Volume 11 1969-1970

STATE OF ALASKA

William A. Egan, Governor

ANNUAL REPORT OF PROGRESS, 1969 - 1970

FEDERAL AID IN FISH RESTORATION PROJECT F-9-2

SPORT FISH INVESTIGATIONS OF ALASKA

ALASKA DEPARTMENT OF FISH AND GAME

Wallace H. Noerenberg, Commissioner

DIVISION OF SPORT FISH

Rupert E. Andrews, Director

Howard E. Metsker, Coordinator

INTRODUCTION

This report of progress consists of Job Segment Reports from the State of Alaska, Federal Aid In Fish Restoration, Project F-9-2, "Sport Fish Investigations of Alaska".

The studies reported herein are investigations evaluating the sport fish resources of the state. Recreational and other impacts on the fishery resources necessitates a continuous endeavor of ascertaining facts and knowledge of the fisheries. The 24 jobs reported on are of a continuing nature. The investigations are composed of 11 projects involved with the inventory and cataloging of the sport fish waters of the state, sport fishery creel censuses, and access. Fish species that received special investigational effort include: Dolly Varden, anadromous fish, grayling, sheefish, whitefish, pike, char, and salmon. The information gathered from the combined studies provides necessary background data for a better understanding of management problems and constitutes a basis for necessary future investigations.

The subject matter contained in these reports is incomplete, and the findings and interpretations subject to re-evaluation as work progresses.

RESEARCH PROJECT SEGMENT

State: Alaska

Project No.: F-9-2 *Name:* Sport Fish Investigations of Alaska.

Job No.: 9-C *Title:* **Salmonid Rearing in Heated Ponds.**

Period Covered: July 1, 1969 to June 30, 1970.

ABSTRACT

Rainbow trout, Salmo gairdneri; coho salmon, Oncorhynchus kisutch; and king salmon, O. tshawytscha, have been reared in cooling ponds at Fort Richardson and Elmendorf Air Force Base for several years. Maximum annual production has ranged upward to 96,200 rainbow trout, 255,100 coho salmon, and 538,300 king salmon at Fort Richardson. Maximum annual production at Elmendorf has been 5,000 rainbow trout. Growth rates and food conversions have been satisfactory, and few disease problems have been encountered.

The inability of Ship Creek to provide an adequate water supply during the winter has been the most serious limitation to the potential of the ponds. The facilities at both stations have been constantly revised since inception of this program and operational procedures developed to make the facilities satisfactory for fish cultural use.

RECOMMENDATIONS

1. Continue the study to determine optimal pond stocking rates and to improve pond management techniques.
2. Determine methods of developing the rearing potential of the Elmendorf pond more fully.
3. Make a concerted effort to overcome the water shortage in Ship Creek.

OBJECTIVES

To determine the potential of rearing salmonids in heated ponds.

TECHNIQUES USED

Ponds which provide a source of water for cooling power-generating turbines at Fort Richardson and Elmendorf Air Force Base have been used to rear fish. These cooling ponds are under cooperative programs between the Alaska Department of Fish and Game and the U.S. Army and Air Force. The ponds provide a continuous source of warm water during the winter, thus providing benefits to a year-around fish cultural operation.

All fish are incubated at the Fire Lake Hatchery and transferred to the ponds at appropriate times. Rainbow trout reared in the ponds are used in stocking programs which provide catchable-size trout for

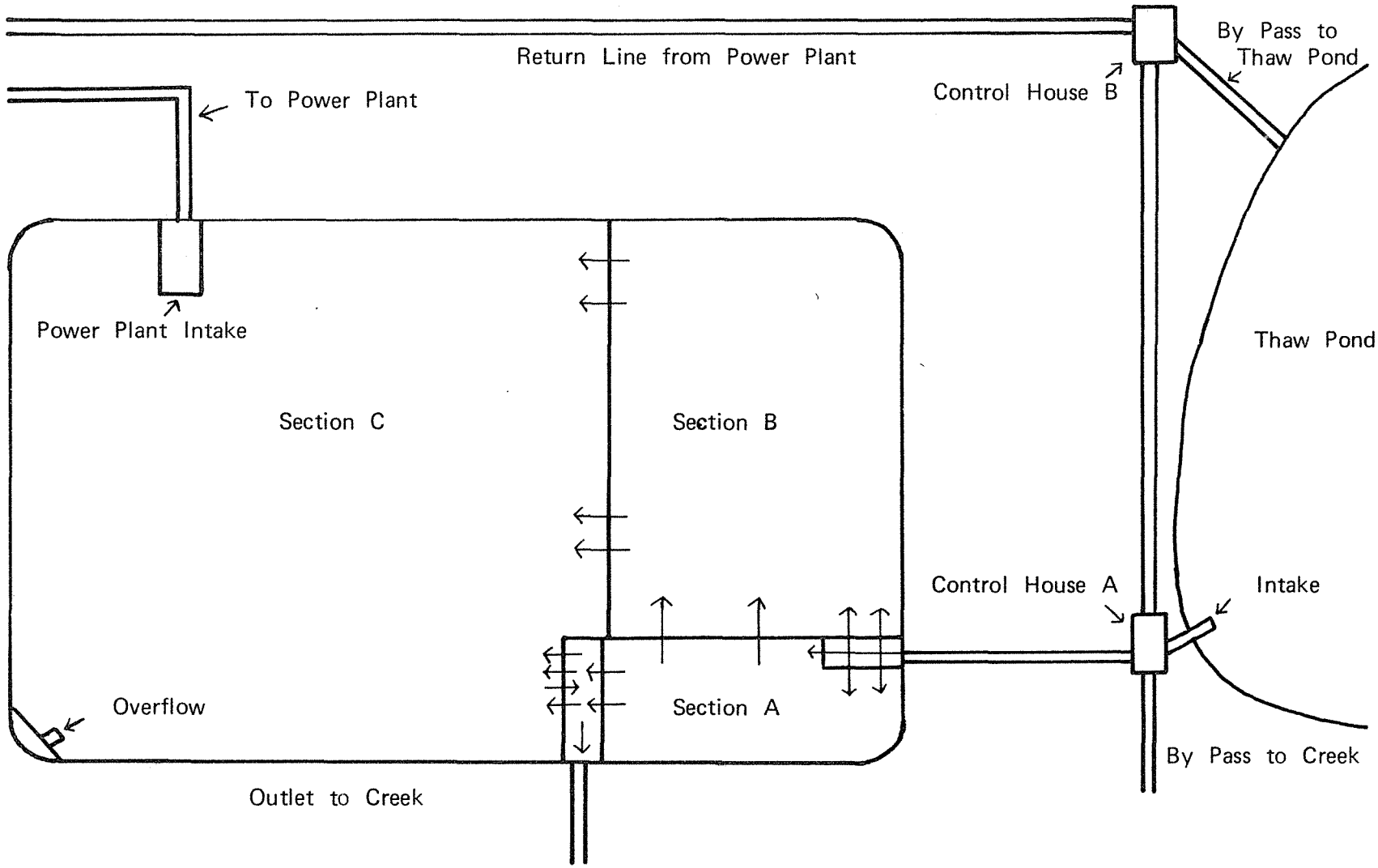

FIGURE 1 SKETCH OF FT. RICHARDSON POWER PLANT COOLING POND.

recreational anglers, both civilian and military. Salmon are used in an experimental program by the Department of Fish and Game to determine the feasibility of enhancing salmon runs in Ship Creek and Bear Lake with smolt plants.

Military personnel are assigned to conduct work at the ponds; Department of Fish and Game personnel provide technical assistance and recommendations for feeding schedules, disease examination and treatment, and overall pond management. Department personnel are also responsible for conducting fin-marking projects and planting the salmon smolts.

Fort Richardson Pond

The cooling pond at Fort Richardson is 160 feet wide x 255 feet long, and is operated at a four-foot water depth (Figure 1). The pond is divided into three sections by concrete bulkheads; water flows from one section to another through perforated aluminum screens located at several openings in the partitions. Water enters the pond from the primary intake for the system, Control House A, and passes through Sections A, B, and C as indicated by arrows. Water is then pumped through a screened intake into the power plant which normally circulates approximately 2,200 gallons of water per minute through heat exchangers. From the power house the warmed water is piped to Control House B where it can be diverted into either the thaw pond or Control House A. The usual procedure is to mix warm water from the plant with cooler water from the thaw pond at Control House A to obtain water of a desired temperature. During part of the year none of the warmed water is re-used. At other times, enough water is used to achieve a desired temperature; exact quantities vary throughout the year.

Elmendorf Ponds

The cooling pond at Elmendorf Air Force Base is approximately 270 feet wide x 800 feet long and operates at approximately a six-foot water depth. The pond is similar in construction and operation to the pond at Fort Richardson, but fish are not reared in the main cooling pond. Three 25-foot diameter ponds were installed adjacent to the pond in 1965 and water is supplied to the wooden ponds by gravity flow through a pipeline from the main pond. No control of pond water temperature has been exercised. Pipe sizes and differences in water levels limit the quantity of water which can be supplied to each pond (approximately 100 GPM).

FINDINGS

Pond Production

Fort Richardson:

A summary of the number of fish stocked in the pond, total mortality, and number of fish planted from the pond from 1959 to 1969 is presented in Table 1. Production summaries for fish reared during the period 1966-1968 have been reported previously (Wallis, 1967, 1968; Wallis and Estabrook, 1969). A production summary for lots of fish reared during the 1968-1969 rearing season is presented in Table 2.

During the year a number of problems were encountered with control of water flows and temperatures at the cooling pond. In January, 1970, the Ship Creek flow proved inadequate due to high domestic use by Fort Richardson and the city of Anchorage. During the period of limited stream flow, oxygen levels in the pond dropped to less than 5.0 ppm. Minimum oxygen level recorded was 1.0 ppm at the power house intake. Before corrective measures were taken, approximately 27,000 rainbows at an average size of 9 per pound, in addition to approximately 12,000 king salmon fingerling, and less than 100 coho were lost.

TABLE 1 Fish Production Summary, Fort Richardson Cooling Pond, 1959-1969.

Brood	Species Source*	Pond Stocked Number	Pond Stocked Size (No./lb)	Pond Stocked Date	Total Loss Number	Total Loss Percent	Fish Planted Number	Fish Planted Size (No./lb)	Fish Planted Date
1959	RT	500	160	Oct 1959	450	90.0	50	4 1/2"	May 1960
1960	RT	8,000	340	Sep 1960	4,300	53.8	3,700	5	May 1961
1961	SH-Ktn	9,200	388	Sep 1961	9,200	100.0	0	-	--
1962	RT	19,600	380	Sep 1962	1,200	6.1	18,400	6	May-Jun 1963
1963	RT	19,100	316	Oct 1963	18,000	94.2	1,100	7	Jun 1964
1965	RT-Win	47,000	91	Sep 1965	4,900	10.5	42,100	2.3-2.5	May-Jul 1966
1966	RT-Win	50,000	290	Sep 1966	15,100	30.2	34,900	2.1-2.4	Jun-Jul 1967
1967	RT-Win	45,300	172	Sep 1967	25,600	56.5	19,700	2.2	Jun-Jul 1968
1968	RT-Win	110,800	101	Oct 1968	14,600	13.2	96,200	3.0-4.7	Jun-Jul 1969
1969	RT-Win	100,000	181	Aug 1969	Still on Hand 2/28/70				
1963	KS-ShCr	13,500	---	Nov 1963	13,100	96.8	400	3"	May 1964
1964	KS-ShCr	2,600	---	Nov 1964	2,200	84.1	400	3"	Mar 1965
1964	KS-GrR	95,300	---	Apr 1965	86,900	91.2	8,400	30	Aug 1965
1965	KS-GrR	167,100	194	Jun 1966	200	0.1	166,900	98	Jul 1966
1966	KS-GrR	489,700	880	Mar 1967	15,200	3.1	474,500	58	May-Jun 1967
1966	KS-ShCr	70,000	1,080	Dec 1966	6,200	8.9	63,800	19	May 1967
1967	KS-ShCr	113,700	1,205	Nov 1967	31,300	27.5	82,400	29	May 1968
1968	KS-ShCr	121,700	1,290	Oct 1968	25,800	21.2	95,900	17	May 1969
1969	KS-ShCr	209,700	1,380	Oct 1969	Still on Hand 2/28/70				
1961	SS	10,000	2,300	May 1962	4,300	43.0	5,700	60	Sep 1962
1966	SS-BC/Ore	229,400	196-409	Jul 1967	17,500	7.6	211,900	18-20	Apr 1968
1967	SS-EC/Ore	226,600	205	Jul 1968	8,700	3.8	225,100	12-15	May 1969
1968	SS-BL	273,600	144	Sep 1969	Still on Hand 2/28/70				

*Species: RT - Rainbow trout; KS - King salmon; SS - Silver salmon (coho); SH - Steelhead trout.

Source: Ktn - Ketchikan; Win - Winthrop (WN) National Fish Hatchery; Sh Cr - Ship Creek; Gr R - Green River, Washington; BC/Ore - Big Creek, Oregon; EC/Ore - Eagle Creek, Oregon; BL - Bear Lake.

TABLE 2 Production Summary for 1967 Brood Coho, 1968 Brood King Salmon, and 1968 Brood Rainbow Trout Reared at Fort Richardson Pond.

	1967 Coho	1968 Kings	1968 Rainbows
Date Pond Stocked	July 22, 1968	October 21-25, 1968	October 2, 1968
Initial Number	226,600	121,700	110,800
Total Recorded Loss	1,500	2,900	7,300
Total Unaccounted Loss (-) or Gain (+)	+800	-22,900	-7,300
Total Loss - Number	1,500	25,800	14,600
Percent	0.7	21.2	13.2
Total Number Planted	225,100	95,900	96,200
Total Weight Planted	14,882 lbs.	5,724 lbs.	22,475 lbs.
Total Fish Weight Gain	13,781 lbs.	5,630 lbs.	21,378 lbs.
Total Weight Food Fed	21,918 lbs.	12,901 lbs.	35,557 lbs.
Food Conversion	1.6	2.3	1.7

Elmendorf Ponds:

A summary of the number of fish stocked in the ponds, total mortality, and number planted from the pond from 1965 to date is presented in Table 3. In addition, some lots of fish have been reared in the ponds for short periods when additional space was required for the Fire Lake Hatchery program. In April, 1969, virtually all the rainbow trout being reared in the ponds died when the water level in the cooling pond dropped below the pond intake.

Evaluation of Production

Fort Richardson Pond:

Fish growth rates at the Fort Richardson pond have been very good. An attempt has been made to obtain near maximum growth from rainbow trout and king salmon, while coho salmon growth has been restricted to produce fish of a predetermined size at planting. Increase in average size of the three species by time period is illustrated in Figure 2. Instances of lower growth rates for king salmon and rainbow trout occurred when inexperienced personnel did not follow prescribed feeding schedules, and during one year, warm water temperatures were not maintained during certain periods.

Food conversions for 1965-1968 broods have usually been satisfactory (Table 4). Instances of very poor conversion were associated with groups which had relatively high unaccounted losses.

TABLE 3 Rainbow Trout Produced at Elmendorf Rearing Ponds, 1965-1969.

	Pond Stocked			Mortality		Fish Planted		
Brood	No.	Size (No./lb)	Date	No.	%	No.	Size (No./lb)	Date
1965	5,000	---	Sep '65	200	3.1	5,000	2.0	May '66
1966	9,000	290	Sep '66	7,600	84.4*	1,400	2.1	Jun '67
1967	5,000	172	Oct '67	3,000	60.0**	2,000	5.0	May '68
1968	5,400	101	Oct '68	5,400	100.0*	0		
1969	10,000	116	Sep '69	Still on Hand 2/28/70				

*Loss primarily due to water stoppage to ponds.
**Primarily unaccounted loss, suspected to be due to loose screens.

The maximum density of fish reared in the pond occurred during the 1968-1969 rearing season. The estimated weight of fish in the pond by time period is shown in Figure 3. This is typical of changes in the load of fish throughout the year under the current rearing program, although weights will vary.

Due to flow characteristics of the pond, it is not realistic to use most of the standard methods of evaluating efficiency of hatchery operations. A comparison of pounds of fish per cubic foot of water is not realistic as each species is held in a separate section. Calculating weight on the basis of the volume per section would be more meaningful, but still has limitations. There is no means of determining exactly how much water passes through each section; therefore, strict adherence to a comparison of pounds per gallon per minute of water flowing through the pond also has limitations. With the power plant pumping 2,200 GPM, all the water would be passed through the turbines every 9 hours 15 minutes. During certain periods, no warm water is reused; thus, the turnover rate would be 0.11 change per hour. During periods when approximately two-thirds of the warm water is being reused, the effective turnover rate is once every 27 hours 45 minutes, or 0.04 water change per hour. These are extremely slow water exchange rates in comparison to more conventional hatchery ponds, and would call for relatively low densities of fish per unit of volume.

The most realistic approach to determining optimal pond stocking rates is to rear varying numbers of fish in the pond. During 1968-1969, eroded dorsal fins were observed on rainbow trout. This condition is common to most hatchery rainbow populations, but had not been observed on rainbow trout in the Fort Richardson pond previously. The condition is not necessarily indicative of an over-crowded population, but suggests the optimal limit is being approached.

Elmendorf Ponds:

Lack of detailed records and excessive losses due to physical features of the ponds and water supply precludes any attempt to evaluate the results to date.

Diseases

An extensive ulcer disease infection was diagnosed in rainbow trout at both Fort Richardson and Elmendorf in 1967, and a relatively light infection was noted at Fort Richardson in 1968. Therapeutic treatment with Terramycin provided effective control of the disease.

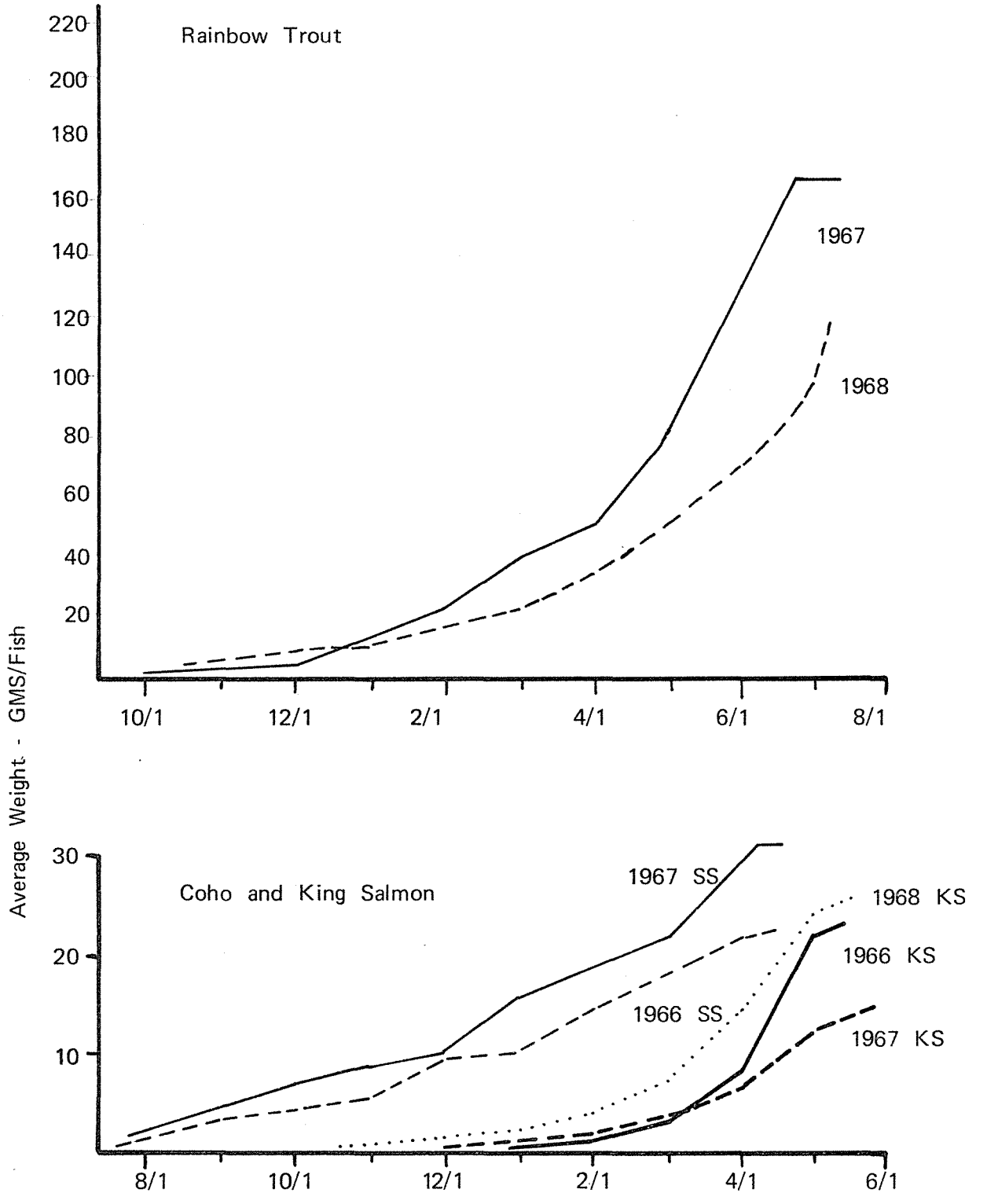

FIGURE 2 AVERAGE INDIVIDUAL WEIGHT OF RAINBOW TROUT, COHO, AND KING SALMON IN FT. RICHARDSON, BY TIME PERIOD.

TABLE 4 Pounds of Fish Produced, Pounds of Food Fed, and Food Conversions for Fish Reared in Fort Richardson Cooling Pond, 1965-1969.

Species	Rearing Season	Brood	Source	Weight Planted	Fish Wt. Gain	Tot. Lbs. Food Fed	Food Conv.	Type of Food Fed
RT	1965-66	1965	Win	17,062	16,545	30,600	1.66	Clark's
	1966-67	1966	Win	16,165	15,993	27,200	1.70	Clark's
	1967-68	1967	Win	8,817	8,554	31,725	3.71	Clark's
	1968-69	1968	Win	22,475	21,378	35,557	1.66	Rangen's/Clark's
KS	1965-66	1965	GrR	1,689	838	800	0.95	Oregon Pellet
	1966-67	1966	GrR	8,125	7,569	12,550	1.66	Abernathy Diet
	1966-67	1966	ShCr	3,429	3,364	6,331	1.88	AM/OP*
	1967-68	1967	ShCr	2,864	2,770	15,285	5.52	AM/OP
	1968-69	1968	ShCr	5,724	5,630	12,901	2.29	AM/OP
SS	1967-68	1966	Ore.	9,342	8,715	17,095	1.96	AP/OP**
	1968-69	1967	Ore.	14,882	13,781	21,918	1.59	Oregon Pellet

*Fish were started to feed on Abernathy Mash and switched to Oregon Pellets at approximately 700/lb.
**Abernathy Pellets and Oregon Pellets were used interchangeably.

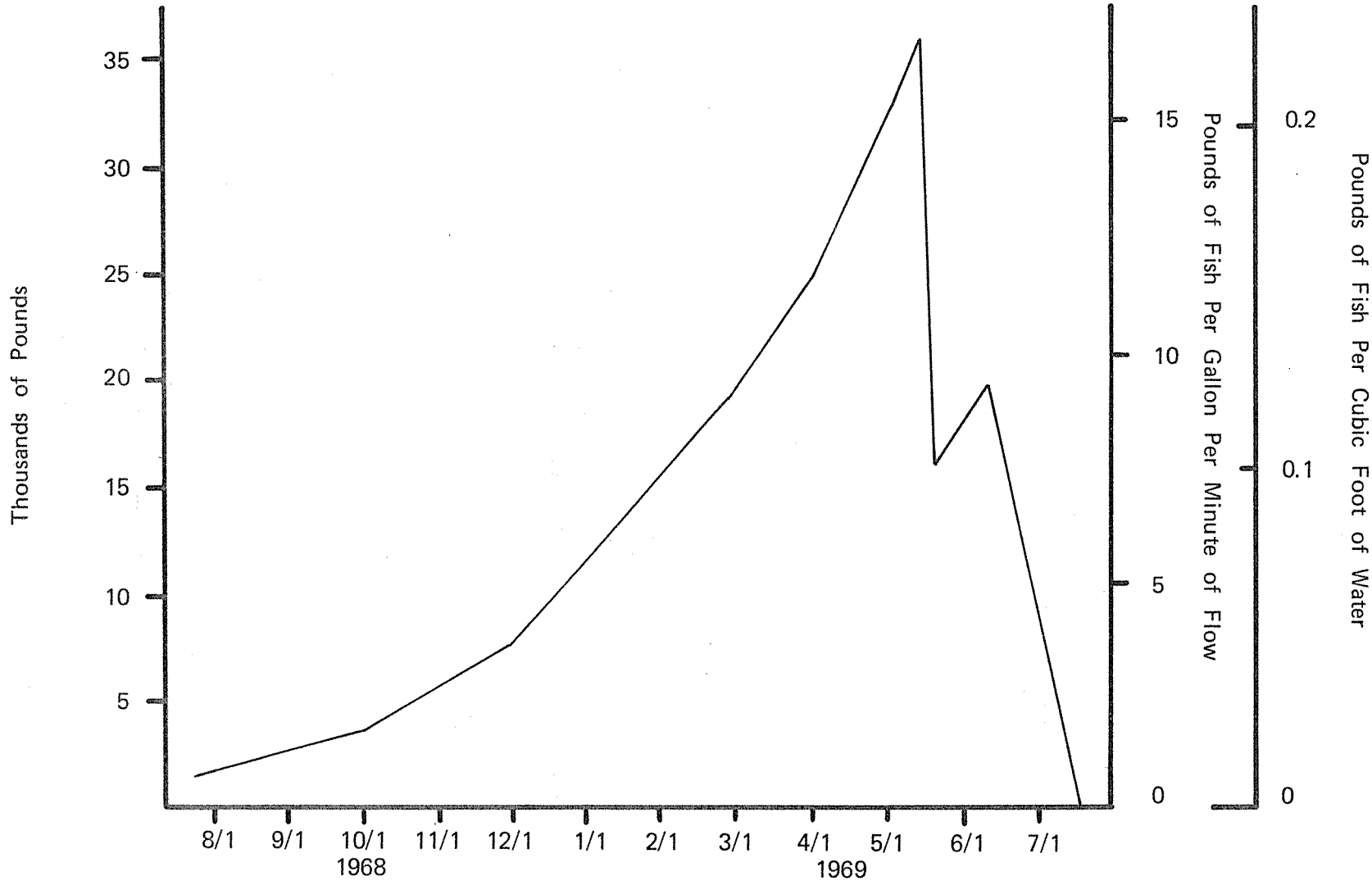

FIGURE 3 ESTIMATED TOTAL WEIGHT OF FISH IN FT. RICHARDSON POND BY TIME PERIOD, AUGUST, 1968 TO JULY, 1969.

In 1968 a very heavy infestation of Trichodina was observed on all species at Fort Richardson. The organisms apparently were stirred up from muck on the pond bottom during seining operations. External chemical treatment was not feasible; however, the infestation gradually lessened.

In 1969 a gill disorder developed in coho salmon at the Elmendorf ponds due to overcrowding and an excessive buildup of metabolic wastes. Treatment with Roccal was not effective in correcting the problem, and the fish were moved to Fort Richardson. Mortality continued to be very high for approximately ten days, then dropped to normal without treatment.

Diseases which may be controlled by feeding drugs can be controlled as easily here as anywhere. Chemical bath treatments for control of external diseases can be administered easily in the Elmendorf ponds, but due to the size and nature of the Fort Richardson pond, external treatments would be difficult to administer. The best approach is to try to prevent serious disease outbreaks by controlling maximum temperatures, keeping the ponds as clean as possible, and to avoid overcrowding the fish.

Water Supply

Fort Richardson:

During February and March, stream flow in Ship Creek is very low and at times non-existent. Flow stoppage is caused by the diversion of water at the uppermost dam on Ship Creek which is the water source for the military bases and the city of Anchorage. During winter periods when large quantities of water are diverted to water treatment plants and flows entering the reservoir are reduced, water is drawn below the spillway level at the dam, effectively shutting off the flow in Ship Creek until the reservoir fills again. Ice jam formation in the creek below the dam also sometimes blocks the flow and diverts it to another channel of the creek.

When the Ship Creek flow drops too low at the pond intake, it is necessary to close the system to prevent water from flowing back to the creek from the pond. During these periods, the system is operated as a completely closed system with no new water being introduced into the pond. Consequently, the water temperature is warmer than desired, metabolic wastes accumulate, and oxygen levels decrease as the water is used repeatedly without replacement.

Several interim measures have been taken in an attempt to maintain oxygen levels during the no-flow periods. These include: removing ice jams from the creek; installation of a compressor and air lines in the pond; and pumping water and spraying it back into the pond. Recently a nearby well was activated to supply a very small quantity of new water, and plans were made to have a pumper truck from the Fort Richardson Fire Department pump water from the thaw pond until the creek begins to flow again.

A permanent solution to this problem is needed. A guaranteed minimum flow in Ship Creek at the pond intake is needed, but appears to be infeasible. Both military bases and the city have a number of wells which may be used to supplement their requirements, and these have not always been used to their capacity. However, there are periods when the water available from the wells and from Ship Creek are necessary for domestic use. There is every likelihood that water requirements for domestic use will increase in future years; consequently, the problem of supplying water to the cooling pond will become more serious. Available information indicates there is a substantial quantity of sub-surface water in the vicinity of Ship Creek, and installation of wells or infiltration galleries may be the most practical method of obtaining a dependable water source.

A minor problem with the water supply in both locations is that it contains glacial silt during the summer run-off. The problem is that it is difficult to observe the fish and be sure how they react to feeding. However, they do feed and grow well, and there is no evidence of disorders resulting from the suspended particles.

Elmendorf Ponds

The effect of low flows on the main cooling pond at Elmendorf is similar to that of Fort Richardson, but there is a difference in that fish are not reared in the main pond. The problem at Elmendorf is that the cooling pond level drops below the rearing pond intake, thus shutting off the water to the rearing ponds. The only corrective measure taken to date is to provide closer surveillance of the cooling pond level. A permanent solution would be to lower the pond intake or to provide standby emergency pumps.

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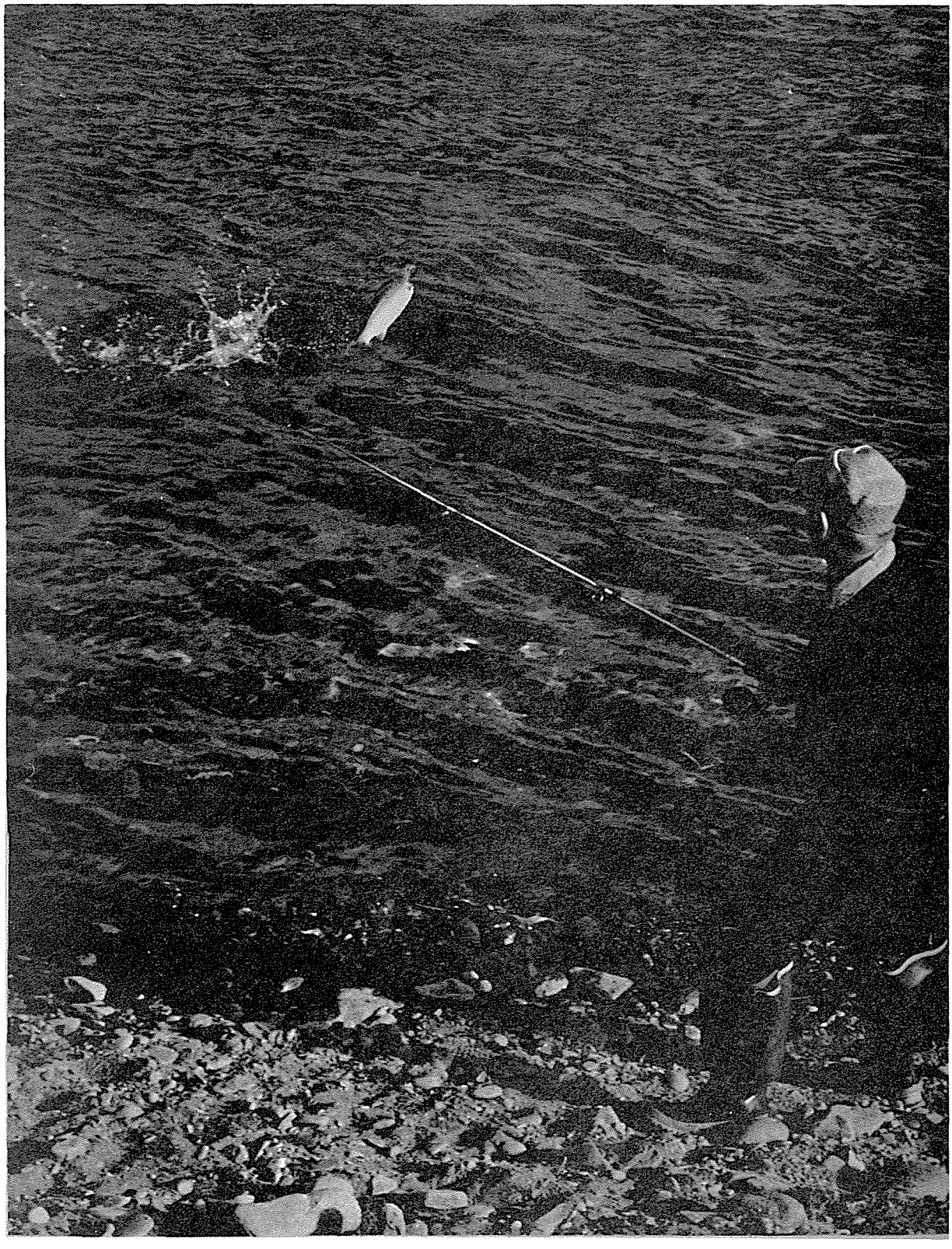

THE KVICHAK RIVER RAINBOW TROUT ARE SOUGHT FOR THEIR TROPHY-SIZE QUALITIES.