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2011 Foskett Spring Speckled Dace Investigations

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Photograph showing minnow traps set at the north pond at Dace Springs.

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INTRODUCTION

Speckled dace (*Rhinichthys osculus*) are geographically widespread throughout the western United States and occur in many isolated subbasins and interior drainages in south-central Oregon. The Foskett Spring speckled dace (*R. osculus* ssp.) is represented by a single naturally-occurring population that inhabits Foskett Spring (Figure 1) on the west side of Coleman Lake (Warner Lakes Basin) in Lake County, Oregon. Foskett speckled dace were listed as threatened under the federal Endangered Species Act in 1985 (U.S. Fish and Wildlife Service 1985). The Foskett speckled dace became isolated in Foskett Spring at the end of the Pluvial period (9,000-10,000 years ago). 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). A second population in Dace Spring, located approximately 0.8 kilometer south of Foskett Spring, was established from an introduction of 100 fish from Foskett Spring in 1979-1980 (Williams et al. 1990); however this population eventually failed due to lack of successful recruitment. In 1987, the U.S. Bureau of Land Management (BLM) acquired, through exchange, a 65 hectare parcel of land containing Foskett and Dace Springs. Both sites were fenced to exclude livestock. In 2009, BLM and USFWS completed a habitat restoration project that created two spring-fed pools at Dace Spring. In 2010, Oregon Department of Fish and Wildlife (ODFW) introduced 49 dace from Foskett Springs into these ponds (24 in the north pond and 25 in the south pond).

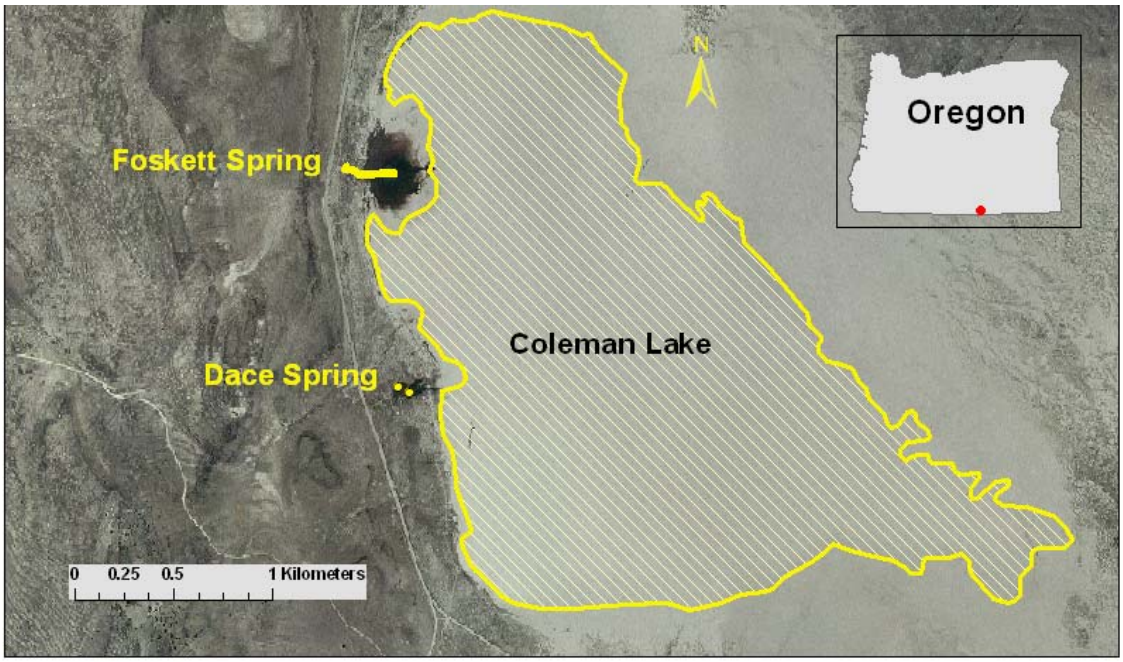

Figure 1. Map showing the location Foskett and Dace Springs in the Warner Valley of south central Oregon.

The Recovery Plan for the threatened and rare native fishes of the Warner Basin and Alkali Subbasin states that Foskett speckled dace will probably not be delisted in the near future because of its extremely isolated range and potential for degradation of its

habitat from localized events (U.S. Fish and Wildlife Service 1997). The primary recovery objective for this species is long-term persistence through preservation of its native ecosystem. The plan further states that the conservation and long term sustainability of this species will be met when: 1) long-term protection of its habitat, including spring source aquifers, springpools 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 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 dace population and habitat conditions, and evaluating long-term effects of climatic trends on recovery of this fish population.

The purpose of this investigation was to determine the status of the federally listed Foskett Spring speckled dace and its habitat at Foskett and Dace Springs. This report updates monitoring initiated by ODFW in 2005 (Scheerer and Jacobs 2005; 2007; 2009) by providing results of monitoring conducted in 2011. Specifically, this monitoring program calls for bi-annual estimates of population abundance, assessments of distribution and demographic parameters, and assessments of physical habitat conditions.

METHODS

The ODFW's Native Fish Investigations Project used baited minnow traps to obtain a mark-recapture population estimate of Foskett Spring speckled dace at Foskett and Dace Springs. We fished baited traps during the day for ~3-4 hours. Following capture, all fish that were >25 mm TL were marked with a partial caudal fin clip and returned to the water. Fish were returned to the approximate location where they were captured. The following day, we again fished the traps and recorded the total number of marked and unmarked fish captured. Following capture, all fish <25 mm TL were enumerated and released near the location where they were captured We estimated population abundance using single-sample mark-recapture procedures (Ricker 1975). We calculated 95% confidence intervals using a Poisson approximation (Ricker 1975). Population estimates were also obtained for each of the four distinct habitat areas at Foskett Spring (Figure 2). We measured total length (TL) on a sample of 139 and 34 fish collected at the Foskett and Dace springs, respectively.

RESULTS

We obtained a population estimate of 751 (95% CI: 616-915) speckled dace at Foskett Spring on 27 July 2011. This estimate was significantly lower than the 2005, 2007, and 2009 estimates ($p<0.05$) (Table 1). We estimated there were approximately equal numbers of dace in the spring pool, spring brook, and tule marsh; no dace were captured in the cattail marsh. All abundance estimates obtained since 2005 at Foskett Spring are significantly lower than the 1997 estimate ($\hat{N}$ = 27,787, with 26,881 in the cattail marsh) (Dambacher et al. 1997).

We obtained population estimates of 14 (95% CI: 14-14; i.e. all 14 marked fish were recaptured and no unmarked were captured on the recapture date) and 20 (95% CI: 11-36) specked dace at the north and south ponds at Dace Spring, respectively. Survival of individuals introduced in 2010 was 69 percent. We found evidence of limited recruitment (juvenile dace) in the South Pond and captured one adult dace at the spring head, which had exited one of the ponds and moved upstream in the shallow channel. Many of the adults handled in July 2011 had swollen abdomens (fecund?). In 2011, we transferred 25 and 50 additional specked dace from Foskett Spring into the north and south ponds, respectively.

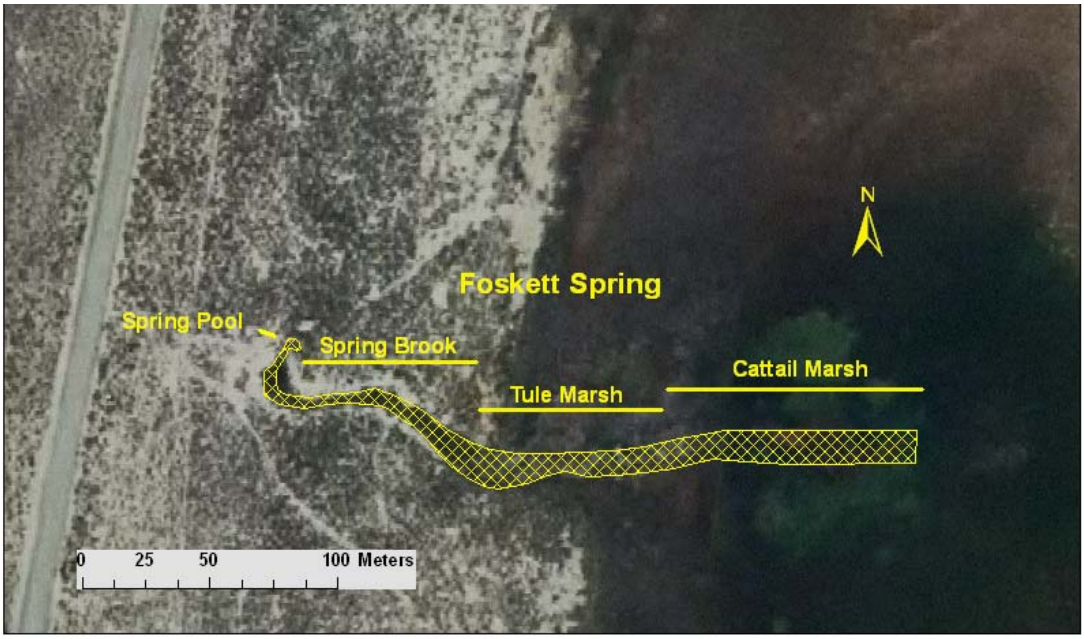

Figure 2. Map showing the extent of distinct habitat areas at Foskett Spring.

Table 1. Mark-recapture population estimate details for Foskett Spring speckled dace, 1997, 2005, 2007, 2009, and 2011. Note: site estimate totals were calculated from total numbers of marks and recaptures and are not a sum of the estimates for the distinct habitat areas.

Location	1997	2005	2007	2009	2011
Spring Pool	204 (90 - 317)	1,627 (1,157 - 2,281)	1,418 (1,003 - 1,997)	247 (122 - 463)	322 (260 - 399)
Spring brook	702 (321 - 1,082	755 (514 - 1,102)	719 (486 - 1,057)	1,111 (774 - 1,587)	262 (148 - 449)
Tule Marsh	not sampled	425 (283- 636)	273 (146 - 488)	1,062 (649 - 1,707)	301 (142 - 579)
Cattail Marsh	26,881 (13,158 - 40,605)	353 (156-695)	422 (275 - 641)	158 (57 - 310)	0
Entire Site	27,787 (14,057 - 41,516)	3,147 (2,535 - 3,905)	2,984 (2,403 - 3,702)	2,830 (2,202-3,633)	751 (616 - 915)

The 2011 abundance estimate at Foskett Spring includes dace ranging from 25-71 mm TL. Length-frequency analysis suggests the presence of multiple age-classes, with two apparent peaks (Figure 3). The presence of fish $\leq$ 25mm in all four sampling years suggests that successful reproduction occurs annually. A comparison of the size distribution of dace collected in 2011 at Foskett and Dace Springs is presented in Figure 4; the Dace Spring size distribution was skewed towards larger individuals, relative to the Foskett Spring distribution. This suggests there has been limited recruitment and growth of translocated individuals in the novel habitat.

Habitat conditions at Foskett Spring have changed steadily since 2005, with a large reduction in open-water in all habitat areas, resulting from the expansion of rooted aquatic macrophytes at the site. This has been especially notable in the downstream tule and cattail marshes. Habitat conditions at Dace Spring have changed little since 2009, with the exception of occasional algal blooms.

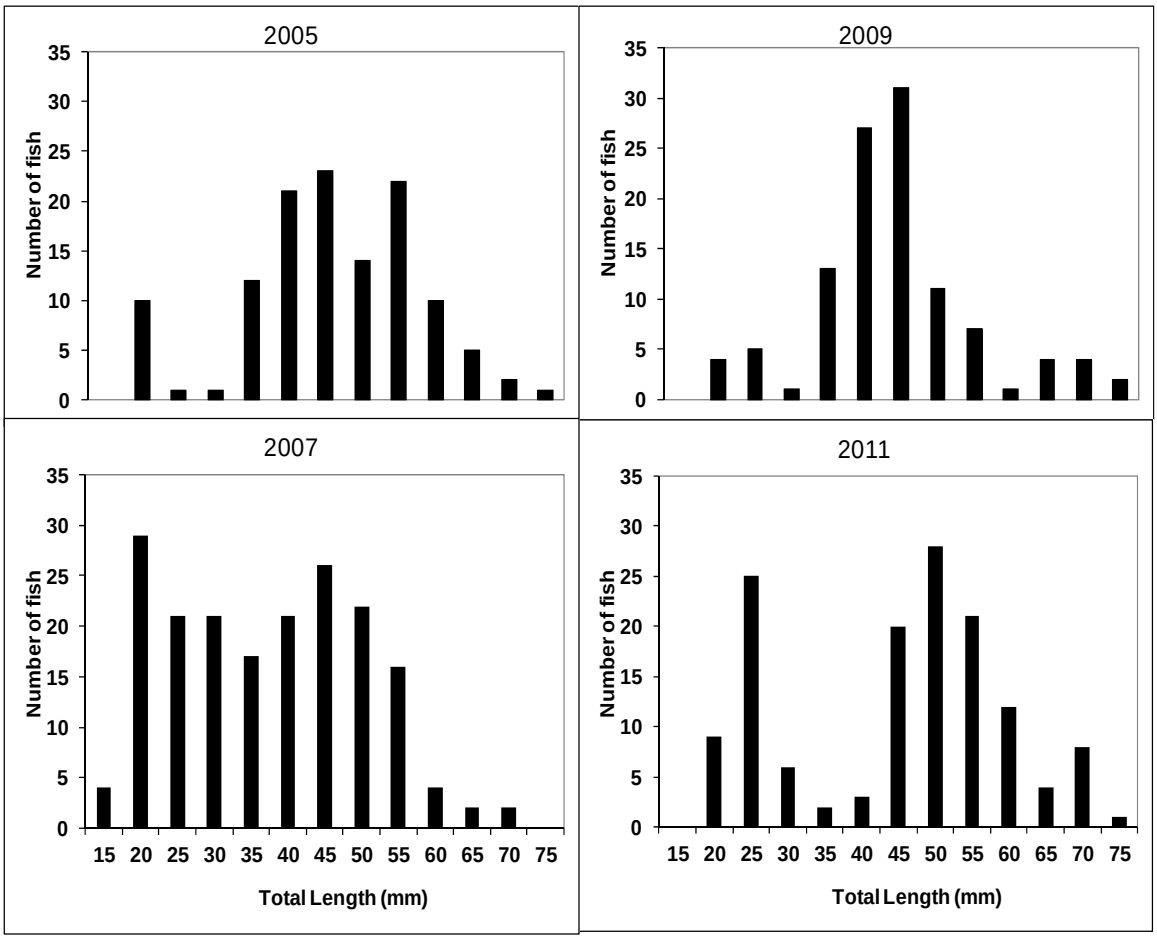

Figure 3. Length-frequency histograms for Foskett Spring speckled dace, 2005, 2007, 2009, and 2011.

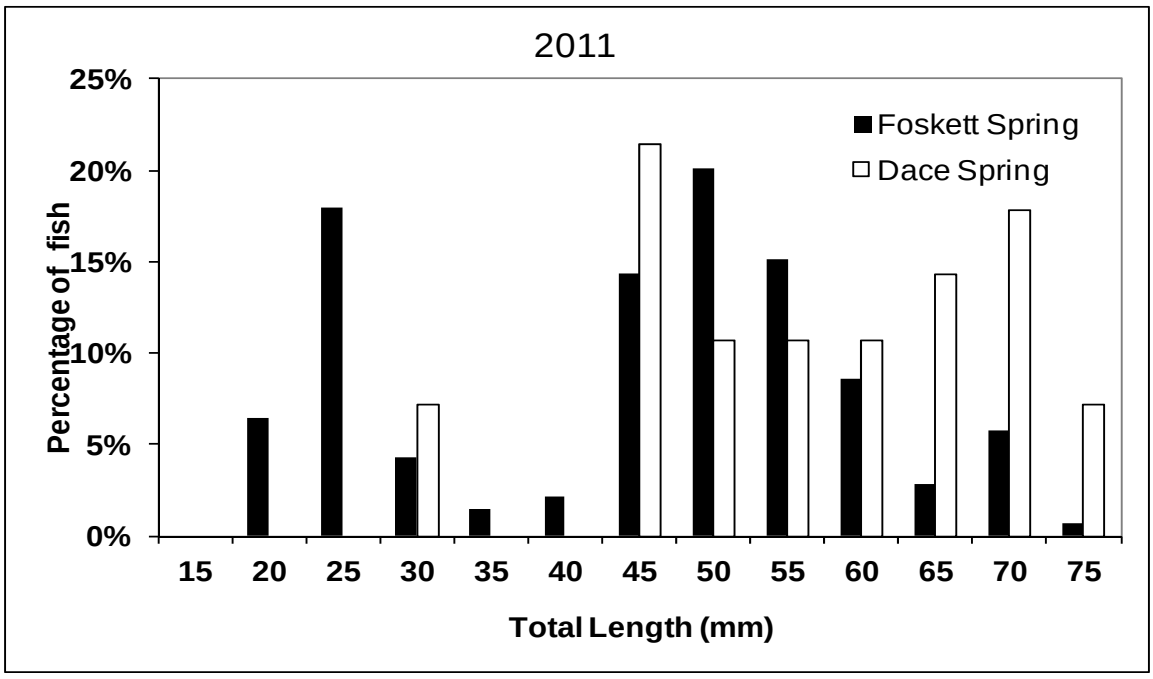

Figure 4. Length-frequency histograms for Foskett Spring speckled dace collected in 2011 from Foskett and Dace Springs.

DISCUSSION

The populations of the federally listed Foskett Spring speckled dace at Foskett and Dace Springs were monitored in 2011; abundance at Foskett Spring was found to have declined substantially in the past two years. Examination of length-frequency data indicated that multiple age-classes were present and provided evidence of recent recruitment. Dace were the only fish species found to be present and the fish appeared to be in good condition with no obvious external parasites. We documented approximately 70% survival of the fish introduced into Dace Spring and found evidence of recent recruitment and fish movement among habitats.

With the assistance of Dr. Jim Peterson, Oregon State University, we examined a subset of the mark-recapture data from previous years in program MARK, using the closed captures option, and found heterogeneity in capture and recapture probabilities both within and between years. This heterogeneity generally resulted in underestimation of population abundance when using the Lincoln-Petersen estimator. However, the decline in abundance from 2005 through 2011 was still evident in the adjusted estimates. In 2012, we propose to conduct a trial experiment to examine factors that may be affecting differences in (re)capture probabilities from year to year and to examine the effects of this heterogeneity on our abundance estimates. We plan to include additional capture events and also examine relationships between body size and capture probability.

At Foskett Spring, encroachment by aquatic macrophytes since the habitat was fenced has substantially reduced the open-water habitat, which appears to be limiting the dace population. After springs are fenced and livestock removed, desert spring ecosystems can experience increases in aquatic vegetation, reduction of open-water

habitat, and reduction of fish populations (Kodric-Brown and Brown 2007). Initially, the population declined substantially between 1997 and 2005, as vegetative encroachment eliminated open-water habitat in the cattail marsh. Since 2005, substantial vegetative encroachment in the tule marsh and spring pool has occurred, and the population has declined even further.

The U.S. Fish and Wildlife Service's Foskett Specked Dace 5-Year Review (U.S. Fish and Wildlife Service 2009) recommended assessing encroachment by aquatic vegetation at Foskett Spring and developing a restoration plan and regular maintenance schedule to increase and maintain suitable open-water habitat for Foskett speckled dace. We recommend mechanical removal of aquatic vegetation from the spring pool and spring brook and the use of controlled burns to reduce biomass in the tule and cattail marshes at Foskett Spring in the near future. Controlled burns can be an effective management tool to reduce vegetative biomass, restore open water, and increase plant diversity in desert spring habitats (Kodric-Brown et al. 2007).

Additional recommendations from the 5-Year Review included: 1) collecting key life history information including population age structure, age and size at maturity, longevity, and spawning timing and duration, 2) assessing the restoration potential at Dace Spring and evaluating the feasibility of a Foskett speckled dace transplant effort, and 3) developing a long-term management and monitoring plan (U.S. Fish and Wildlife Service 2009). The Dace Spring restoration project was completed in 2009 and dace were introduced in 2010 and 2011. It is still too early to assess the success of this restoration project. A proposal to initiate a study to collect the life-history information was submitted in 2008 by Dr. Markle, Oregon State University, but remains unfunded. We initiated an ageing validation study in 2010, but were unable to detect the oxytetracycline mark on five exposed individuals; we will need to repeat this study using a longer exposure time and/or higher dosage (M. Terwilliger, personal communication). The current protocols that we use to monitor fish populations and spring habitats could easily be incorporated in the long-term management and monitoring plan. We recommend development and implementation of this plan within the next one to two years.

A recent genetic analysis has called into question the taxonomic status of the species (Ardren et al. 2010). Specked dace from the Warner Basin, including those from Foskett Spring, were found to be closely related, but showed signs of recent isolation from each other. Levels of genetic divergence observed between dace from Foskett Spring, compared to other dace from the Warner Basin, were in the range typically observed between populations belonging to the same species. Preliminary findings from a geographic, taxonomic, and phylogenetic analysis of speckled dace from Foskett Spring and adjacent basins (K. Hoekzema, Oregon State University, personal communication) also suggest that Foskett specked dace are closely related to other Warner speckled dace. Foskett Spring and other Warner stream dace grouped together when morphometric characters were analyzed using canonical variate analysis. In addition, Foskett dace did not form a distinct monophyletic unit (i.e., Foskett dace did not form a separate group, but were instead interspersed among fish from the Warner Basin) when preliminary phylogenetic trees were developed based on nuclear and mitochondrial sequences. Completion of this study will help resolve Foskett Spring speckled dace's taxonomic status, which could ultimately affect their listing status.

ACKNOWLEDGEMENTS

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