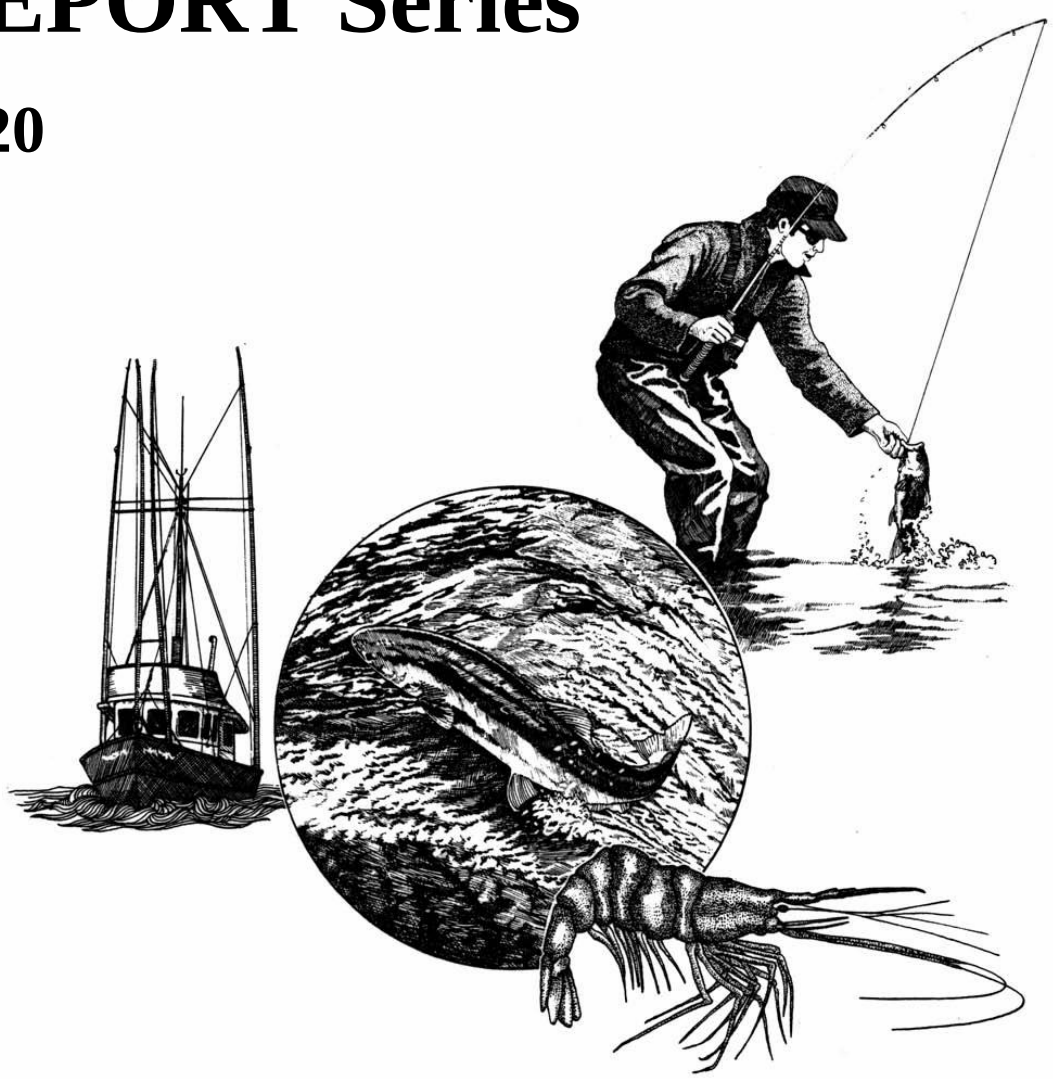
ODFW PROGRESS REPORT Series

2020



Oregon Department of Fish and Wildlife

2019 Foskett Speckled Dace Investigations at Foskett Spring

Contract Numbers: F17AC00448, F16AC0087, and F15AC00767

ANNUAL PROGRESS REPORT
FISH RESEARCH PROJECT
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PROJECT TITLE: 2019 Foskett Speckled Dace Investigations at Foskett Spring

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Photograph of an excavated pool in the lower tule marsh at Foskett 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. In 2019 the U.S. Fish and Wildlife Service removed Foskett Speckled Dace from the Federal List of Threatened and Endangered Wildlife. A post-delisting monitoring (PDM) program has been developed for the species that requires monitoring population abundance over the next five years. As part of this plan, our 2019 study objectives were to 1) obtain a population estimate of Foskett Speckled Dace in Foskett Spring, and 2) quantify the amount of vegetation-free open water habitat at Foskett Spring. We estimated population size in Foskett Spring with a Huggins closed-capture model in program MARK. Dace abundance was estimated at 9,493 fish (95% CI 9,265–9,740), with most fish found in the tule marsh habitat (6,005 fish; 95% CI 5,795–6,234). Adult-sized dace abundance was estimated at 7,354 (95% CI 6,975–7,833). At least three age classes were observed in Foskett Spring based on a length-frequency distribution that ranged in size from 22-93 mm TL. In addition, larval fish (5-6 mm TL) were observed during sampling in early September. A visual inspection of Dace Spring was conducted and fish numbers in the south pool were similar to 2018. The surface area of vegetation-free open water habitat at Foskett Spring was assessed before and after mechanical excavation of pool habitat that occurred in August 2017. Aerial photographs of the habitat were taken with systematic unmanned aerial vehicle flights on July 2017, November 2017, and December 2019. Georeferenced orthophotos were developed for each flight and the surface area of vegetation-free open water was measured. Just prior to mechanical excavation of pool habitat, the surface area of open water was estimated at 6.3 m^2. Immediately following mechanical excavation, open water increased to 318.8 m^2. The amount of open water by December 2019, after two seasons of vegetative growth, had decreased to 133.0 m^2. These results suggest the population is stable, and additional management action (as defined in the PDM) is not required at this time, although the reduction in open water habitat since 2017 suggest measures to improve habitat conditions may be needed in the future.

INTRODUCTION

Speckled Dace *Rhinichthys osculus* show a high degree of endemism and exhibit large differences in morphological traits among populations across the species' large geographic range in the western United States (Pfrender et al. 2004). Foskett speckled dace are considered to be a distinct evolutionary lineage of *R. osculus* that have been genetically isolated from nearby populations in the Warner Basin for over 9000 years and represent a significant contribution to the genetic diversity of the Speckled Dace taxonomic group (Ardren et al. 2010; Hoekzema and Sidlaukas 2014).

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 1a). 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 1b). Dace Spring consists of two pools excavated in a shallow spring brook.

Foskett Speckled Dace were listed as threatened by the U. S. Fish and Wildlife Service (USFWS) under the federal Endangered Species Act 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). A recovery plan for Foskett Speckled Dace was developed in 1998 (U.S. Fish and Wildlife Service 1998) listing the three recovery criteria that would need to be met for the conservation and long-term sustainability of Foskett Speckled Dace. These recovery criteria include:

> (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.

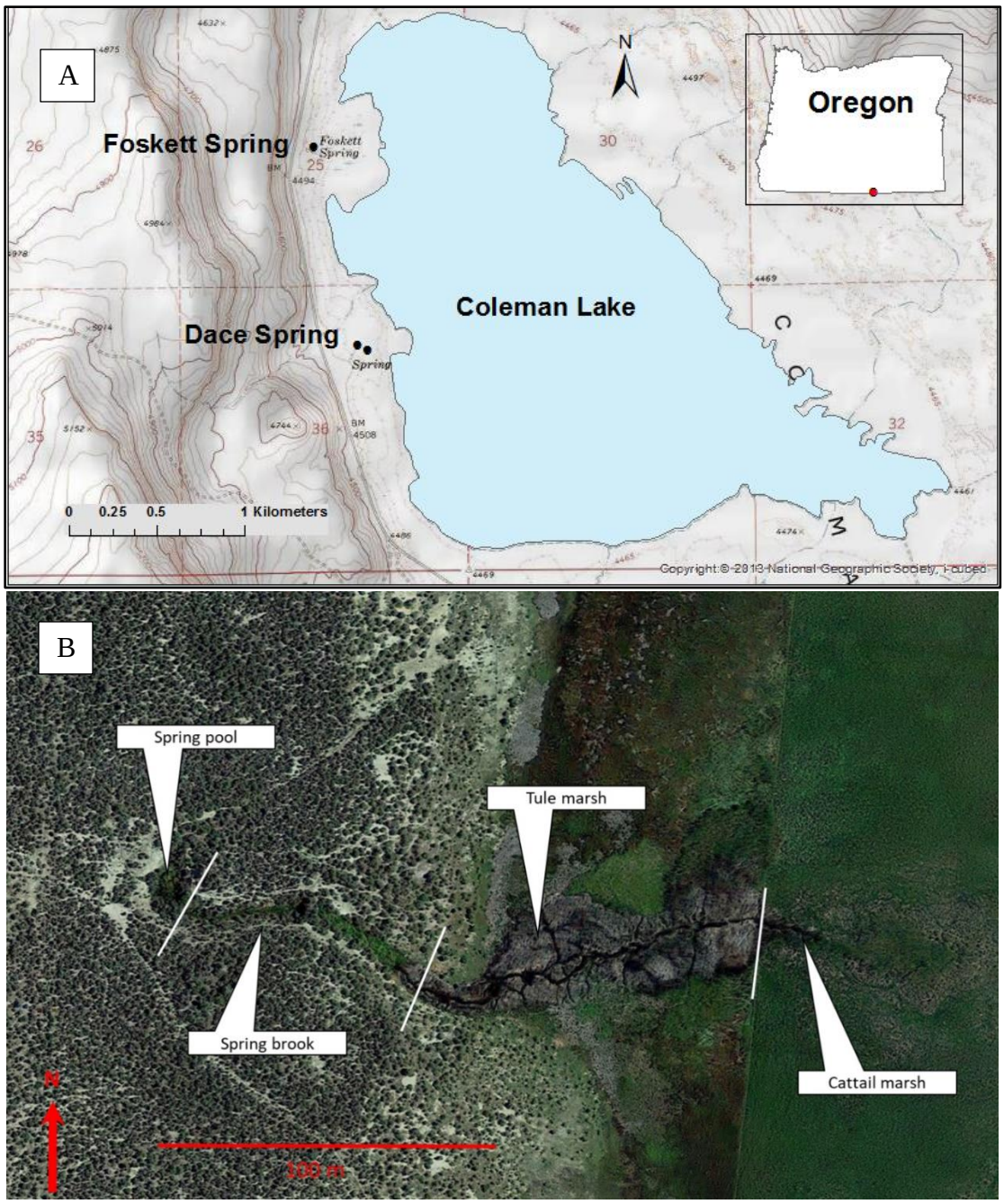

Figure 1. Map showing the locations of Foskett and Dace springs in the Coleman Lake subbasin (A) and aerial view of Foskett Spring with habitat features (B). Coleman Lake is a normally dry lake bed in the Warner Basin in southeastern Oregon.

Since the time of listing substantial progress has been made in achieving the three recovery criteria, leading to the species' de-listing in 2019. Long-term protection of Foskett Speckled Dace habitat has occurred through the acquisition and fencing of both Foskett and Dace springs by the Bureau of Land

Management (BLM). In 1987, the BLM acquired the 65 hectare parcel of land containing the springs and fenced 28 hectares to exclude cattle from the springs.

Long-term habitat management guidelines were developed as part of a Cooperative Management Plan (CMP) entered into in 2015 by the BLM, USFWS and the Oregon Department of Fish and Wildlife (ODFW)(U.S. Fish and Wildlife Service 2015a). The purpose of the CMP is to provide for the long-term persistence of Foskett Speckled Dace through the management and protection of habitat at Foskett and Dace springs. The actions identified in the CMP include: (1) protect and manage these habitats; (2) monitor the Foskett Speckled Dace populations and habitats; (3) enhance the habitat when needed; and (4) implement an emergency contingency plan to address potential threats from pollutants, nonnative species, or other unforeseen threats.

An ongoing component of habitat protection is the maintenance of open water habitat at Foskett and Dace springs because long-term monitoring has shown that Foskett Speckled Dace abundance is related to the amount of open water habitat (Scheerer et al. 2017). The species is considered conservation reliant, requiring active management to address the threat of loss of open-water habitat from vegetation encroachment. The BLM has conducted several habitat enhancement activities through the years to increase the amount of open-water habitat. In 2012, the BLM conducted a controlled burn in the tule and cattail marshes at Foskett Spring 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). 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). However, by 2016 vegetation encroachment had reduced the amount of open water habitat by more than 50% compared with 2013, and dace abundance had decreased to 1,830 individuals. In 2017, the BLM mechanically excavated a total of eight pools with an excavator in the spring brook and tule marsh and removed vegetation in the spring pool (Appendix Figure 1).

In addition to monitoring abundance and habitat, much research has been conducted into life-history, genetics, and other important demographic parameters of Foskett Speckled Dace since the decision to list this species. Population monitoring has documented multiple age groups, annual recruitment, and spawn timing beginning in late-March and extending into July, as evidenced by the presence of larval fish. Individuals/recruits can grow to adult size and mature in a single year and their longevity is 3-4 years (Scheerer et al. 2014). Recent phylogenetic studies of Foskett Speckled Dace revealed that the population has been genetically isolated from other speckled dace populations in the basin since the last pluvial period (9,000-10,000 years ago) but they are not monophyletic and do not warrant species or subspecies status (Ardren et al. 2010; Hoekzema and Sidlauskas 2014).

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 to make recommendations regarding potential changes to the species' listing status. Given the substantial progress made in achieving recovery criteria, the most recent Foskett Speckled Dace 5-Year Review completed in 2015 recommended a proposal to remove the species from the federal list of threatened and endangered species (U.S. Fish and Wildlife Service 2015b). Foskett Speckled Dace were removed from the federal list of threatened and endangered species on October 15th of 2019 (U.S Office of the Federal Register 2019).

As required by law under Section 4(g) of the Endangered Species Act of 1973, the US Fish and Wildlife Service, in cooperation with ODFW and BLM, has developed and implemented a post-delisting monitoring plan to ensure Foskett Speckled Dace remain secure from the risk of extinction (U.S. Fish and Wildlife Service 2019b). The plan calls for monitoring population abundance and habitat over the next five years. This report provides results of monitoring conducted in 2019. Our objective was to obtain a population estimate of Foskett Speckled Dace in Foskett Spring and assess the amount of open water habitat available since mechanical excavation of pools in 2017.

METHODS

Population Abundance.- We used baited minnow traps (1.6 mm mesh) to sample Foskett Speckled Dace over a three-day period from 04–06 September 2019 in Foskett Spring. Minnow traps were distributed in each habitat (n = 4 traps in the spring pool; n=7 traps in the spring brook; n=7 traps in tule marsh). The cattail marsh was excluded from sampling in 2019 because it was too shallow to allow setting of traps (Figure 2).

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) was recorded. We marked a minimum of 200 fish per trap with a partial upper caudal fin clip and recorded the number of marked fish in each of three size categories. We returned all marked and unmarked fish 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 collected 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 Foskett 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). To account for only partial marking on day 1, the recapture probability of fish not marked that day was set to zero. 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 Foskett Spring population, and calculated separate abundance estimates for the spring pool, spring brook, and tule marsh. We also estimated abundance for each size group. 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 had the greatest effect on capture probability (sampling occasion, fish size, and habitat location, we examined the parameter estimates for the best approximating capture probability model. The parameter estimates were on a logit scale, so to facilitate interpretation 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).

Habitat Assessment.- We assessed the quantity of open water habitat by taking systematic aerial photographs of the Foskett Spring habitat and measuring the surface area of vegetation-free water. The BLM used a DJI Phantom 3 Pro

unmanned aerial vehicle (UAV) flown 30.5 m above ground level with the camera pointed directly downward. DroneDeploy mobile software was used to photograph the target area in a grid pattern with a 70% photo overlap. Photos were processed using Agisoft Photoscan to produce a georeferenced orthophoto of the project area. The orthophotos were uploaded to Google Earth Pro, where open water was estimated by drawing polygons around areas that appeared to contain open water, relatively free of vegetation.

The first UAV flight was in July 2017, prior to BLM mechanically excavating pools at Foskett Spring in August. The second flight was November 2017, after excavation and before any vegetation growth had occurred in the disturbed area. The most recent flight was in December of 2019, after two seasons of vegetative growth. In addition to the UAV flight in December 2019, the eight excavated pools were measured for maximum depth (nearest 0.03 m) using a stadia rod.

RESULTS

Population Abundance.- We estimated the Foskett Speckled Dace abundance in Foskett Spring at 9,493 fish (95% CI 9,265–9,740) in 2019. The tule marsh contained the most dace at 6,005 fish (95% CI; 5,795–6,234) followed by the spring brook with 2,207 fish (95% CI 2,146–2,301) and the spring pool with 1,281 fish (95% CI 1,235–1,334). The best approximating capture probability model included five parameters (Table 1). Fish were ‘trap shy’ with a recapture parameter indicating fish were 3.8 times less likely to be recaptured after initial capture. In addition, large fish were more likely to be caught than smaller fish.

Medium-sized fish comprised 69% of the total population in Foskett Spring in 2019. The total number of small, medium, and large fish was 2,139 (95% CI 1,957–2,352), 6,595 (95% CI 6,220–7,077) and 759 (95% CI 741–780), respectively. Assuming the adult population is comprised of the medium and large dace, the estimated adult population was 7,354 (95% CI 6,975–7,833).

Length frequency distribution suggest at least three age classes were present in Foskett Spring (Figure 3). In addition, larval dace were observed in Foskett Spring; two fry (5-6 mm TL) were inadvertently captured while filling buckets in the spring brook.

At Dace Spring, several hundred dace were observed in the south pool during a visual inspection from the bank. Overall, observed fish density appeared similar to 2018 when 1,387 fish were estimated in the pool (Monzyk et al. 2018).

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	0.404	0.049	0.308	0.501		
Recapture	-1.333	0.054	-1.439	-1.227	0.26	Fish were 3.79 less likely to be recaptured after initial capture
Small body size	-1.036	0.097	-1.225	-0.846	0.36	Small fish were 2.82 times less likely to be caught
Large Body size	0.442	0.071	0.302	0.581	1.56	Large fish were 1.56 times more likely to be caught
Spring pool	-0.623	0.103	-0.824	-0.422	0.54	Fish were 1.86 times less likely to be caught in the Spring pool (relative to spring brook)
Tule marsh	-0.669	0.051	-0.770	-0.568	0.51	Fish were 1.95 times less likely to be caught in the Tule marsh (relative to spring brook)

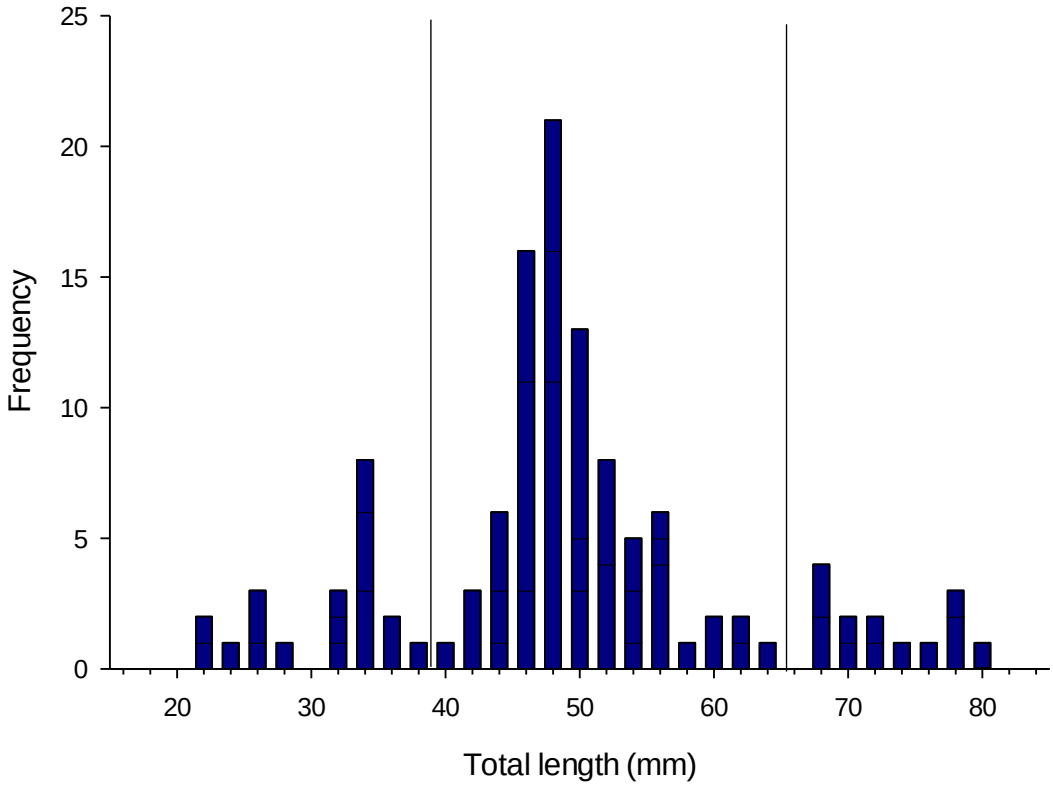

Figure 2. Length-frequency of Foskett Speckled Dace in Foskett Spring, 2019. Vertical lines demarcate putative year-classes. Not shown are fry (5-6 mm TL) captured during sampling.

Habitat Assessment.- Just prior to mechanical excavation of pool habitat at Foskett Spring in the summer of 2017, the total amount of surface water free of vegetation estimated via aerial imagery at 6.3 m^2 (Table 2). Immediately following mechanical excavation of pools, the amount of vegetation-free surface water increased to 318.8 m^2. After two seasons of vegetation growth post-excavation, the amount of vegetation-free surface water decreased by December 2019 to 133.0 m^2. The amount of open water has remained consistent in the spring pool following two seasons of vegetation growth (Table 2). In contrast, the amount of open water habitat decreased by 50% and 72% in the spring brook and tule marsh, respectively (Table 2). Although vegetation has been encroaching in the last two years, the excavated pools remain relatively deep. The three pools in the spring brook ranged from 0.34-0.37 m deep and the five pools in the tule marsh ranged in depth from 0.70-1.07 m in December 2019. In general, all pools over 1 m in depth were free of vegetation.

Table 2. Area of surface water at Foskett Spring that was vegetation-free by habitat category before and after mechanical excavation. Mechanical excavation occurred in August 2017.

Habitat type	Vegetation-free Surface Water Area (m^2)		
	July 2017 (pre)	November 2017 (post)	December 2019 (post)
Spring Pool	1.0	36.2	34.4
Spring Brook	4.2	85.4	42.9
Tule Marsh	1.1	197.2	55.7
TOTAL	**6.3**	**318.8**	**133.0**

DISCUSSION

The estimated 2019 abundance in Foskett Spring of 9,493 Foskett Speckled Dace was more than double the estimate prior to the habitat enhancement in 2017 (Table 3). According to the post-delisting monitoring plan, a decline in estimated population abundance to ≤500 adults at Foskett Spring would trigger the Service and its cooperators to initiate a response to address the decline. Scheerer et al. (2014) indicated that Foskett Speckled Dace are capable of reaching sexual maturity in their first year. Speckled Dace can reach 20-30 mm fork length in their first year of growth in more northern latitudes (McPhail 2007). Therefore, we believe using fish >35 TL (medium and large size categories) is a conservative estimate of the adult population in Foskett Spring. The estimated adult population of 7,354 dace in 2019 was well above the number that would trigger a management response by the USFWS and its cooperators.

Table 3. Estimates of Foskett Speckled Dace abundance in Foskett Spring, 2011–2019.

Year	Population Estimate	95% Confidence Interval	
		Lower	Upper
2011	1,728	1,269	2,475
2012	1,848	1,489	2,503
2013	13,142	10,665	16,616
2014	24,888	19,250	31,510
2015	16,340	10,980	21,577
2016	1,830	1,694	2,144
2017	4,279	3,878	4,782
2019	9,493	9,265	9,740

Scheerer et al. (2014) suggested that Foskett Speckled Dace spawning starts in late March and extends into July, as evidenced by the presence of larval dace. Larvae hatch 4-6 d after eggs are fertilized and swim-up occurs after an

additional 4-8 d at around 7 mm TL (John 1963; Kaya 1991; Moyle 2002). The capture of fry 5-6 mm TL during our sampling on 06 September suggest that spawning at Foskett Spring may extend to late August.

Management Considerations.- Foskett Speckled Dace are a conservation reliant population requiring management actions in order to assure habitat conditions (open water habitat in particular) are maintained (U. S. Fish and Wildlife Service 2019). Habitat enhancement efforts at Foskett Spring have long been based on the working hypothesis that the habitat carrying capacity for dace is controlled by the amount of open water (Dambacher et al. 1997). Scheerer et al. (2017) reported a significant relationship between Foskett Speckled Dace abundance and open water habitat area at Foskett Spring from 2012 through 2017 (Figure 3).

The encroachment by aquatic vegetation has been an ongoing management issue at Foskett Spring since the area was fenced in the 1980s. Over the past few decades the BLM has carried out controlled burns and hand-digging of pools to increase open water habitat, all with relatively temporary effect. Mechanically excavating of pools in 2017 greatly increased the amount of open water habitat, but after two growing seasons vegetation encroachment has reduced the amount of open water habitat by half. It is very likely more management actions will be needed in the coming years.

The BLM is considering future options to maintain open water habitat including additional excavation, addition of physical barriers to vegetative growth (e.g., pond liner, sunken water trough, etc.), aquatic herbicides, and managed livestock grazing. Of these options, limited livestock grazing may provide a management tool closest to historic natural processes. Kodric-Brown and Brown (2007) suggest that prior to European settlement, native ungulates maintained open water habitat in desert spring habitats, and the role of large ungulates have since been replaced with livestock. When desert springs are fenced and livestock removed, these ecosystems often experience increases in aquatic vegetation, reduction of open water habitat, and reduction of fish populations. Prior to fencing Foskett Spring in the 1980s, cattle grazing is thought to have maintained open-water areas (Dambacher et al. 1997). A future research goal could be to test the effects of livestock grazing at this site by comparing vegetation encroachment in areas that permit livestock access to areas that exclude livestock (exclusion areas would serve both as a control, and to protect particularly sensitive habitat like the spring head pool).

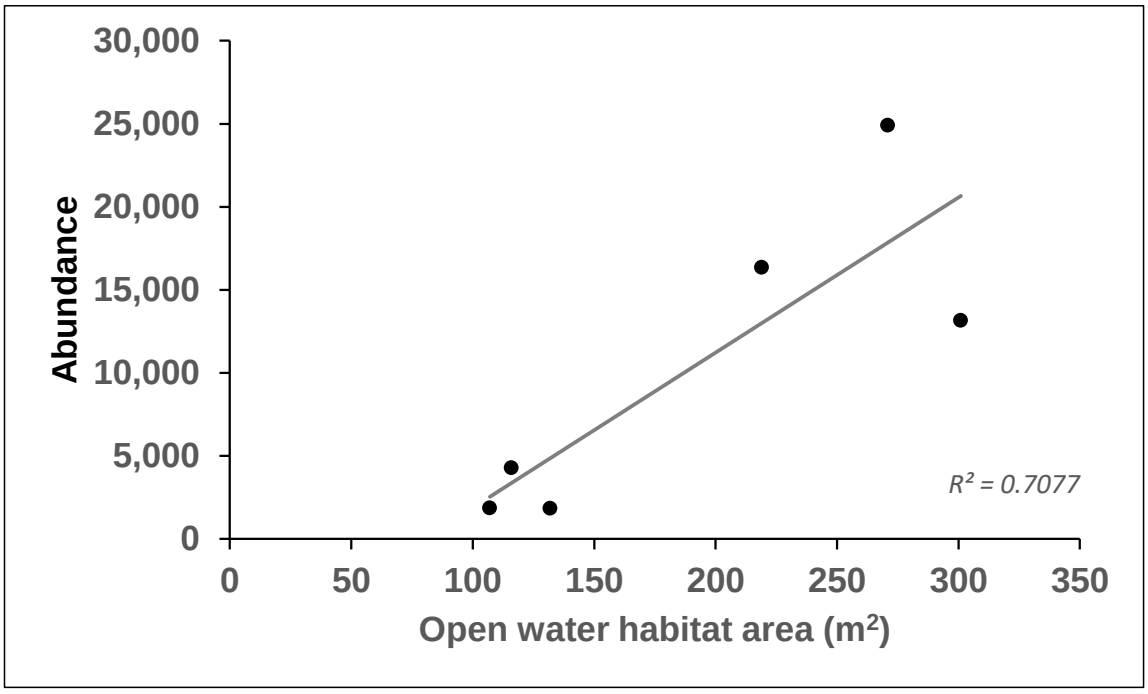

Figure 3. The relationship between Foskett Speckled Dace abundance and open water habitat area at Foskett Spring, 2012 – 2017. Figure from Scheerer et al. (2017). Open water habitat was defined as standing water >0.05m deep.

ACKNOWLEDGEMENTS

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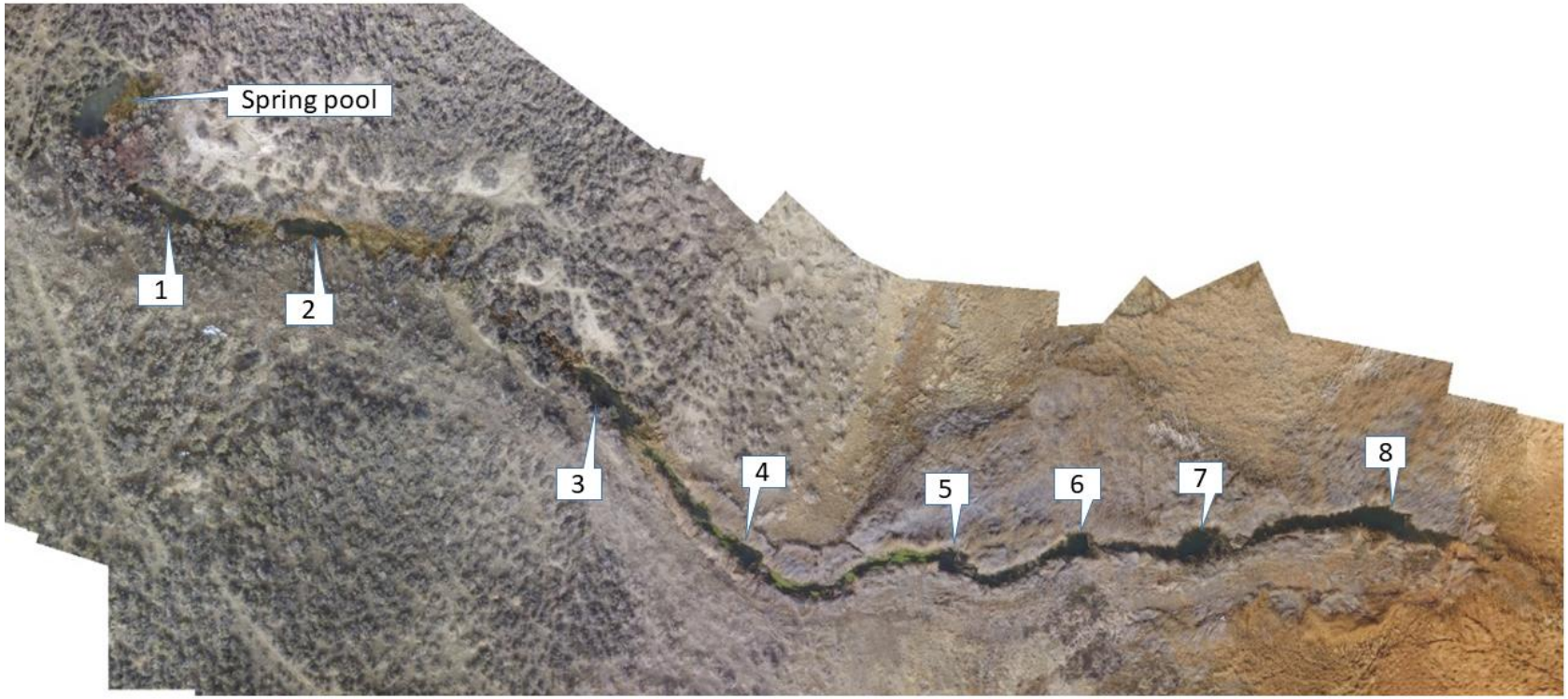
APPENDIX



Appendix Figure 1. Orthophoto of Foskett Spring taken in November 2017 showing location of mechanically excavated pools. Pools 1-3 were in the spring brook and pools 4-8 were in the tule marsh.

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