MONTANA DEPARTMENT OF FISH AND GAME
FISHERIES DIVISION

JOB PROGRESS REPORT

State: Montana

Project No.: F-9-R-20 Title: Southwestern Montana Fisheries Study

Job No.: II-a Title: Evaluation of Stream Improvements on Prickly Pear Creek

Period Covered: July 1, 1971 to June 30, 1972

ABSTRACT

Rock and soil berms were constructed at the toe of four steep eroding banks to stop stream bank sloughing along the relocated channel of Prickly Pear Creek. The berms were used in shrub experiments to test the survival of naturally occurring species, when transplanted to reestablish stream bank vegetation.

Five shrub species and five different treatments were used in the experiments. The best results were obtained from spring-planted horizontal willows (Salix sp.) with 66.3 percent of the 84 planted surviving the summer. Vertical willow and dogwood (Cornus stolonifera) had survival rates of 38.0 and 12.5 percent respectively, from the spring planting. Survival of summer transplants was not satisfactory. Common snowberry (Symphoricarpos albus) proved to be the most successful among the rooted stock transplanted to the back slopes adjacent to each berm. Spring was the most favorable time of year for these transplants.

Soil was placed on 260 feet of rip-rap and 100 willow cuttings were planted in the spaces between rocks during the spring of 1971. Following spring runoff, 58 shoots remained and 93.0 percent (54) of the remaining plants survived the summer.

Fish population estimates were made using the mark and recapture method in the relocated channel. Rough fish comprised 50.7 percent of the total numbers and 81.0 percent of the total weight. Brown trout were the predominant game fish comprising 28.8 percent of the total number and 12.3 percent of the total weight. Rainbow trout made up 20.5 and 6.7 of the total numbers and weight, respectively. These data were compared to fish population data from 1967, 1968, 1969 and 1970.

BACKGROUND

The Prickly Pear Creek study was initiated in 1965 to document the condition of the fishery and stream channel prior to construction of Interstate Highway 15 seven miles south of Helena. A continuous 3,300 foot channel change was proposed for Prickly Pear in that area. To mitigate the loss of natural channel, the stream was artificially meandered in the flood plain to retain its original length. Prior to construction, the average depth and width were 1.4 and 26.4 feet, respectively, and spacing of successive pools was every 6.6 times the average stream width or a pool every 180 feet (Elser, 1968).

Fish population estimates indicated that suckers made up 62.1 percent of the

total number and 78.6 percent of the total weight. Trout comprised 37.9 and 21.5 percent of the total numbers and weight, respectively. Rainbows were the most abundant trout species (Elser, 1968).

Physcial parameters and fish populations have been measured in three post-construction years; 1968, 1969 and 1970. The man-made channel was 3 percent (3,150 to 3,250 feet) longer than the natural channel. Construction reduced average width, depth and thalweg depth by 4 percent (26 to 25 feet) 28.6 percent (1.4 to 1.0 feet) and 21.8 percent (2.3 to 1.8 feet), respectively, except for a slight increase in average thalweg depth (1.9 to 2.0 feet) in 1970. The pool riffle periodicity has undergone adjustment toward the 6.6 stream widths of the original channel. In 1968, the first year after construction, spacing was 15.7 widths or a pool every 380 feet. The periodicity had adjusted to 8.8 widths in 1969 and 7.8 widths (a pool every 196 feet) in 1970 (Elser, 1971).

The sucker:trout ratio of 2:1 remained unchanged following construction; however, brown trout became the most abundant game fish in weight and numbers per acre (Elser, 1971). The most significant change in the fish population came in a reduction of the total standing crop. Numbers and weight of fish per acre were reduced by 45.8 percent (432 to 234) and 51.1 percent (168 to 82 pounds per acre), respectively, between 1967 and 1968. Population estimates in 1969 were 228 fish per acre weighing 78 pounds per acre.

Woody vegetation which existed in the area of the new Prickly Pear Creek channel was removed during construction and banks of the new channel were left steep and easily erodable (Elser, 1969). Attempts in 1969 to replace the vegetation which was lost met with little success due to bank sloughing in many areas. This report describes an experimental method employed to halt bank sloughing. In 1971, another attempt was made to speed up revegetation of the man-made channel.

OBJECTIVES

The Prickly Pear Creek Study in 1971 included the following:

1. Experimentation with rock and soil berms as a method of controlling stream bank erosion.

2. Determination of which naturally occurring shrub species can be successfully transplanted to speed up revegetation of a denuded area.

3. Estimation of fish population numbers in the area affected by construction.

PROCEDURES

A front-end loader was used to pick up rock and soil in the areas of severe bank erosion and construct low, flat berms along the water's edge at the toe of four of the eroding banks. Rocks were placed along the face of each berm to keep them from washing away. The banks were then sloped with a tractor-mounted backhoe.

Shrub experiments were conducted on the surface of the berms and backslopes. The berms ranged in length from 36 to 146 feet long. Berms one and two were divided into experimental plots of 60 square feet each; berms three and four were not divided. Each plot received a different species or treatment of a species to be evaluated.

Treatment consisted of spring plantings, summer plantings, vertical or horizontal shoot cuttings and rooted stock. Table 1 lists the scientific and common names and quantity of each plant species used in the experiments. Eight of the 14 experimental plots were planted prior to spring runoff, and six were planted in early summer, after all plants were fully leafed. Horizontal shoot cuttings consisted of an eight to ten inch section of main stem including one branch. The section of main stem was laid in a trench and covered with soil so that the branch protruded from the soil. Vertical shoot cuttings were taken from branches which had soft pliable bark and a terminal bud. Cuts were made at a 45^{0} angle to expose a large surface area to the soil for root production. A steel rod was used to make a hole in the soil as deep as possible (12 to 18 inches) to prevent damaging the cut end of the shoot (Jensen, 1971).

TABLE 1. Scientific names, common names and total numbers of each shrub used in the revegetation experiments

Scientific Names*	Common Names*	Quantity
Salix, species	Nativewillow	507
Cornus stolonifera	Red Osier dogwood	108
Symphoricarpos albus	Common snowberry	43
Rosa woodsi	Woods rose	19
Prunus virginiana	Common chokecherry	11

* Scientific and Common names from Jensen, 1971

Outside bends along the toe of the highway grade were rip-rapped during constuction to control erosion. Soil was placed in the interstices between large rocks to provide a place for experiments with revegetation of a large-rock rip-rap area.

Fish populations were sampled using 0-500 variable voltage direct current electrofishing equipment and the population estimates were made by the mark and recapture method. Procedures used in population sampling and data analysis are described by Vincent (1971).

FINDINGS

Erosion Control

Four eroding banks were chosen for berm construction and sloping. Berms were constructed before spring runoff at the toe of each of the four banks. Bank heights, before berm construction, length, amount of material used in each berm and figure numbers are shown in Table 2. To facilitate sloping, the creek bank in area one was cut down to about eight feet high and leveled, bank two was cut to six feet high and leveled, banks three and four were left at their original heights. Berms were inundated during the 1971 spring runoff. Some soil was lost; however, no actual damage was evident and the berms were successful in stopping further sloughing of the once steep banks (Figure 4).

TABLE 2. Bank and berm measurements for four experimental areas on Prickly Pear Creek

Area Number	Bank height (Feet)	Berm length (Feet)	Berm material (Cubic Yards)	Illustrated in figure number
1	4 - 12	146	75	1 and 2
2	4 - 10	100	52	3 and 4
3	13	68	17	5
4	13	36	13	6

VEGETATION

Berms were built so that moisture from the stream would percolate into the soil and provide shoot cuttings and grass seed with adequate moisture.

A total of 213 native willow (Salix, sp.) and 80 dogwood (Cornus stolonifera) shoots were planted on the berms prior to spring runoff. The final inventory, taken August 24, 1971, indicated that the best survival was among spring-planted horizontal willows (66.3%). Survival rates for spring-planted vertical willow and dogwood were 38.0 percent and 13.8 percent, respectively, (Table 3).

Summer plantings were made to test survival of the same species as tested in the spring. Survival was again highest among horizontal willow (17.2%). Vertical willow and dogwood survival rates were 13.1 percent and 0 percent, respectively, (Table 3).

TABLE 3. Number of each species and treatment planted on the berms and numbers surviving, with percent surviving in parentheses

Berm		Vertical Willow		Horizontal Willow		Dogwood	
		Spring	Summer	Spring	Summer	Spring	Summer
1	Planted	50	80	32	32	30	25
	Surviving	19(38)	11(14)	26(81)	11(34)	10(33)	0(0)
2	Planted	50	50	32	32	50	
	Surviving	16(32)	6(12)	24(75)	0(0)	0(0)	
3	Planted	29					
	Surviving	14(48)					
4	Planted			20			
	Surviving			9(45)			
Totals		129	130	84	64	80	25
		49(38.0)	17(13.1)	59(66.3)	11(17.2)	10(12.5)	0

Rooted shrubs were planted along the edge of the top bank adjacent to each berm. Common snowberry transplanted in the spring proved the most successful with a survival rate of 63.0 percent. Rose was second with 31.6 percent surviving the summer. All dogwood and chokecherry plants died (Table 4). Common snowberry was the only species transplanted on the backslopes in early summer; however, none of them survived (Table 4).

Figure 1. Eroding bank in area one on Prickly Pear Creek.

Figure 2. Prickly Pear Creek showing berm one before high water.

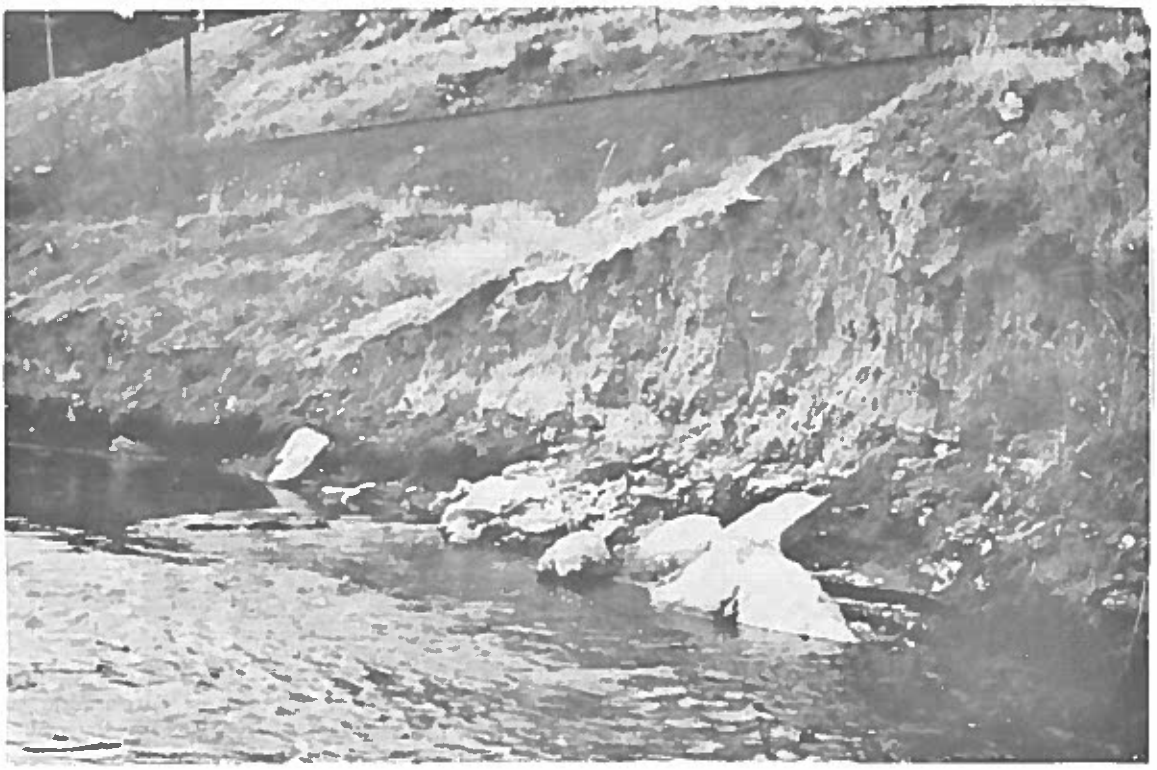

Figure 3. Eroding bank in area two on Prickly Pear Creek.

Figure 4. Berm in area two after high water on Prickly Pear Creek.

Figure 5. Berm in area three and high backslope on Prickly Pear Creek.

Figure 6. Eroding bank in area four on Prickly Pear Creek.

TABLE 4. Common names and numbers of each species planted on the backslopes adjacent to each berm along with numbers and percent surviving from each season

Species	Season Planted	Number Planted	Number Surviving (%)	Backslope Number
Common Snowberry	Spring	27	17 (63.0)	2, 3, 4
	Summer	16	2 (12.5)	2
Common Chokecherry	Spring	11	0 (0)	1
Woods Rose	Spring	16	6 (37.5)	1, 3
	Summer	3	0 (0)	1
Red Osier Dogwood	Spring	3	0 (0)	3

Soil was placed on 260 feet of rip-rap. The soil was worked into the spaces between rocks and 100 vertical willow shoots were planted in protected areas before high water. Following high water, 58.0 percent of the willow shoots remained and 93.0 percent (54) of the remaining plants survived the summer.

Common Snowberry transplanted in spring, when soil moisture and temperatures are favorable, seems to be a hearty species. It is a low growing shrub which spreads via a rhizomatous root system. It is found along the top banks of Prickly Pear Creek where the soil becomes hot and dry during the summer. Its low, dense, growth characteristics along with its adaption to relatively dry soil makes it a desirable species for use in stream bank stabilization.

Willows are better adapted to wet soil immediately adjacent to the water. They survive well when transplanted before growth begins in the spring. The technique of cutting a main stem with one branch and planting the main stem with the branch protruding from the soil gives the plant an advantage. The main stem contains enough stored energy to produce a more vigorous root system than is the case when a single vertical willow cutting is planted (Jensen, personal communication).

FISH POPULATIONS

The most valuable fish population data are those which cover a span of several years. Population trends which become evident from the study of such data can then be related to habitat conditions. Prickly Pear Creek fish population numbers have been estimated every year at approximately the same time of year, since the summer of 1967 in the area of the Interstate Highway 15 channel change. The most obvious change which has occurred is that the stream's ability to produce fish has been reduced by 50 percent in the area of the channel change (Table 5).

In 1967 (pre-construction), rainbow trout made up 22.7 percent of the total numbers and 7.1 percent of the total weight, brown trout comprised 14.1 and 14.3 percent of the total numbers and weight, respectively. Longnose suckers comprised 54.0 percent of the population numbers and 74.4 percent of the total weight and white suckers made up 9.1 and 4.2 percent of the total numbers and weight, respectively. In 1971, four years after construction, the population was 20.5 percent rainbow trout, 28.8 percent brown trout and 50.7 percent longnose suckers, which

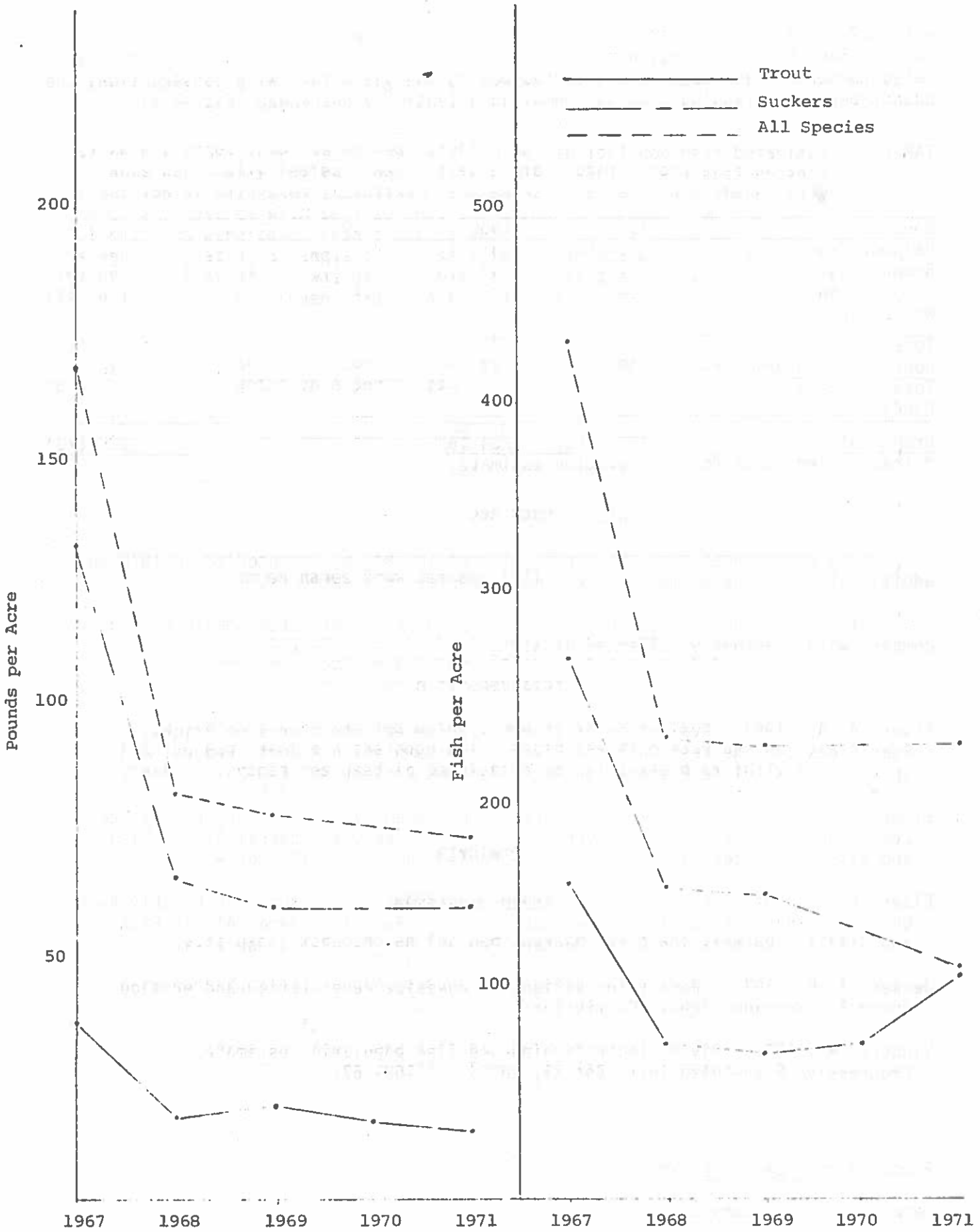

FIGURE 8. Population and biomass estimates for the altered section of Prickly Pear Creek from the years 1967 through 1971

were 6.7, 12.3 and 81.0 percent of the population by weight, respectively. White suckers have become an insignificant fraction of the population. Although the estimated number of each species has varied during the years following construction, the pounds per acre standing crop has remained essentially unchanged (Figure 8).

TABLE 5. Estimated fish populations for Prickly Pear Creek, pre-(1967) and post-construction (1968, 1969, 1970, 1971), expressed as numbers per acre, with pounds per acre in parentheses. Confidence intervals at 95% level.

Species	1967	1968	1969	1970	1971
Rainbow Trout	98 (12)	31 (4)	19 (4)	37 (5)	47 (5)
Brown Trout	61 (24)	47 (13)	55 (15)	41 (11)	66 (9)
Longnose Sucker	234 (125)	128 (59)	147 (53)	*	116 (59)
White Sucker	39 (7)	28 (6)	7 (6)	*	*
Total Trout	159 (36)	78 (17)	74 (19)	78 (16)	113 (14)
Confidence interval ($\pm$)	38	11	18	22	36
Total Suckers	273 (132)	156 (65)	154 (59)	*	116 (59)
Confidence interval ($\pm$)	62	30	28		41
Grand Total	432 (168)	234 (82)	228 (78)		229 (73)

* Insufficient data for a population estimate.

RECOMMENDATIONS

It is recommended that the shrubs planted in 1971 be inventoried in 1972 and additional plantings be made to test more species or treatments.

Detailed channel measurements and fish population estimates should be made to compare with previously collected data.

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Date: January 2, 1973