F-07-4 also,
F-7-R-15
07 to
F-7-R-35
Flathead
Below So. Fork.
#35050

REGION 1

LAKE MARY RONAN FISH MANAGEMENT MONITORING REPORT
1965 - 1986

A summary of information and recommendations from Federal Aid in Fish Restoration Projects: Montana F-7-R-15 to F-7-R-35

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Date: February 27, 1987

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ABSTRACT

This report summarizes an ongoing fisheries monitoring program at Lake Mary Ronan in existence since 1965 with emphasis on the kokanee fishery. Information presented includes fish population trend data from spring and fall gill netting surveys, and creel information collected during the winter fish season and on opening day of the summer season. Trophic status of the lake is discussed. Water temperature-oxygen profile measurements were collected during summer in the late 1960's and early 1970's to assess kokanee habitat limitations. Management decisions are updated periodically based largely on findings of the fish monitoring program. Recommendations include adjustments to the stocking program and the continuation of the present fisheries monitoring program. Optional fish management studies are presented.

INTRODUCTION

Lake Mary Ronan is one of the most popular kokanee fishing lakes in northwestern Montana. There were an estimated 20,588 angler days during the summer of 1968 based on an on-site creel census (Domrose 1970). Estimates for the 1975-76 and 1984-85 fishing seasons were 31,544 and 34,750 angler days respectively based on mail questionnaire surveys (Montana Department of Fish Wildlife and Parks, Kalispell, MT, 1976, 1985).

Some serious management problems evolved in the late 1960's when the kokanee (Oncorhynchus nerka) fishery began to decline. Angler catch success for this species was less than 0.20 fish per hour in 1968 and comprised only 31 percent of the catch. The survival of kokanee fry plants to fish of catchable size was extremely low.

Cursory data collected from a series of vertical dissolved oxygen-temperature profiles taken in late August of 1968 suggested that low dissolved oxygen concentrations were present in the middle and lower strata of the thermocline. This condition, coupled with low lake levels and the possibility of high mortality of off-shore kokanee fry plants was believed responsible for the poor fishery in the late 1960's.

A recent decline in the kokanee fishery experienced in 1982 was believed to be related to poor survival of two successive annual fry plants.

OBJECTIVES

Fisheries management objectives are to maintain or improve water quality and quantity for survival and growth of kokanee, westslope cutthroat trout (Salmo clarki lewisi), rainbow trout (Salmo gairdneri), and largemouth bass (Micopterus salmoides).

The success and well being of the fishery is monitored annually by determining angler catch rates, age and growth rates, water quality, and relative abundance and size of fish. These data are evaluated and serve as a basis for formulating strategies for maintaining or improving the fishery with the major emphasis on kokanee. This has been an ongoing monitoring program since 1965.

AREA DESCRIPTION

Lake Mary Ronan is located in Lake County, Montana, approximately 35 miles southwest of Kalispell. It lies at an elevation of 3,700 feet (msl) and has a surface area of 1,506 acres at full pool with a maximum depth of 47 feet (Figure 1). About 40 percent of the lake area is 30 feet or less in depth. The lake has a volume of 45,431 acre-feet with a shoreline length of 6.84 miles. The surrounding topography ranges from a moderately steep shoreline

bordering the south shore to a gentle sloping shoreline along the west, north, and eastern shorelines. The entire shoreline, with the exception of the dike outlet area, is timbered with the dominant species being larch, douglas fir, cottonwood, and alder. The littoral areas of the lake are moderately to heavily vegetated with the dominant species being potamogeton spp., cattails, and bull-rush.

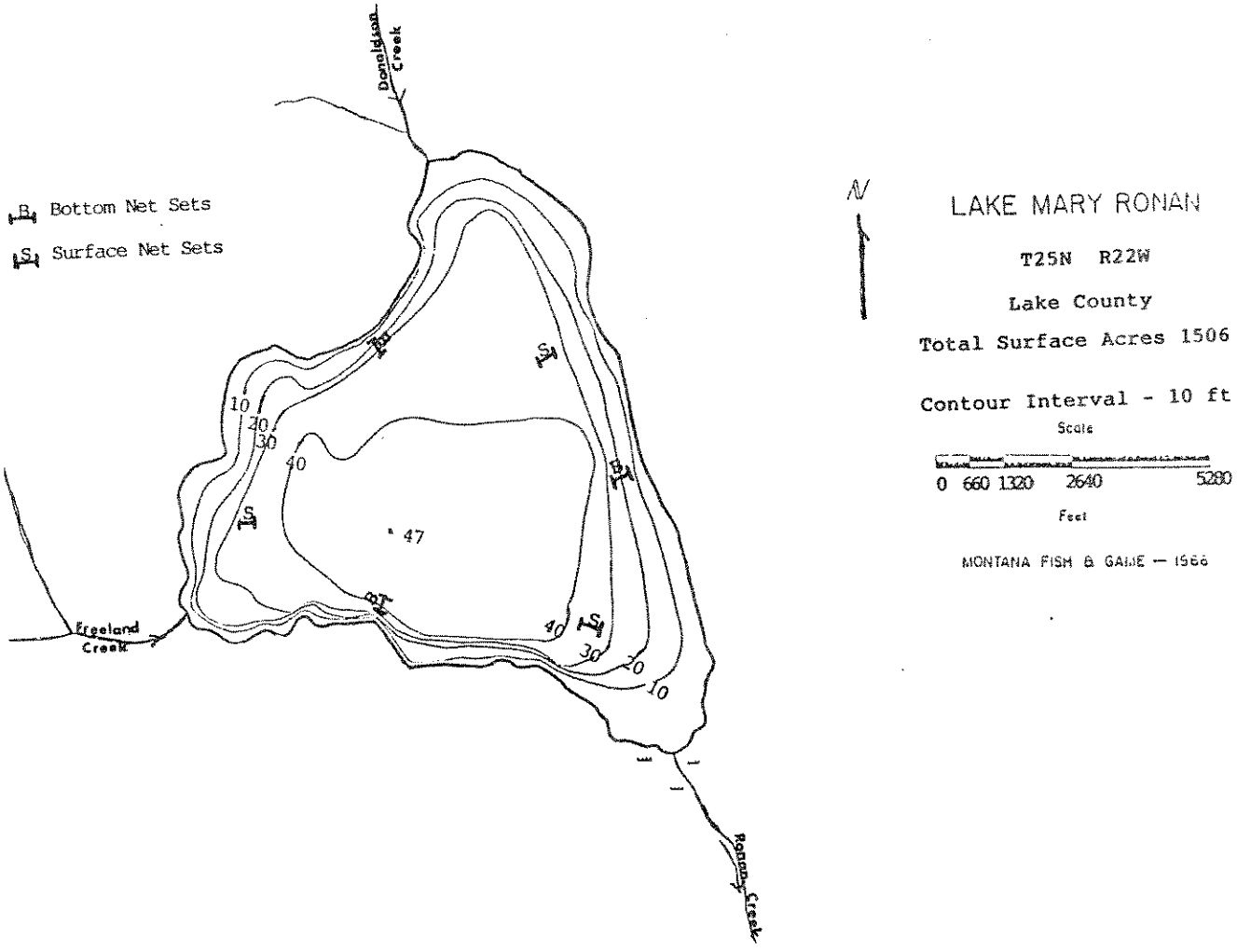


Figure 1. Depth contour map of Lake Mary Ronan and location of gill net sampling sites.

The lake has a drainage area of 32.3 square miles and is fed primarily by two small tributary streams--Freeland and Donaldson creeks. In years of average spring runoff, stream flows range from 15 to 20 cfs. Late summer inflows decrease to about 2 cfs or less. In extremely dry years, such as experienced in 1977, portions of Freeland Creek dry up by late summer.

An earthen dike with a water control structure constructed in the early 1930's at the lake outlet controls the lake level. Downstream users presently have water rights to about 12,600 acre feet of lake storage. Summer lake levels for six years of record between 1976 and 1984 have fluctuated an average of 1.6 feet per year from full pool elevation. From full pool elevation the lowest water level occurred in September of 1977 (-3.05 feet) and the highest (+.86 feet) in June of 1980.

The outlet drainage is Ronan Creek, a tributary to Flathead Lake. In the summer of 1977 several miles of this stream were dry during the period of maximum irrigation use.

Shoreline ownership is approximately 75 percent Plum Creek Timberlands, 22 percent small private parcels, and 3 percent Department of State Lands and Department of Fish, Wildlife and Parks land. Three commercial resorts (catering almost entirely to fishermen) and approximately 60 summer cabins including several year-round home sites border the lakeshore. All cabin site leases on land controlled by Plum Creek Timberlands were terminated within the past 14 years. The Montana Department of Fish, Wildlife and Parks maintains a 76-acre campground (Lambeth State Park) located along the east shore. Other park facilities include a day use area and a boat launching and docking facility with parking space for several cars and boat trailers.

Land ownership in the drainage area above the lake is 60 percent Plum Creek Timberlands, 30 percent Flathead National Forest, 5 percent Department of State Lands, and 5 percent small private land holdings. The upper drainage is managed for timber production and livestock grazing.

FISHERIES RESOURCE

An account of probably the first planting of Lake Mary Ronan was given by Ole Anderson of Proctor, Montana, and related to H. B. Stanford on May 24, 1932 ("Kalispell Weekly News").

> In the spring of '92, Major Ronan had shipped to him from Denver, three hogsheads (approximately 32 gallons each) of fingerlings--two of cutthroat trout and one of peamouth or shiners. The latter as food for the trout in the fishless lake. These were unloaded at Ravalli and hauled with a big four horse team across the reservation, ferried over the Pend d'Oreille at the foot of the lake, up the valley of Dayton Creek and over a rough hay cut road into the Big Meadow south of Lake Ronan. After much chopping on the fourth day the hogsheads were emptied of their contents into the lake.

The fish species presently inhabiting Lake Mary Ronan include kokanee, westslope cutthroat trout, rainbow trout, largemouth bass, and pumpkinseed (Lepomis gibbosus). Attempts prior to 1953 to introduce several other fish species met with limited success. These species include Coho salmon (Onocorhynchus kisutch), chinook salmon (Onocorhynchus tshawytscha), arctic

grayling (Thymallus arcticus), brook trout (Salvelinus fontinalis), and Yellowstone cutthroat trout (Salmo clarki bouvieri).

Kokanee were introduced into Lake Mary Ronan prior to 1918. Department seining crews captured kokanee in their nets in November of 1918 while trying to obtain brook trout eggs. It was assumed that the plant came from a mixed shipment of chinook salmon eggs from Oregon planted in 1916 (Alvord 1975). The first recorded kokanee introductions were made in 1931. By 1948 kokanee became an integral segment of the management stocking program. After 1967 kokanee fry were dispersed by boat in pelagic areas of the lake in early spring. Prior to that time, kokanee fry were planted from shore. Numbers of kokanee fry planted from 1954 through 1986 are shown in Figure 2.

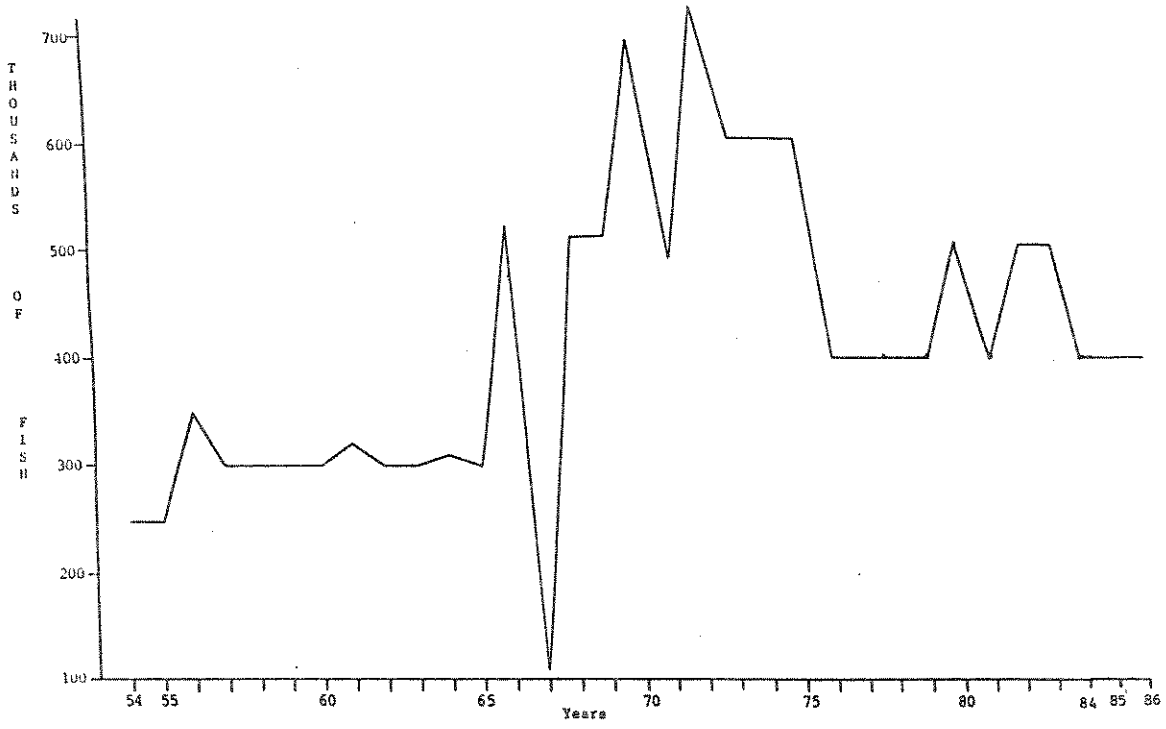


Figure 2. Annual kokanee fry plants in Lake Mary Ronan.

Westslope cutthroat trout were initially introduced in 1974 and are planted annually in late spring as sub-catchable 4-6 inch fish.

Rainbow trout were stocked annually until 1974 and then were replaced on the stocking program with westslope cutthroat trout. At present the rainbow

trout population is maintained by natural reproduction. Inlet tributaries Freeland and Donaldson creeks provide spawning and nursery areas. Stocking records for rainbow and westslope cutthroat trout from 1953 through 1986 are shown in Table 1.

Table 1. Rainbow and westslope cutthroat trout planted in Lake Mary Ronan, 1953 to 1986.

Year	Rainbow	(Inches)	Cutthroat	(Inches)
1953	26,696	3		
	12,365	4-6		
1954	246,449	3		
	21,240	4-6		
1955	331,200	3		
1956	356,690	3		
1957	228,056	3		
1958	210,112	3		
1959	250,368	3		
1960	171,252	3		
1961	137,816	3		
1962	63,000	4-6		
	21,735	7		
1963	89,620	3		
	42,780	4-6		
	20,600	7		
1964	21,000	4-6		
	34,304	7		
1965	88,820	4-6		
1966	48,000	7		
1967	70,500	4-6		
1968	71,700	4-6		
1969	40,700	4-6		
1970	39,960	4-6		
1971	49,500	4-6		
1972	50,400	4-6		
1973	50,156	4-6		
1974	41,320	4-6	22,506	4-6
1975	-	-	29,376	4-6
1976	-	-	40,698	4-6
1977	-	-	40,099	4-6
1978	-	-	40,365	4-6
1979	-	-	40,000	4-6
1980	-	-	50,633	4-6
1981	-	-	40,691	4-6
1982	-	-	59,362	4-6
1983	-	-	23,266	4-6
1984	-	-	60,135	2
1985	-	-	45,460	5
1986	-	-	48,914	4

Pumpkinseed and largemouth bass were believed to have been introduced sometime between 1931 and 1932 as a result of a bass sunfish salvage operation carried out by the Somers Hatchery (Alvord 1975).

REGULATIONS

The current fishing season opens with the general season for streams on the third Saturday in May and closes March 15 of the following year. The daily and possession bag limits are: for cutthroat trout and rainbow trout--10 fish or 10 pounds and 1 fish not to exceed 10 pounds; largemouth bass--5 fish. The daily limit for kokanee is 10 fish with a possession limit of 20 fish. Possession limits for trout and bass are the same as daily limits. Fishing is closed year around in Freeland and Donaldson creeks to protect rainbow trout spawning runs. A fall kokanee snagging season opens October 15 and ends November 30. The limit for the snagging season is 20 fish daily and 40 in possession.

METHODS

Opening day creel information was derived from angler interviews. The data collected included the residence of the angler, number of hours fished, and the number and species of fish caught. Other information collected were length and weights of fish and scale samples. Most angler contacts were made at the state access site. Opening day creel data were collected from boat anglers and included only complete trip information.

Winter creel census interviews from 1974 to 1984 included both complete and incomplete trips and provided qualitative data on angler catch rates and harvest composition. Winter creel census data in 1985 and 1986 were taken from completed trip information in a complete creel census. Average catch and harvest rates were expanded by traffic counter readings to calculate total fishing pressure and harvest rates.

Water samples were collected with a Kemmerer water sampler. Oxygen determinations as described in the section on oxygen and temperature profile monitoring were made using the modified Winkler method. Water temperatures were recorded with an electric thermometer.

Sinking and floating experimental gillnets, 125 feet in length by 6 feet in depth with a graduated mesh measuring 1/2 to 2 inches bar length, were used to sample fish populations in the spring and fall. On occasions small mesh gillnets (1/4 to 1/2 inch bar mesh) 75 feet by 6 feet, were used during the spring netting period to capture small yearling fish.

FINDINGS

Winter Fishery

Prior to 1967 Lake Mary Ronan had been closed to winter fishing. The winter closure was intended to prevent over-exploitation of adult rainbow trout to protect egg-taking operations. Large numbers of rainbow trout were trapped annually at the mouth of Donaldson and Freeland creeks and eggs were transported to several state hatcheries for rearing. After the development of a rainbow trout broodstock at the Arlee Hatchery, the need no longer existed to maximize the protection of the rainbow trout spawning population. The last year of spawning-taking operations was in April, 1967, when 33,820 eggs were collected from the Freeland Creek trap site. A summary of rainbow trout spawn-taking operations from 1954-1967 is presented in Table 2.

Table 2. Summary of rainbow trout spawn-taking operations from Donaldson and Freeland creeks, 1954-1967.

Year	Date of first egg take	Number females	Number males	Total number fish	Number of eggs taken
1954	4/16	1,195	398	1,593	1,879,284
1955	4/24	1,682	621	2,303	3,040,676
1956	4/15	1,008	129	1,137	1,766,424
1957	4/13	830	273	1,103	1,571,820
1958	4/07	898	403	1.301	1,481,983
1959	4/05	1,405	682	2,087	2,368,987
1960	4/01	1,031	309	1,340	1,724,125
1961	3/28	616	140	756	944,860
1962	4/24	266	83	349	536,475*
1963	4/03	499	141	640	684,515
1964	None				
1965	None				
1966	None				
1967	--	--	--	--	33,820

*Donaldson Creek only.

After meeting with resort owners, lakeshore residents, and local sportsmen about the merits of providing a winter fishery, an experimental ice fishing season was approved by special Fish and Game Commission action for the winter of 1966-1967. The initial winter fish season was restricted to weekend days only covering a four-week period (a total of 8 angler days). A pilot creel census study was conducted to compile complete fishing pressure and harvest data (Domrose 1968).

It was anticipated that a winter angling season would attract large numbers of anglers with the result of a large harvest of fish. However, these

expectations were not realized. The entire season attracted only 444 anglers with a total catch of 114 game fish. The average catch per angler was extremely low (0.26 fish), and the average catch per angler hour was 0.08 fish. Rainbow trout comprised 97 percent of the catch with largemouth bass and kokanee comprising the remaining 3 percent.

The extremely poor fishing success during the initial ice fishing season was in part due to low population densities of kokanee. This was borne out by the low catch success rate (0.68 fish per angler) for anglers during a creel census conducted the following summer of 1968 (Domrose 1970).

The data seemed to indicate that the added fishing pressure exerted by a winter fishery would not be at the detriment of the summer fishery. Furthermore, a more liberal winter fishery could be adopted to expand winter fishing opportunities for the angler.

In 1968, a proposal to extend the winter fishing season for a six-week period from January 14 through March 3 had the support of local sportsmans' groups and was approved by the Fish and Game Commission. A follow-up winter creel census was conducted to determine total harvest with an extended season (Domrose 1969). An estimated 412 fishermen harvested 306 game fish during the entire season. The average catch per angler was 0.74 fish, and the average catch per hour was 0.21 fish. Rainbow trout and largemouth bass were the only species contributing to the catch comprising 90 and 10 percent respectively.

In 1969 the season was liberalized further and extended from the opening day of the general fishing season in May to March 30 the following year, a period of approximately 10 1/2 months. This season was in effect until May, 1982, when the season was shortened by two weeks to end March 15.

Since the initial winter creel census in 1967, periodic creel checks were conducted from 1974 through 1986 to monitor winter angling success (Table 3). The kokanee fishery experienced a marked improvement since 1967 and became the predominant fish species in the game fish harvest, comprising 96 percent of the catch. Angler success for kokanee taken on random census days over a 13-year period averaged 5.4 fish per angler at a rate of 1.7 fish per hour. This catch rate represents data collected from both complete and incomplete trips. The average catch rates per angler would be higher if only completed trip information were collected. The average catch for all species was 5.5 fish.

Total fishing pressure and harvest estimates were obtained for the winter fishery in 1985 and 1986. The estimates were derived from creel census interviews and expanded from car count data. In 1985 5,770 angler days were expended resulting in a harvest of 42,528 fish at a catch rate of 6.7 fish per angler (Domrose 1985). In 1986 an estimated 3,301 anglers harvested 16,476 fish at a catch rate of 5.0 fish per angler (Domrose 1987).

A length frequency of kokanee collected from winter creel data is presented in Table 4. During the past 13 years, the average kokanee ranged between 10.0 and 14.4 inches. The age group composition of the catch and average total length (by age class) is shown in Table 5. Age class III+

comprised the largest percent of the harvest with the exception of 1974, 1983, and 1984. Collectively age classes II+ and III+ comprised greater than 94 percent of the kokanee harvest with the exception of 1974 when these age groups comprised 75 percent of the harvest.

Table 3. Summary of Lake Mary Ronan winter creel census data collected for years 1974-1986. (Species composition percentage in parentheses.)

Year	No.of Census Days	No.Anglers Interviewed	Total Hours Fished	Average Length/ Trip(Hrs)	Total Fish Caught	Number Kokanee	Number Rainbow	Number Cutthroat	Catch/Angler All Species	Catch/Angler Kokanee	Catch/Man Hour All Species	Catch/Man Hour Kokanee
1974	1	23	57.0	3.8	164	163 (99)	1 (1)	0 (0)	7.1	7.1	1.9	1.9
1975	1	24	53	2.2	101	94 (93)	7 (7)	0 (0)	4.2	3.9	1.9	1.8
1976	2	67	214.0	3.2	182	180 (99)	0 (0)	2 (1)	2.7	2.7	0.9	0.8
1977	4	64	256	4.0	274	273 (99.6)	1 (0.4)	0 (0)	4.3	4.3	1.1	1.1
1978	4	78	181	2.3	337	289 (86)	7 (2)	41 (12)	4.3	3.7	1.9	1.6
1979	6	93	311	3.3	432	388 (90)	12 (3)	32 (7)	4.7	4.2	1.4	1.3
1980	3	68	310	4.6	331	318 (96)	9 (3)	4 (1)	4.9	4.7	1.1	1.0
1981	4	107	311	2.9	353	338 (95)	6 (2)	9 (3)	3.3	3.2	1.1	1.1
1982	4	25	63	2.5	17	4 (24)	9 (53)	4 (24)	0.7	0.2	0.3	0.1
1983	5	185	498	2.7	1122	1078 (96)	1 (0)	43 (4)	6.1	5.8	2.3	2.2
1984	7	306	872	2.8	1966	1922 (98)	13 (0.5)	31 (1.5)	6.4	6.3	2.3	2.2
1985	11	528	1783	3.4	3566	3537 (99)	0 (0)	29 (1)	6.8	6.7	2.0	2.0
1986	12	249	790	3.2	1229	1165 (95)	12 (1)	52 (4)	4.9	4.7	1.6	1.5
13 yr. Total	64	1817	5731	3.2	10074	9749 (97)	78 (1)	247 (2)	5.5	5.4	1.8	1.7

Table 4. Length frequency of kokanee collected from winter creel census, 1974-1986.

Size interval Inches	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
8.0- 8.5	--	--	2	1	--	--	--	--	--	--	2	--	--
8.6- 9.0	1	3	4	15	--	8	6	--	--	2	34	93	7
9.1- 9.5	--	2	2	50	2	13	20	--	--	28	247	359	26
9.6-10.0	9	3	--	18	1	17	22	--	--	93	390	203	74
10.1-10.5	11	--	2	17	7	11	7	4	--	167	134	311	60
10.6-11.0	12	3	6	35	41	23	11	2	--	234	48	739	73
11.1-11.5	3	12	6	19	19	60	38	6	--	148	77	486	269
11.6-12.0	6	19	1	2	4	77	53	16	--	73	120	96	366
12.1-12.5	8	16	--	1	--	35	67	75	--	16	71	8	138
12.6-13.0	7	9	--	--	--	16	50	126	--	2	24	--	24
13.1-13.5	12	1	--	--	1	4	15	83	--	2	8	--	4
13.6-14.0	15	--	1	--	--	1	4	22	1	4	--	--	1
14.1-14.5	13	1	--	--	--	--	3	--	1	1	--	--	--
14.6-15.0	8	--	--	--	--	--	1	3	--	9	--	1	--
15.1-15.5	1	--	--	--	--	--	1	1	1	3	--	--	--
15.6-16.0	1	--	--	--	--	--	--	--	--	3	--	--	--
16.1-16.5	--	--	--	--	--	--	--	--	--	--	--	--	--
16.6-17.0	--	--	--	--	--	--	--	--	--	--	--	--	--
17.1-19.0	--	--	--	--	--	--	--	--	--	1	1	1	--
Total number	107	69	24	158	75	265	298	339	3	786	1156	2297	1042
Average size	12.4	11.8	10.4	10.0	10.9	11.4	11.7	12.8	14.4	10.9	10.3	10.5	11.4

Table 5. Age group composition and average total length by age of kokanee creeled during the winters of 1974-1986. Average total length (inches) is in parentheses.

Age group	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
II	38% (11.5)	12% (9.4)	18% (8.7)	49% (9.3)	22% (10.2)	16% (9.6)	15% (9.5)	3% (10.8)	---	97% (10.7)	72% (9.7)	27% (9.4)	19% (10.0)
III	37% (13.8)	85% (12.0)	81% (10.9)	50% (10.8)	77% (10.9)	78% (11.6)	77% (12.1)	95% (12.8)	100% (14.4)	3%* (15.2)	28% (11.9)	73% (10.9)	81% (11.7)
IV	25%** (15.2)	3% (13.7)	1% (14.0)	1% (11.9)	1% (11.8)	6% (13.5)	4%** (14.7)	2% (14.5)	--- ---	--- ---	--- ---	--- ---	--- ---

*Age groups III and IV combined.

**Age groups IV and V combined.

A weak year class of II+ kokanee was evident in 1981 when they comprised 3 percent of the catch. This weak year class was followed by a successive weak year class of II+ fish in 1982. In 1982 only 3 kokanee (age class II+ and III+) were collected for length frequency analysis. Depressed populations of both II+ and III+ fish reflect a poor survival of young-of-year fry plants stocked in 1979 and 1980. The catch success declined to 0.1 fish per hour and 0.2 fish per angler in 1982 (Table 3), the poorest since the initial winter creel census was conducted in 1967. In 1983 age group II+ fish appeared very strong, comprising 97 percent of the kokanee harvest, indicating excellent survival of the 1981 kokanee fry plants. In 1984, age class II+ fish comprised 72 percent of the catch as compared to 28 percent for age class III+ fish. In 1984 the average size of both II+ and III+ age classes declined.

In 12 of the 13 years censused since 1974, kokanee comprised more than 86 percent of the fish creeled. Only in 1982 did rainbow and cutthroat trout exceed kokanee in composition of the catch. Although catch per angler hour and catch per angler rates were extremely low in 1982, rainbow and cutthroat trout comprised 53 and 24 percent of the catch respectively. Starting in 1978 both rainbow and cutthroat trout have shown a slight increase in the number of fish harvested. Over the 13-year period, cutthroat trout averaged 2 percent and rainbow trout 1 percent of the winter harvest. Largemouth bass are caught on rare occasions and comprise less than one-tenth of 1 percent of the catch.

Two access areas serve winter anglers--the Lambeth State Park on the east shore and an off-road parking area along the south shore. Kokanee anglers generally congregate several hundred yards off shore from these locations and have a relatively high degree of angling success. Most of the cutthroat and rainbow trout fishing is done along the littoral areas of east and south shorelines near the lake outlet at depths of 6-12 feet.

Opening Day Creel Census

Opening day creel census data have been collected annually since 1965. Opening day catch statistics, in part, provide an indication as to the relative well-being of the fish population in any given season. Based on a total of 2,067 angler contacts over a 22-year period, anglers were successful in creeling an average of 3.2 fish at a rate of 0.7 fish per hour (Table 6). Kokanee comprised 79 percent of the catch followed by rainbow trout at 11 percent, cutthroat trout at 7 percent, and largemouth bass at 3 percent. The best catch rates were recorded for the years 1977, 1978, 1981, and 1983 when the catch rates equalled or exceeded 5.0 fish per angler (Table 6).

Successful angler rates (anglers successful in catching one or more fish) ranged from a low of 24 percent in 1982 to 100 percent in 1978 and 1983. On seven opening days, successful anglers equalled or exceeded 90 percent of all fishermen (Table 6).

Table 6. Opening day creel census summary for year 1965 through 1986.

Year	Number Anglers	Number Fish	Number Fish/ Angler	Number Fish/ Hour	Percent Successful Anglers	Catch composition(%)[1] KOK	RB	LMB	CT
1965	60	78	1.3	0.3	32	33	59	8	--
1966	65	80	1.2	0.3	46	15	79	6	--
1967	136	206	1.5	0.4	68	37	56	7	--
1968	215	348	1.6	0.3	--	51	38	11	--
1969	62	58	0.9	0.2	52	26	68	16	--
1970	100	127	1.3	0.4	61	78	13	9	--
1971	52	76	1.5	0.6	65	96	4	0	--
1972	133	622	4.7	1.3	99	80	15	5	--
1973	119	402	3.4	0.7	86	86	8	6	--
1974[a]	103	98	1.0	0.2	56	79	10	10	--
1975	87	188	2.2	0.6	72	84	4	12	--
1976	68	139	2.0	0.5	56	72	2	7	21
1977	97	706	7.3	2.7	98	92	1	0	7
1978	91	693	7.6	1.8	100	98	1	0	1
1979	106	224	2.1	0.6	63	94	1	2	3
1980	103	449	4.4	1.0	86	46	5	0	49
1981	81	408	5.0	1.4	97	87	3	2	8
1982	85	26	0.3	0.1	24	23	39	15	23
1983	62	330	5.3	1.3	100	86	2	0	12
1984	94	419	4.5	1.0	90	90	5	1	4
1985	67	209	3.1	0.8	89	91	4	0	5
1986	79	365	4.6	1.1	99	87	2	0	11
Avg.	2067	6521	3.2	0.7	--	79	11	3	7

[1]KOK=kokanee; RB=rainbow trout; LMB=largemouth bass; CT=cutthroat trout
[a]Initial stocking of westslope cutthroat trout.

The average hourly catch rates since 1965 varied from a low of 0.1 in 1982 to a high of 2.7 in 1977. Catch rates exceeding 0.5 fish per hour occurred 59 percent of the time on opening day. Since 1970 this catch rate was exceeded 76 percent of the time. In most instances when catch rates were less than 0.5 fish per hour, kokanee comprised less than 50 percent composition of the catch. Based on the catch per angler hour, angler success during the winter season was twice that of opening day. Since 1974 the average catch per angler hour in the winter was 1.8 fish as compared to 0.9 fish on opening day.

The residency of anglers fishing Lake Mary Ronan on opening day and during the winter months is shown in Figure 3. Local residents from Lake and Flathead Counties accounted for 76 percent of the angling pressure during the winter months. The origin of anglers (by residence) on opening day is more widely distributed with Missoula County residents accounting for the most (35 percent) angling pressure. Non-resident anglers comprised 14 percent of the pressure on opening day as compared to 2 percent during the winter months.

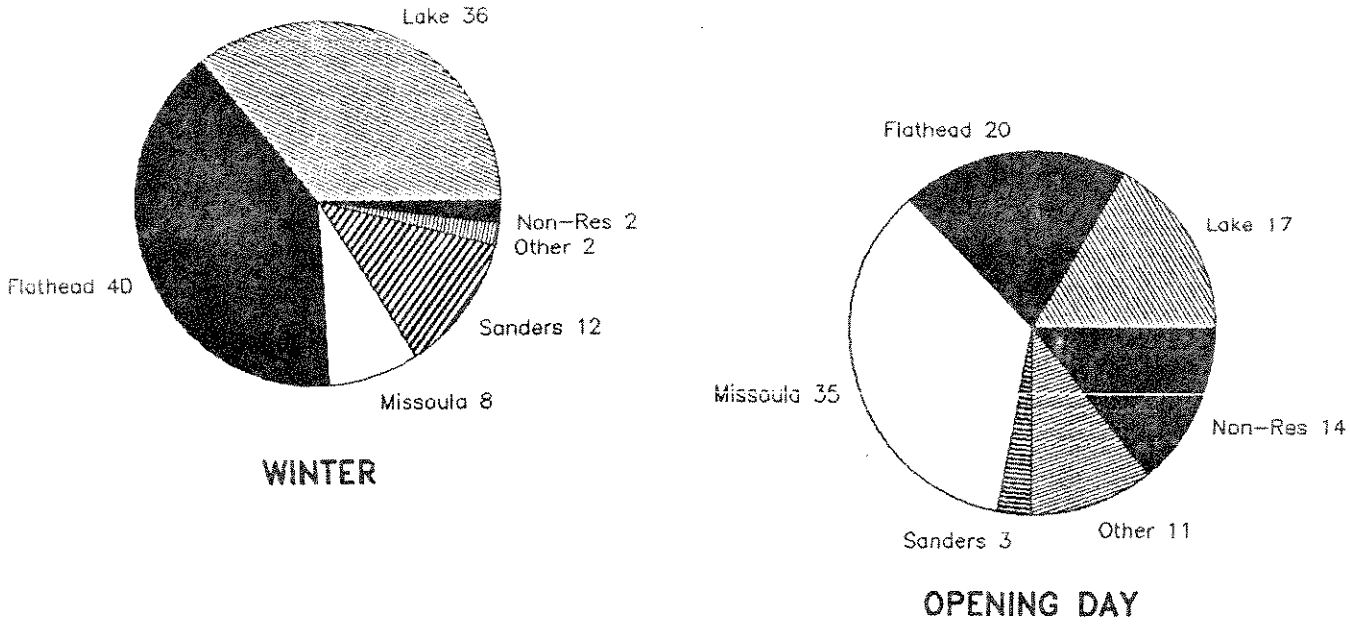


Figure 3. Angler distribution (percent of anglers by county and non-residents) winter vs opening day census at Lake Mary Ronan, Montana.

The results of the 1967 winter creel census are similar to those of the present study. In 1967, 84 percent of the anglers checked were residents of Lake and Flathead Counties with only 1 percent being from out-of-state.

The opening day residency check is probably not indicative of the composition of anglers for the entire summer season. The percentage of non-resident anglers interviewed during the 1968 summer season census was considerably higher (41 percent) than the percentage on the opening day census (14 percent). In 1968 Montana residents comprised 59 percent of the anglers as compared to 41 percent by non-residents. During the summer of 1968 most angler contacts were made at the two resort facilities occupied by a large percentage of out-of-state residents. The opening day census was conducted almost entirely at the state access site used mostly by resident anglers on a daily basis.

Trophic Status

A lake classification study of 33 lakes in northwestern Montana conducted in 1972 by the Department of Fish, Wildlife and Parks classified Lake Mary Ronan as a eutrophic lake (Domrose 1974). This classification was made on the basis of several criteria which included dissolved oxygen levels, vegetative abundance, amount of littoral area, temperature regimes, water chemistry (total alkalinity, pH, total dissolved solids), and transparency.

Lake Mary Ronan was classified as mesotrophic on the basis of an annual phosphorus loading factor of 0.18 gms/m^2 (EPA National Eutrophication Survey 1976). The incoming non-point sources comprised 98.7 percent of the total phosphorus loading. Freeland Creek accounted for 29.9 percent of the phosphorus input, Donaldson Creek 27.7 percent, intermittent tributaries 31.3 percent, and sources from direct precipitation 9.8 percent. Point sources from septic systems comprised the remaining 1.3 percent of the phosphorus input.

These findings added up to an annual total phosphorus loading input of 1120 kgs. The total phosphorus output, by way of Ronan Creek, was 490 kg/yr with a net annual accumulation of 630 kgs. With a mean hydraulic retention time calculated to be 17.4 years, it would appear that phosphorus loading is occurring at a rapid rate.

The incoming non-point phosphorus source is believed to be associated with logging and grazing activities in the upper drainage system. The U. S. Forest Service, Montana State Forest, Plum Creek Timberlands, and a few small isolated private tracts make up the land ownership. Intensive clear-cut logging in the late 1960's and overgrazing by domestic stock probably accelerated the euthrophication rate and had a pronounced effect on altering the water quality of the lake basin. Large mats of filamentous blue-green algae, comprised mostly of Aphanizomenon spp. are observed floating and suspended throughout the entire lake basin during late summer and early fall.

In June of 1976, a feasibility study was conducted by a local consulting engineering firm to determine alternative methods of lake restoration (Morrison-Maierle, Inc. 1976). This project was funded by EPA as a part of Flathead Drainage 208 project. Essentially two areas of concern were addressed: reducing the nutrient loading and preventing further deterioration of the lake through improved land use management.

Several alternatives were studied and evaluated for economic feasibility. The restoration measures considered were: 1) fencing, which included fencing the entire lakeshore perimeter to exclude cattle grazing; 2) inflow augmentation which involved drilling a well and flushing water through the system to dilute nutrient loading; 3) edge dredging or removal of littoral area bottom sediments to which nutrients are attached; 4) aeration, destratification, and artificial mixing of colder deoxygenated bottom water with well oxygenated surface waters by means of mechanical pumping; 5) nutrient inactivation by application of metal salts to precipitate suspended solids and nutrients and render them inactive; and 6) removal of aquatic vegetation; this would be accomplished by mechanical harvesting.

This study concluded that fencing was the most economically feasible method of reducing the nutrient loading. Although this alternative was considerably less expensive than the other alternatives, it was beyond the capability of matching private funding (local lakeshore owners) with government funding.

However, Plum Creek Timberlands, which owns approximately 75 percent of the lakeshore frontage, agreed to provide both manpower and material to fence

the entire lakeshore perimeter and open up spring areas for watering cattle in the upper drainage away from stream courses. This project was initiated in 1979 and completed in 1980. Annual maintenance of the fence line perimeter is a cooperative venture conducted by the Lake Mary Ronaners, Inc., a group of lakeshore owners interested in preserving the lake habitat, and field representatives of Plum Creek Timberlands.

Oxygen-Temperature Profile Monitoring

Dissolved oxygen deficiencies in the thermocline were first observed in August, 1968. Concentrations of less than 2.0 ppm oxygen were recorded in the middle and lower strata of the thermocline within the temperature ranges normally inhabited by small kokanee during late summer. Kokanee fry and fingerlings are not known to tolerate dissolved oxygen concentrations of less than 4.0 ppm or temperatures higher than 60°F for any extended period of time (Fulton 1963).

In 1969 and 1970 a study was conducted to determine dissolved oxygen-temperature conditions in the thermocline during summer stratification. A vertical series of temperature and oxygen measurements were recorded in the deepest portion of the lake basin at 47 feet. The data were collected at two-week intervals from mid-June through the fall overturn period. A comparison of the available kokanee habitat for the two years in relation to depth is shown in Figure 4.

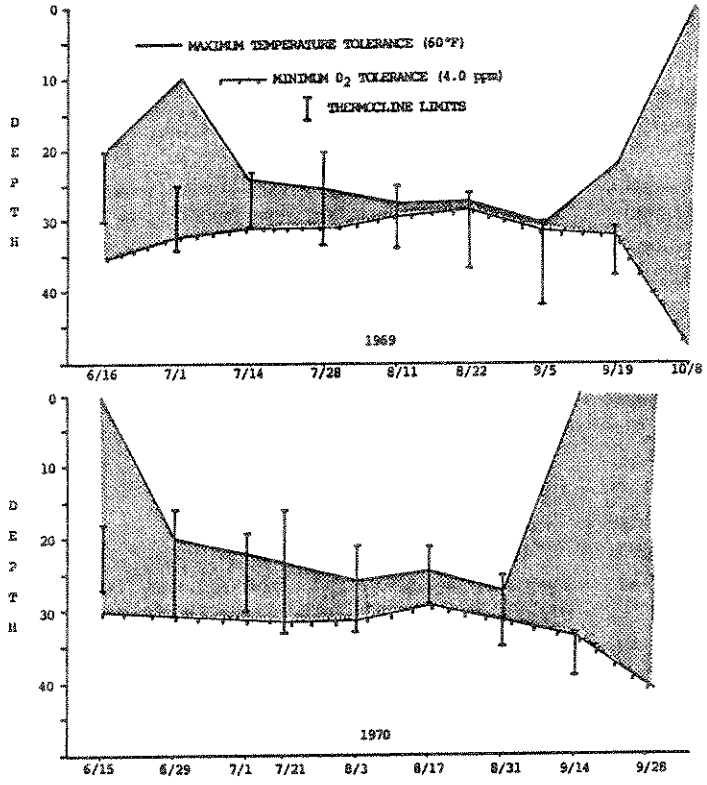


Figure 4. A two-year comparison of available kokanee habitat in relation to depth at Lake Mary Ronan, Montana.

The vertical depth limits of preferred kokanee habitat increased during the summer months of 1970 as compared to 1969. The suitable depth zone from mid-July through August ranged from 4-9 feet in 1970 as compared to 1-6 feet in 1969. Dissolved oxygen deficiencies (less than 4.0 ppm) were recorded at a minimum depth just over 29 feet in 1970 compared to 27.5 feet in 1969. The highest extension (from the bottom) of dissolved oxygen deficiencies into the thermocline occurred during late August of both years. Anaerobic conditions were present at bottom depths during summer stratification and on occasions the odor of hydrogen sulfide was detected from the water samples.

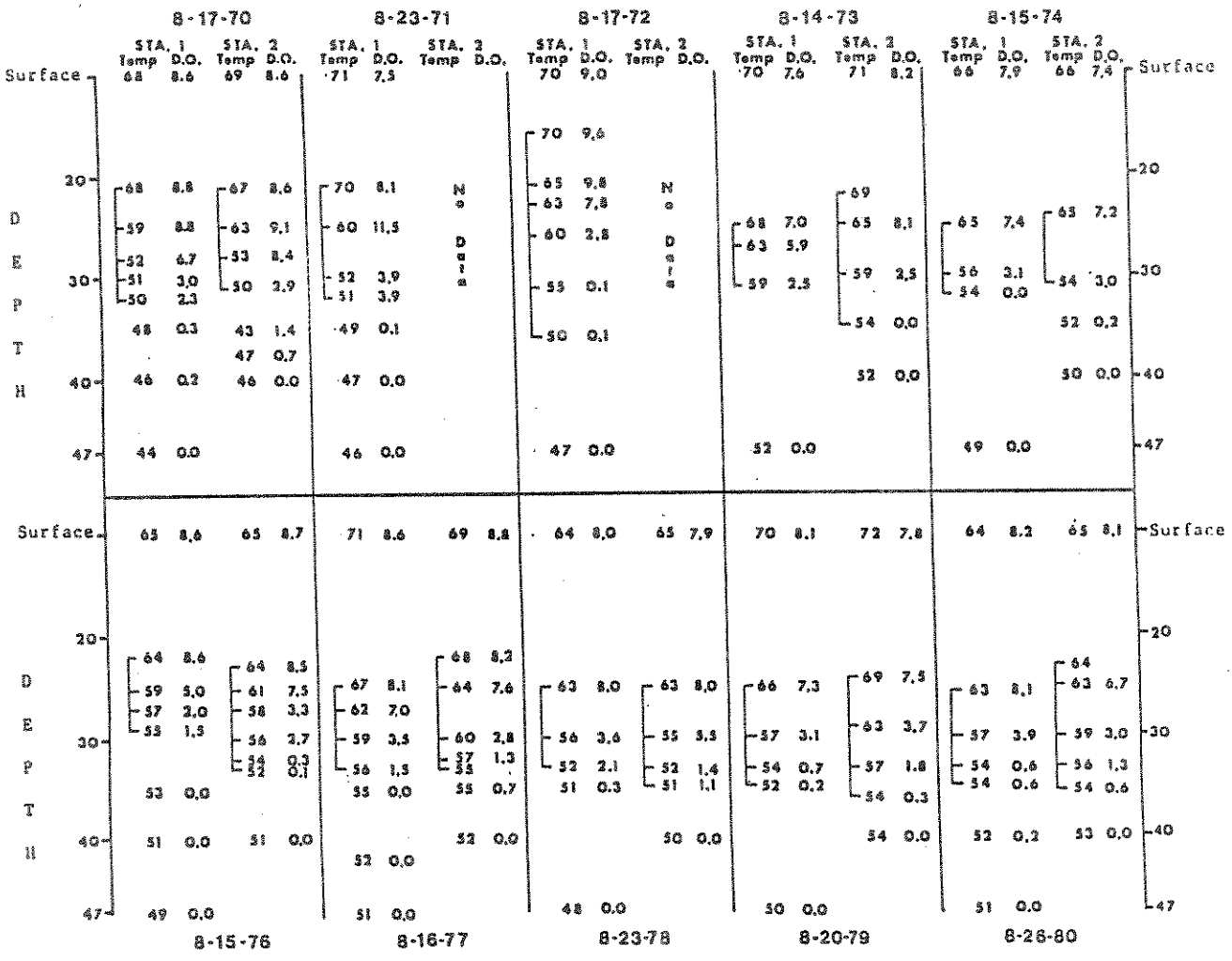
Water temperatures exceeding 60°F extended to depths of greater than 25 feet between the period of July 29 through September 5, 1969. During a comparable period of 1970, temperatures exceeded 60°F at depths exceeding 25 feet on only two occasions, August 3 and August 31. Surface temperatures cooled off more rapidly in 1970 reaching 60°F on September 14 as compared to October 8 in 1969. Correspondingly, thermocline development extended closer to the surface in 1970 thus enlarging the vertical depth limits of preferred kokanee habitat.

The monitoring program continued on a limited basis from 1970 through 1980 (excepting 1975) during the months of July and August. A summary of the mid-August oxygen-temperature profile measurements are presented for Stations I and II in Table 7. Location of the sampling sites are shown in Figure 5.

Surface temperatures during the period range from 64°F to 72°F and bottom temperatures from 44°F to 52°F. With the exception of 1972, the thermocline formation in mid-August ranged from 21 to 25 feet below the lake surface. The depth of the thermocline was quite narrow averaging only 10 feet and ranging from 6 to 20 feet. In most years, adequate dissolved oxygen was available to support salmon and trout populations in the upper 3 to 4 feet of the thermocline. However, dissolved oxygen concentrations declined rapidly with increased depth from the mid to lower limits of the thermocline between depths of 30 and 35 feet.

The temperature span between the upper and lower thermocline limit ranged from degree units of 11°F to 21°F. Both temperature and oxygen levels considered optimimum for kokanee (55°F to 60°F with D.O. levels above 4.0 ppm) occurred near the 25 to 30 feet level in mid-August.

Table 7. Comparison of mid-August oxygen-temperature profile measurements (brackets indicate thermocline limits) for the years 1970 through 1980.



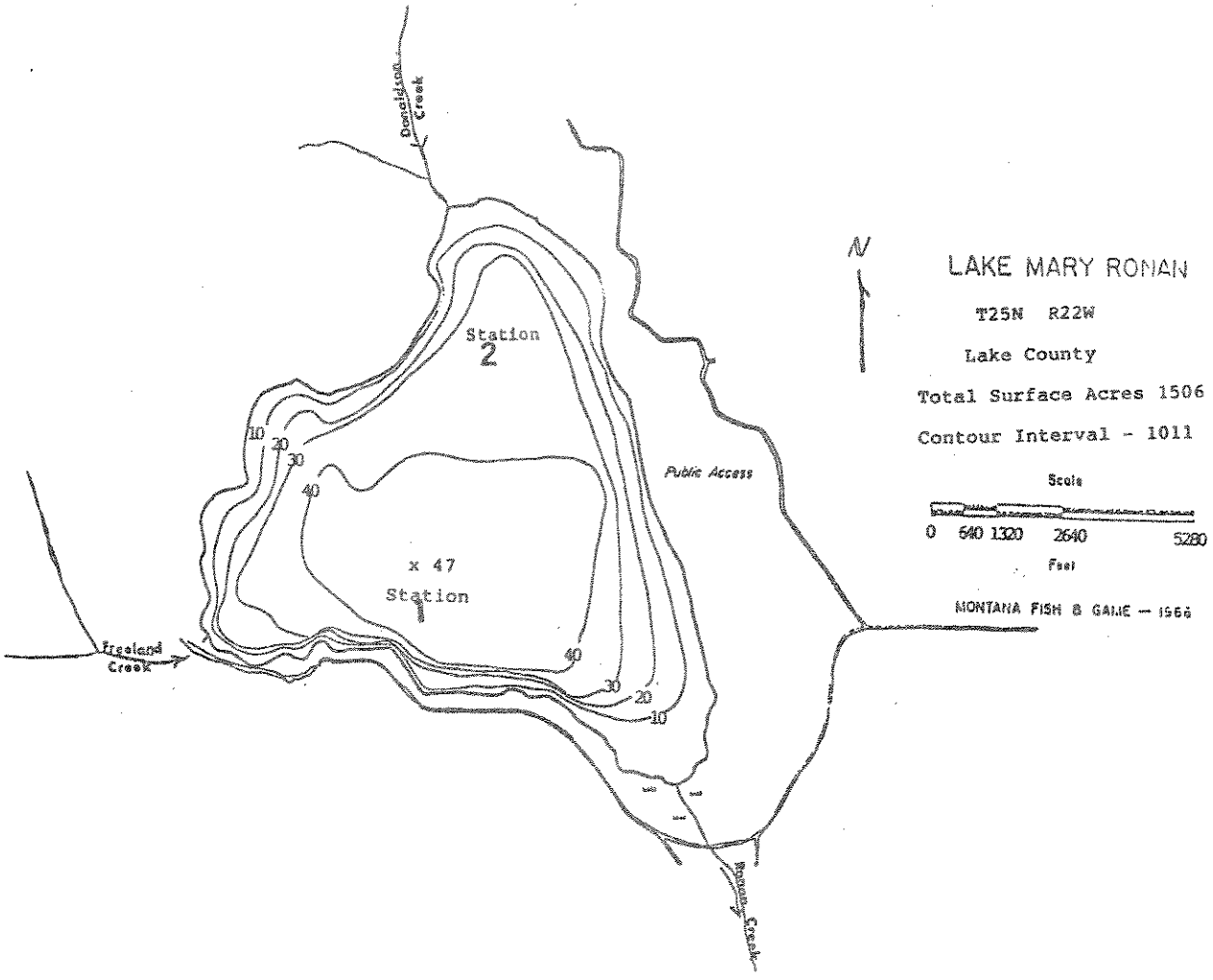


Figure 5. Location of dissolved oxygen-temperature sampling sites, 1970-1980.

Periodic monitoring of dissolved oxygen concentrations was conducted in the late winter months of 1970, 1971, 1975, and 1979 to determine if oxygen deficiencies occurred in the water column under winter ice cover. Dissolved oxygen samples were collected for depths ranging from 7 to 46 feet at several locations. Winter ice cover ranged from 14 to 18 inches with packed snow depth averaging from 2 to 18 inches. The data are presented in Table 8 and the location of sampling sites are shown in Figure 6.

Table 8. Winter dissolved oxygen profile data collected from Lake Mary Ronan for years 1970, 1971, 1975, and 1979.

	Station #1 (16')[1]		Station #2 (45')		Station #3 (31')		Station #4 (38')	
1970	Depth	DO(ppm)	Depth	DO(ppm)	Depth	DO(ppm)	Depth	DO(ppm)
(3/9)	Surface	9.6	Surface	9.8	Surface	9.7	Surface	--
	8'	8.7	22'	7.0	16'	7.7	18'	10.0
	15'	6.1	43'	0.8	30'	5.2	37'	3.1

	Station #5 (45')		Station #6 (25')		Station #7 (29')	
1971	Depth	DO(ppm)	Depth	DO(ppm)	Depth	DO(ppm)
(2/4)	Surface	10.6	Surface	10.2	Surface	10.2
	20'	9.4	15'	9.7	15'	9.5
	45'	3.8	25'	9.0	29'	8.3

	Station #8 (22')		Station #9 (40')		Station #10 (46')	
1975	Depth	DO(ppm)	Depth	DO(ppm)	Depth	DO(ppm)
(2/18)	Surface	10.0	Surface	9.9	Surface	10.4
	10'	9.4	20'	8.4	30'	8.1
	15'	8.7	30'	7.4	35'	5.3
	20'	8.5	32'	6.7	40'	2.8
			35'	4.5	45'	1.6
			40'	3.1		

	Station #11 (31')		Station #12 (44')		Station #13 (18')		Station #14 (8')	
1979	Depth	DO(ppm)	Depth	DO(ppm)	Depth	DO(ppm)	Depth	DO(ppm)
(2/5)	Surface	10.2	Surface	10.1	Surface	10.4	Surface	10.7
&	15'	9.1	22'	8.2	15'	8.9	7'	10.5
(3/19)	29'	7.0	40'	1.1				

[1]Figure in parentheses is maximum depth at stations.

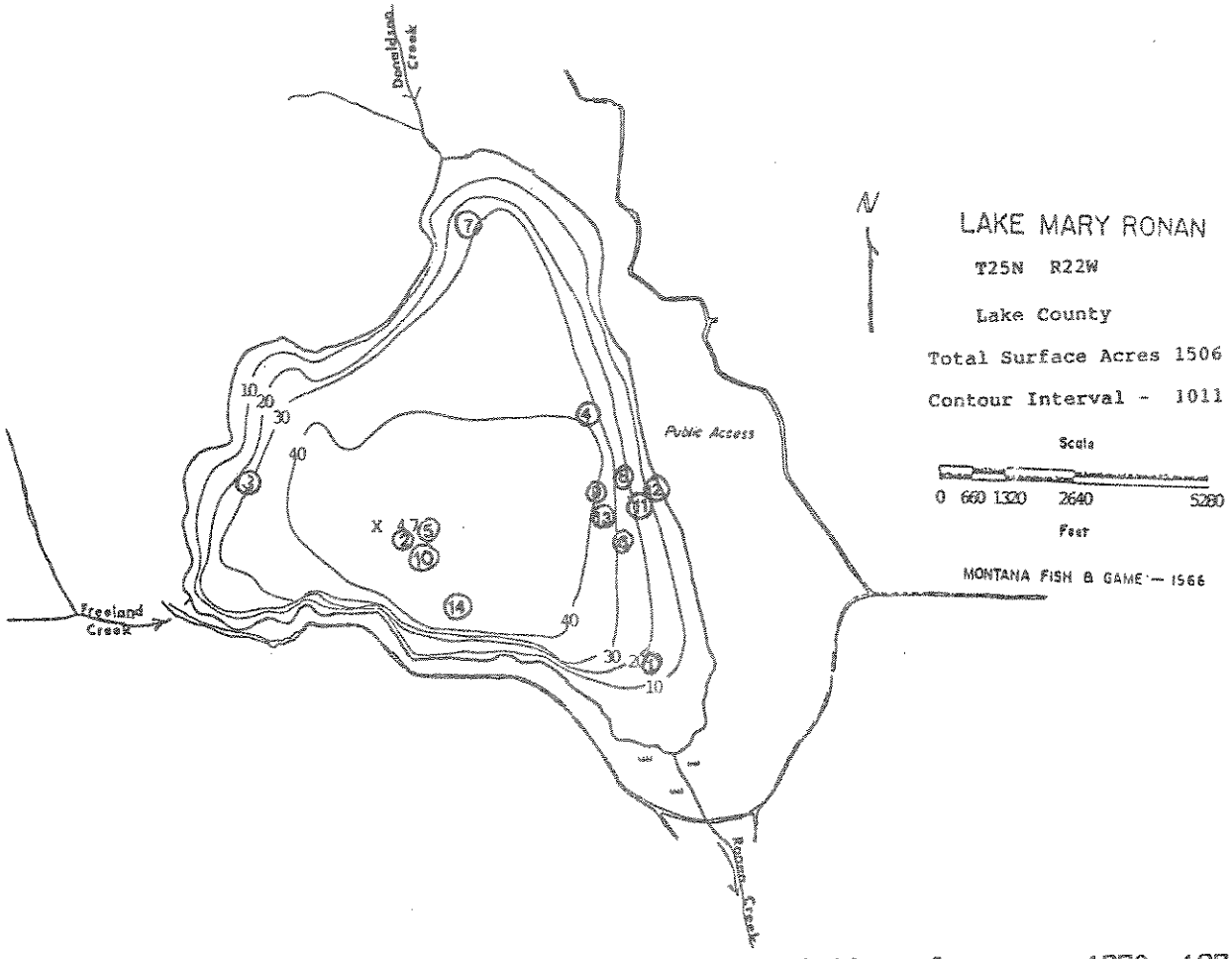


Figure 6. Location of winter dissolved oxygen stations for years 1970, 1971, 1975, and 1979.

Dissolved oxygen concentrations beneath the ice appear to be adequate to support trout and salmon population during the winter stagnation period. No significant oxygen voids were recorded except near the bottom in the deepest portion of the lake basin. Dissolved oxygen concentrations of less than 4.0 ppm occur only at depths exceeding 35 feet. Surface D. O.'s were near saturation and ranged from 9.6 to 10.7 ppm.

Fish Population Trends

Fish population trends were determined, in part, by data collected from spring and fall gill netting for the years 1966 through 1986.

The spring netting was scheduled prior to the opening of the general fishing season sometime during the first two weeks of May. The fall sampling period was usually conducted within the first two weeks of October. For the years of 1966 through 1970, data were collected from bottom sets only. Both bottom and surface sets, usually consisting of three each were used for each sampling period from 1970 through 1986. Gill nets were distributed throughout the lake using both offshore gill nets and pelagic sets (Figure 1). For purposes of comparing gill net catch trends, floating and bottom sets were used individually or collectively depending on catchability of the species involved.

Pumpkinseed Sunfish

In the mid-1960's and early 1970's, pumpkinseed were observed frequently in the weedy, shoal areas. This species was easily caught and comprised the majority of fish creeled by shore fishermen. However, in more recent years, this fishery declined dramatically and pumpkinseed are now only caught occasionally. This decline seems to be consistent with gill net (bottom sets) catch data as presented in Figure 7. The catch-per-net night has steadily declined since 1979. By 1980 the average catch of pumpkinseed caught was less than 1.0 fish per-net-night (bottom sets) for spring and fall netting efforts. The reason for this decline is not known. However, a shift in management emphasis was initiated after 1974 when sub-catchable cutthroat trout replaced rainbow trout in the stocking program. The intra-specific reaction between these species may have influenced a decline in the pumpkinseed population.

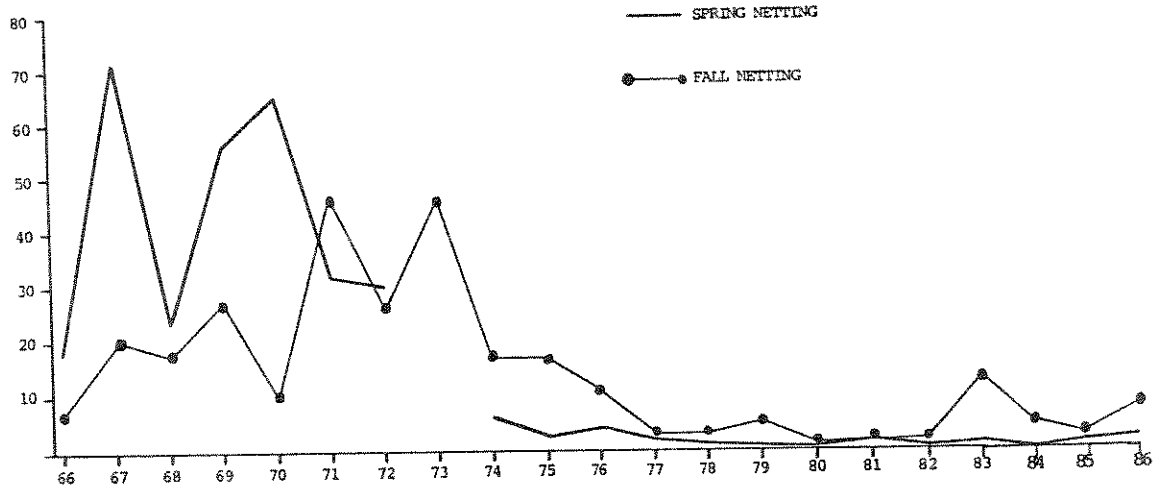


Figure 7. Average catch per net night from bottom gill net sets for pumpkinseed, Lake Mary Ronan, 1966-1986.

Largemouth Bass

Largemouth bass are frequently observed in the shoal areas and are commonly caught by anglers specifically fishing for bass. However, gill nets are not effective for catching this species, and the frequency of largemouth bass captured by gill nets was so low that gill net catch trends could not be determined.

Rainbow Trout

The relative number of rainbow trout as determined by combined surface and bottom gill net catches is shown in Figure 8. The average catch-per-net night was highest for the period of 1965 through 1967 with a peak catch of 9.0 fish occurring in the fall of 1967. This higher gill net catch success rate

could be related to the change from a catchable trout program in effect from 1962 through 1966 to subcatchable plants after 1966.

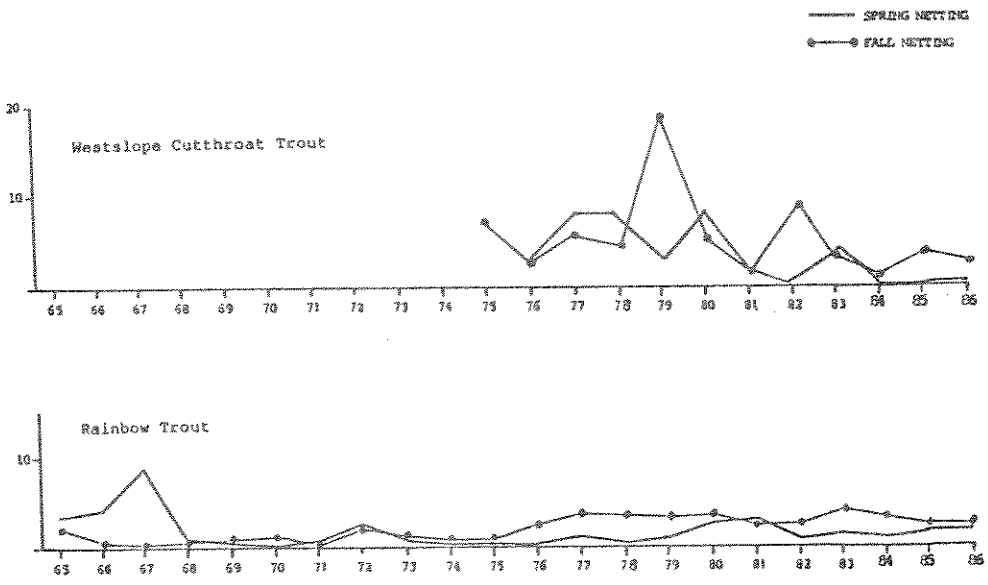


Figure 8. Average catch per net night of rainbow trout (1965-1986) and westslope cutthroat trout (1975-1986) from bottom and surface net sets, Lake Mary Ronan.

From 1967 through 1974, the catch rate remained relatively stable ranging from less than 0.2 to 2.8 fish-per-net night effort. During this period the number of subcatchable trout stocked annually ranged from 40,000 to 71,000. The period following from 1976 through 1980, an increase in the catch ranged from 0.5 to 3.8 fish-per-net-night. This increase in number was experienced despite the discontinuance of rainbow trout stocking after 1974. The increase in rainbow trout numbers is believed to have resulted from improved spawning habitat in Donaldson Creek. A cattle feedlot operation bordering the lower end of McDonald Creek was removed in the early 1970's resulting in improvement of streambank stability and cleansing of stream gravels.

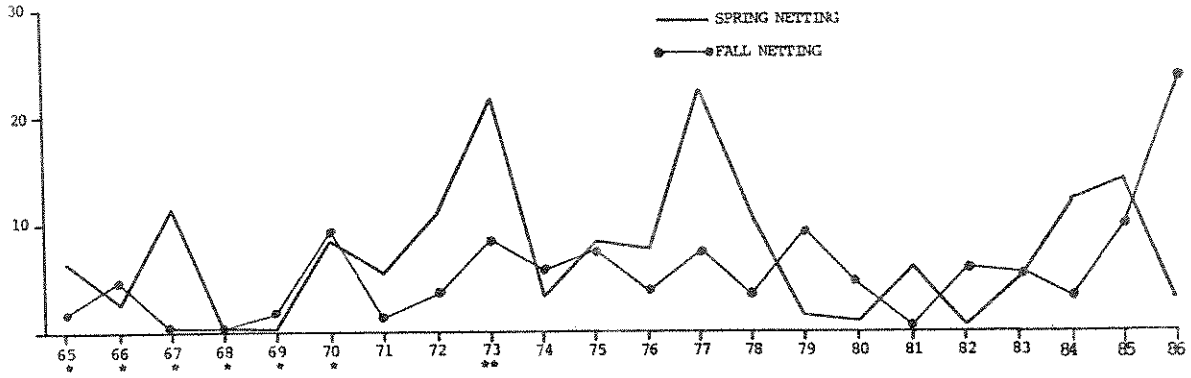
Westslope Cutthroat Trout

Cutthroat trout were reintroduced in the fall of 1974. The numbers of subcatchable (4"-6") fish stocked ranged from 22,506 in 1974 to 59,360 in 1982. In 1984 subcatchable fish were not available for stocking and were replaced with a plant of 60,135 2" fish. The catch success as determined by use of surface gill net sets is shown in Figure 8. With the exception of 1979 and 1984, the number of fish caught ranged from 2.6 to 8.4 fish-per-net-night. Westslope cutthroat trout are not believed to utilize the inlet tributaries for spawning and annual stocking is required to maintain a cutthroat fishery.

Kokanee

The average catch-per-net-night of kokanee caught by a combination of floating and bottom gill net sets is presented in Figure 9. The spring gill

net catch is comprised primarily of two- and three-year-old fish while the fall catch is comprised of immature fish of age I+, II+, and older. Spawning adults age classes II+, III+, IV+, and older were not included in the fall sampling data.



*Catch from bottom sets only
**Catch from surface sets only

Figure 9. Average catch per-net-night of immature kokanee from both bottom and surface gill net sets. Lake Mary Ronan, 1965-1986.

The combined catch for spring and fall netting data during 1968 and 1969 ranged between 0.0 and 1.4 fish-per-net-night. This trend reflected the poor fishing success as determined by a summer creel census conducted in 1968 when the catch rate for kokanee was less than 0.2 fish-per-man-hour. Thereafter the gill net catch success improved with peaks occurring (spring netting data) in 1973, 1977, and 1985. The catch success from spring netting fluctuated widely between 1.0 and 21.6 fish per-net-night; whereas fall netting limits with the exception of 1986, were much narrower ranging from 1.0 and 9.5 fish per-net-night.

The average total length of various age group structures of immature kokanee collected from the spring and fall netting series is shown in Table 9. Also included in the data are small yearling fish caught in fine mesh gill net sets in conjunction with the spring netting series.

Table 9. Number and average total length of immature kokanee collected by age group from spring and fall gill netting, 1965-1986.

	Spring								Fall							
	Age I		Age II		Age III		Age IV		Age I		Age II		Age III		Age IV	
Year	No.	Average Length	No.	Average Length	No.	Average Length	No.	Average Length	No.	Average Length	No.	Average Length	No.	Average Length	No.	Average Length
1965*	17	8.2	1	12.4	1	16.2	--	--	6	9.3	1	11.2	--	--	--	--
1966	--	--	19	11.7	3	13.0	--	--	7	8.6	17	12.0	--	--	--	--
1967	--	--	23	10.1	35	1.1	--	--	1	9.0	--	9.0	--	--	--	--
1968	--	--	--	--	--	--	--	--	--	--	1	13.7	--	--	2	18.2
1969	1	6.9	--	--	--	--	--	--	7	9.0	--	--	--	--	1	19.8
1970	--	--	40	10.0	1	13.8	--	--	12	8.3	31	11.1	--	--	--	--
1971	--	--	5	9.2	18	12.6	9	13.7	3	8.4	2	10.0	1	12.2	--	--
1972	--	--	17	10.0	16	11.9	--	--	8	8.9	18	11.1	--	--	--	--
1973	--	--	18	10.4	85	12.9	3	13.6	24	9.1	21	12.3	18	13.3	1	15.7
1974	--	--	11	10.1	29	13.1	36	14.2	16	8.3	17	11.2	--	--	1	12.4
1975	8	5.3	27	9.6	22	12.2	--	--	16	8.0	31	10.1	2	12.5	--	--
1976	1	5.2	10	8.8	25	11.0	1	11.5	13	8.1	4	9.9	--	--	--	--
1977	12	6.0	39	9.6	40	11.3	--	--	5	8.6	33	10.4	3	10.9	--	--
1978	--	--	16	9.7	46	11.3	1	12.4	8	8.7	7	10.3	--	--	--	--
1979	--	--	6	9.9	2	12.1	--	--	51	8.0	6	11.0	--	--	--	--
1980	1	6.3	3	9.7	2	12.8	--	--	2	9.6	23	11.9	--	--	--	--
1981	1	6.5	3	11.5	19	13.9	--	--	3	10.1	1	12.9	--	--	--	--
1982	--	--	1	11.6	2	14.9	--	--	35	9.6	2	14.0	--	--	--	--
1983	--	--	29	11.3	--	--	1	17.1	25	8.5	7	11.4	--	--	--	--
1984	19	6.8	60	10.0	13	11.3	--	--	13	8.4	6	10.8	--	--	--	--
1985	34	5.4	31	9.6	54	11.4	--	--	28	8.7	30	10.9	--	--	--	--
1986	3	6.3	7	9.8	11	12.4	--	--	86	7.9	53	10.7	--	--	--	--
Total or Avg.	97		366		371		51		369		311		24		5	
% of Catch by Age Group	11%		41%		42%		6%		52%		44%		3%		1%	

*Collected in July.

The data reflect a scarcity of II+ and III+ fish in the fall of 1967, 1968, and 1969. In the fall of 1969 the fishery showed signs of recovery as age class I+ fish began to appear in the net catch. From 1970 through 1980, age class II+ and III+ fish showed up in fairly consistent numbers in the spring. Similarly, the numbers of fish appearing in the fall as either I+ or II+ fish indicated good fall populations.

In the fall of 1980 and 1981, the number of age class I+ declined; and in fall 1981, Age class II+ fish declined. These two year classes again proved to be weak year classes in 1982 as II+ and III+ fish. This decline is thought to have been related to poor survival of two successive annual fry plants. However, age class I+ fish again showed predominance in the fall (1982) and contributed largely to the excellent kokanee fishery in 1983 as II+ fish. In the fall of 1986, the combined catch of immature kokanee per net night (I+ and II+ fish) was 23.2 fish, the highest recorded since 1965.

Overall, age class II+ and III+ fish comprised 83 percent of the spring catch and immature fish of age class I+ and II+ represented 96 percent of the fall net catch.

Kokanee Spawning and Spawn-Taking

Lake Mary Ronan kokanee are shoreline spawners and move onto lakeshore spawning areas in late October. Spawning activity usually begins in late October, peaks in mid-November and continues through December after the lake freezes over. Spawning fish are attracted to incoming ground water seep areas and spawn over gravel substrate at water depths ranging from 1 to 12 feet. Although redd construction and egg deposition occurs, the survival of eggs to fry stage is very low. Kokanee generally spawn in either their third or fourth year of life. Occasionally, however, fast growing fish will mature during their second year of life.

Kokanee spawning takes place in essentially 3 areas: the east shore in front of Mountain Meadow Resort, the southwest shore known as the Christian Church Camp area, and in front of the boat ramp at Lambeth State Park. These areas become popular kokanee snagging sites during the fall snagging season.

Fall spawn-taking operations begin at the onset of spawning and continue through November and into the first week of December. A 300' x 12' seine is employed and operated by 4 to 5 people who collect kokanee for egg-taking purposes. Seining is conducted at night as fish move inshore to spawn. Fertilized eggs are water hardened and transported to the Flathead Lake Salmon Hatchery for incubation and hatching. Lake Mary Ronan is a major source of kokanee eggs for the state hatchery system. This lake supplied 85 percent of the kokanee eggs taken for propagation in 1984, 57 percent in 1985, and 95 percent in 1986. A summary of Lake Mary Ronan egg collections for the years 1971 through 1984 is shown in Table 10.

Table 10. Kokanee egg-take operations, 1971 through 1986.

Year	Number of Eggs
1971	380,000
1972	175,000
1973	130,000
1974	none
1975	94,000
1976	500,000
1977	380,000
1978	360,000
1979	none
1980	1,100,000
1981	235,000
1982	300,000
1983	1,887,000
1984	1,527,904
1985	2,670,610
1986	2,184,448

Random samples of mature spawning kokanee are collected annually for length and weight measurements. The average total length of spawning males and females for the years 1954 through 1966 is presented in Figure 10. These measurements vary considerably from year to year. A close relationship exists between size (total length) of spawning year class with age group strength. The weak year classes that spawned in 1967, 1968, and 1969 and again in 1981 and 1982 show up as extremely large fish, probably a density dependent factor related to abundance of fish. In contrast, large spawning runs developed in 1975, 1976, 1977, and 1984 were comprised of relatively smaller fish.

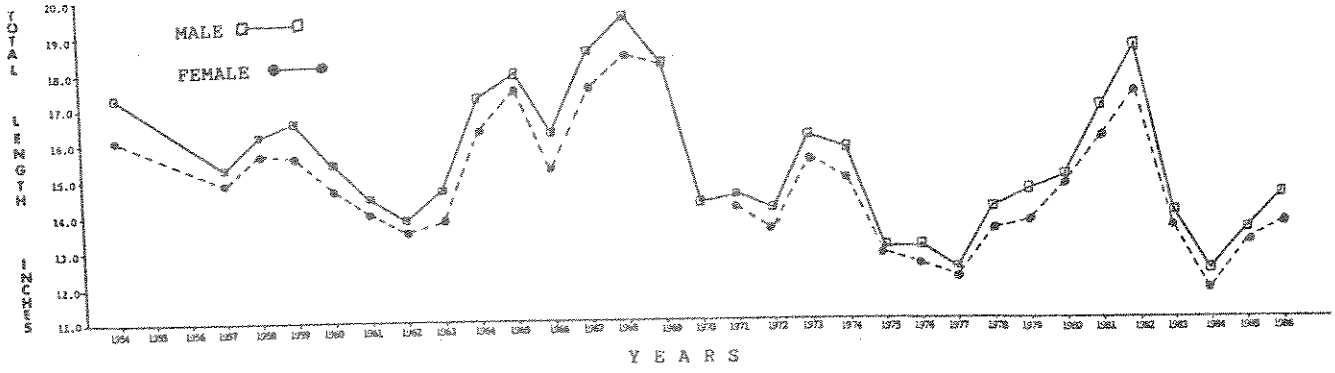


Figure 10. Average length of mature spawning kokanee from Lake Mary Ronan, years 1954 through 1986.

MANAGEMENT CONSIDERATIONS

Management decisions for the Lake Mary Ronan fishery are based largely on the findings of spring and fall gill netting data and creel census information collected during the winter fishery and on opening day. These data, when used in combination, are fairly reliable in predicting the well being of the kokanee fishery.

The kokanee fishery is maintained by annual stocking of hatchery-reared fry. The year class strength of yearling fish begin to appear in the late August fishery and in the late fall gill net catch as fish ranging from 8.0 to 9.5 inches. These fish enter the winter fishery as II+ fish along with III+ fish from the previous year class. In most years, these two age groups comprise over 95 percent of the kokanee harvested during the winter and summer months.

Kokanee stocking methods throughout the years have evolved from releases of small fry from the shore to stocking larger fry in pelagic areas by boat. The success of shore plants was unpredictable, often resulting in high mortality from predation or loss by strong onshore wave action at the time of release. Since the early 1970's, fry plants were dispersed by a planting boat in the pelagic areas in mid-April. Beginning in 1981 to the present, fish were raised to the advanced fry stage (1 1/2" - 2") before being released in mid-

May. It is believed that these delayed releases of larger fish increase the survival to adult fish.

Annual kokanee stocking numbers from 1954 through 1983 varied from a low of 110,00 in 1967 to a maximum of 720,000 in 1972. Annual fry stocking rates averaged about 300,000 per year from 1954 through 1968 or about 200 fish per acre. This rate was increased to an average of 600,000 per year or 400 fish per acre for the years 1969 through 1975. The numbers were reduced to 400,000 fish in the mid-1970's because of a substantial decrease in size and growth rates. In 1980, the kokanee plant was again increased to 500,000 fish or about 333 fish per acre. With the exception of 1981, when only 400,000 fish (267 per acre) were available for stocking, this stocking rate continued through 1983. The increase in stocking rate was initiated when year class failures of the 1979 and 1980 plants became evident. The reason for the failure of these plants is not known.

As strong year classes emerged from the 1981 and 1982 fry plants, growth rates of both age II+ and III+ fish exhibited a marked decline in the winter of 1984. In view of these findings, the annual plant was decreased to 400,000 fish in 1984 and continued through 1986.

The future of the kokanee fishery is directly related to the incoming sources of nutrient enrichment. The small drainage area, low water exchange rate, and the relatively shallow lake basin are conducive to nutrient buildup and acceleration of the lake aging process. The data show that the biological oxygen demand is high in late summer, approaching critical levels in the cooler portions of the thermocline. Under a certain set of conditions, lower water levels and a warmer-than-average summer, summer kokanee mortality could be a reality.

Although rainbow trout, westslope cutthroat trout and largemouth bass comprise less than 10 percent of the total fishery, these species provide a diverse supplement to the kokanee fishery. Mature rainbow trout in the trophy size range from 2-8 pounds offer a challenge to the fly fishermen fishing the littoral areas. The quality of this unique wild trout fishery hangs in the balance of maintaining suitable spawning and rearing habitat in the Donaldson and Freeland Creeks drainages. Adverse land use practices in the drainage area above the lake such as significant logging activity, increased grazing, or lakeshore home developments could have a gross impact on water quality and eliminate the spawning habitat of rainbow trout.

In 1985 Plum Creek Timberlands initiated a timber cutting plan (clear and selective cuts) to harvest 50 million board feet of timber in the drainage during the next 20 years. In addition, the Flathead Forest plans to harvest insect killed lodgepole pine at the headwaters of Donaldson and Freeland creek drainages. The state will also enter section 16 in the Freeland Creek drainage to selectively harvest timber. The cumulative logging impacts over a relatively short term entry time will greatly increase water yields and could have long-range adverse impacts on the entire watershed. Mitigation measures to partially offset logging and roading impacts will be implemented. These will include fencing streambanks to exclude grazing, providing leave strips along stream courses, seeding road cut fills, and restoration of streambank vegetation.

Cutthroat trout are managed as hatchery-reared fish with an average of 40,000 to 50,000 yearling 4-6 inch fish being stocked annually in late May. These fish enter the fishery as 10-12 inch fish the following winter and grow to 12-14 inches by summer. After two years, cutthroat trout will average 14-16 inches; but few remain in the population two years after stocking. Similar to the rainbow fishery, the majority of cutthroat are taken by artificial flies and lures in the littoral areas.

Little is known about the status of the largemouth bass population. However, it is believed that the numbers of fish have decreased since the decline of the pumpkinseed beginning in the late 1960's. Recent increased fishing for largemouth bass coupled with the loss of spawning habitat due to shoreline development practices may have contributed to the decline of this species. In 1985 several brush shelters were constructed and placed along the south shore to provide cover for bass and forage fish species. The primary forage base is crayfish which are extremely abundant in shoal areas.

SUMMARY

1. In Region 1, the Lake Mary Ronan fishery ranked third in the summer and fourth in the winter for fishing pressure during the 1975-1976 season. Total annual angler use was estimated at 31,544 mandays.

2. Kokanee comprise the largest segment of the harvest, making up 97 percent of the catch during the winter months and 79 percent of the catch on opening day.

3. Kokanee age classes II+ and III+ collectively comprise greater than 95 percent of the winter and opening day kokanee harvest.

4. Rainbow trout made up 1 percent of the winter catch compared to 11 percent on opening day.

5. Cutthroat trout comprise 3 percent of the winter harvest compared to 7 percent on opening day.

6. Largemouth bass were seldom harvested during the winter, but provided 3 percent of the catch on opening day.

7. The average catch per angler-hour of kokanee since 1974 was 1.8 fish during the winter season compared to 0.9 fish per angler hour on opening day.

8. Nutrient enrichment is occurring at a rapid rate creating a high biological oxygen demand in the lower and mid-thermocline during summer stratification. The poor kokanee fishery in 1968 and 1969 is believed related, in part, to stress caused by oxygen levels of less than 4.0 ppm in the thermocline.

9. Dissolved oxygen levels remain adequate through the winter months and is not believed a stress-related factor in kokanee survival.

10. Kokanee eggs taken at Lake Mary Ronan for restocking other waters are an integral part of the kokanee management program in northwestern Montana. The percent of total kokanee eggs taken for propagation in the state from Lake Mary Ronan was 85 percent in 1984, 57 percent in 1985, and 95 percent in 1986.

11. Montana residents comprised 98 percent of the winter angling pressure with 76 percent of the anglers residing in nearby Lake and Flathead counties.

12. Montana residents comprised 86 percent of the opening day fishing pressure; Missoula County residents comprised 35 percent of the angling pressure. Non-resident fishermen, mostly from Idaho and Washington, made up the remaining 14 percent of the angling pressure.

RECOMMENDATIONS

It is recommended that the current monitoring programs be continued on an annual basis in support of the ongoing fisheries management program. The total manpower required for this minimal monitoring effort will require an estimated 22 mandays of field activities per year. In addition, if time, finances, and manpower become available, periodic intensive monitoring programs should be initiated to strengthen support of the management program.

Annual Monitoring

1. Continue spring and fall gill net sampling series to determine relative trends in abundance, size, and species composition of all fish species.
2. Continue winter creel census. Continue opening day creel census along with periodic sampling through the summer to determine trends in fishermen use and catch success of game fish species.
3. Continue collections of lengths, weights, and scale samples to determine size, age class structure, and growth of game fish populations. These data will be used as a basis in formulating various management options such as stocking, setting bag limits, or seasons.
4. Continue collecting length-weight measurements of mature kokanee spawners in conjunction with egg-taking operations.
5. Attend at least one meeting per year of the Lake Mary Ronaners, Inc. to present an update on the management program and address concerns of the members.

Monitoring Needs

1. Initiate a year-round creel census to estimate total fisherman use and game fish harvest. Since the last creel census estimate of 1968, it is believed that both the fishing pressure and game fish harvest have increased considerably since the decline of the kokanee fishery in Flathead Lake.
2. Reactivate the summer monitoring of temperature and dissolved oxygen profile regimes from the onset of summer stratification to fall overturn. Sampling should be conducted at two-week intervals to measure changes in the vertical kokanee habitat during the summer stagnation period.
3. Conduct a quantitative year-round water quality--plankton monitoring program to evaluate trophic status of the lake.
4. Monitor the spawning migration run of rainbow trout in Donaldson and Freeland creeks to enumerate the strength of spawning year classes and out migration of fry and fingerling recruitment to the lake.
5. Inventory redd construction activities and suitable spawning gravel substrate of Donaldson and Freeland creeks.
6. Conduct a seasonal food habit study of kokanee, trout, and largemouth bass.

Other vital management concerns relative to land use activities in the Lake Mary Ronan watershed must be addressed. The future of the kokanee hangs in the balance of maintaining and/or improving water quality. Several proposed dredging projects to improve boat access by lakeshore property owners could impact the lake ecology by accelerating nutrient releases into the open water. Close coordination efforts by the Department and the Lake County Planning Department are imperative to initiate sound policy for lakeshore

development. Other agencies controlling land use in the drainage: Plum Creek Timberlands, the U. S. Forest Service, and the State Forest Service have an obligation to maintain the integrity of the watershed. Any activities associated with logging or livestock grazing are a matter of concern for the Department.

Prepared by: Robert J. Domrose
Date: November 2, 1987

Waters referred to:

Water	Water Code No.
Donaldson Creek	07-1210
Freeland Creek	07-1575
Lake Mary Ronan	07-7700
Ronan Creek	07-3750

LIST OF FIGURES

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