 estimate may have been biased and imprecise due to methodological matters. Scheerer et al. (2017) applied capture probabilities from previous surveys to estimate abundance. This was done in part to minimize handling stress associated with marking fish. However, capture probability may change over time for a number of reasons including, but not limited to, habitat changes and changes in true abundance. Therefore, the capture probabilities used by Scheerer et al. (2017) may have biased the abundance estimate and its precision. In 2018 we aimed to re-estimate capture probabilities to provide a more precise estimate of abundance. Nonetheless, all indications are that 2017 was a strong recruitment year for dace in Dace Spring. When just considering the number of fish captured in minnow traps, small fish (<35 mm FL) accounted for 38% of the total catch in 2017 compared to 3.6–9.6% from 2014–2016. The small proportion of small-sized fish in 2018 (<1%) may be the result of poor recruitment or simply an artifact of our later sampling date in 2018. In previous years, sampling was conducted in June, but in 2018 we conducted sampling in early August and young-of-year dace may have grown beyond the small category by the time we sampled. Continued monitoring to ensure recruitment is occurring in Dace Spring is recommended since past efforts to establish a self-sustaining dace population in Dace Spring have failed due to poor recruitment.

Table 2. Estimates of Foskett Speckled Dace abundance in Dace Spring, 2013–2018.

Year	Population Estimate	95% Confidence Interval Lower	Upper
2013[a]	34	17	62
2014	552	527	694
2015	876	692	1,637
2016	1,964	1,333	4,256
2017	15,729	3,470	58,479
2018	1,924	1,890	1,968

[a] additional 200 dace translocated after population estimate conducted.

One of the greatest current threats to dace persistence in spring habitats of the Coleman Basin is the encroachment by aquatic macrophytes that reduce the size of their habitat. A correlation between open water habitat and dace abundance has been demonstrated by Scheerer et al. (2014, 2016). The north pool at Dace Spring is becoming choked with cattails and other aquatic vegetation and contained only a third of the number of dace as the more open south pool. Management actions to reduce the amount of vegetation in the north pool may be needed.

Vegetation encroachment is common in desert spring ecosystems. When springs are fenced and livestock removed, these ecosystems often experience increases in aquatic vegetation, reduction of open water habitat, and reduction of fish populations (Kodric-Brown and Brown 2007). Krodic-Brown and Brown (2007) speculated that prior to pre-European settlement native ungulates maintained open water habitat in desert spring habitats, and the role of large ungulates have since been replaced with livestock. There is some archeological evidence that American bison *Bison bison* were extant in the Warner Basin as recently as 300 years ago (Grayson 2006), and they may have played a role in maintaining open spring habitat along with other large ungulates.

The recovery plan for the threatened and rare native fishes of the Warner basin and Alkali subbasin includes a criterion for Foskett Speckled Dace that, in part, calls for the investigation for and evaluation of new spring habitat (USFWS 1998). The establishment of a population at Dace Spring can be considered an effort to meet this criterion. However, the suitability of Dace Spring for translocation is diminished by it relatively small size. An attempt to establish a population in Dace Spring in 1979 failed after 17 years. Although the current population has persisted for the last 8 years, its continued existence will likely require frequent management efforts to maintain the habitat and water quality.

There is a larger spring located in the Coleman Basin that may be suitable habitat for Foskett Speckled Dace. It is located on private property about 3.6 km south of Dace Spring (Appendix Figure 1). Based on remote sensing imagery, it appears much larger than Dace Spring with more open water habitat, similar to Foskett Spring. To the best of our knowledge, no surveys have been conducted at the spring to determine if a dace population already exist or, if not, if it would be suitable for dace translocation in the future. We recommend efforts be made to contact the landowner and determine the suitability of the spring as dace habitat. The establishment of another population in the Coleman Basin may enhance the conservation and long-term sustainability of Foskett Speckled Dace.

ACKNOWLEDGEMENTS

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Appendix Figure 1. Satellite imagery showing the location of a spring that may be suitable habitat for Foskett Speckled Dace in the southern portion of the Coleman Lake subbasin. The spring is on private property and located about 3.6 km south of Dace Spring.

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