Movement of Catchable Rainbow Trout after Stocking in Rapid Creek

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By

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PREFACE

The data and summaries presented in this report were collected in 2005. Copies of this report and references to the data can be made with permission from the authors or the Director of the Division of Wildlife, South Dakota Department of Game, Fish and Parks, 523 E. Capitol, Pierre, South Dakota, 57501-3182.

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EXECUTIVE SUMMARY

Angler expectations and attitudes towards their pastimes direct fisheries managers towards efficient and cost-conscious practices. The stocking of trout for anglers use has been remotely studied in various ways. Determining the return to the anglers via tagged or marked fish has been one past effort. This study utilizing radio-transmitters to study stocked rainbow trout in a South Dakota creek was an effort in understanding trout resources after leaving the hatchery.

Five major points can be ascertained from this report:

- Initial movement of trout appears to be dependent on flow.
- Overall total movement of trout averaged 205 meters.
- By stocking trout at bridge crossings, much of the fishable portion of Rapid Creek can be populated with trout when movement potential is taken into account.
- Trout movement occurred in three different scenarios and included the fish finding apparent preferred areas (pools or runs), yet some individuals ventured from these areas in an apparent random fashion.
- Stocking levels of 0.14-0.31 fish per lineal meter of stream appears to be adequate for establishing a fishery for South Dakota anglers.

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

Two Rapid City entrepreneurs first introduced trout into the Black Hills of South Dakota in 1886. Scott and Hughes made the long arduous journey via horse drawn wagon across the open prairie from Colorado to the Black Hills. The purpose of introducing these trout to the naturally modest ichthyofauna of the Black Hills was to provide a sport fishery to attract tourists to the area (Barnes in press). Since the first introduction of trout to the Black Hills and the establishment of local state run hatcheries, information detailing the outcome of stocking these fish is limited. This is especially true for those trout stocked into area streams.

Available habitats for fisheries in the Black Hills consist of perennial streams, seasonal streams, large reservoirs, small impoundments and beaver ponds. Large amounts of information has been gathered about these areas from lake or stream surveys. Except for stream and lake surveys, specific studies on naturally produced trout are limited. Studies concerning hatchery trout are also limited in the same regard except with the addition of occasional creel surveys. Traditional survey methods were recently interjected with new techniques such as radio-telemetry.

Telemetry studies involving the movement of salmonids in freshwater systems have occurred for many years. Several studies to determine the possible influences to trout movements have been performed. Gowan et al. (1994) found that the majority of studies concluded that stream fishes were sedentary with relatively small home ranges. Yet later studies have questioned this principle of limited movement (e.g., Smithson and Johnson 1999). Movement of fish beyond that predicted by the “restricted movement paradigm” might be from a number of factors including individual differences within the population. It has been assumed that in a population, there exists two types of behavior, sedentary and long-range movers and that an individual may switch between the two behaviors (Northcote 1992 and Gowan et al. 1994).

Other factors such as species difference and if the fish was naturally produced may be involved in aspects of trout movement. Wild brown trout (*Salmo trutta*) appear to quite restricted in their movement patterns. Wild produced brown trout were studied in regards to the effects of storm water runoff and their movement patterns (James 2003). It was found that brown trout only made slight movements during storm events in an urban setting. The major movement of wild brown trout seemed to be related to spawning activity. Rainbow trout (*Oncorhynchus mykiss*) have also shown a variety of movement patterns. Mellina et al (2005) determined that two distinct cycles of rainbow trout movement existed in British Columbia streams. Low flows, encountered during the summer months, were the main factor influencing the movement of trout. Both the wild brown trout and the rainbow trout study indicated that long distance movement might be associated with spawning activity. These studies were

performed with naturally produced populations. Hatchery fish may perform differently than their wild counterparts in regards to movement patterns.

The purpose of this study was to determine the extent to which hatchery rainbow trout move after stocking. In this particular instance, how much would a strain of highly domesticated rainbow trout move after stocking. Many studies utilizing radio-telemetry technology involve the use of "wild" fish. Fewer have delved into the movement patterns of hatchery fish after stocking. One study indicates that there was significant movement out of the area by hatchery rainbow trout when stocked in an area with a resident trout population (Bettinger and Bettoli 1999).

Rapid Creek was chosen due to a unique stocking pattern that developed. Historically, Rapid Creek was stocked with rainbow trout from Cleghorn Hatchery. In the early 1990's this practice was discontinued, as adequate wild fish populations and size classes of brown trout existed in the creek. Stocking efforts were reexamined as the wild trout populations significantly dropped throughout a portion of Rapid Creek. The exact cause of the drop is not certain; however, the presence and extent of the diatom, *Didymosphenia geminata*, may have had an influence on trout survival. It has been noted by department personnel that a large extent of what was first described as "toilet paper" was later identified as *Didymosphenia*. In some places of Rapid Creek the presence of this diatom is so great that thick mats (as much as 7.5cm {3-inches} in depth) are covering virtually all of the streambed (Jack Erickson, pers. comm.). One theory proposed by biologists, involves the diatom restricting the insect life that would be available to trout. Without the food source, trout would then be limited in regards to their food supply, thus reducing condition of fish. Trout in poorer condition would therefore have a worse competitive edge and thus succumb to various mortality events.

Objectives of this study

1. Determine movement patterns of rainbow trout after stocking in two sections of Rapid Creek
2. Determine any restrictive movement patterns of stocked catchable rainbow trout
3. Evaluate effects of flow and how this parameter influences trout movement post stocking
4. Determine appropriate stocking levels in these two portions of Rapid Creek in order to establish a fishable population in regards to dispersion from the stocking site

Figure 1. Map detailing the study sections of Rapid Creek where rainbow trout were tracked via radio telemetry and area of limited fishing access identified.

SAMPLING METHODS

Study Area

Two stocking sections in Rapid Creek were chosen for this study. These areas were identified as they have not received hatchery fish for several years. The first section starts above Canyon Lake (in Rapid City) and continues to Dark Canyon. McGee Siding is the next section starting point and continues to Johnson's Siding. In the case of these two Rapid Creek sections, one large area is not accessible to anglers due to remoteness and private landholdings and therefore has not been stocked by SDGFP (Figure 1). This area was thus excluded from stocking and from the tracking of fish in this study. Local anglers and biologists note these areas as the last bridge in Dark Canyon and continuing to below Hisega. Four locations were identified and received the stocking of transmitter trout along with the normal stocking of rainbow trout (Figure 1). Other stocking locations were made during the period but did not include transmitter fish.

The total distance of section 3 (Canyon Lake to Dark Canyon) and section 4 (McGee Siding to Johnson's Siding) was 6,181 and 12,830 meters, respectively. In 2005, the stocking of trout in these two sections of Rapid Creek totaled 1890 fish in section 3 and 1800 fish in section 4. These data represent a concentration of 0.31 and 0.14 fish per linear meter of stream for these two sections.

Recent stream surveys have shown a dramatic reduction in overall trout presence, especially of larger or catchable sized trout (Daniel James, pers. comm.). The reduction of the wild component of these populations may have been influenced by the presence of the diatom *Didymosphenia geminata* (Didymo). Mats of Didymo, in some case covering the entire streambed have been noted in many of these reaches (Jack Erickson, pers. comm.). The impact of the presence of Didymo in these concentrations has not been determined; however, the presence of the increase in Didymo directly correlates to the timing of the decline in large trout. Due to the decline of the catchable trout in these sections of creek, stocking of catchable rainbow trout from Cleghorn Springs State Fish Hatchery (CSSFH) was decided upon for recreation purposes.

Surgical implantation of transmitters

Rainbow trout raised to 280mm (11-inch) at CSSFH were surgically implanted with radio transmitters via the shielded needle technique as described by Ross and Kleiner (1982). This process was utilized due to past experience of technique and poor success with other techniques available (Petering and Johnson 1991). Transmitters were kept below the 10.4% body weight limit in order to limit poor swimming performance (Adams et al 1998). Experimental fish were tagged with individually numbered "floy-tags" so that they could be identified at the time of stocking. All transmitter fish were kept in the hatchery for

a period of at least 21-days to comply with regulation (FDA) of MS222 (Tricaine Methanesulfonate) used as an anesthetic during transmitter operation. The holding period also allowed for full recovery from the surgical procedures. All instruments and transmitters were sanitized and fish anesthetized according to the Animal Welfare Act (1985 Amendment) as described by Mulcahy (2003).

Stocking of trout and recovery of transmitters

Trout implanted with transmitters were stocked in an identical fashion as their "non-transmitter" counterparts. Customary stocking of trout from South Dakota coldwater hatcheries occurs at stream access points. A small stocking trailer pulled with a All-Terrain Vehicle is used for stocking fish in more remote or traditionally inaccessible areas. Many times these access points are bridge crossings where a "net full" of fish is dropped into the water. The fish with transmitters were tracked three times a week for a period of at least three weeks. After the three-week period, recovery of the transmitter fish was attempted with backpack electrofishing equipment. In some instances, transmitter fish moved into deep pools and recovery of the transmitters was not deemed cost effective.

Movement of trout

Trout were tracked three times a week via the radio frequency produced from the transmitter. The approximate location of the fish was determined using triangulation techniques. A location of the fish was determined along the stream edge and the coordinates marked with the use of a Trimble Geo3 GPS unit. Longitudinal movement patterns were the emphasis of this study and as such, triangulation of the individual fish's lateral position was not determined. Individual transmitter frequencies were kept separate for analysis purposes. Direct movement patterns of individual trout were used in analysis. In the instances where transmitters were not found in the fish, the last upstream movement was considered as the final location point.

Analysis of movement patterns

Trout were identified as to their individual position along the stream course. Daily and total distances were measured after data was incorporated into ArcInfo (GIS). Distances of trout movement were compared to the areas that hatchery trucks were likely to stock trout. The areas of trout stocking were determined from aerial photographs of the stream sections. General patterns of movement were determined for the release patterns during high and low flow periods.

RESULTS & DISCUSSION

Fish Movement Patterns

Overall Trend of Fish Movement

Rainbow trout from CSSFH exhibited a variety of movement patterns after stocking. Some fish remained closely associated to the stocking point, whereas other individuals searched out other areas. Of those fish that migrated out of the immediate stocking area, a general observation was that they moved to a pooled area or run section and remained in that area for the duration. Few fish remained in high flow areas for a period of more than a few days. The importance of a variety of habitats was apparent as the pool and runs were primary locales for residing fish, whereas the riffle or higher flow areas are places of primary productivity (Hynes 1970).

High Flow Period

Flow releases from Pactola Reservoir were higher in the first tracking period than the second (Figure 2). Fish were exposed to flows of over 100 cubic feet per second (CFS) during the first tracking period. A general trend of fish habits during this period showed that trout immediately moved in a downstream fashion after release. In only a few cases did trout remain closely associated to their release location. In one case a trout did move upstream after the release during the high flow period.

Lower Flow Period

Fish exhibited a much different movement pattern during lower flows than that of the high flow period. A general trend consisting of movement in an upstream fashion was observed during the lower flow period. Once upstream, these fish established themselves in either a pool or run environment. Fewer fish remained in or directly around the original stocking locale during the low flow period. If the fish were forced out due to competition for habitat from fish stocked previous is not known.

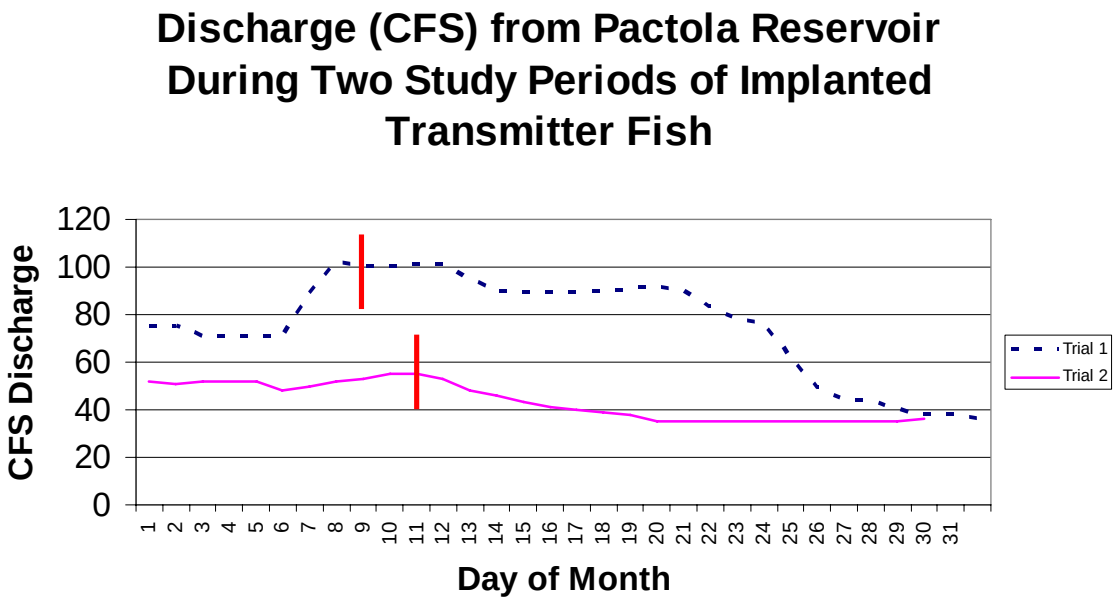

Figure 2. Flow measurements from Gauging station below Pactola Reservoir during July and September, 2005. July data is noted with the dashed line in trial 1 and September data is noted with the solid line in trial 2.

Restricted Movement Patterns

General Trend of Movement Patterns

The overall trend of fish movement during this study showed fish in one of three categories. Fish were either those that stayed somewhat close to their original stocking location, moved either upstream or downstream to a pool or run stretch and established themselves, or established themselves in a pool or run stretch and made rather significant short term movements only to return to their original occupied area.

Unique Movement Patterns

A movement pattern that was observed in only a few cases is similar to that represented in the restricted movement paradigm. The specific case of transmitter "#492" exhibited such a pattern (Figure 3). In one situation an individual moved from, what appeared to be a preferred pool area, to distant only to return to the original pool. On July 22, 2005, this fish was located in a pool where it had resided for nearly two weeks. Just two days later "#492" was located 438 meters upstream of the pool where it had previously resided. Two days following this movement, "#492" had returned to the same pool where it had originally started.

The cause of an animal to search out new areas is not entirely clear. Certainly, an advantage of exploring new areas enables a species with the ability to become established in different locales. The ability of a few individuals to move in areas not yet established or even those individuals that seem to have wandering abilities seems to correlate with attempts of genetic changes such as the founder effect (Mayr 1942). In this regard, the whole of the population stays somewhat stable in the population dynamics, yet some individuals are able to search out and explore new potential sites to spread out the genome and start new populations. This works out to a competitive advantage for the species as only a few individuals run the risk of not finding a new area, are lost, or run a higher risk of predation when traveling through unfamiliar territory.

Fish Stocking Implications

Distance Trout Moved vs. Stocking Locations

The average total distance that trout moved during this study was 205 meters. This distance, when compared to "normal" stocking patterns (i.e. at bridge crossings) were compared for overlap (Figures 4 and 5). This information reveals that for many locales in Rapid Creek, stocking at bridge crossings is sufficient for the distribution of fishes throughout most of the stream. Trout once stocked demonstrated the distribution capacity across the stream section. The limited scope of this study did not allow for long-term migration patterns such as that seen during spawning events; however, the immediate movement of trout throughout the system does indicate that few if any special stocking locales need to be established (i.e. stocking across private property).

In the case of these two Rapid Creek sections, one large area is not accessible to anglers and therefore has been an area not currently stocked by SDGFP (Figure 1). The area starts below Hisega and continues downstream until the upper bridge in the area known as Dark Canyon. Much of the "non-stocked" area is remotely located with difficult access and other areas severely restricted due to private land holdings. This non-stocked area has traditionally received little attention except for the occasional fish survey (McGee Siding, RAP15, 1993, 1994, 1995). Trout were not tracked with radio-telemetry in this area due to the same access issues noted above.

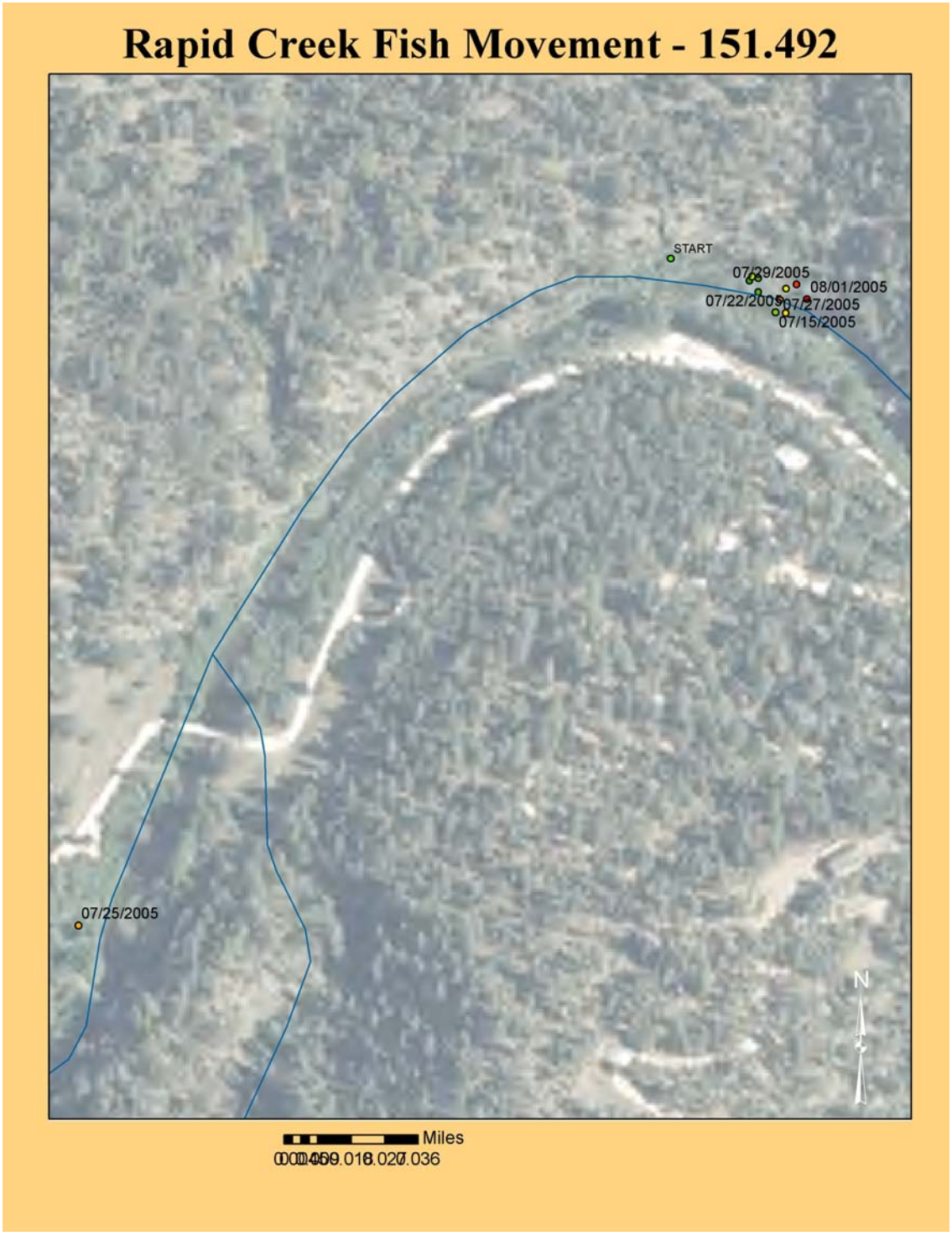

Figure 3. Movement pattern by date exhibited by rainbow trout with transmitter #492 depicting similar responses to the restricted movement paradigm.

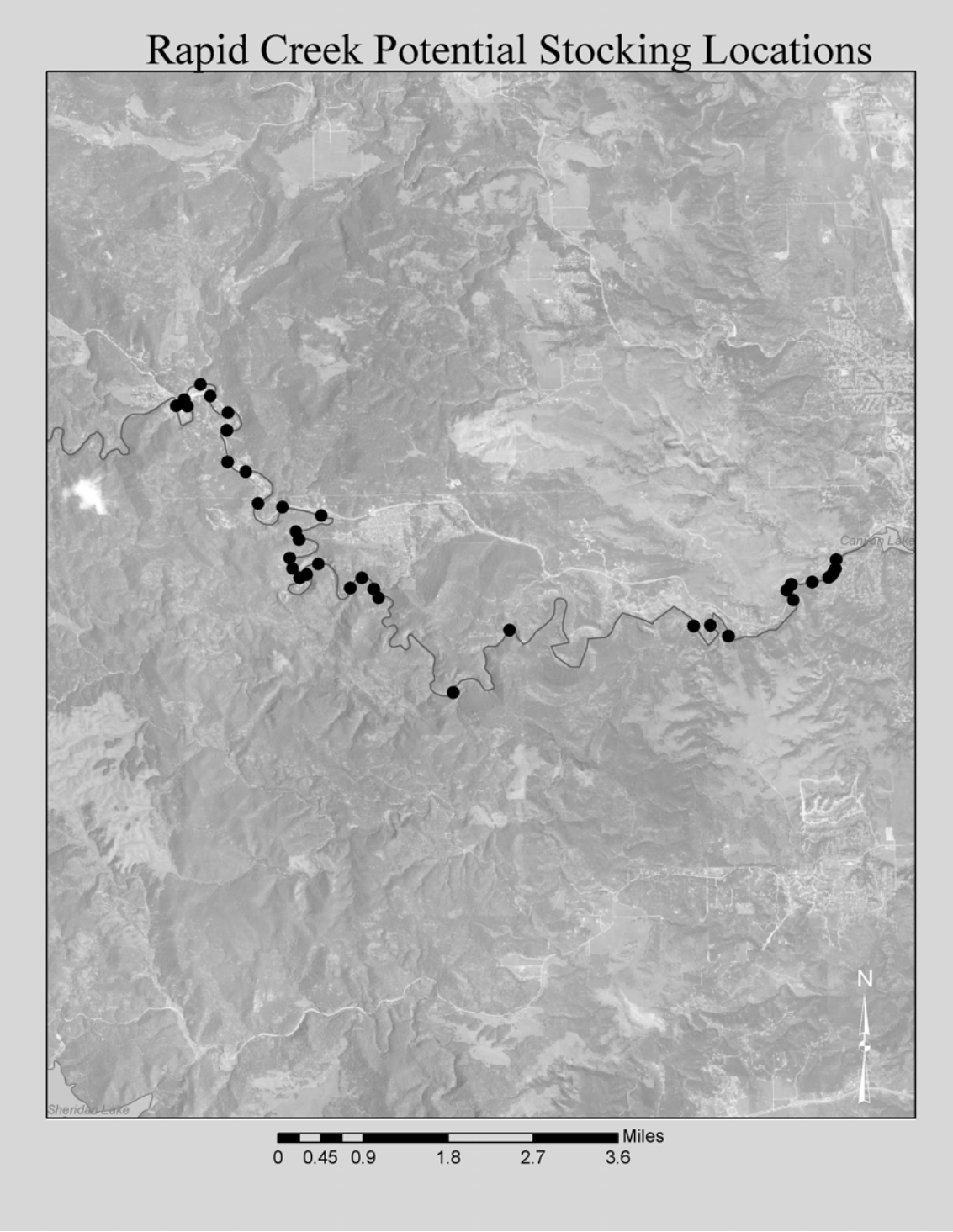

Figure 4. Potential trout stocking locations identified from Johnson Siding to Canyon Lake.

Figure 5. Potential stocking locations from Johnson Siding to Hisega with overlay of the 205 meter buffer for movement of trout out from these points.

Fish Stocking Level Concerns

The number of fish stocked into waters is dependent on a number of factors. First, survival of the fish after stocking and angler utilization are two important facets that continually need to be evaluated. Secondly, when anglers harvest fish the replacement or remaining fish must be at adequate numbers to allow for reasonable success to the angler during subsequent attempts. In the case of reservoirs, Black Hills fisheries managers now utilize angling satisfaction as a measure of adequate fish presence. Surveys of stream fishermen in the Black Hills have been unreliable in representing any measures from creel surveys due to the low number of completed angler interviews.

Past-recommended stocking levels have been derived from a variety of sources. In some cases, fisheries managers have determined stocking rates by considering harvest levels, stream surveys, reports of lack of fish from Conservation Officers, landowners, and hatchery personnel or from the "more is better" philosophy. The overabundance of fish in stream situations has also been used to fine-tune the stocking regime as well. Hatchery personnel, due to their contact with the resource while stocking fish, have been invaluable in this regard. The return of transmitters by the public is yet another avenue that may be used to determine the overall usage of these resources.

Eighteen total trout were tracked with radio-transmitters during this study. Out of these fish, five were returned by anglers or were determined to have been harvested by biologists. These data calculate to a harvest rate of 28 percent of those fish followed. These data indicate that there were sufficient trout available to the anglers and that they were being harvested in numbers that require stocking at similar levels. The lack of complaint from any sources also indicates that the stocking regime is adequate for the restocking of trout in the studies sections of Rapid Creek. The unbiased account of the recovery and return of transmitters by anglers may be another tool used to determine if stocking levels are adequate for the fishery.

RECOMMENDATIONS

1. Utilize results gathered in this study and apply them to the stocking of fish in these two sections of Rapid Creek. In Rapid Creek, trout moved a total of 205 meters over a three-week period. If barriers do not exist, stocking of trout to reestablish a fishable population across the stream at whole should occur every 500 meters of stream length.

2. Before stocking of trout into these sections of Rapid Creek, the flow of water out of Pactola Reservoir should be noted as a general trend on flow and fish movement was observed. These observations indicate that flows upwards of 90 CFS seemed to immediately push fish downwards and lower flows (below 60 CFS) allowed for more upstream movement.

3. Stocking levels of trout in these sections of Rapid Creek appear to be adequate. Replacement fish, those left over after one fish is harvested, are available to the anglers at the current levels. Stocking levels of trout in Section 3 (Canyon Lake to Dark Canyon) should approximately be 0.31 fish/linear meter of stream. Stocking levels in Section 4 of Rapid Creek (McGee Siding to Johnson's Siding) should approximately be 0.14 fish/linear meter of stream.

4. The use of transmitter fish and the retrieval or return by anglers is an alternative method for determining use of the resource.

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