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# Rainbow Trout Redd Locations in Cleopatra Creek and Iron Creek, Lawrence County, South Dakota, USA

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**Abstract**

*For this study, rainbow trout (Oncorhynchus mykiss) redd surveys were conducted on two tributaries of Spearfish Creek, Lawrence County, South Dakota, USA. A 1.16 km stretch of Cleopatra Creek and a 1.88 km stretch of Iron Creek were surveyed weekly from 29 March through 26 April 2024. No redds were observed in Iron Creek. The first redds (eight in total) were observed in Cleopatra Creek on 19 April with 17 additional redds observed on 26 April. A total of 25 rainbow trout redds were documented. This is the first and only study to document rainbow trout redd locations and the timing of rainbow trout redd construction in any Black Hills stream.*

## 1. INTRODUCTION

Rainbow trout (*Oncorhynchus mykiss*) were first introduced to the Black Hills of South Dakota, USA in the early 1900s (Barnes 2007). Brown trout (*Salmo trutta*) were first introduced in 1890 and dominate Black Hills streams (Barnes 2007; Cordes 2007). They have since become naturalized and self-sustaining, leading to dramatic decreases in stocking (Erickson & Koth 2000; James 2011; Keintz 2016). Natural reproduction of rainbow trout in Black Hills streams typically does not occur, except in isolated instances (James 2011; Davis et al. 2013; Kientz 2016). There is a small population of self-sustaining rainbow trout in Spearfish Creek, Lawrence County (Cordes 2007; James 2011).

Rainbow trout spawning in the Black Hills occurs in the spring, typically in March and April for four weeks (Becker 1983; Cordes 2007). Like other salmonids, rainbow trout create gravel nests, or redds, for egg deposition (Becker 1983; Holecek & Walters 2007). The location of a redd in a stream is dependent upon stream morphology, substrate, water depth, and water velocity (Holecek & Walters 2007; Marchildon et al. 2012). Redd data can be used to assess trout populations (Meffe 1986; Konkel & McIntyre 1987; Pratt 1992; Weaver 1992; Rieman & McIntyre 1996) for example location and number of redds may be useful in assessing environmental impacts of changes in water flows or temperatures (Warren et al. 2012). However, Holecek and Walters (2007) suggested caution in using redd counts to estimate the number of spawning rainbow trout.

Cleopatra Creek, a tributary of Spearfish Creek, is located approximately 14 km upstream from the city of Spearfish, South Dakota. Electrofishing surveys indicated the presence of brook trout (*Salvelinus fontinalis*), rainbow trout, and brown trout in Cleopatra creek (SDGFP 2016). In addition, there is a small population of self-sustaining rainbow trout in Spearfish Creek suspected to use Cleopatra Creek to spawn (Cordes 2007; James 2011). Iron Creek is a further-upstream tributary of Spearfish Creek, approximately 19 km upstream from city of Spearfish (Hoogestratt 2011). The most recent electrofishing survey indicated that 95% of the fish sampled were brown trout and 3% were rainbow trout (SDGFP 2020). While rainbow trout have never been documented spawning in Iron Creek, anecdotal information suggests this may be occurring.

Studies seeking and documented rainbow trout redds in the Black Hills of South Dakota have not been conducted. In fact, only one previous study has examined rainbow trout spawning, focusing on spawning-related movement patterns in Spearfish Creek using radio transmitters (James 2011). In this study a small number of rainbow trout were observed moving into Cleopatra Creek during the typical spawning period (James 2011). Thus, the objective of this study was to provide initial observations on redd formation, redd numbers, and timing in the Cleopatra and Iron Creek tributaries of Spearfish Creek.

## 2. METHODS AND MATERIALS

### 2.1 Study Areas

The study area consisted of two tributaries of Spearfish Creek, Cleopatra Creek and Iron Creek. Both streams are located in the Northern Black Hills of Lawrence County, South Dakota, USA (Figure 1). The Cleopatra Creek study reach began at its confluence with Spearfish Creek (44.401275° N 103.894586° W) and ended approximately 1.16 km upstream. The Iron Creek study reach began at its confluence with Spearfish Creek (44.373458° N 103.919114° W) and ended approximately 1.8 km upstream.

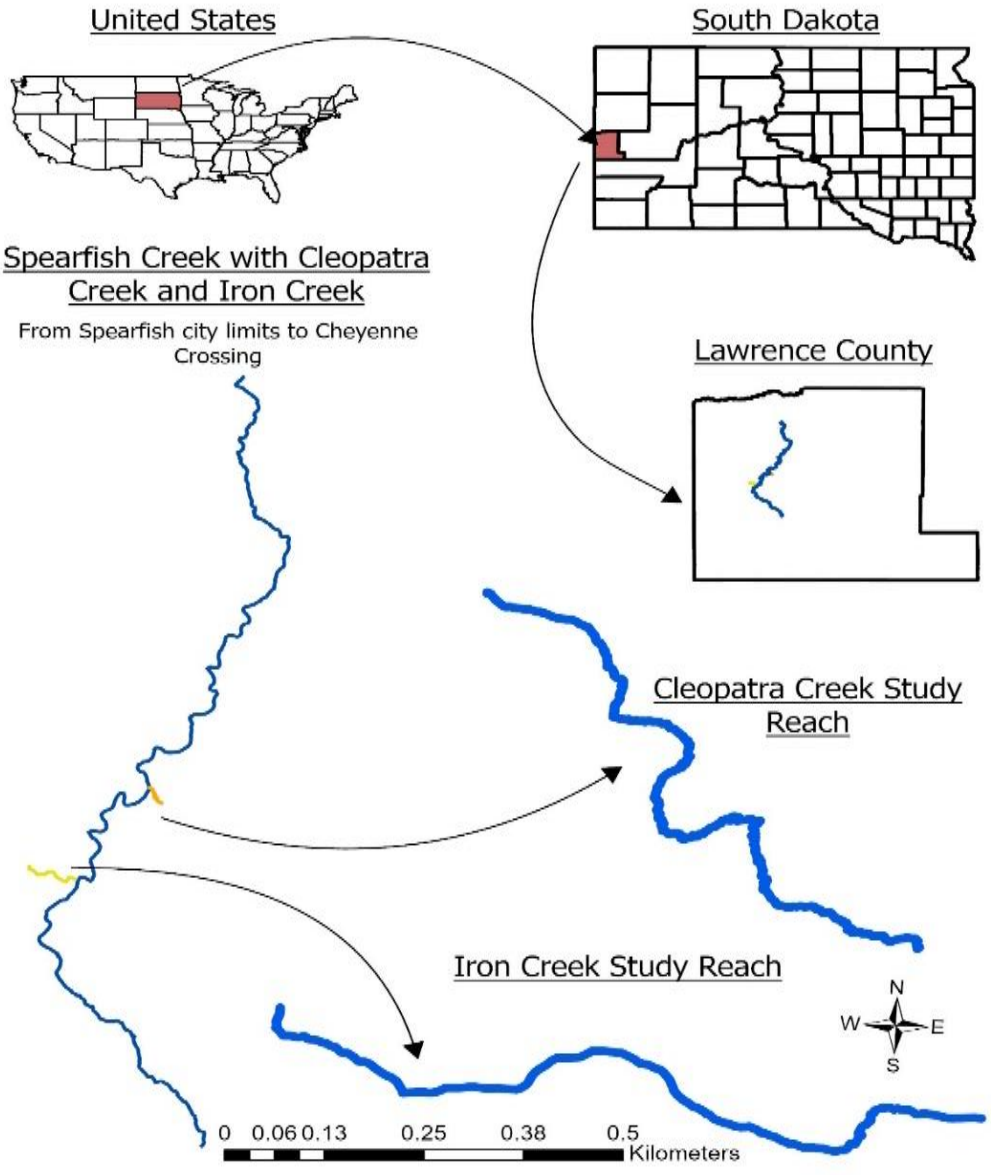


**Figure 1.** Location of Cleopatra and Iron Creeks in Lawrence County, South Dakota, USA.

Both historic and current gold mining operations are upstream in the Cleopatra Creek watershed, with minimal impacts on stream water quality (Rahn et al. 1996; DANR 2020). Cleopatra discharge during the study ranged from approximately 0.113267 $m^3/s$ to 0.339802 $m^3/s$ (USGS 2024).

Iron Creek lays in a narrow canyon consisting of Paleozoic and Cenozoic-aged rocks with igneous quartz latitic intrusive beneath the creek (Hoogestraat 2011). Classification of Iron Creek is an intermittent stream characterized by seasonal flows from precipitation and groundwater (United States Environmental Protection Agency 2013).

### 2.2 Redd Identification and Location

Redd surveys began on 29 March 2024 and ended on 26 April 2024. Redd observations took place weekly, with redd location data collected with a Global Position System unit (Geo 7X Trimble, Westminster, California, USA). Redd identification was determined by techniques described previously (Gallagher et al. 2007). As expected, redds varied in size and condition and were loosely defined as the presence of a clear pit and overturned substrate that formed a mound and/or a clear tail. Redd locations were recorded each week, including redds that may have been repeats of observations from prior weeks.

## 3. RESULTS

Redds were only observed in Cleopatra Creek; no redds were observed in Iron Creek. The first redds (eight in total) were observed in Cleopatra Creek on 19 April with an additional 17 redds observed on 26 April (Table 1, Figure 2). A total of 25 rainbow trout redds were documented.

**Table 1.** *Weekly and cumulative rainbow trout redd numbers in 2024 from Cleopatra Creek, Lawrence County, South Dakota, USA.*

| Date | New | Cumulative |
|---|---|---|
| 29 March | 0 | 0 |
| 5 April | 0 | 0 |
| 12 April | 0 | 0 |
| 19 April | 8 | 8 |
| 26 April | 17 | 25 |

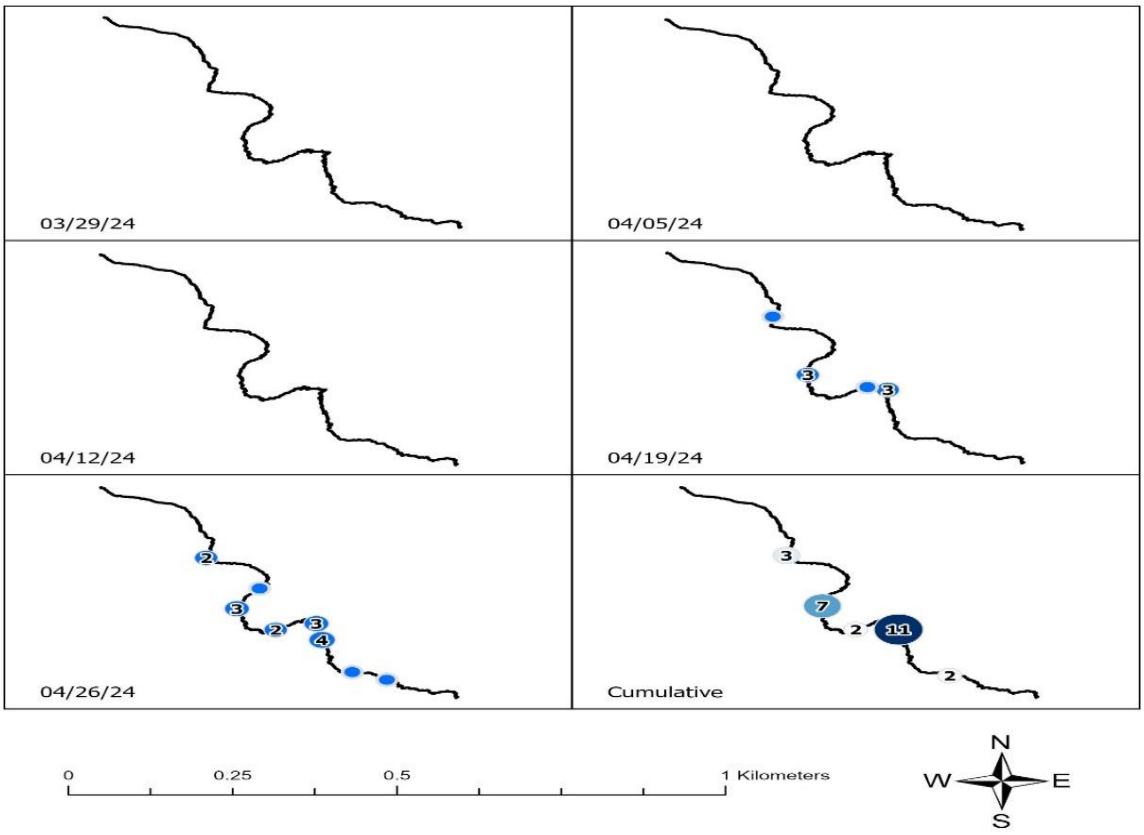


**Figure 2.** Location and number of rainbow trout redds overtime in Cleopatra Creek, Lawrence County, South Dakota, USA.

## 4. DISCUSSION

This study is the first to document rainbow trout redd locations in any stream in the Black Hills. It also confirms the suggestion by James (2011) that rainbow trout were attempting to use Cleopatra Creek for reproduction. Similar to the presumed spawning movements observed by James (2011), rainbow trout spawning in Cleopatra Creek occurred in May and April. Only two other studies have suggested that rainbow trout are potentially reproducing in other Black Hills streams. Naturally-reproduced rainbow trout were observed in Deerfield Reservoir, with spawning presuming to occur in the inlet streams Castle Creek and South Fork Castle Creek (Davis 2013; Kientz 2016). No redds were documented in either of these creeks however.

Rainbow trout spawning in the Black Hills occurs later in the year than spawning in their native range. In California, rainbow trout spawn from early December to early April with peaks in early January to late February (Giovannetti 2007; Hannon & Deason 2008; Schaefer et al. 2019). However, rainbow trout outside of their native range at similar latitudes in Wisconsin and Idaho spawn from late March to early May (Orcutt et al. 1968; Holecek & Walters 2007; Schleppenbach 2023). Rainbow trout spawning durations in the Black Hills are likely shorter than the four-month durations in native ranges (Giovannetti 2007; Schaefer et al. 2019; Hannon & Deason 2008). Although the spawning duration in this study cannot be conclusively determined because the observations did not occur long enough to observe a decline, spawning in similar latitudes as the Black Hills lasted approximately one month (Orcutt et al. 1968; Schleppenbach 2023).

The rainbow trout redd densities in Cleopatra Creek were observed at approximately 22 redds/km. This is considerably greater than the densities of 7.4/km, 12.2/km, 11.6/km reported from streams in the native range of rainbow trout (Hannon & Deason 2008). Rainbow trout redd densities in Cleopatra Creek are much less than those reported for brown trout in other streams in the Black Hills. The number of rainbow trout redds in Cleopatra are lower than brown trout redd studies downstream in Spearfish Creek reporting 84-to-91 redds/km (Martling et al. 2020; Robidoux et al. 2022). However, the 22 redds/km reported in this study are more than the 6 redds/km reported for brown trout in Black Hills streams (Blaine et al. 2017; Weavill et al. 2024). Wide variation in redd densities have been reported for brown trout in their native range as well (Zimmer & Power 2006; Youngson et al. 2011; Gortazar et al. 2012). Lower densities in Iron Creek and Crow Creek may be because of heavy sedimentation, lower water velocities, and differences in stream morphology and substrate size. (Martling et al. 2020; Robidoux et al. 2022; Weavill et al. 2024). Similarly, densities in Cleopatra Creek may be lower due to differences in water quality.

Redd superimposition, when a female trout deposits eggs in a previously excavated redd, can be both intraspecific and interspecific. While superimposition was not observed in this study, it was not explicitly measured. Probable redd superposition in the Black Hills has been reported previously (Blaine et al. 2017; Martling et al. 2020). However, in Iron Creek, a small tributary of Spearfish Creek similar to Cleopatra Creek, Weavill et al. (2024) reported no superimposition. Superimposition is likely because of trout homing behavior, altered creek substrates, or other non-habitat related reasons (Essington et al. 1998; Frank et al. 2012; Gortazar et al. 2012). Because Cleopatra Creek is very narrow and short, the likelihood of superimposition is increased (Togaki et al. 2023), although no superimposition was observed.

This study was conducted for one spawning season and may not be indicative of spawning activities in different years or conditions. Also, because new redds were observed on the last day of the study, spawning may have continued. Lastly, the inexperience of the redd observer may have also impacted the results (Gallagher et al. 2007).

This study serves as a baseline for redd numbers and locations in Cleopatra Creek, allowing potential subsequent counts to provide information on rainbow trout population dynamics. Redd counts can be used to estimate salmonid populations (Meffe 1986; Konkel & McIntyre 1987; Pratt 1992; Weaver 1992; Rieman & McIntyre 1996; Elliot & Hurley 1998) and are a relatively inexpensive alternative to electrofishing typically used for population monitoring (Meffe 1986; Konkel & McIntyre 1987; Pratt 1992; Weaver 1992; Rieman & McIntyre 1996). Redd location data can also assess environmental changes (Warren et al. 2012). Thus, the results of this study may be used for comparison in future redd

counts to evaluate any changes in stream condition or the effects of any potential future stream restoration or habitat improvement projects (Barlaup et al. 2008; Mundahl & Schnaser 2023).

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