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MONTANA FISH & GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Project No. F-27-R-8 Name Rock Creek Creel Census

Job No. I Title Summer Census

Period Covered July 1, 1966 - June 30, 1967

Abstract:

A creel census study to determine the contribution of catchable-size rainbow trout was continued for the ninth year on a 40-mile section of Rock Creek near Missoula, Montana. Fishing pressure and catch estimates were obtained by a regression analysis of complete car counter data and data from checking station contacts on randomly selected dates during the summer fishing season.

An estimated 10,117 anglers fished a total of 37,661 hours and caught 23,210 fish during the 1966 fishing season.

The average catch per man hour during the initial three years of the study (with fish stocking) was 0.92. The average catch per man hour during the next four years (without fish stocking) was 0.68. Rock Creek was stocked with 10,000 catchable rainbow trout during the 1966 fishing season and the average catch per man hour was 0.62.

The first-year return of trout stocked during 1958, 1959 and 1960 ranged from 34.3 - 40.1 percent and averaged 37.9 percent. The return to the creel of hatchery trout stocked in 1965 and 1966 was 35.5 and 51.4 percent, respectively, for an average of 43.4 percent.

Recommendations:

To fulfill the basic objectives of the study, the following is recommended:

1. The study be continued for one more year and then discontinued.

2. Stocking of hatchery fish be continued in 1967, and that 30,000 fish be stocked in Section I.

3. The practice of making note of the names and license numbers of as many of the same fishermen who fished Rock Creek since 1963 should be continued until completion of the study. At this time, information relating to the catch rate and harvest of these fishermen should be retrieved from I.B.M. cards for all years in which it has been collected.

Objectives:

The long-range objective of the Rock Creek Study is to obtain the necessary harvest and pressure information for an evaluation of the stocking program of catchable-sized rainbow trout in Rock Creek. This report covers the ninth year of the study. The objective of the remaining years of study should be to continue the determination of the return of hatchery fish from Rock Creek at various stocking levels and the effect of these levels on the overall catch rate. The catch rate of anglers who have a known catch history on Rock Creek should also be determined for its effect on the overall catch rate.

Techniques Used:

Techniques used were the same as in previous years with the following exceptions: The fishing season began on May 21 and ended November 30 - a total of 193 days. The lower station was closed November 30, whereas the upper station closed September 5. Between opening day and their respective closing dates, 83 days were censused at the lower station and 56 days at the upper station. The days censused are shown in Appendix A.

After four years without fish stocking 5,000 catchable hatchery rainbow trout were stocked in Section I of Rock Creek in 1965. No fish were stocked in Section II. In 1966, 10,087 catchable rainbow trout were stocked in Section I. No fish were stocked in Section II in 1966.

In both years the total plant of hatchery fish was distributed at about 14 points along Rock Creek up to the Tekoa cable crossing. No fish were planted above this point in 1965 or 1966. In 1966 one-half the 10,087 fish were stocked on June 29 and the other half on July 20.

Lower station traffic counters kept incomplete records or were inoperative from June 20-22, October 4-9 and October 30-November 5, inclusive. Between October 4-9 when no count was available, an estimate was obtained by averaging the traffic counts for the same day of the previous and following week.

Between October 30 and November 5, 1966 the lower station counter accumulated traffic counts but did not print them each hour. There were a total of 648 cars counted within a time period of 149 hours. This equals an average of 4.3 cars per hour. Daily estimates during this period were derived in the following manner: for those days with a partial hourly count the hours of unknown count were derived by multiplying total unknown hours by 4.3. This figure was added to the partial (known) count to obtain a 24-hour total count. For days when no partial count was available an estimate was made by multiplying 24 hours by 4.3 cars.

The same situation existed from June 20-22 inclusive. A total of 240 cars were counted and accumulated by the counter during a period of 45 hours for an average of 5.3 cars per hour. Total daily estimates were derived as stated above. No separate estimates of fishermen, hours and fish were obtained for these days. They are included in the estimates obtained by regression analysis.

A revised creel census form was used in 1966 and is illustrated in Appendix B. This form allowed easier recording of information and allowed each item to be coded readily for IBM compilation. Two additional spaces on the extreme right hand of

the form (Species unknown and Caught & released) were used to record data from fishermen who disposed of their catch by eating the fish and/or releasing some of the fish they caught. In previous years this information was not readily recorded for IBM processing. Information from fishermen who had spent several days up Rock Creek and had caught fish each day was also recorded in these spaces. Since this type of data had not been recorded in previous years a statistical analysis was made of the data to see if this additional information made any difference in the estimates of fishermen, hours, and fish which would normally be obtained. It was found that there would be no significant difference in the estimates. That is, the estimates arrived at without taking these into account as separate factors were as good as the estimates made when they were separated out and handled individually.

Creel census instructions were revised (April 1966) to conform to the new census form used. These instructions explain how to fill out each of the items on the contact form.

A listing was made of the average sizes of hatchery rainbow planted in Rock Creek since 1958. This information was obtained from the 1954-1963 Fish Planting Record (IBM Summary) with subsequent information obtained for 1965 and 1966. These data are presented in Table 1.

Table 1. Number, weight and size of marked hatchery rainbows stocked in both sections of Rock Creek from 1958 through 1960, 1965 and 1966.1/

Year	Number stocked	Total weight	Ave. no./lb.	Approx. ave. length (in.)
1958	34,195	7179	4.76	8.00
1959	26,765	5775	4.63	8.25
1960	28,917	6590	4.39	8.25
1965	5,000	1960	2.55	10.00
1966	10,087	2850	3.54	9.00

1/No fish were stocked from 1961-1964 inclusive

Findings:

Six species of game fish were taken by anglers in 1966. These were rainbow trout (Rb), Salmo gairdneri Richardson; cutthroat trout (Ct), Salmo clarki Richardson; brown trout (LL), Salmo trutta Linnaeus; Dolly Varden (DV) Salvelinus malma (Walbaum); brook trout (Eb), Salvelinus fontinalis (Mitchill); mountain whitefish (Wf), Prosopium williamsoni, (Girard).

The species composition of the catch from 1958 through 1966 is given in Table 2. The most apparent change in species composition is the reduction of natural rainbows in the total catch during years of fish stocking. However, if the hatchery rainbows are deleted, there is less variation in catch composition of natural rainbow trout with and without stocking (Table 3). In 1966 the percent of natural rainbows in the total catch decreased to a level comparable with the first three years of fish stocking (1958-1960). Also when hatchery rainbows were deleted the catch of natural rainbows remained lower than it had been since 1961.

The catch of cutthroat trout and whitefish decreased in 1966. All other species had a slightly increased catch composition. The brown trout showed the largest increase in numbers. This may be related to the steadily improving brown trout population in the Clark Fork River since pollution abatement about 1961 by the Anaconda Company (Rock Creek is tributary to the Clark Fork). The species composition pattern established in the last three years (Table 3) was altered somewhat by data from the 1966 census.

Table 2. Species composition of the anglers catch, in percent, from both sections of Rock Creek in the years 1958-1966.

Year	Hatchery Rb	Natural Rb	Ct	Eb	DV	LL	Wf
1958	26	38	7.3	15	5.0	1.2	7.0
1959	24	39	5.8	14	4.7	1.4	11.0
1960	25	34	8.0	13	5.2	1.9	13
1961	2.9	46	12.0	13	6.9	4.3	16
1962	1.3	53	8.6	12	5.5	4.9	15
1963	1.3	48	12.0	11	6.6	7.3	14
1964	tr.	53	10.0	11	4.8	7.2	14
1965	5.7	48.2	10.2	10.8	4.8	6.6	13.5
1966	16.6	39.3	7.3	10.6	6.4	8.7	11.1

Table 3. Species composition of the anglers catch, in percent, exclusive of the hatchery rainbows, from both sections of Rock Creek during the years 1958-1966.

Year	Rb	Ct	Eb	DV	LL	Wf
1958	52	10	20	6.8	0.2	9.5
1959	52	7.6	18	6.2	0.2	14
1960	45	11	17	7.0	0.2	17
1961	46	12	13	6.9	4.3	16
1962	53	8.6	12	5.5	4.9	15
1963	48	12	11	6.6	7.3	14
1964	53	10	11	4.8	7.2	14
1965	51.1	10.9	11.4	5.1	7.1	14.4
1966	47.1	8.7	12.7	7.7	10.4	13.3

The estimates of harvest in numbers of fish, pressure in man-hours and man-days are found in Appendix C. Confidence limits at the 95 percent level have been applied to these estimates. Because fishing pressure at the upper station was extremely low after September 5, no estimate of pressure, hours, and harvest was made after that date, as it would not significantly affect the overall results.

Correlation coefficients (r) showing the relationship between cars counted by traffic counter and each of the other variables (fishermen, hours, fish) are also shown in Appendix C for each station.

Trends in catch per hour, catch per angler and average length of trip since 1958 are shown in Table 4.

Table 4. Average catch per hour and per trip, and the average length of trip for both stations of Rock Creek, 1958-1965.

Year	Catch per angler	Catch per hour	Combined catch per hour	Average length of trip (hours)
1958	3.39	0.91		3.7
1959	3.07	0.94	0.92	3.5
1960	3.13	0.93		3.3
1961	2.23	0.75		2.9
1962	2.05	0.70	0.68	3.0
1963	2.04	0.64		3.2
1964	2.34	0.62		3.8
1965	2.35	0.67	0.64	3.5
1966	2.29	0.62		3.7

Based on a known return of 2,003 hatchery fish, it is estimated that 5,182 or 51.4 percent of the 1966 stocked fish were returned to the creel in the first year. This is the highest return of hatchery fish recorded since the beginning of the study (Table 5). Hatchery rainbows comprised 16.6 percent of the total catch in 1966 compared with 5.7 percent in 1965. It would appear that the high catch of hatchery fish resulted in the decline in catch of natural rainbow trout. A greater decline of natural rainbows occurred in 1966 than occurred in 1958 through 1960 when a greater percentage of hatchery rainbows were caught.

Table 5 also summarizes the estimated number of fishermen, hours fished, fish harvested and number of fish stocked since 1958. Eighty-five (85) 1966 marked hatchery rainbows were checked through the upper checking station in 1966. In addition, six 1965 hatchery fish were checked at the upper station. A total of 147 (7.0%) 1965 hatchery fish were checked in 1966 at both stations for an accumulated return of 42.5 percent.

Table 5. Estimated number of fishermen, hours fished, and fish harvested, number of hatchery fish planted and their percent return from Rock Creek, 1958-1966.[1]

Year	Fishermen	Hours	Fish	No. hatch. fish stocked[2] Sec. 1	Sec. 2	% return(1st year) of hatchery fish
1958	14,800	55,300	50,300	21,795	16,400	34.3
1959	14,920	48,894	45,809	14,330	12,435	39.3
1960	14,563	49,104	45,537	19,917	8,955	40.1
1961	11,278	33,367	25,144	none	none	-
1962	12,399	36,450	25,457	none	none	-
1963	10,110	32,178	20,665	none	none	-
1964	9,258	34,887	21,637	none	none	-
1965	9,961	35,174	23,439	5,000	none	35.5
1966	10,117	37,661	23,210	10,087	none	51.4

1/1960-1962 figures are revised data and differ from those found in completion reports for those years. See explanation in F-27-R-4 completion report (pg. 7) covering period July 1, 1962-June 30, 1963.

2/Numbers are from D-J Job Completion reports for respective years.

The catch per hour of 0.62 in 1966 was slightly lower than the CPH of 0.67 in 1965 and is equal to the CPH found in 1964 when no fish were stocked. As shown in Table 4, the CPH for 1965-1966 combined was lower than that for the 1958-60 period when fish were stocked. It was also lower than the CPH for the 1961-64 period when no fish were stocked. The average length of trip increased only slightly in 1966 over 1965 and again closely approximates the trip length of 1964.

The rate of catch of natural and hatchery rainbows and other game fish combined from 1958 through 1966 is shown in Figure 1. The overall catch per hour increased when hatchery fish were stocked until 1966 when it decreased slightly. Catch per angler also decreased in 1966 from the previous year. Figure 1 shows that the decrease in overall catch rate in 1966 was due primarily to the decrease of natural rainbows in the catch.

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Date December 15, 1967

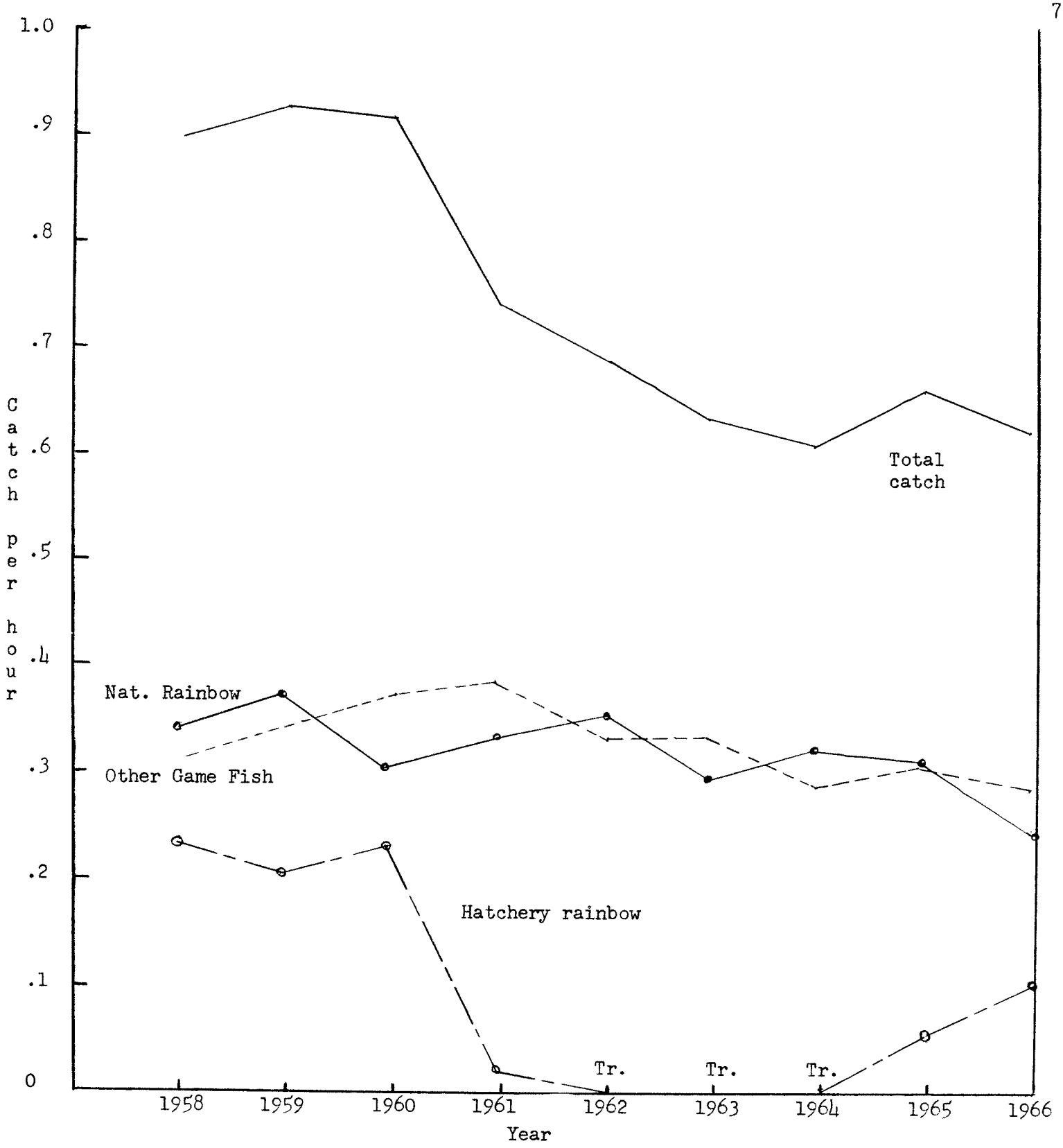

Figure 1. - Rate of catch in numbers of fish per man-hour for both sections of Rock Creek during the years 1958 through 1966.

Appendix A

Rock Creek creel census schedule - 1966
(Dates shown are census days)

Lower Station

May

- - - - - - - - - -- -- -- -- -- -- -- -- -- -- -- -- -- 22 23 -- 25 -- 27 -- 29 30 --

June

- 2 - 4 - 6 7*8 - 10 -- 12 -- 14 -- 16 -- 18 -- 20 -- 22 -- 24 -- 26 -- 28 -- 30

July

- 2 - 4 - 6 - 8 - 10 -- 12 -- 14 -- 16 -- 18 -- 20 -- 22 -- 24 -- 26 -- 28 -- 30 --

August

1 - 3 - 5 - 7 - 9 -- 11 -- 13 -- 15 -- 17 -- 19 -- 21 -- 23 -- 25 -- 27 -- 29 -- 31

September

- 2 - 4 5 - - 8 - 10 -- 12 13**14 -- 16 -- 18 -- 20 -- 22 -- 24 -- 26 -- 28 -- 30

October

- 2 - - 5 - - 8 - 10 -- -- -- -- -- 16 -- -- -- -- 21 22 -- -- -- -- 27 -- -- 30 --

November

- - - - 5 - - - - - -- 11 -- 13 -- -- -- -- -- 19 -- -- -- -- -- -- -- 27 -- -- --

* Substituted for 5-31
**Substituted for 9-6

Appendix A (continued)

Rock Creek creel census schedule - 1966
(Dates shown are census days)

Upper Station

May

- - - - - - - - - -- -- -- -- -- -- -- -- -- -- -- -- -- 22 -- 24 -- 26 -- 28 29 30 31

June

- 2 - 4 - 6 - 8 - 10 -- 12 -- 14 -- 16 -- 18 -- 20 -- 22 -- 24 -- 26 -- 28 -- 30

July

- 2 - 4 - 6 - 8 - 10 -- 12 -- 14 -- 16 -- 18 -- 20 -- 22 -- 24 -- 26 -- 28 -- 30 --

August

1 - 3 - 5 - 7 - 9 -- 11 -- 13 -- 15 -- 17 -- 19 -- 21 -- 23 -- 25 -- 27 -- 29 -- 31

September

- 2 - 4 5 - - - - --

Appendix B

Example of revised Rock Creek individual contact form used in 1966 census[1/]

ROCK CREEK INDIVIDUAL CONTACT FORM

Date _____ Day _____ Station No. _____ Sheet No. _____ Checker _____

R or N	Lic. No.	Section fished	Lure	Hours fished	Total fish kept	No. of Clipped Hat. Fish					Nat. Rb	Ct	Eb	DV	LL	Wf	Species unknown	Caught & released
						Ad (1)	Ad-Lv (2)	Rt-Pmx (3)	Lf-Pmx (4)	Ad-Rv (5)								
9	10 15	16	17	18 20	21 23	24 26	27 29	30 32	33 35	36 38	39 41	42 44	45 47	48 50	51 53	54 56	57 58	59 60
TOTALS																		

Time: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Codes:

R or N
- Resident..... 1
- Non-resident..... 2

Lic. No.
- Juvenile..... J
- Over 70..... 0

Section Fished
- Lower Sec..... 1
- Upper Sec..... 2
- Both Sec..... 3

Lure
- Flies only..... 1
- Hardware only..... 2
- Bait only..... 3
- Any combination of 2 or 3 of above.. 4

Day of Week
- Sun..... 1
- Mon..... 2
- Tues..... 3
- Wed..... 4
- Thurs..... 5
- Fri..... 6
- Sat..... 7

1/Note: Numbers under column headings correspond to digits on IBM cards onto which coded information is punched.

Appendix C

Estimates of harvest, hours fished and angler trips with confidence intervals at the 95 percent level, for Rock Creek, Lower Station, 1966.[1]

	Lower limit	Point estimate	Upper limit
Harvest:			
Regression estimate	7075	9069	11053
Known	11511	11511	11511
T o t a l	18586	20580	22564
Hours:			
Regression estimate	11748	15026	18304
Known	18100	18100	18100
T o t a l	29848	33126	36404
Anglers (man-days):			
Regression estimate	3217	4112	5007
Known	4836	4836	4836
T o t a l	8053	8948	9843

[1]/Formula for calculation of confidence intervals (Reference - Snedecor, George W. 1950. Statistical Methods. 4th Ed. Iowa State College Press, Ames. Pg 120.):

1. $S_{\hat{y}} = \sqrt{s^2 + \frac{s^2}{n} + \frac{(\text{estimated total} - \bar{x})^2}{n}}$

2. Upper and lower limits = $N \pm t_{.05} \times S_{\hat{y}}$

Where

$S_{\hat{y}}$ = predicted standard error

s^2 = variance for each variable (fishermen, hours, or fish) obtained from multiple regression analysis

n = number of days with known data (census days, opening day included)

(continued)

Appendix C (continued)

estimated total = total fishermen, hours, or fish estimated by car count for non-census days (obtained from regression analysis)

$\bar{x}$ = total mean daily number of fishermen, hours, or fish (obtained from regression analysis)

$\hat{N}$ = point estimate of each variable (obtained from sum of known and estimated data)

* * * * *

Correlation coefficient (r) showing the relationship between cars counted and each of the three other variables (fishermen, hours, fish) Rock Creek, Lower Station, 1966

	Cars
	r
Fishermen	.8778
Hours	.8510
Fish	.7975

Appendix C (continued)

Estimates of harvest, hours fished and angler trips with confidence intervals at the 95 per cent level for Rock Creek, Upper Station, for the period May 22 through September 5, 1966.[1/]

	Lower limit	Point estimate	Upper limit
Harvest:			
Regression estimate	872	1185	1498
Known	1445	1445	1445
T o t a l	2317	2630	2943
Hours:			
Regression estimate	1483	2010	2537
Known	2525	2525	2525
T o t a l	4008	4535	5062
Anglers (man-days):			
Regression estimate	379	515	651
Known	654	654	654
T o t a l	1033	1169	1305

[1/] Formula and reference for confidence interval calculation are same as for Lower Station.

* * * * *

Correlation coefficients (r) showing relationship between cars counted and each of the three other variables (fishermen, hours, fish) Rock Creek, Upper Station, May 22 through September 5, 1966.

	Cars
	r
Fishermen	.8674
Hours	.7585
Fish	.5685