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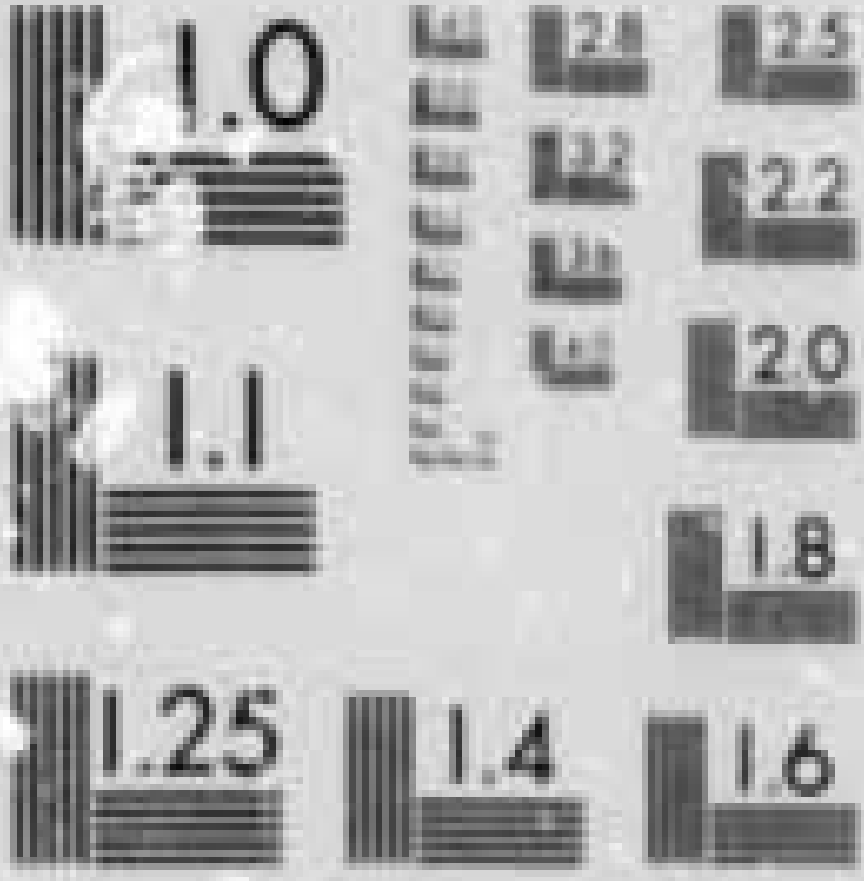

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BEAR LAKE CUTTHROAT FISHERY ENHANCEMENT PROGRAM

Annual Performance Report
July 1975 - December 1976

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INTRODUCTION

Bear Lake is an ancient, natural lake 32.2 m (20 miles) long and 6.4-12.9 m (4-8 mi) wide covering 28,252.8 ha (62,760 ac) with a maximum depth of 63.4 m (208 ft). Unique chemical characteristics include total dissolved solids in excess of 1000 ppm, abnormally high quantities of zinc and magnesium and pH values ranging to 8.7.

Around the turn of the century a substantial commercial fishery developed on Bear Lake. Utah sucker (Catostomus ardens), two endemic species of whitefish: Bear Lake (Prosopium abyssicola) and Bonneville (Prosopium Spilonotus) and most importantly, cutthroat trout (Salmo clarki) were marketed to surrounding areas. This practice continued into the early 1920's.

During the last thirty years the fishery in Bear Lake has continued to decline. Bonneville cisco (Prosopium gemmiferum) and whitefish species are still harvested on a seasonal basis. The rainbow (Salmo gairdneri) fishery is supported by the stocking of catchables, while the lake trout (Salvelinus namaycush) catch is very variable and depends on the experience of the angler and the time of year. The most concern, however, is centered around the drastic decline of the once prominent cutthroat fishery.

Previous investigators have indicated that Bear Lake was

unproductive and incapable of supporting many fish. The presence of large populations of whitefish, cisco, and sucker with marginal populations of carp (Cyprinus carpio) and Utah chub (Gila atraria) would indicate that food, at least in the form of plankton, was sufficiently abundant.

Speculation would indicate that the major factor in the decline of the native cutthroat population was the advent of man and his alterations in the form of irrigation diversions on the lake's two main spawning tributaries, Swan and St. Charles creeks.

During the 1960's a considerable number of cutthroat fry were stocked as an interim measure preliminary to development of the current program.

Experiences of other agencies under similar circumstances at Eagle Lake, California and Pyramid Lake, Nevada indicated that reintroduction of hatchery-reared fish obtained from native brood stock that have survived the environment of the receiving lake returned much better to the creel than fish produced from other egg sources. The Bear Lake cutthroat enhancement program has been developed along these lines of reasoning.

CUTTHROAT EGG TAKING OPERATIONS ON BEAR LAKE

Job I

Background

In an effort to obtain eggs from wild brood stock, a permanent spawning station was constructed on Swan Creek. The first cutthroat eggs were taken there in 1973 and have been taken each year since. In 1975 the Idaho Fish and Game Department installed a temporary fish trap on St. Charles Creek. Cutthroat captured there were then moved to Swan Creek and held with the fish captured in the trap at that tributary. In 1975 the St. Charles Creek fish made up 75 percent of the egg-take.

In conjunction with the egg-taking activities, a hatchery to rear the cutthroat to acceptable stocking sizes was needed. Since no suitable sites were available in the Bear Lake area, the new hatchery was constructed in Mantua, Utah, 113 km (70 miles) southwest of the lake. Construction began in 1973 and was completed in 1976. All of the eggs taken at Bear Lake have been transported to this station for hatching and rearing. The cutthroat progeny resulting from these activities have been returned and stocked into Bear Lake.

Methods

A permanent concrete fish trap and holding pen was built on Swan Creek approximately 91.4 m (100 yd) upstream from the lake. This facility is capable of holding 300 spawners in 9 separate pens. A canvas cover provides limited security and protection to the brood stock. In 1976 trapping was carried out at Swan and St. Charles Creeks. Cutthroat captured in St. Charles Creek were transported to the Swan Creek station 11.3 km (7 miles) away where all the fish were held and handled as a conglomerate group. Fishing regulations imposed by both states restrict angling at the mouths of the tributaries and portions of the streams.

From April through June four groups of fish ascended the tributaries. Cutthroat were held while rainbow, rainbow-cutthroat hybrids, and Utah suckers were released above the trap to continue their upstream migration. Twenty percent of the cutthroat running up St. Charles Creek were passed upstream to perpetuate any natural reproduction and to satisfy public concern. Criteria for distinguishing the "Bear Lake type" cutthroat were a combination of spotting patterns, coloration, and scale size. Spots on these fish were rarely found anterior to the dorsal fin, were round in shape with increasing density toward the tail, and were usually concentrated above the lateral

line. Coloration was a typical brilliant orange for males and a duller brown cast for females with no maxillary splashes. Scales were smaller than those found in rainbow and were deeply imbedded in the spongy epidermis of the males.

When a cutthroat was captured in the trap, total length, weight and sex were recorded. The fish were examined for previous marks and then tagged with a numbered spaghetti tag inserted under the dorsal fin. Additional information including trap source, time of spawning, and returns were recorded.

Once a week all ripe fish were anesthetized with chlorobutanol, stripped by the dry-pan method and released downstream. The eggs were then disinfected and shipped to Mantua Hatchery where they were counted, disinfected again, and placed in hatching trays or eyeing jars. During the latter part of the spawning season, periodic treatments of malichite green were administered to the brood stock to control fungus.

Results

Cutthroat began entering the Swan Creek trap during the middle of April with the peak of the run occurring about May 20 with fish numbers dropping off substantially by June 15. Spawning began on May 11 and was concluded on June 29.

A total of 310 females and 152 males were handled. Of these fish, 228 females were spawned, 52 from Swan Creek and 176 from St. Charles Creek for a yield of approximately 900,000 eggs. The overall average was 4,007 eggs/fish. A total of 140 males were stripped with 29 and 111 captured in Swan Creek and St. Charles Creek, respectively. When considering the total lot of fish, 22 percent ascended Swan Creek and 78 percent were caught in St. Charles Creek.

Total lengths (TL) ranged from 339 mm to 747 mm and weights from 208 g to 5500 g. The average male was 609 mm in total length and weighed 2597 g while females averaged 558 mm and 1979 g. Fish from St. Charles Creek were larger overall.

Discussion

The combined egg take in 1976 was the second largest since the project began (Table 1). Two factors which contributed to a reduction in the number of eggs taken in 1976 compared to the 1,285,609 taken in 1975 were the 20 percent released above the trap and losses of fish due to vandalism at the St. Charles Creek station. Another influencing factor was the change in the average size of the brood stock. The average size for females dropped from 605 mm and 2931 g in 1975 to 558 mm and 1980 g in 1976. This is the result of a better distribution in the smaller size classes. No positive identification was

Table 1. Bear Lake Cutthroat Egg Collection Data, 1973-1976.

Category	1973	1974	1975[a]	1975[b]	Total 1975	1976[a]	1976[b]	Total 1976
Number of male cutthroat tagged	25	95	24	91	115	28	124	152
Number of female cutthroat tagged	115	141	57	178	235	60	250	310
Ave TL of tagged male cutthroat (mm)	—	386	—	—	614	553	622	609
Ave wgt of tagged male cutthroat (g)	—	407	—	—	3,074	1,903	2,753	2,597
Ave TL of tagged female cutthroat (mm)	—	447	587	612	605	524	568	558
Ave wgt of tagged female cutthroat (g)	—	1,386	2,776	2,981	2,931	1,560	2,080	1,980
Ave number of eggs per female	3,825	2,538	2,361	5,559	5,471	3,151	4,202	4,007
Total ounces of eggs taken	1,955	1,136	1,205	3,980	5,185	690	2,598	3,288
Ave number of eggs per ounce	225	315	246	249	248	—	—	278
Total number of eggs taken	439,896	357,845	296,530	989,079	1,285,609	191,914	712,529	913,506
Trapping season begin/end	3/1-6/18	3/9-6/18	4/3-6/24	4/4-6/19		4/2-6/29	5/1-6/15	

[a]Swan Creek cutthroat

[b]St. Charles Creek cutthroat

made, but it appeared that there were some precocious males that probably originated from the initial 1973 year class collected at Swan Creek.

The return of previously tagged spawners has been small, indicating that few fish return to spawn again. In the 1976 spawning season, there was one return from 1973, one from 1974, and five from 1975. Eleven confirmed spawners were harvested by anglers in 1976.

Recommendations

In subsequent years efforts should be made to improve both trap sites for the efficient handling of spawning fish. Continued operation of the St. Charles Creek trap is beneficial, and an efficient trap would further the objectives of the project and provide an accurate estimate of the spawning stock.

The spawning station on Swan Creek should be improved by the construction of a permanent structure over the trap and the installation of improved screens. A program of prophylactic treatments should be initiated to reduce the incidence of fungus infection which is a chronic problem and causes mortality in the trap.

As more cutthroat begin to enter the traps in future years, efforts should be made to check for possible marks and correlate length-frequency histograms from creel or gillnetting activities with those of the spawning fish.

Investigations of other tributaries, especially Big Spring Creek, should be initiated to ascertain to what extent the stocked fish ascend them and to what degree they return to Swan and St. Charles Creeks to spawn. Stocking time, areas, and methods could then be compared with these data.

GILL-NETTING SURVEY

Job II

Fish Distribution

Background

Minimal work has been done on Bear Lake to evaluate the distribution of cutthroat trout and associated species. Most of the fragmentary and unpublished gill netting done by Utah State University and others seems to indicate that cutthroat are not concentrated in any specific areas and are found in deep water near the bottom. During the first segment of this project, 1968-1974, an effort was made to sample areas around the lake in water depths averaging 18.3 m (60 ft) with experimental, monofilament gill nets 30.5 m (100 ft) long with stretched mesh sizes of 12.7 mm (0.5 in), 24.5 mm (1.0 in), 38.4 mm (1.5 in) and 50.8 mm (2.0 in.). This yielded some baseline data that indicated cutthroat could be found in nearly any water depth down to 27.4 m (90 ft) in the southern half of the lake. Vertical gill nets were used to a limited extent in 1974 but were ineffective.

Methods

During the 1975-76 segment of the project, emphasis was placed on netting in distinct habitat types around the lake in an effort to locate areas that stocked cutthroat tended to

inhabit (Figure 1). During 1975 six experimental nets of the type described above were set in the evening and pulled the following morning. Data were recorded on all species as to net location, depth, fishing time and species distribution within different mesh sizes. Total lengths were recorded on all fish while weights, stomach samples, otoliths and scales were collected from cutthroat and lake trout.

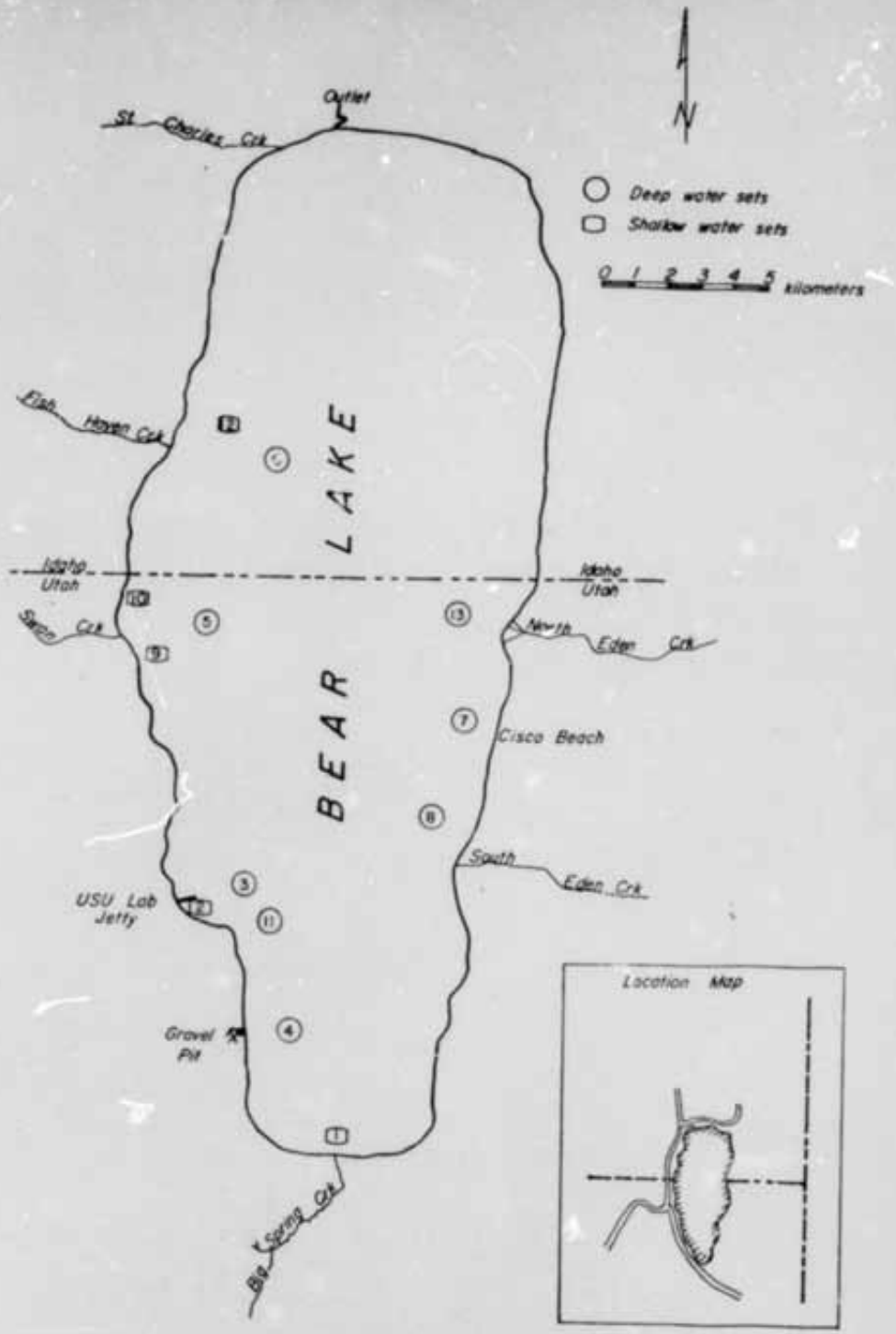

Figure 1. Bear Lake Map.

Attempts were made to sample the water column by setting nets at 3.2 m (10 ft) increments from the bottom, but subsequent SCUBA investigations indicated the nets were negatively bouyant and their midsections had sunk to the bottom. In 1976 there was an increased effort to float the horizontal gill nets within the water column. Underwater floats and additional flotations were used but with variable results. Consequently, there were not as many fish caught compared to 1975 when all nets were on the bottom. No definitive data were collected on distribution of cutthroat within the water column.

In 1976 a gang of nets consisting of four experimental nets, as described, and two 15.2 m (50 ft) exploratory monofilament nets of 12.7 mm (0.5 in) and 19.0 mm (0.75 in) stretch mesh were used. The exploratory nets were bottom sets incorporated into the program to sample for year classes 1+ cutthroat and forage species. Nets were normally set at 1800 hours, pulled and picked at 0700 hours, reset in the same location and pulled at 1800 hours. This regimen was used to determine if there were differences between daytime and nighttime efficiency.

Results

During 1975 gill-netting activities extended from July 22 to November 17 with the majority of netting occurring in August and September. Ten different locations were sampled at least once for a total of 1438 gill-net hours. Considerable effort was expended netting the littoral areas in attempts to locate year-class 1+ cutthroat. A total of 1051 fish of all species were captured for a catch rate of 0.699 fish/net-hour.

A breakdown of all species, total numbers, catch rates, percent of catch and average sizes is presented in Table 2.

In 1975 a total of 31 cutthroat were netted for a catch rate of 0.022 fish/net-hour. Sizes ranged from 155 mm and 22 g to 520 mm and 1850 g. The average total length of the cutthroat in 1975 gill nets was 284 mm and 316 g. Dates locations and depths for various gill-net sets are presented in Table 3.

Gill netting in 1976 was expanded to the day-night regimen and concentrated on deep-water sets with nets stratified as to depth. Netting started in April and continued through November with intensified efforts in September and October. A total of 1976 net-hours were fished with an overall catch rate of 0.755 fish/net-hour (Table 4).

The catch rate on cutthroat remained static at 0.023 fish/net-hour. Sizes for 1976 gill-netted cutthroat ranged from 205 mm and 60 g to 480 mm and 1000 g while the average was 364 mm and 416 g. A summary of the 1976 cutthroat netting is presented in Table 5.

When comparing the differences between the day and night sets, the overall catch rates were 0.641 and 0.807 fish/net-hour, respectively (Table 6). Catch rates for cutthroat were found to be higher during the daytime sets with 0.030 fish/net-hour for day sets and 0.022

Table 2. 1975 Bear Lake gill-netting summary

Species	Total Number	% of Catch	Catch /net hr	$\bar{X}$ TL(mm)	$\bar{X}$ Wgt(g)
Cutthroat	31	3	0.0216	284.3	316.0
Lake trout	57	5	0.0396	689.1	2549.7
Rainbow	1	1	0.0007	483.0	
Whitefish[a]	216	21	0.1502	251.5	
Cisco	391	37	0.2719	137.7	
Utah sucker	247	24	0.1718	349.5	
Utah chub	97	9	0.0675	142.1	
Carp	2	1	0.0014	370.0	
Yellow perch	4	1	0.0028	145.0	
Redside shiner	5	1	0.0035	107.6	
Total	1,051		0.7309		

[a]Include both Bonneville (*Prosopium Spilonotus*) and Bear Lake whitefish (*Prosopium Abyssicola*).

Table 3. Summary of Cutthroat Captured in Gill Nets on Bear Lake, 1975

Date	Location	$\bar{X}$ Depth (m)	Hr Fished	Total Cutthroat	Catch/net-hr	$\bar{X}$ TL (mm)	$\bar{X}$ Wgt (g)
7/22-23	5[a]	20	75 N[b]	4	0.053	365	754
7/28-29	5	27	93 N	1	0.011	420	500
8/ 5- 6	2	4	74 N	3	0.041	166	41
8/ 6- 7	9	5	74 N	3	0.041	192	55
8/11-12	10	3	66 N	0	---	---	---
8/12-13	3	21	78 N	4	0.051	276	247
8/18-19	3	23	77 N	0	---	---	---
8/19-20	3	19	85 N	4	0.050	387	637
8/21	11	33	30 D	1	0.033	330	285
8/25-26	6	25	78 N	0	---	---	---
8/26-27	12	6	93 N	1	0.011	179	52
9/ 8- 9	13	29	96 N	1	0.010	236	115
9/ 9-10	7	25	99 N	2	0.026	260	126
9/23-24	5	23	76 N	0	---	---	---
9/25-26	3	20	108 N	0	---	---	---
10/10-11	5	24	74 N	2	0.030	464	1250
11/17-20	5	25	162 DN	5	0.030	360	652
Total			1438	31	0.022	284	316

[a]Note Bear Lake map - Figure 1

[b]D = day N = night

Table 4. 1976 Bear Lake gill-netting summary

Species	Total Number	% of Catch	Catch /net hr	$\bar{X}$ TL(mm)	$\bar{X}$ Wgt(g)
Cutthroat	43	3	0.0243	363.8	460.5
Lake trout	56	4	0.0283	575.2	2811.3
Rainbow	5	1	0.0025	384.2	
Whitefish[2a]	337	23	0.1705	247.7	
Cisco	567	38	0.2869	157.6	
Utah sucker	440	29	0.2227	399.3	
Utah chub	26	2	0.0132	276.4	
Carp	2	1	0.0010	379.5	
Yellow perch	2	1	0.0010	129.0	
Redside shiner	6	1	0.0030	96.0	
Sculpin	1	1	0.0005	110.0	
Cisco X whitefish	2	1	0.0010	239.5	
Total	1,492		0.7551		

[a]Include both Bonneville and Bear Lake whitefish

Table 5. Summary of cutthroat captured in gill nets on Bear Lake, 1976.

Date	Location[a]	$\bar{X}$ Depth (m)	Hr Fished	Total Cutthroat	Catch/net-hr	$\bar{X}$ TL (mm)	$\bar{X}$ Wgt (g)
4/27-28	1	2	78 N[b]	0	—	—	—
6/17	2	3	26 D	3	0.115	314	283
6/17-18	2	3	72 N	2	0.027	318	363
6/28	3	21	48 D	0	—	—	—
6/28-29	3	21	72 N	0	—	—	—
7/ 8	4	26	51 D	0	—	—	—
7/ 8- 9	4	26	93 N	2	0.022	410	700
7/27	5	33	48 D	2	0.042	388	463
7/27-28	5	3	96 N	2	0.021	392	475
8/ 5	6	21	48 D	3	0.063	343	380
8/ 5- 6	6	21	93 N	1	0.011	370	450
8/ 9	7	33	120 N	2	0.016	344	358
8/30	13	15	57 D	2	0.035	279	193
8/30-31	13	15	99 N	1	0.010	205	60
9/23	5	20	84 D	0	—	—	—
9/23-24	5	20	60 N	0	—	—	—
9/27	6	29	60 D	1	0.016	480	1000
9/27-28	6	29	84 N	2	0.024	464	850
9/30	3	28	54 D	0	—	—	—
9/30-31	3	28	90 N	1	0.011	404	525
10/ 7	4	23	45 D	1	0.022	450	1000
10/ 7- 8	4	23	96 N	1	0.010	392	500
10/13	8	30	36 D	4	0.011	408	706
10/13-14	8	30	102 N	2	0.020	348	425
10/18	5	13	48 D	2	0.042	340	450
10/18-19	5	13	108 N	4	0.037	320	388
10/30-31	5	22	108 N	10	0.093	287	235
Total			1976	48	0.023	364	461

[a]Note Bear Lake Figure 1

[b]D = day N = night

Table 6. Day versus night gill-net catches on Bear Lake, 1976.

Species	Total Number	% of Catch	Catch/net hr	$\bar{X}$ TL (mm)	$\bar{X}$ Wgt (g)
Day total hours fished: 605					
Cutthroat	18	5	0.0298	374.3	540.0
Lake trout	20	5	0.0331	546.1	2627.5
Rainbow	1	1	0.0017	365.0	500.0
Whitefish[a]	119	31	0.1967	353.3	
Cisco	69	18	0.1140	162.9	
Utah sucker	153	39	0.2529	432.2	
Utah chub	3	1	0.0049	266.7	
Carp	2	1	0.0033	379.5	
Sculpin	1	1	0.0017	110.0	
Cisco X whitefish	2	1	0.0033	239.5	
Total	388		0.0641		
Night total hours fished: 1371					
Cutthroat	30	3	0.0219	339.9	404.0
Lake trout	39	3	0.0284	588.9	2908.3
Rainbow	4	1	0.0029	389.0	577.5
Whitefish[a]	218	20	0.1590	241.8	
Cisco	498	45	0.3632	156.6	
Utah sucker	287	26	0.2093	396.3	
Utah chub	23	2	0.0168	276.4	
Yellow perch	2	1	0.0015	129.0	
Redside shiner	6	1	0.0044	96.0	
Total	1107		0.0807		

[a]Includes both Bonneville and Bear Lake whitefish

fish/net-hour at night. In addition to netting in 1975, temperature profiles were taken on corresponding days throughout the season (Figure 2). They illustrated the typical pattern of stratification for a temperate lake with a well developed thermocline present by August, dissipating in October.

Discussion

The data collected over this segment with gill nets are difficult to interpret relative to the cutthroat fishery. Evaluation of catch rates and numbers should be with reservations since it is not apparent whether these are or are not representative of the population structure. For example, it should be pointed out that rainbow make up the largest percent of the trout creeled but are rarely recovered in gill nets. Adult cutthroat appear to be pelagic and are not particularly closely associated with the bottom or littoral areas, but fingerling cutthroat do appear to inhabit the littoral zones to a greater degree during their first two years in the lake.

The proportion of cutthroat in the gill nets has been increasing as the project continues. They made up 1.2 percent of the catch in 1974 and 3.0 percent of the catch during this segment. The spacial relationship between the cutthroat and its forage and competitors is complex and cannot be addressed at this early stage of data collection.

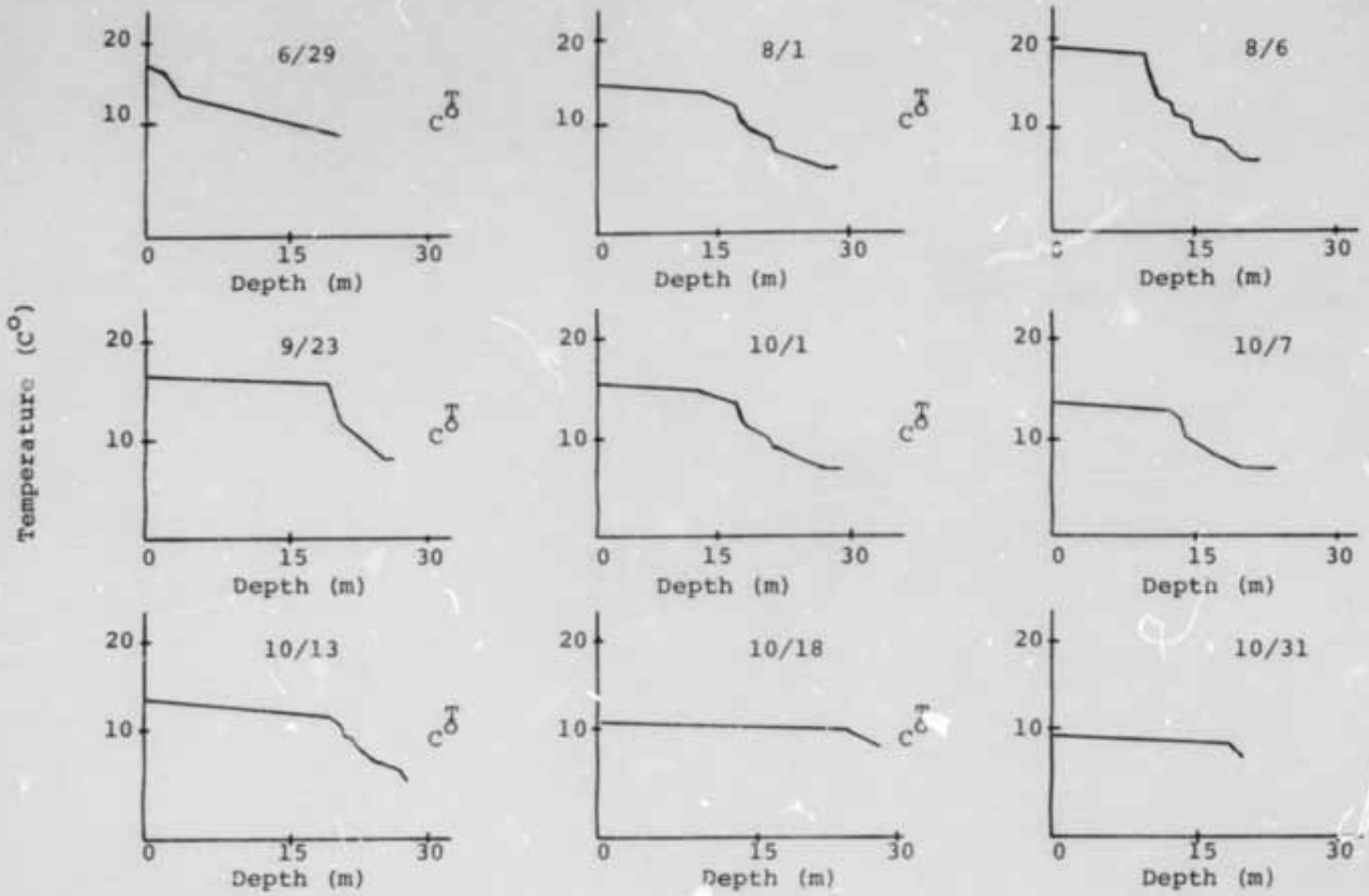

Figure 2. Water temperature profiles on Bear Lake, 1976.

Recommendations

It is recommended that the netting program be expanded to include locations having different characteristics and on which baseline data are available. These would include Fish Haven, which is characterized by a marl substrate adjacent to the largest littoral area in the lake. Swan Creek sample areas are associated with the spawning tributary and the area of heaviest fingerling stocking. The Utah State University laboratory location represents a sandy, gradually sloping area which receives the heaviest recreational use on the lake. The gravel pit location is representative of a sandy bench which drops off rapidly into the marl, profundal zone. The cisco beach area provides a steep drop-off with large boulders where the most intensive fishing pressure occurs on Bear Lake. The north Eden area represents one of the major deltas on the east side with a cobble bottom extending into the shallower reaches of the north end. Sampling at these locations should include day-night sets at stratified depths, if possible, to determine vertical distribution. Frequency of sampling is difficult to maintain considering activities and personnel restrictions, but a quarterly sampling of all locations would be optimum.

In future work, echo sounding and associated trawling should be explored along with random netting in the

littoral areas, stream mouths and deeper portions of the lake.

Food Habits and Age-Growth

Background

Food habits and growth of cutthroat in Bear Lake have never clearly been defined. McConnell (1957) reports that fish were the predominant prey item in 20 stomachs collected from cutthroat in 1955. Bonneville cisco (*Prosopium gemniferum*) and Bear Lake sculpin (*Cottus extensus*) were the most prevalent species observed. Preliminary work on this subject in 1974 indicated that Bonneville cisco were found in 30 percent of the stomachs sampled.

Age and growth information on cutthroat is also lacking. McConnell (1957) also stated that cutthroat collected in 1951-55 averaged 55 mm, 258 mm, 360 mm and 450 mm for the 2+, 3+, 4+, and 5+ year classes, respectively.

Methods

Stomach samples were taken in conjunction with gill-netting activities in 1975. The stomachs were analyzed fresh with only gross items being recorded. The stomachs analyzed in 1976 were preserved in formalin from netting and creel census checks in the fall. These were then analyzed as to frequency of occurrence within major food categories.

Age and growth work is not complete since scales and otoliths have not been read. Scales were taken from fish in the creel and gill nets in 1975, and in 1976 otoliths were collected in addition to scales.

Results

Stomach analyses in 1975 were performed on 27 cutthroat. Of these fish 32 percent had empty stomachs. The rest were classified according to total length increments as presented in Table 7. In the group that was less than 200 mm, terrestrial insects appeared in 50 percent of the stomachs as did aquatic insects. In fish between 200 mm and 299 mm, 56 percent had fed on terrestrial insects while all other categories, except cisco, were represented to a lesser degree. Cisco and terrestrial insects were represented to a lesser degree. Cisco and terrestrial insects were each represented in 25 percent of the fish ranging between 300 mm and 299 mm. The 400 mm to 499 mm group fed primarily on cisco and unidentified fish while the cutthroat over 500 mm fed exclusively on fish.

In 1976 there was a larger sample size (75 fish) with both gill-net catches and fall creel catches included. Twenty-five percent of the fish had empty stomachs (Table 7). Fish less than 300 mm fed primarily on insects and organic debris. Surprisingly, terrestrial insects were represented

Table 7. The frequency of occurrence of food items found in cutthroat trout in Bear Lake, 1975–76.

TL (mm)	Sample Size	Terrestrial Insects	Aquatic Insects	Sculpin	Cisco	Unk. Fish	Organic Debris	Misc	Empty
				1975[a]					
200	8	50.0%	50.0%	—	—	—	—	25%	25%
200 - 299	9	56 %	11 %	11%	—	22%	33%	33%	22%
300 - 399	4	25.0%	—	—	25.0%	—	—	—	50.0%
400 - 499	5	—	—	—	20	20	0	60	
500 - 599	2	—	—	100	100	—	—	—	—
	27								
				1976[b]					
200	1	—	—	—	—	—	100.0%	—	—
200 - 299	24	46 %	21 %	13%	4%	13%	42 %	4%	38 %
300 - 399	21	33 %	24 %	14%	5%	24%	19 %	5%	19%
400 - 499	19	32 %		16%	5%	24%	21%	11%	16%
500 - 599	6	17	—	—	33%	50%	17%	0%	17%
600	4	25 %	—	—	35%	—	—	25%	75%
	75								

[a]Stomachs taken from gill-net fish

[b]Stomachs taken from gill-netted and creeled fish

in significant percentages in all size increments from 300 mm to 600 mm. Fish remains were important in cutthroat over 400 mm.

Length-frequency histograms of the fish collected indicated that throughout the field season in 1975 the 2+ cutthroat were averaging 350 mm and 400 g while the 1+ age class averaged 200 mm and 125 g. In 1976 the 3+ year-class average total length was 475 mm and 1000 g and the 2+ cutthroat were 375 mm and 450 g. Due to the late stocking date, the 1+ age class was not represented.

Discussion

The food habits of the cutthroat in Bear Lake appear to reflect an opportunistic feeding behavior influenced by size. The smaller cutthroat prey heavily on drift from the adjacent land for their food sources. Since the aquatic insect populations in Bear Lake are limited, this food source has a minor role and is primarily made up of chironomids, coleoptera, and mayfly nymphs. Fish as small as 250 mm had fish remains in their stomachs, and from this point on other fishes make up the major proportion of their food supply.

The growth rates of cutthroat in Bear Lake correspond with earlier reports with the average cutthroat stocked at 127 mm (5.0 in) growing 125 mm per year for the first two years.

Recommendations

It is mandatory that continued work be done on the food habits of the cutthroat with larger sample sizes and a complete seasonal cross-section. The majority of the stomachs analyzed during this segment were in the summer and fall. More creeled fish would be valuable since bias due to regurgitation would be removed. Analysis of the samples in a fresh state with a volumetric measurement would improve the value of these studies.

The age and growth material requires considerable time but should be continued. Following comparison of scales versus otoliths as the aging material, the superior method should be adopted.

Literature Cited

McConnell, William J., William J. Clark and William F. Sigler. 1957. Bear Lake, its fish and fishing. Utah Dept Fish and Game, Idaho Dept Fish and Game and Wildlife Management Dept, Utah State Agricultural College. 76 p.

BEAR LAKE FISH STOCKING AND MARKING

Job III

Background

In the past twenty years, cutthroat trout stocking by both Idaho and Utah has been intermittent. Since 1969 there have been 8,128,310 cutthroat fry planted by the Utah Division of Wildlife Resources (UDWR) in Bear Lake. Creel surveys indicated that there were negligible returns to the creel from these fish.

From 1969 to June 30, 1975, there were 602,071 fingerling cutthroat and 30,670 catchable cutthroat stocked. Of the fingerlings, 330,269 were progeny from the Bear Lake stock. The remainder were fish from eggs taken at Strawberry Reservoir, which originally were of Yellowstone Lake ancestry.

These fish were mass marked with different color combinations of fluorescent dyes (Phinney 1967) for later identification. Creel census and other sampling programs were implemented to ascertain the success of these different plants.

Methods

Two main factors, which were considered in developing a stocking program for Bear Lake were the size and

time of year of stocking. A 127 mm (5.0 in) fish was selected initially due to results of other studies on large bodies of water with competing nontrout species. At present the hatchery system dictates the time of stocking as determined by the time required to produce a 127 mm fingerling. Stocking is normally in the spring but due to problems was in the summer and fall of this segment. Another factor is the method and area of planting. The majority of fish were dispersed by barge and single point dumping in the more extensive littoral areas or in the vicinity of a spawning tributary.

Fish which were released directly from the distribution truck were tempered to the lake water and dumped directly into the lake via an irrigation pipe. The preferred stocking technique was to use a distribution barge. This equipment has holding tanks and a recirculating pump which draws water directly from the lake to temper the fish to the lake conditions. This allows the biologist to observe the fish's behavior and condition prior to planting. Its mobility also allows for distribution throughout littoral areas which provides more efficient dispersal. The fish, after being acclimated to the water, are released through a butterfly valve and tube at the rear of the boat at a rate that can be selected by the operator.

The mass marking of cutthroat was accomplished with a heavy-duty, gasoline air compressor and a sandblasting gun. The specially manufactured dye pigment is available in a variety of colors. The pigment was strained through a screen to remove particles which would clog the spray gun. Canisters were filled three-quarters full and shaken continuously while spraying.

After the fish have been segregated in the raceway, they are netted into a box with a screen bottom and sprayed at a distance of 305 mm (12 in) for approximately eight seconds. Excess pigment remained on the fish for a period of time until the mucus layer sluffed off leaving only the imbedded pigment. Work done with this type of marking in Colorado (Wiltizius 1976) indicated that some modifications in the spraying operation may be advisable to improve efficiency and mark retention. This will be tested in future operations to determine its suitability for cutthroat.

Results

From July 1, 1975 to December 31, 1975 there were 36,150 cutthroat at 23.0 fish/lb stocked in the southwest end of Bear Lake. These fish were marked with a red pigment and were Bear Lake strain. In addition, there were 15,072 Strawberry strain catchable-size cutthroat tagged with red anchor tags and 838,012 fry from the same source

Table 8. Summary of cutthroat stocking on Bear Lake, July 1, 1975 through December 31, 1976.

Date	Number	Lbs	No/lb	Mark[a]	Method
7/2/75	31,200	1300	24.0	red dye	pt release
7/2/75	3,072	640	4.8	red "T"	pt release
7/29/75	4,950	275	18.0	red dye	pt release
9/25/75	276,012	198	1394.0	-	tributary
9/30/75	272,000	200	1360.0	-	pt release
9/30/75	136,000	100	1360.0	-	tributary
10/8/75	154,000	140	1100.0	-	pt release
7/13/76	28,700	1400	20.5	green dye	barge
7/13/76	29,960	1400	21.5	green dye	barge
7/20/76	20,295	990	20.5	green dye	barge
8/6/76	60,000	2500	24.0	green dye	barge
8/12/76	15,912	670	23.8	green dye	barge
8/20/76	12,000	1000	12.0	adipose	barge
9/21/76	56,250	2500	22.5	green dye	barge
9/22/76	9,675	430	22.5	green dye	pt release
9/23/76	14,814	685	21.6	ad-lp	tributary

[a]Red dye - Bear Lake strain

Red "T" - Strawberry strain catchables

- - Strawberry strain fry

Green dye - Bear Lake strain

Adipose clip - Strawberry strain

ad-lp - Adipose-left pelvic - Bear Lake strain

Table 9. Summary of all fish species stocked by Utah Division of Wildlife Resources in Bear Lake from July 1, 1975 through December 31, 1976.

Year	Species[a]	Tot No	Tot lbs	No/lb	Mark
1975	cutt	36,150	1575	23.0	red dye
1975	cutt	15,072	3040	4.9	red "T"
1975	cutt	838,012	638	1313.5	
1975	rbt	9,710	3460	2.8	
1975	lake	45,260	730	62.0	
1976	cutt	220,792	9890	22.3	green dye
1976	cutt	12,000	1000	12.0	adipose
1976	cutt	14,814	685	21.6	ad-lp
1976	rbt	23,676	6395	3.7	
1976	lake	62,348	5720	10.9	

[a]cutt - cutthroat

rbt - rainbow

lake - lake trout

averaging 1313 fish/lb stocked in the lake and its tributaries. In 1976 Bear Lake strain cutthroat were marked with a green pigment. There was a total of 235,606 fish averaging 22.3 fish/lb stocked in the lake and tributaries. Another 12,000 Strawberry strain sub-catchables were also distributed in the lake at 12 fish/lb (Table 8).

Other species of fish stocked by UDWR during this segment were 9710 rainbow at 2.8 fish/lb and 45,205 lake trout at 62 fish/lb in 1975 and 23,676 rainbow at 3.7 fish/lb and 62,348 lake trout at 10.9 fish/lb in 1976 (Table 9).

Discussion

The stocking of fish into Bear Lake is often a perplexing problem. Due to the morphology of the area, there are few locations which seem more suitable than others. The extreme weather conditions and lake levels often severely restrict a choice of stocking. Tributary stocking for imprinting and enhancement of future spawning runs is also a consideration. During this segment nearly all of the possibilities were utilized but, since there is no return or survival data available at this time, no conclusions were made.

Supplemental stocks of other species are providing additional fishing returns. Bear Lake is lightly fished and has a poor reputation that may be somewhat enhanced

by the stocking of rainbow which are easy to catch and lake trout which provide a trophy fishery.

Recommendations

It appears that, when conditions are favorable, the distribution barge is the most efficient means to distribute the fish. The gradual tempering of the water for temperature and chemical characteristics is vital. General observations indicate that cutthroat immediately migrate over large areas, and the actual spot of distribution is not as important as the general area. Fish also readily ascend tributaries near the stocking sites, and this should be used to advantage as opposed to the direct tributary stocking.

Literature Cited

Phinney, D.C., D.M. Miller, and M.L. Dahlberg. 1967. Mass-marking young salmonids with fluorescent pigment. Trans Amer Fish Soc 96(2):157-162.

Wiltizius, William J. 1976. Curecanti Unit, lower Gunnison River fishery investigations. In Colorado Fisheries Research Review, Oliver B. Cope, Ed. Review No. 8 Colo Div Wildl. p. 39-40

MEASUREMENT OF BEAR LAKE'S FISHING PRESSURE, HARVEST, AND SUCCESS

Job IV

Background

The first intensive creel census was initiated in 1974 which, with few modifications, has been continued to date. The last published census data on Bear Lake in 1955 (McConnell, 1957) indicated a slow fishery with an average catch rate for all game fish of 0.125 fish/hour. Unpulbished data as early as 1939 also describes fishing success as consistently below 0.10 fish/hour.

Two problems with conducting a creel census of Bear Lake are angler trends and dispersal. A road completely encompasses the lake, but only certain locations are fished regularly. The lake is too large for instantaneous counts, and during the summer months, with excessive recreational traffic, distinction between fishing and nonfishing boats is difficult. Another problem is the large number of private residences and ramps around the lake.

In comparison with other waters of similar size, Bear Lake's fishing pressure is negligible. Taking these problems into consideration, a creel census has been devised to document trends in pressure and success.

Methods

The creel census method used during this segment of the project consisted of an average of 14 census days per month with two randomly scheduled counts during each census day. The creel clerk drives around the lake and interviews as many shore parties as possible and boats when approachable. Each interview determines the number of anglers in the party, the total hours spent fishing, the number and species of fish caught and each angler's state of residence. The cutthroat are measured for total length and weight, scale and otolith samples are taken for age and growth information, each fish is inspected under an ultra-violet light for possible marks, and stomachs are taken when available. Additional information may be taken on lake trout and other species if conditions warrant.

Results

The creel census summary for the last half of 1975 is found in Table 10. Boat fishermen expended 3445 hours to catch 380 fish, and shore anglers fished 20,965 hours for 5251 fish for a mean catch of 0.231 fish/hr. Creel data projections showed rainbow to be the most prevalent fish harvested with 3058 caught followed by cutthroat, 523; whitefish, 502; and lake trout, 410. Catch rates were in

Table 10. 1975 Bear Lake creel census data.

Month	Estimated Angler hr/mo		Catch/hr	Total Harvest		Catch/hr by species				Estimated catch			
	Boat	Shore		Boat	shore	cut	lake	rbt	whf[a]	cut	lake	rbt	whf
July	315.7	3501.3	0.075	62	223	.003	.005	.057	.007	13	21	217	26
August	1448.4	3287.8	0.280	153	1159	.050	.030	.180	.014	236	144	866	66
September	989.4	4063.0	0.290	129	1348	.020	.003	.270	.003	89	15	1358	15
October	33.4	6196.1	0.220	36	1379	.020	.030	.140	.024	127	198	934	156
November	358.6	2194.5	0.170	0	446	.004	.009	.068	0	10	23	174	0
December	0	1723.0	0.400	0	[illegible]	.028	0	.240	.140	48	0	409	239
Total	3445.5	20,965.7	0.231	380	5251	.021	.017	.162	.021	523	410	3958	502
Total 1975	4108.5	40,177.7	0.409	455	17,639	.022	.016	.128	.230	1033	707	5655	10,164

[a]whf - whitefish

the same order with 0.162 fish/hr, 0.021 fish/hr, 0.021 fish/hr and 0.017 fish/hr. For the entire year of 1975 there were 4108.5 boat hours and 40,177.7 shore hours expended for 455 and 17,639 fish captured, respectively. The mean catch rate was 0.409 fish/hr for 1975.

In 1976 angling pressure increased by 51.8%. There was a total of 9726.9 boat hours and 57,477.8 shore hours for a total of 67,204.7 angler hours (Table 11). The total fish harvested decreased by 9 percent to 16,468 from 18,094 the previous year. Conditions unfavorable to the winter whitefish harvest were responsible for the overall catch decline. The composition of the creel remained the same with species ranking and total numbers being 8308, 4730, 1805, and 573 for rainbow, whitefish, cutthroat and lake trout, respectively. The mean catch rate in 1976 declined to 0.250 fish/hr from 0.409 fish/hr in 1975. The cutthroat catch rate increased slightly from 0.023 fish/hr to 0.027 fish/hr while the lake trout catch rate declined from 0.016 fish/hr to 0.009 fish/hr. The rainbow catch remained about the same with 0.124 fish/hr and 0.128 fish/hr in 1976 and 1975, respectively. The average cutthroat creeled in 1975 was 301.9 mm and 604.7 g from a sample of 63 fish. In 1976 the average creeled cutthroat was 420.4 mm and weighed 892.6 g from a sample of 40 fish.

Table 11. 1976 Bear Lake creel census data

Month	Estimated Angler hr/mo		Catch/hr	Total Harvest		Catch/hr by species				Estimated catch			
	Boat	Shore		Boat	Shore	cut	lake	rbt	other	cut	lake	rbt	other[a]
Jan-Mar	0	5704.0	0.870	0	4967	.190	0	.150	.650	925	0	728	3214
April	316.0	3206.0	0.072	23	231	.020	.010	.020	.020	53	43	67	77
May	2269.0	19,330.4	0.076	199	1441	.007	.014	.040	.015	166	311	858	315
June	2131.5	7464.8	0.220	92	2022	.009	.012	.170	.026	90	112	1667	245
July	1752.4	8026.6	0.240	102	2222	.013	.004	.200	.016	129	40	1998	157
August	1914.0	3390.0	0.190	709	1256	.005	.005	.180	.003	28	28	935	18
September	490.0	2685.0	0.110	20	329	.040	.004	.070	0	112	14	223	0
October	377.0	2692.0	0.180	34	528	.020	.004	.150	.010	56	12	455	39
November	150.0	1897.0	0.330	108	574	.030	.006	.240	.050	67	13	497	95
December	327.0	3082.0	0.480	197	1432	.050	0	.260	.170	179	0	880	570
Total	9726.9	57,477.8	0.250	1484	15002	.027	.009	.124	.070	1805	570	8308	4730

[a]See footnote p. 37

Discussion

The most successful period of fishing on the lake is late fall through early spring. Since most of the pressure occurs on the east side of the lake, accessible only by gravel road, snow and ice conditions can preclude angler use. This is precisely what happened in 1976. Poor ice fishing conditions existed throughout the winter and the east-side road was closed for five weeks. Since the whitefish make up half of the total fish in an expanded harvest estimate, a poor or excellent winter season will substantially influence the total catch rate.

Of primary interest is the cutthroat harvest. In 1976, there was a 70 percent increase in the estimated harvest over 1975 from 1033 to 1805 cutthroat. This is a reflection of increased pressure since the change in catch rate was negligible. The 0.027 fish/hr in 1976 does compare favorably with the 0.0037 fish/hr in the first year of census, 1974. Bear Lake is well known for its water-related recreation and poor fishing. Subsequently, during the summer months when most of the pressure occurs, fishing is a secondary activity to waterskiing, swimming, SCUBA diving and other water sports. Though these people fish, their abilities and dedication to catching fish are marginal which depresses the annual catch rate substantially. Careful examination of the creel census reveals fair fishing for most of the year with the exception of these summer months.

Recommendations

Probably one of the key recommendations concerning increasing the number of cutthroat in the creel would be angler education. People continue to fish in the same manner and areas that have been popular for the last thirty years. Increased emphasis should be put on educating fishermen that there are other productive areas in the lake that are seldom fished which could provide better angler success.

One other part of the education process is to improve the angler's ability to distinguish the cutthroat from the rainbow. In Bear Lake, the creeled cutthroat rarely exhibit the cutthroat slash and are silvery in appearance with a discrete spotting pattern. Once anglers can distinguish the cutthroat and associate them with their quality, perhaps more pressure will be exerted on this species.

Literature Cited

McConnell, William J., William J. Clark and William J. Sigler. 1957. Bear Lake, its fish and fishing. Utah Dept of Fish and Game, Idaho Dept of Fish and Game and Wildlife Management Dept, Utah State Agricultural College. 76 p.

Appendix A. List of species mentioned in text.

Common Name	Scientific Name
Cutthroat trout	*Salmo clarki* Richardson
Lake trout	*Salvelinus namaycush* Walbaum
Rainbow trout	*Salmo gairdneri* Gibbons
Bonneville cisco	*Prosopium gairdneri* Gibbons
Bonneville whitefish	*Prosopium spilonotus* Snyder
Bear Lake whitefish	*Prosopium abyssicola* Snyder
Utah sucker	*Catostomus ardens* Jordan and Gilbert
Utah chub	*Gila atraria* Girard
Carp	*Cyprinus carpio* Linnaeus
Redside shiner	*Richardsonius balteatus* Cope
Yellow perch	*Perca flavescens* Mitchell
Bear Lake sculpin	*Cottus extensus*

APPENDIX B. SIGNATURE PAGE

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Archives Approval Number: 7700364

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