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North Platte River - Miracle Mile Programmed Creel Survey, 2009

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Abstract

A programmed creel survey was conducted at the Miracle Mile reach of the North Platte River from late March – October, 2009 to determine fishing pressure, catch and harvest rates, angler residency, and tackle use. Bank anglers were counted by a roving creel clerk and anglers were interviewed and given creel cards if they were not done fishing for the day. Data from the 2009 creel survey were compared to data from previous creel surveys conducted at the Miracle Mile. Anglers fished an estimated 19,062 hours from April – October, 2009, which was the lowest estimate ever reported in Miracle Mile creel surveys. The management objective catch rate of 0.6 fish/hour was not met in 2009 and had not been met in seven of eight Miracle Mile creel surveys conducted 1978-2001. Angler catch rates for both rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta)* were highest in the fall and lowest in spring. Regression modeling indicated that rainbow trout catch rates were positively correlated with the number of Miracle Mile-stocked rainbow trout and variations in spring flows from Kortes Dam two years prior to creel surveys. Overall trout catch rates were correlated with the number of Miracle Mile-stocked rainbow trout. Brown trout catch rate models did not identify significant relationships with Kortes Dam flow, flow variations, or Pathfinder Reservoir water storage. Recommendations include redefining the catch rate objective for the fishery, conducting spot creel surveys in 2012-2014, stocking the Miracle Mile with 100,000 Firehole River rainbow trout, and evaluating movements of Pathfinder Reservoir-stocked fish into the Miracle Mile.

Introduction

The North Platte River from Kortes Dam to Pathfinder Reservoir is known as the Miracle Mile (Figure 1). Although the length of river in this section depends on the water level in Pathfinder Reservoir and can vary from 6 to 12 miles in length, it is defined for management purposes as the 7 miles between Kortes Dam and the Sage Creek confluence. The Miracle Mile is a blue ribbon trout fishery and supports over 1,400 trout per mile (Table 1). Rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) are the dominant game fish species, but cutthroat trout (*Oncorhynchus clarkii ssp.*) and walleye (*Sander vitreum)* are present in low numbers. The public may access the length of both banks of the Miracle Mile through an extensive network of roads. Although there are no established boat ramps for float access,

numerous comfort stations, campsites, and picnic areas are available. Miracle Mile is subject to creel and possession limits of three trout, one of which may exceed 16 inches.

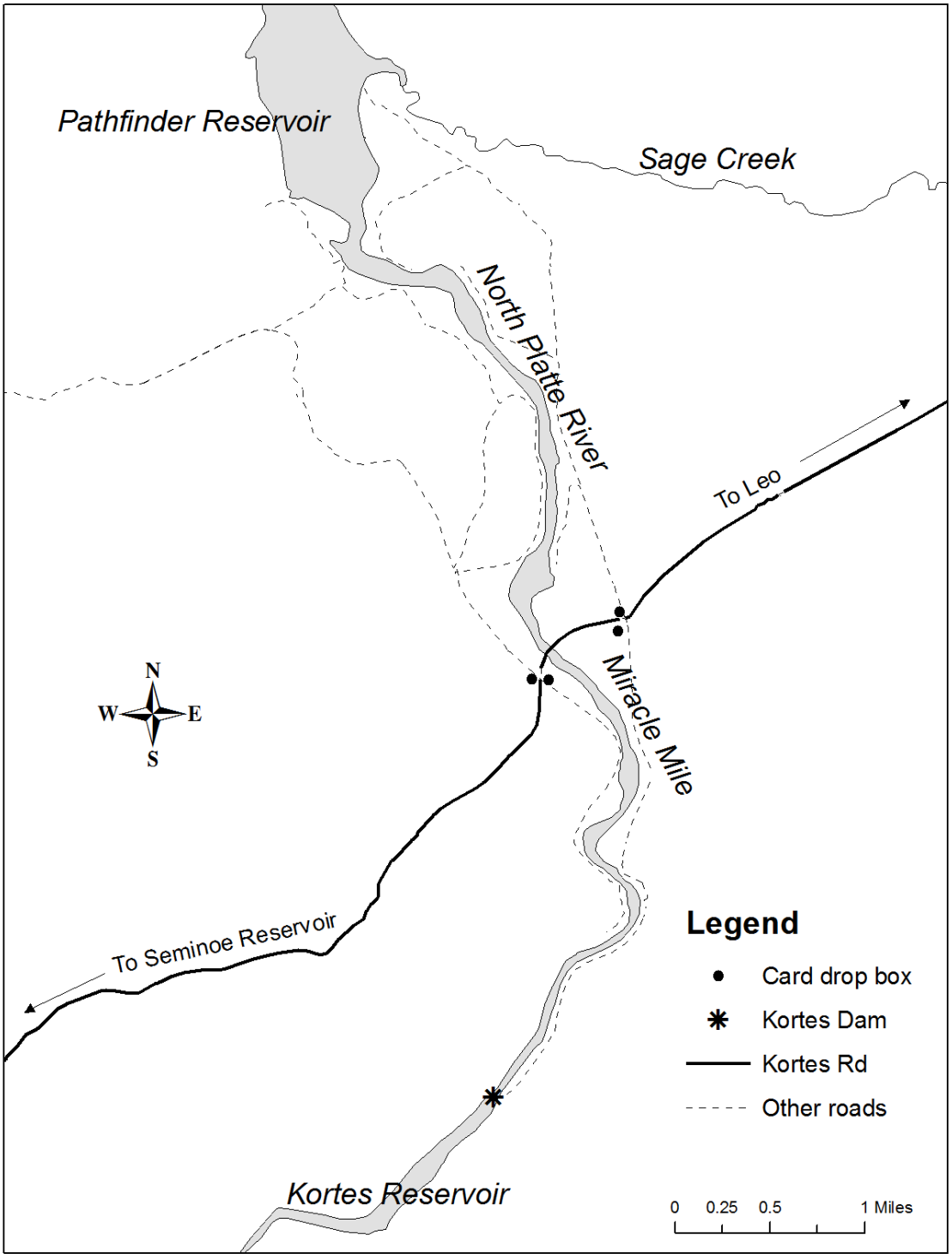

FIGURE 1. Map of the Miracle Mile

TABLE 1. Miracle Mile population and standing stock estimates for brown trout (BNT), rainbow trout (RBT), and all trout (TRT). Standard errors are in parentheses. Mark-recapture estimates were generated by raft electrofishing.

Species	Year	Number/mile	Pounds/mile
BNT	2009	878 (123)	655 (72)
	2008	1,175 (214)	616 (52)
	2006	1,505 (191)	677 (50)
	2004	575 (136)	429 (32)
	2002	841 (60)	858 (51)
	2000	735 (143)	662 (95)
	1998	2,953 (387)	1,205 (107)
	1996	3,409 (235)	2,248 (152)
	1995	3,719 (549)	2,920 (314)
	1993	1,378 (192)	2,811 (323)
RBT	2009	2,045 (431)	1,420 (103)
	2008	2,508 (422)	947 (80)
	2006	1,022 (139)	652 (41)
	2004	818 (176)	852 (72)
	2002	758 (85)	1,013 (51)
	2000	920 (106)	1,350 (137)
	1998	1,278 (166)	1,662 (142)
	1996	947 (179)	1,003 (165)
	1995	793 (136)	1,407 (199)
	1993	192 (75)	419 (132)
All Trout	2009	2,924 (448)	2,075 (125)
	2008	3,683 (473)	1,563 (96)
	2006	2,527 (235)	1,329 (62)
	2004	1,437 (229)	1,266 (75)
	2002	1,650 (98)	1,959 (98)
	2000	2,342 (200)	3,360 (235)
	1998	4,460 (423)	3,341 (198)
	1996	4,356 (295)	3,251 (225)
	1995	4,513 (566)	4,327 (372)
	1993	1,570 (207)	3,230 (349)

Natural trout reproduction is limited in the Miracle Mile. Because it is a tailwater, no new spawning gravels are recruited. Congress established a minimum flow of 500 cfs in the Miracle Mile in 1971. However, releases from Kortes Dam can vary from 500 to over 2,000 cfs over the course of a day to meet hydroelectric demands. These variations affect spawning and juvenile

trout habitat in the Miracle Mile (Zafft and Vogt 1992) and have been linked to declines in trout standing stocks (Mavrakis 2002, WGFD 2008). Pathfinder Reservoir water levels may affect spawning habitat in the lower Miracle Mile by inundating spawning gravels during high water years.

The Miracle Mile is managed as a semi-wild, basic yield fishery. Wild brown trout comprise between 30% and 88% of the Miracle Mile trout standing stock in a given year (Table 1). In a 2009 electrofishing survey, 52% of the age-1 RBT were wild fish (WGFD 2009). A significant proportion of rainbow trout stocked into Pathfinder Reservoir swim upstream into the Miracle Mile, probably to spawn (Mavrakis and Yule 1998, Deromedi 2000). Management objectives for this fishery include 1) maintaining at least 1,500 trout per mile, 20% of which exceed 16 inches, and 2) maintaining angler catch rates at or above 0.6 fish per hour. In order to meet these objectives, the trout population requires enhancement through stocking (Mavrakis and Yule 1998). The Miracle Mile has been stocked with between 47,198 and 107,290 rainbow trout annually since 1991 (Table 2). A study evaluating the performance of two rainbow trout strains, Eagle Lake rainbow trout (ELR) and Firehole River rainbow trout (FHR), was conducted at the Miracle Mile from 2005-2009, (Hahn, in review). During this study, fish stocked in the Miracle Mile received strain-specific pelvic fin clips. Forty thousand ELR were given right pelvic clips and 40,000 FHR were given left pelvic clips and stocked each year from 2005-2008. This strain evaluation did not reveal clear differences in the growth, survival, or catchability of the two strains. However, FHR were slightly more abundant in electrofishing surveys. The stocking recommendation from this strain evaluation was 80,000 FHR per year.

Angler creel surveys are a common approach for describing catch rates and species composition of fish caught. When such data are combined with angler counts, this information can be used to estimate angler use, catch, and harvest. Accurate creel information is integral to successful fisheries management (Newman et al. 1997). In Wyoming, creel information has been used to assess angler attitudes (Mavrakis 2002), model the effects of regulations (Gerrity 2009), evaluate the return of stocked fishes (Mavrakis and Yule 1998; Bradshaw 2004), and investigate trends in catch rates over time (Cavalli 2010). Catch rate is an important measure of angler success and is known to influence angler satisfaction with a fishery (Spencer 1993).

Programmed creel surveys were conducted at the Miracle Mile in 1961 (Eiserman 1962), 1973 (Peterson and McMillan 1976), 1978 (WGFD archive data), 1982 (Peterson 1984), 1995-1996 (Mavrakis and Yule 1998), and 2001 (Mavrakis 2002). The 15 month-long, 1995-1996 creel survey was part of a coded wire tagging study that included trout in the North Platte River and reservoirs from the Interstate 80 bridge near Sinclair to the Roberson Road bridge in Casper. In addition to the programmed surveys, spot creel surveys were conducted at the Miracle Mile in 1997, 1998 and 2003.

Anecdotal evidence indicated a decrease in angler numbers at the Miracle Mile in years leading up to 2009. The first objective of this creel survey was to evaluate patterns in angling use and angler success at the Miracle Mile over time. Angler hours, catch rates, proportional angling success (PAS; Bailey 2007), and fish harvest in 2009 were compared to similar data from previous creel surveys. The second objective was to identify factors related to angler catch rates. Such factors that were considered were Miracle Mile trout stocking, discharge from and variations in Kortes Dam discharge, and Pathfinder Reservoir water storage.

TABLE 2. Trout numbers stocked in the Miracle Mile, 1991-2009. Abbreviations refer to Eagle Lake rainbow trout (ELR), Firehole River rainbow trout (FHR), river strain rainbow trout (RRB), Snake River cutthroat trout (SRC), and all trout (TRT).

	ELR	FHR	RRB	SRC	TRT
1991	98,989				98,989
1992	91,692				91,692
1993	103,046				103,046
1994					0
1995			15,180		15,180
1996			10,935		10,935
1997	66,796				66,796
1998	47,198				47,198
1999	50,061				50,061
2000	54,955				54,955
2001	54,990				54,990
2002	107,290				107,290
2003	48,960			47,538	96,498
2004	50,050				50,050
2005	40,018	39,876			79,894
2006	37,224	39,198			76,422
2007	42,756	39,000			81,756
2008	37,950	35,960			73,910
2009	40,789	37,026			77,815
2010		91,214			91,214
2011		86,127			86,127

Methods

A programmed creel survey was conducted at the Miracle Mile from March 17, 2009 to October 31, 2009. The sampling schedule and creel estimates were generated by Kevin Gelwicks, Aquatic Assessment Crew Supervisor, using WyoCreel version 1.63. Potential sampling dates within a month were stratified into weekdays and weekend days, then selected at random within each stratum. Four weekday and four weekend days were sampled each month from April-October. Two days in each stratum were sampled the last two weeks in March.

Angler counts were conducted three times each sampling day by driving along the banks. The starting point (the upstream or downstream end of the reach) for the first count of the day was selected randomly. The observer would start the next count for the day from the opposite end of the reach. Between angler counts, creel clerks conducted angler interviews. Interview data collected included hours fished, whether the angler was done fishing for the day, tackle type, county or state of residence, and the number and species of fish kept or released. Because a only a small number of anglers float the Miracle Mile (e.g., 5% of the use in 2001, Mavrakis 2002), boat angler interviews were lumped in with bank angler interviews in this creel survey. Thus, no

separate estimate of boat angling pressure was attempted. Data from anglers who had been fishing < 0.1 hours when interviewed were not included in pressure or catch rate estimates. However, these data were used to evaluate residency and tackle use. Lengths of creeled fish were recorded to the nearest 0.1 inch and left or right pelvic fin clips were recorded.

Anglers who were not done fishing for the day were given a card to fill out upon completing their fishing day. Information recorded on the card included the date and angler identification number, hours fished, and number of each fish species kept or released. Cards were deposited in one of four drop boxes located at the Miracle Mile or mailed using the postage paid, self-addressed card. Estimates of catch rates, number of anglers, and length of a completed trip from card data were compared to estimates that did not include card data using z-tests of log-transformed data (Thompson et al. 1998). The numbers of completed trips from data with and without cards were compared using χ^2 analysis. For all statistical comparisons, *P*-values less than 0.1 were considered statistically significant.

Comparison to Historical Estimates

The number of angler hours in 2009 was compared to estimates from programmed creel surveys conducted in 1973 (Peterson and McMillian 1976), 1978 (WDFD archive data), 1982 (Peterson 1984), 1995 (Mavrakis and Yule 1998) and 2001 (Mavrakis 2002). These creel surveys were conducted over different lengths of time, so estimates of angler use were standardized to include only data from April-October. Including angler information from creel cards may significantly increase the average length of a completed trip (Mavrakis 2002; this study). Because dividing the estimate of angler hours by the length of a complete trip yields the estimate of the number of anglers, inclusion of card data significantly reduces the estimated number of anglers. Therefore, angler hours was selected as the measure of angler use for comparisons because it is not dependent on whether the creel survey utilized creel cards (2001 and 2009) or did not (1973, 1978, 1982, and 1995). Angler hours in 2009 were compared to estimates from other creel surveys using z-tests. A standard error was not available for the 1982 estimate, so the SE of the mean monthly angler hours estimates was used as a measure of variation in the z-test for this year. The numbers of game fish harvested from April-October in these creel surveys are presented graphically; SE estimates were not available for three out of the six creel surveys, so no statistical comparisons of harvest were attempted.

Mean angler catch rate and proportional angler success (Bailey 2007) were calculated from individual angler interview data collected at the Miracle Mile in 1995, 1996, 1997, 1998, 2001, 2003, and 2009. Individual angler catch rate data from other creel surveys were not available for analyses. Proportional angling success is the proportion of anglers that achieve a given catch rate; for this study the proportion of anglers achieving the Miracle Mile objective catch rate of 0.6 fish/hour (PAS 0.6) was calculated. Some of the creel surveys were conducted over longer periods than others. For example, 1997 creel data was collected January – November, whereas the 2009 survey was conducted late March – October. However, catch rate data could not be standardized as it would significantly reduce sample size in some of the smaller spot creel surveys. Thus, data from all months were used in calculation of mean catch rates and PAS. The PAS 0.6 in 2009 was compared to PAS 0.6 in other years using χ^2 analysis.

Catch Rate Modeling

Multiple regression was used to assess relationships between angler catch rates, environmental variables and fish stocking. Mean individual catch rates for rainbow trout (RBT),

brown trout (BNT), and all trout (TRT) from creel surveys in 1995-1998, 2001, 2003, and 2009 were considered dependent variables. Potential predictor variables were similar to those previously used to predict trout standing stock in the Miracle Mile (Mavrakis 2002; WGFD 2008) and are listed in Table 3. A lag of two years was used for flow variation variables and RBT stocking to ensure that fish recruited to the fishery by the time of the creel survey. Collinearity prevented some variables from being included in all models. For instance, Pathfinder Reservoir storage was significantly correlated with stocked RBT ($r = -0.780$, $P = 0.039$), so Pathfinder storage was not included in the RBT or TRT catch rate models. Candidate models were screened using best subsets regression in the program Minitab (version 15.1, Minitab Inc. 2007). Models were selected based on the statistical significance of the regression coefficients and R^2 values. Residuals from the selected models were analyzed for normality, linearity, homoscedasticity, and outliers.

TABLE 3. Potential independent variables for RBT, BNT, and TRT catch rate models.

Model	Independent Variable	Description
RBT catch rate	Stocked RBT	Number of RBT stocked in the Miracle Mile 2 years prior to the creel survey.
	Apr.-Jun. flow	Sum of maximum daily flow variations (cfs) by month, Nov.-Apr. 2 years prior to the creel survey.
	Yearly discharge	Total Kortes Dam discharge (AF), Jan.-Dec. year of creel survey.
BNT catch rate	Pathfinder storage	Mean monthly water storage (AF), in Pathfinder Reservoir year of creel survey.
	Nov.-Apr. flow	Sum of maximum daily flow variations (cfs) by month, Apr.-Jun. 2 years prior to the creel survey.
	Summer discharge	Total Kortes Dam discharge (AF), Apr.-Sep. year of creel survey.
TRT catch rate	Stocked RBT	Number of RBT stocked in the Miracle Mile 2 years prior to the creel survey
	Nov.-Jun. flow	Sum of maximum daily flow variations (cfs) by month, Nov.-Jun. 2 years prior to the creel survey.
	Yearly discharge	Total Kortes Dam discharge (AF), Jan.-Dec. year of creel survey.

Results

A total of 1,254 angler interviews were conducted, of which174 could not be used for pressure, catch or harvest estimates because the anglers had fished for less than 0.1 hours. Ninety-one percent of anglers contacted were given creel cards. Of the 1,138 creel cards given out, 660 were returned for a return rate of 56.0%. Inclusion of the creel card data led to significantly more completed trips, longer length of a completed tip, and reduced the estimate of anglers by roughly one-half (Table 4). Estimates of angler catch rate with and without card data were not significantly different. Because estimates that included card data probably represent patterns of angler use at the Miracle Mile better than those without card data, only the card data will be discussed for the remainder if this report.

TABLE 4. Comparison of number of anglers (S.E.), number of complete trips, average length of a complete trip (S.E.), and total catch rate estimated with and without card data.

Parameter	**With cards**	**Without cards**	**Test statistic**	***P*-value**
Number of anglers	4,277 (329.44)	8,413 (644.97)	z = -8.78	< 0.001
Complete trips	505	116	χ^2 = 193.04	< 0.001
Length comp. trip (hours)	4.8 (0.20)	3.0 (0.25)	z = 5.04	< 0.001
Catch rate (fish/hour)	0.51 (0.04)	0.46 (0.06)	z = 0.69	0.489

Angler use was highest during May, followed by August and June (Figure 2). Catch rates for TRT, RBT, and BNT were highest in September and October (Table 5). Overall angler catch rate was 0.51 fish per hour, below the objective for the fishery (0.6 fish/hour). April had the lowest RBT catch rate (0.20 fish/hour) and June had the lowest BNT catch rate (0.04 fish/hour).

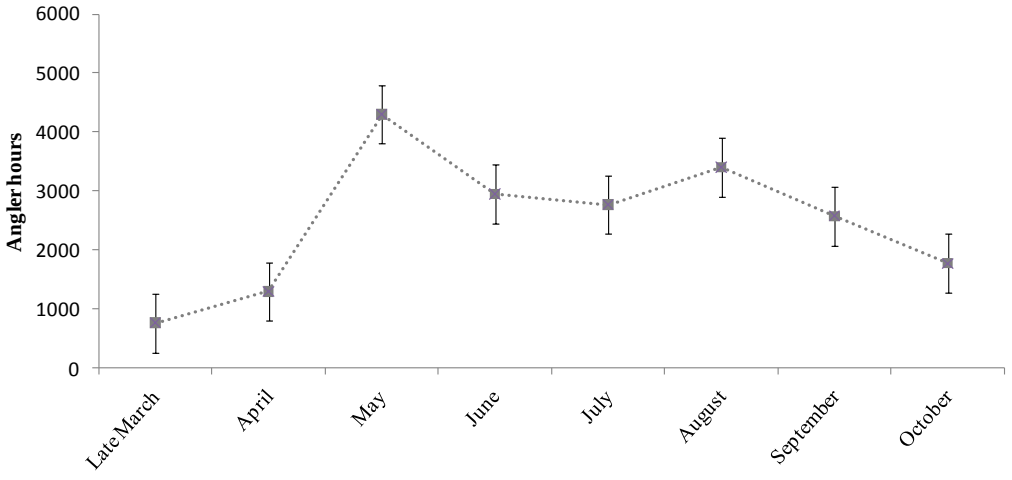

FIGURE 2. Estimated angler hours by month at the Miracle Mile 2009. Error bars represent 1 standard error.

TABLE 5. Catch rates (fish/hour) for trout species at the Miracle Mile by month.

	RBT		BNT		CUT		TRT	
	Catch rate	**SE**	**Catch rate**	**SE**	**Catch rate**	**SE**	**Catch rate**	**SE**
Late March	0.30	0.10	0.10	0.06	0.01	0.01	0.42	0.14
April	0.20	0.08	0.09	0.03	0.00	0.00	0.29	0.11
May	0.28	0.07	0.06	0.02	0.00	0.00	0.34	0.08
June	0.25	0.08	0.04	0.02	0.00	0.00	0.29	0.08
July	0.35	0.09	0.13	0.03	0.00	0.00	0.48	0.12
August	0.43	0.16	0.12	0.05	0.01	0.02	0.56	0.21
September	0.79	0.27	0.18	0.10	0.02	0.00	0.99	0.34
October	0.56	0.27	0.18	0.09	0.00	0.00	0.75	0.35
Total	0.40	0.03	0.11	0.01	0.01	0.00	0.51	0.04

Anglers caught an estimated 10,107 trout, 1,094 (10.8%) of which were harvested (Table 6). Rainbow trout comprised 77.7% of the catch and 77.1% of the harvest. Brown trout comprised 21.0% of the catch and 21.2% of the harvest. Cutthroat trout comprised 1.2% of the catch and 1.7% of the harvest. Creel clerks measured 107 trout (Table 7). Average length of fish measured in the creel survey was 15.6 inches (SD = 2.63) for RBT and 16.6 (SD = 2.07) for BNT. One SRC was measured that was 19.2 inches. Rainbow trout with pelvic fin clips (Miracle Mile-stocked ELR and FHR) comprised 20.6% of all measured trout and 33.8% of the measured rainbow trout.

Of the 1,254 anglers interviewed, 363 (29%) were Wyoming residents and 891 (71%) were nonresidents. Of the nonresident anglers, most were from Colorado (Table 8). Most resident anglers were from Natrona County (52%), followed by Carbon County (12%), and Laramie County (9%). Flies were the most common terminal tackle, followed by bait, and lures (Table 9).

TABLE 6. Estimated catch, catch rate (fish/hour), harvest, and harvest rate (fish/hour) of trout in the Miracle Mile 2009.

	Catch	**Catch rate**	**Harvest**	**Harvest rate**
RBT	7,857 (811.98)	0.40 (0.033)	843 (107.98)	0.04 (0.005)
BNT	2,124 (325.42)	0.11 (0.012)	232 (76.99)	0.01 (0.004)
CUT	126 (54.42)	0.01 (0.002)	19 (16.61)	0.00 (0.001)
Total TRT	10,107 (1041.46)	0.51 (0.037)	1,094 (159.89)	0.06 (0.007)

TABLE 7. Number and percent of harvested trout species and RBT strains measured by creel clerks in the 2009 Miracle Mile creel survey. Unmarked RBT were either wild, stocked in Pathfinder Reservoir, or stocked in the Miracle Mile before 2005.

Species/strain	**Number**	**Percent of total**
BNT	19	17.8
All RBT	87	81.3
RBT FHR	11	10.3
RBT ELR	11	10.3
RBT unmarked	65	60.7
SRC	1	0.9
TRT	107	100.0

TABLE 8. Number and percent of nonresident anglers by state. The 29 states not listed in this table each contributed < 1% to the total number of nonresident anglers.

State	**Number**	**Percent**
Colorado	728	81.71
California	20	2.24
Nebraska	15	1.68
Texas	15	1.68
Minnesota	11	1.23
Utah	10	1.12
29 other states	92	10.33

TABLE 9. The number and percent of anglers using different tackle.

Tackle type	**Number**	**Percent**
Bait	325	25.92
Flies	556	44.34
Lures	203	16.19
Bait and flies	21	1.67
Flies and lures	56	4.47
Bait and lures	72	5.74
Bait, flies, and lures	21	1.67

Comparison to Historical Estimates

Anglers fished an estimated 19,062 hours (SE = 1,569) from April-October 2009. This estimate was less than half of the next lowest estimate, which occurred in 1982 (Figure 3). Angler hours declined 71.3% between the 2001 and 2009 creel surveys. Differences in angler hours between 2009 and all historical creel estimates were statistically significant (z = -9.01-20.91, *P*-values < 0.001). Fish harvest has generally declined over time, with the lowest estimate occurring in 2009.

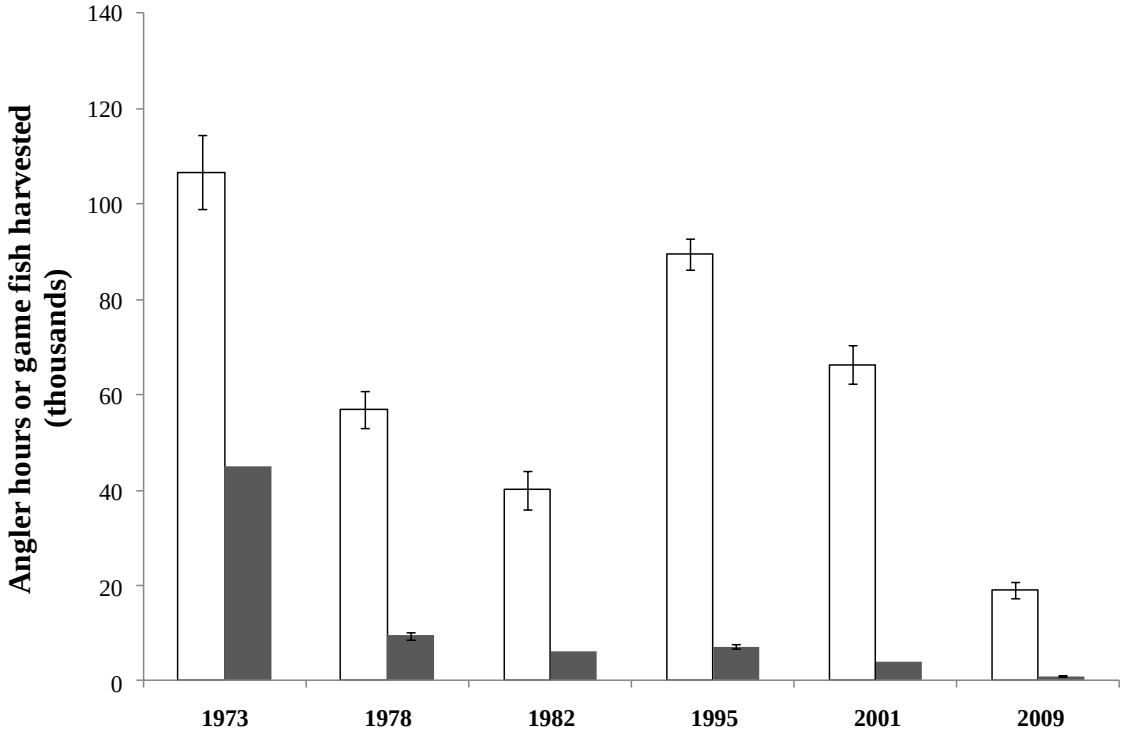

FIGURE 3. Estimated angler hours (white bars) and game fish harvest (black bars) from Miracle Mile programmed creel surveys. Error bars represent one SE.

The proportion of anglers catching the objective of 0.6 fish/hour was 0.25 in 2009 (Table 10). PAS 0.6 ranged from a low of 0.15 in 2003 to a high of 0.32 in 1995. PAS 0.6 in 2009 was significantly higher than 2003, 2001, 1998, and 1997 and significantly lower than 1995. PAS 0.6 in 2009 was not significanly different than 1996. Mean individual catch rate was not significantly different (two sample t-test, t = 1.02, *P* = 0.309) than the statified estimate (catch rate = total fish caught/total hours) calculated by Wyocreel in 2009.

Catch Rate Modeling

No RBT were stocked in 1994 (two years prior to the 1996 creel survey). At least 10,935 RBT were stocked in all other years used in the catch rate modeling. Regression modeling indicated that the 1996 data were outliers in both the RBT and TRT catch rate models. Accordingly, the 1996 data was removed from analysis. Number of RBT stocked two years prior (*P* = 0.001) and April-June flow variations (*P* = 0.003) were significant predictors in the RBT

catch rate model. The equation for the RBT model (adj.R^2 = 0.969, overall model P = 0.003) is RBT catch rate = 0.0713 + 0.000003(RBT stocked) + 0.000018(Apr.-Jun. flow). The best fitting TRT catch rate model (R^2 = 0.816, P = 0.014) included only RBT stocked two years prior. The equation for this model is TRT catch rate = 0.229 + 0.000003(RBT stocked). The BNT catch rate models did not result in statistically significant predictors (P values ≥ 0.467) and had R^2 values ≤ 0.11.

TABLE 10. Catch rates (SE) and PAS (0.6 fish/hour) from creel surveys at the Miracle Mile. PAS in 2009 was compared to other years using χ^2 analysis. Individual catch rate data were not available from the 1978 and 1982 creel surveys, so PAS could not be calculated. Catch rates from 1978 and 1982 were computed using a stratified estimator. Catch rates from the 1995, 1996, 1997, 1998, 2001, 2003, and 2009 are the average of individual angler catch rates.

Year	Number of Interviews	Creel Period	Catch rate	PAS 0.6	χ^2	*P*-value
1978	817	Apr.-Nov.	0.24[1] (0.050)	n/a	n/a	n/a
1982	n/a	Jan.-Dec.	0.26[1] (n/a)	n/a	n/a	n/a
1995	2427	Apr.-Dec.	0.62[2] (0.021)	0.32	19.37	<0.001
1996	1140	Jan.-Nov.	0.49[2] (0.029)	0.24	0.00	0.962
1997	327	Jan.-Nov.	0.31[2] (0.034)	0.18	4.57	0.033
1998	413	Mar.-Nov.	0.28[2] (0.029)	0.16	11.71	0.001
2001	3253	Mar.-Oct.	0.40[2] (0.014)	0.21	5.35	0.021
2003	442	Apr.-Sep.	0.31[2] (0.039)	0.15	17.62	< 0.001
2009	1080	Mar.-Oct.	0.46[2] (0.028)	0.25	------	------

[1]Catch rate computed using a stratified estimator.
[2]Average of individual angler catch rates.

Discussion

In the 2001 Miracle Mile creel survey (Mavrakis 2002), creel cards were found to be an effective and economical way to increase the number of completed trip interviews. The rate of return of creel cards in 2001 was 28%. In 2009 the rate of creel card return was 58%. While the cause for the high rate of return in 2009 is not exactly clear, creel clerks did try to explain the importance of creel data and returning the cards during angler interviews. Also, while two card drop boxes were provided in 2001, four boxes were used in 2009, possibly making card returns more convenient.

Angler use of the Miracle Mile in 2009 was at an all time low. During the coded wire tagging study, the Miracle Mile experienced the highest angler use of the North Platte River reaches that were studied (Mavrakis and Yule 1998). Anglers fishing the Miracle Mile also had the highest catch rate. Angler use tends to increase as angler success increases (Spencer 1993). This may have been the case at the Miracle Mile in the past, but anglers spent less time fishing the Miracle Mile in 2009 than ever before even though catch rates were relatively high. For example, anglers fished only 28.7% of the hours in 2009 compared to 2001, even though PAS

was significantly higher in 2009. Over the same period that angler use has declined at the Miracle Mile, use of the North Platte River downstream of Grey Reef Dam has increased significantly (Bailey 2002; Hahn , in preparation). There were 89,511 angler hours at the Miracle Mile during April-October 1995. During this same period in 1995, anglers fished 33,660 hours below Grey Reef Dam. In April-October 2009 anglers fished more hours below Grey Reef Dam (80,981 angler hours) than at the Miracle Mile (19,062 hours). Thus, it appears that the Grey Reef reach has diverted anglers that would otherwise have fished the Miracle Mile.

The increase in catch and release fishing over the past three decades has resulted in anglers harvesting fewer fish. In the 1978 and 1982 creel surveys, anglers harvested 70% and 60%, respectively, of the fish they caught. By the 1995-1996 creel survey the percentage was down to 12%. In 2009 the percentage was just under 11%.

An average of 77,996 RBT and 2,013 pounds of RBT were stocked in the Miracle Mile annually from 2005-2008. Of the few creeled fish measured during the 2009 creel survey, 20.6% had pelvic fin clips, indicating that they were stocked in the Miracle Mile. Applying the 20.6% to the 10,107 trout caught in 2009, 2,082 of the trout were RBT stocked in the Miracle Mile, resulting in an annual rate of return for stocked fish of 2.7%. For comparison, Miracle Mile stocked fish had return rates of 15% in April-October 1995 and 7% during the same months in 2001. The average weight of RBT caught in the 2009 population estimate was1.01 pounds, resulting in a pounds caught to pounds stocked ratio of 1.04. Appling the average length of a creeled RBT in the 2009 survey (15.6 inches) to a length-weight regression generated from 2009 electrofishing data [weight = $0.0004(\text{length})^{2.9941}$, $P < 0.001$, $R^2 = 0.98$], the average weight of a creeled rainbow trout was 1.50 pounds. Applying this weight, the ratio of pounds caught to pounds stocked is 1.54. In April-October 1995, the pounds caught to pounds stocked ratio for Miracle Mile was 16.13. During these months in 2001, approximately seven pounds were caught per pound stocked. The decrease in return of stocked fish is attributable to the decrease in angling pressure in 2009. Miracle Mile RBT stocking still met the criteria of one pound caught for one pound stocked in 2009, a benchmark by which the success of fingerling trout stocking programs have been assessed (Wiley et al. 1993).

Catch rates for BNT and RBT increased over the summer and peaked during September. Catch rates for BNT tend to increase as fish move out of Pathfinder Reservoir to spawn in the Miracle Mile. Spawning movements of fish from Pathfinder Reservoir may also explain the seasonal pattern in RBT catch rates. Pathfinder Reservoir has been primarily stocked with fall rainbow trout (FRB) since 1998 (Table 11). Pathfinder Reservoir-stocked FRB are thought to spawn in the Miracle Mile between September and March (Deromedi 2000). Fall rainbow trout catch rates in 1995 display a similar pattern to that of RBT in the 2009 survey (Figure 4). In contrast, spring spawning ELR did not show this pattern in 1995. If we consider that 15.7% of the rainbow trout caught in 1995-1996 were Pathfinder Reservoir-stocked FRB, and this was during a period when less than a third of the FRB were being stocked compared to 2006-2008, it is likely that FRB contributed an even higher percentage to the RBT catch in 2009. The lowest catch rates in 2009 occurred April-June. Catch rates have been enhanced in the Miracle Mile during spring and early summer by the movement of Pathfinder Reservoir-stocked ELR (9.9% of the catch in May; Mavrakis and Yule 1998) and SRC (22.8% of the catch in June; Mavrakis 2002) into the Miracle Mile. Eagle Lake rainbow trout and SRC are no longer stocked regularly in Pathfinder Reservoir because they did not return to reservoir anglers as well as FRB (Mavrakis and Yule 1998; WGFD 2000). Due to hatchery availability, 50,000 catchable SRC from Speas Rearing Station will be stocked in Pathfinder Reservoir in fall 2011. These SRC

could enhance Miracle Mile catch rates in June of subsequent years and may perform better than previous lots due to improved water quality and production capabilities at Speas. Also, these SRC will be the Bar BC strain which have performed better than the fall-spawning Auburn strain that were stocked until1994 (Jim Barner, personal communication).

TABLE 11. Number of trout stocked in Pathfinder Reservoir 1991-2009.

	ELR	FHR	FRB	KRB	SRC	YSC
1991	7,989		19,789	10,026	37,861	
1992	36,393		24,826	28,838	37,227	
1993	27,354		28,830	26,568	22,471	
1994	64,285		28,424	48,551	28,892	
1995	58,961			52,476		
1996	8,982		71,395	70,638	7,990	
1997	185,426		60,111	46,959	44,731	
1998	53,836		114,034			
1999	135,639		138,179			
2000			72,489			
2001	27,768		85,729		80,554	
2002	935	1,182	322,698		20,312	
2003	25,148	45,244	99,582			40,014
2004	19,119	994	112,214			
2005	1,014	1,038	86,292			
2006	1,034	1,112	108,262			
2007	1,008	1,100	116,437			
2008	9,603	928	96,000			
2009			98,611			
Total	846,364	51,598	2,006,579	284,056	541,680	50,036

The catch rate objective of 0.6 fish/hour was not met at the Miracle Mile in 2009 or eight of the nine years for which catch rate data were available. Because catch rate data are highly skewed, a small proportion of anglers will exceed a mean catch rate (Bailey 2007). One quarter of the anglers at the Miracle Mile caught ≥ 0.6 fish/hour (PAS 0.6 = 0.25). The PAS 0.6 of 0.25 suggests that a minority of anglers are able to catch the majority of the fish. Using PAS as a measurable objective of angler success better represents angler success and improves statistical power over compared to mean catch rate (Bailey 2007). Maintaining a PAS 0.6 > 0.25 would correspond to maintaining average catch rate of > 0.5 fish per hour (Figure 5) and would be an appropriate management objective for the Miracle Mile.

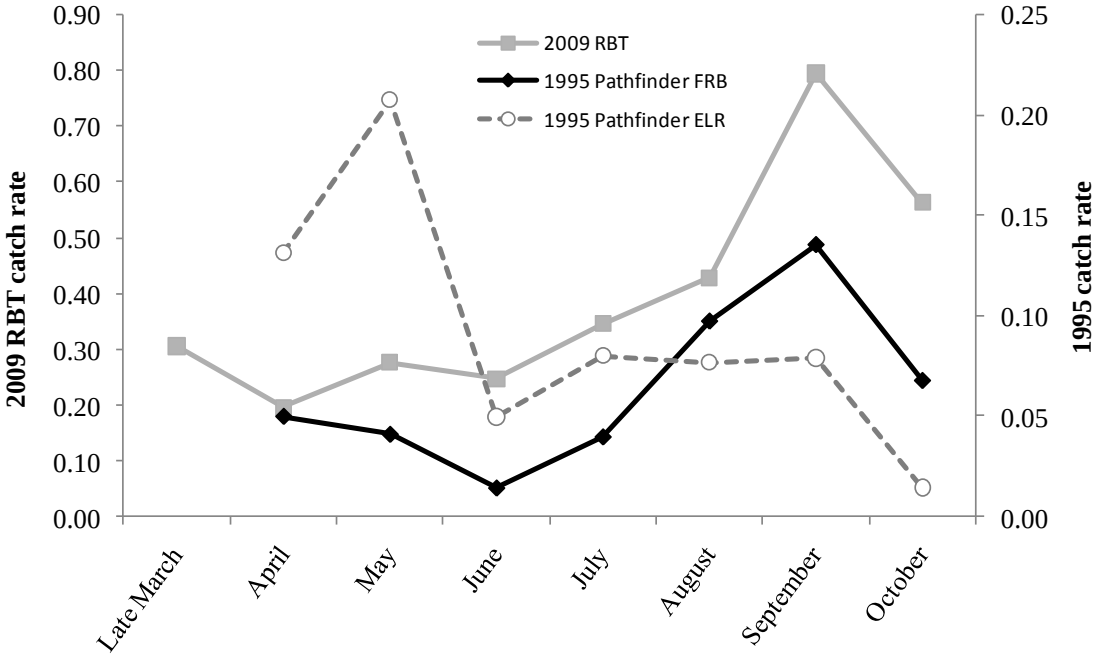

FIGURE 4. Miracle Mile monthly catch rates for fall rainbow trout (FRB) and Eagle Lake rainbow trout (ELR) in 1995 and all RBT in 2009.

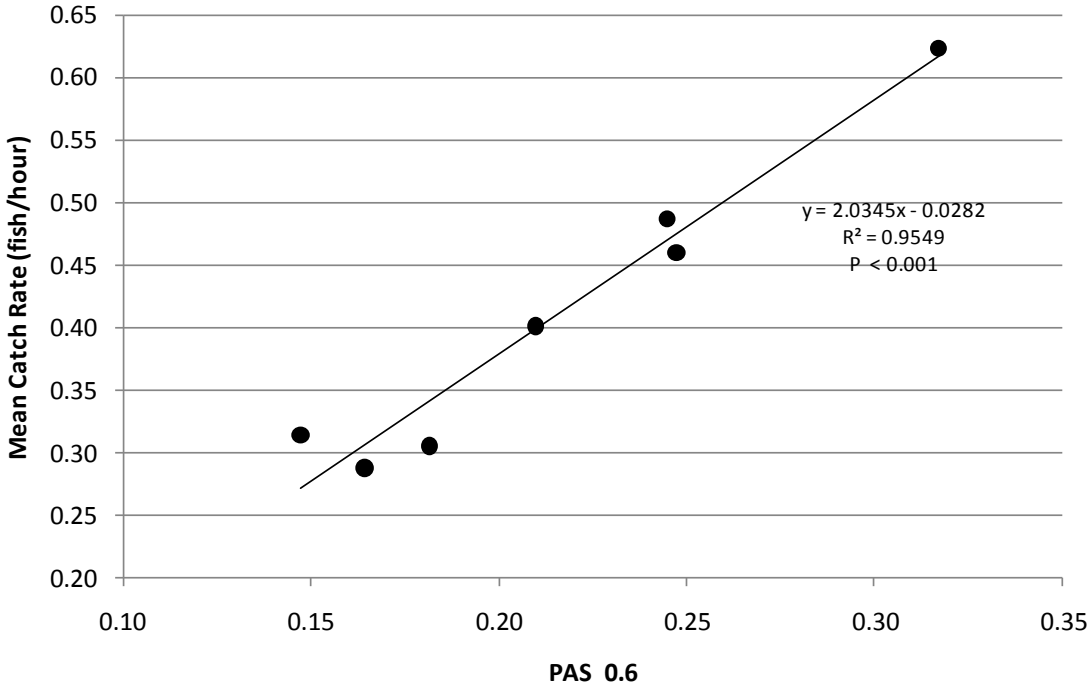

FIGURE 5. Relationship of the proportion of anglers catching ≥ 0.6 fish per hour (PAS 0.6) and mean angler catch rates in 1995-1998, 2001, 2003, and 2009 creel surveys.

Rainbow trout catch rate was positively related to both stocking and spring flow variations two years prior to the creel survey. While the positive influence of stocking on angler catch rates is intuitive, catch rates would be expected to decrease following significant variations in flows during fish spawning (Zafft and Vogt 1992). A three-dimensional look at the relationship of these three variables suggests that moderate catch rates can be maintained two years after springs with variable flows, if enough RBT are stocked (Figure 6). This 3-D model shows the lowest catch rates are likely when flow variation is high and stocking numbers are low. The highest catch rates occur when flow variation is minimal and stocking is high. This suggests that stocking trout can offset, to some extent, potential negative effects of flow variations on angler catch.

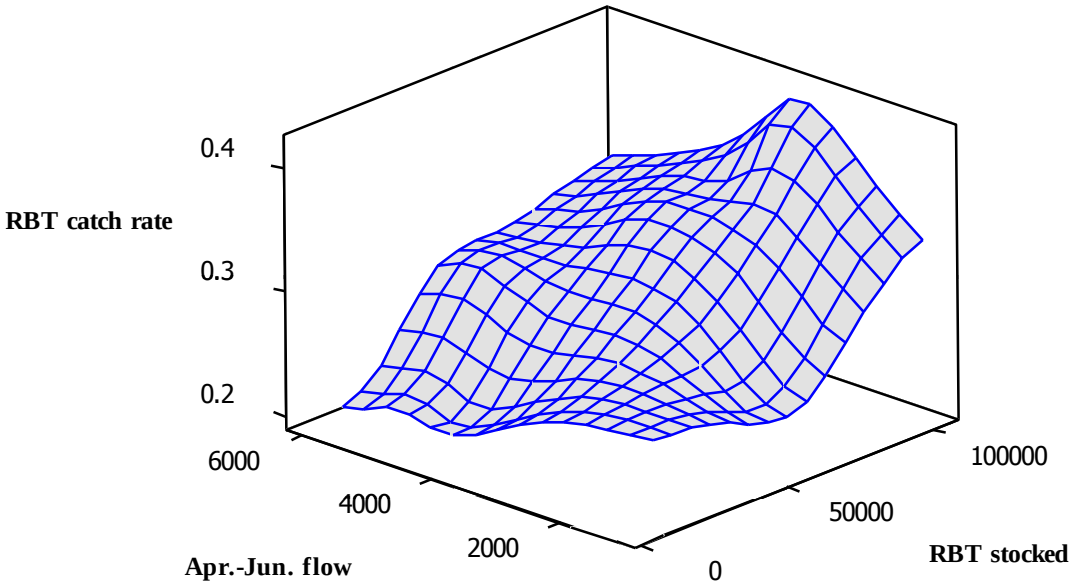

FIGURE 6. 3-D surface plot depicting the relationships between spring flow variations, rainbow trout stocked, and RBT catch rate in creel surveys two years later.

The highest catch rates at the Miracle Mile occurred in 1995 and 1996. The 1995-1996 creel survey was conducted during a time when BNT were the dominant salmonid in the Miracle Mile. The brown trout population declined considerably between the mid-1990s and 2009; this decline is partially responsible for the reduced angler catch rates at the Miracle Mile. Increased November-April flow variations can negatively impact future BNT numbers at the Miracle Mile (Mavrakis 2002; WGFD 2008). However, this kind of flow variation did not appear to influence future angler BNT catch rates in this study.

Prior to the coded wire study, the Miracle Mile was stocked with 100,000 RBT annually, but annual stocking was reduced 50,000 per year in 1998. A Miracle Mile stocking plan formulated in 2000 (Mavrakis 2002) stated that stocking should be increased to 100,000 if one of two conditions were not being met: 1) total catch rates fell below 0.60 fish/hour, or 2) the percentage of Miracle Mile stocked RBT was below 33% of the RBT population estimate.

Miracle Mile-stocked FHR and ELR comprised 45% of the RBT population estimate in 2009 (WGFD 2009). The objective TRT catch rate of 0.6 fish/hour was not met in the 2009 creel survey. The TRT catch rate model indicates that stocking 91,000 RBT in the Miracle Mile should produce a mean TRT catch rate of 0.5 fish/hour (Figure 7). Attempting to increase catch rates above 0.6 fish/hour by stocking > 125,000 RBT is not prudent given the low angler use and modest returns of Miracle Mile stocked trout.

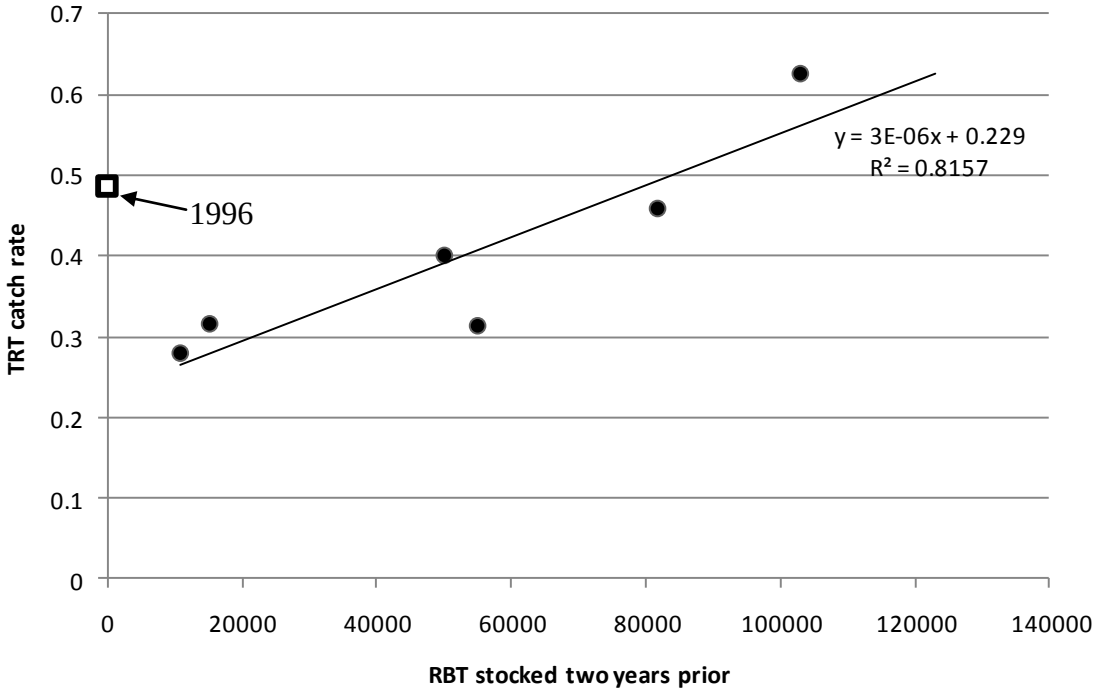

FIGURE 7. Linear regression of angler catch rate versus RBT stocked two years prior to the creel survey. The data point from 1996 was considered an outlier and was not included in the regression model.

Recommendations

- Redefine the angler success objective from a catch rate of ≥ 0.6 fish/hour to PAS 0.6 > 0.25. Using the PAS objective will improve statistical power for future comparisons and more accurately reflect angler success at the Miracle Mile.

- Measure catch rates in May and June of 2012-2014 through a spot creel surveys. These data will be used evaluate whether the PAS objective is being met and the return of Pathfinder Reservoir-stocked SRC in the Miracle Mile. If catch of SRC assist in meeting the overall trout PAS objective, a request for SRC or spring-spawning RBT (such as ELR) for Pathfinder Reservoir may be considered. Return of these fish would also need to be monitored in Pathfinder Reservoir.

- Stock the Miracle Mile with 100,000 FHR annually.

- Determine FRB spawning period through monthly electrofishing, September-May. This information will be used to evaluate seasonal influences on angler catch rates and will provide a broader understanding of the composition of the Miracle Mile trout population.

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Literature Cited

Bailey, 2002. Evaluation of North Platte River trout stocking: Gray Reef Dam to Mills bridge. Administrative Report. Wyoming Game and Fish Department, Cheyenne.

Bailey, P.E. 2007. Proportional angling success: An alternative approach to representing angling success. Fisheries 32: 129-135.

Bradshaw W.H. 2004. Programmed creel survey of LAK Reservoir, Weston County Wyoming, mid-April through September 2002. Administrative Report. Wyoming Game and Fish Department, Cheyenne.

Cavalli, P. 2010. Soda Lake: Trends in creel survey data and trout population estimates through 2004. Administrative Report. Wyoming Game and Fish Department, Cheyenne.

Deromedi, J. 2000. Trout strain evaluation in the upper North Platte River System. Administrative Report. Wyoming Game and Fish Department, Cheyenne.

Eiserman, F. 1962. 1961 Programmed Creel Census. Wyoming Game and Fish Commission Investigations Project Completion Report, Cheyenne.

Gerrity, P. 2009. Growth, mortality, and exploitation of walleyes in Glendo Reservoir with simulated effects of minimum length and protective slot limits. Administrative Report. Wyoming Game and Fish Department, Cheyenne.

Hahn, M. In review. Performance of Firehole and Eagle Lake strain rainbow trout in two tailwater fisheries: Miracle Mile and Cardwell reaches of the North Platte River. Administrative Report. Wyoming Game and Fish Department, Cheyenne

Hahn, M. In preparation. North Platte River-Grey Reef Dam to Bessemer Bridge Creel Survey 2011. Administrative Report. Wyoming Game and Fish Department, Cheyenne

Mararaki**s**, P. 2002. Programmed Creel Survey and Stocking Evaluation, Miracle Mile, Carbon County, 2001. Administrative Report. Wyoming Game and Fish Department, Cheyenne.

Mavrakis P. H. and D.L. Yule. 1998. North Platte Comprehensive Fisheries Study: Creel Survey and Stocking Evaluation, 1995-1996. Administrative Report. Wyoming Game and Fish Department, Cheyenne.

Newman, S.P., P.W. Rasmussen, and L.M. Andrews. 1997. Comparison of a stratified, instantaneous count creel survey with a complete mandatory creel census on Escanaba Lake, Wisconsin. North American Journal of Fisheries Management 17:321-330.

Peterson, L. 1984. North Platte River (Miracle Mile) Use Investigations – 1982. Administrative Report. Wyoming Game and Fish Department, Cheyenne.

Peterson, L. and J. McMillan. 1976. North Platte River Use Investigations – Miracle Mile, 1973. Administrative Report. Wyoming Game and Fish Department, Cheyenne.

Spencer, P.D. 1993. Factors influencing the satisfaction of anglers on Lake Miltona, Minnesota. North American Journal of Fisheries Management 13:201-209.

Thompson, W.L., G.C. White and C. Gowan. 1998. Pages 145-151 *in* Monitoring Vertebrate Populations. Academic Press. San Diego.

WGFD 2000. Casper Region Aquatic Habitat and Fisheries Management Fish Division Progress Report. Pages 20-22 *in* Annual Fisheries Progress Report on the 2009 Work Schedule. Wyoming Game and Fish Department, Cheyenne.

WGFD 2008. Casper Region Aquatic Habitat and Fisheries Management Fish Division Progress Report. Pages 33-43 *in* Annual Fisheries Progress Report on the 2008 Work Schedule. Wyoming Game and Fish Department, Cheyenne.

WGFD 2009. Casper Region Aquatic Habitat and Fisheries Management Fish Division Progress Report. Annual Fisheries Progress Report on the 2009 Work Schedule. Wyoming Game and Fish Department, Cheyenne.

Wiley, R.W., R.A. Whaley, J.B. Satake, and M. Fowden. 1993. Assessment of stocking hatchery trout; a Wyoming perspective. North American Journal of Fisheries Management 13: 160-170.

Zafft, D. J., and G. T. Vogt. 1992. Evaluation of the effects of rapid flow fluctuations on potential trout production in the Miracle Mile. Administrative Report. Wyoming Game and Fish Department, Cheyenne.