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STATE OF ALASKA

William A. Egan, Governor



ANNUAL REPORT OF PROGRESS, 1963 - 1964

FEDERAL AID IN FISH RESTORATION PROJECT F-5-R-5

SPORT FISH INVESTIGATIONS OF ALASKA

ALASKA DEPARTMENT OF FISH AND GAME

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INTRODUCTION

This report of progress consists of Job Segment Reports from the State of Alaska Federal Aid in Fish Restoration Project F-5-R-5, "Sport Fish Investigations of Alaska."

The project is composed of 25 separate studies designed to evaluate the various aspects of the State's recreational fishery resources. Of these, eight jobs are designed to continue the cataloging and inventory of the numerous State waters in an attempt to prepare an index of the recreational waters. Four jobs are designed for specific sport fishery creel census while the remainder of the jobs are more specific in nature. These include independent studies on king salmon, silver salmon, grayling, Dolly Varden, a statewide access evaluation program, egg take program and a residual toxaphene study. The information gathered from the combined studies will provide the necessary background data for a better understanding of local management problems and assist in the development of future investigational studies.

The subject matter contained within these reports is often fragmentary in nature. The findings may not be conclusive and the interpretations contained therein are subject to re-evaluation as the work progresses.

JOB COMPLETION REPORT

RESEARCH PROJECT SEGMENT

STATE: ALASKA Name: Sport Fish Investigations
of Alaska.

Project No: F-5-R-5 Title: Evaluation of the Fire Lake
Hatchery Water Supply.

Job No: 8-C-3

Period Covered: February 1, 1963 to January 31, 1964.

Abstract:

Water temperatures at Fire Lake Hatchery reached a maximum of 59°F. during July, August and September and a minimum of 34°F. in November. The bypass valve remained open during subzero air temperatures to maintain suitable hatchery water temperatures and prevent freezing of the pipelines. Maximum water temperatures recorded at the surface and 20-foot depth on Upper Fire Lake were 62°F. and 48°F., respectively. Both recordings were made in August. The annual mean dissolved oxygen concentration in the hatchery was approximately 6.8 ppm. On only one occasion a reading of less than 5 ppm was recorded. Dissolved oxygen in Upper Fire Lake was lowest at all depths in late spring. The hydrogen-ion (pH) ranged from 6.7 to 7.8 in the hatchery and 6.8 to 7.8 in Upper Fire Lake. Carbon dioxide and total alkalinity concentrations in the hatchery closely corresponded with those at the 15 and 20-foot depths in Upper Fire Lake during the year. The maximum snow cover measured in 1963 was 9.5 inches and the ice depth measured 34 inches. The peak runoff in Fire Creek occurred in June soon after breakup on Upper Fire Lake. Holes were drilled in the water supply pipeline below the surface of Upper Fire Lake to release the gas that accumulates within the pipeline. The flow of water to the wooden tanks was maintained through October 1963 to hold the marked coho salmon (Oncorhynchus kisutch) for the restocking of Bear Lake on the Kenai Peninsula.

Recommendations:

Continuation of this project is recommended with emphasis placed on the evaluation of the existing data for the proper manipulation of the hatchery water supply intake.

Simplified methods of measuring water flows within the hatchery, at the bypass, and below the hatchery on Fire Creek should be devised and operated periodically to establish seasonal trends and variations.

A filter should be installed along the water supply pipeline to prevent small fish, silt and other debris from entering the hatchery.

The intake portion of the water supply pipeline should be secured to the tower on Upper Fire Lake to increase ease of manipulation and accuracy of depth control.

Objectives:

To evaluate the Fire Lake Hatchery water supply and to provide recommendations for improvements and procedures designed to fully utilize its potential.

Techniques Used:

Water temperatures were continuously recorded on a Taylor recording instrument during the year. The thermograph is a spring-wound device that measures the water temperature and simultaneously records them on a circular chart in 7-day periods.

Maximum-minimum outside air temperatures were taken and recorded throughout the report year from a Taylor mercury thermometer mounted on the north wall of the hatchery.

Water samples were collected, analyzed and recorded at the intake tower in Upper Fire Lake and at the hatchery to determine variations between the two stations, observe any chemical or physical changes in the hatchery during egg and fish occupancy, and establish seasonal trends. Dissolved oxygen, pH and turbidity tests were conducted on a Hach direct reading colorimeter. Carbon dioxide and total alkalinity concentrations were determined by the titrimetric method. Ice and snow cover and water and air temperatures were recorded on each sample date.

Measurements of the flow of water at the bypass, through the hatchery and below the hatchery were taken periodically during the year. Three methods were employed in recording the flows: the time-volume displacement method, rectangular weir method and the Embody method.

One hole was drilled in the water supply pipeline to alleviate the dissolved gas problem which occurs with the onset of warm weather. The hole was drilled in one submerged pipe section in Upper Fire Lake.

The aluminum trough aerators were placed in operation in early summer to alleviate the "gas-bubble" disease which occurs during the summer months.

Findings:

A description of the Fire Lake Hatchery and its operation was presented in the 1962 completion report F-5-R-3 (ADFG, 1962).

UPPER FIRE LAKE

The water supply for the Fire Lake Hatchery is obtained from Upper Fire Lake which is located approximately 34 feet above the level of the hatchery. Water samples were collected periodically from five depths at the intake tower (Station 1) on Upper Fire Lake. The samples were tested for dissolved oxygen, carbon dioxide, total alkalinity, pH and turbidity. Water and air temperatures, and snow and ice cover were recorded simultaneously with each water sample.

Water temperatures recorded at the various depths in Upper Fire Lake are presented in FIGURE 1. Maximum temperatures at all depths occurred during the month of August. The water temperature at the surface reached a high of 62°F. in August, while the maximum temperature at the 20-foot level was 48°F. recorded during the same month. No temperatures and dissolved oxygen samples were taken in the latter part of May due to the ice breakup. Tight schedules in other projects precluded dissolved oxygen and temperature determinations during June and early July. The chart indicates that the spring turnover occurred in late April and fall turnover occurred early in October (FIGURE 1).

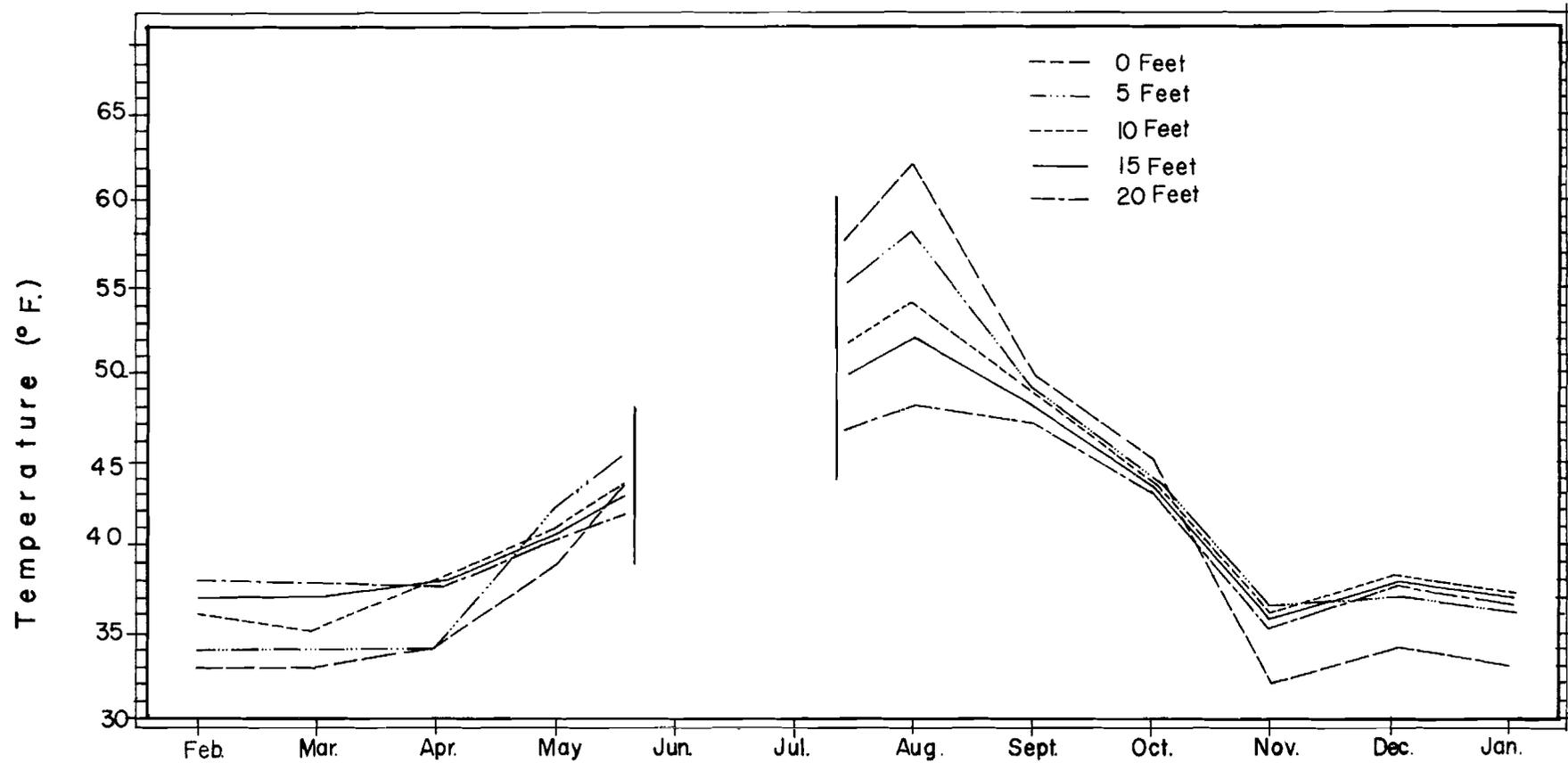


Figure 1. Monthly mean water temperatures of Upper Fire Lake at five depths from February 1963 to January 1964.

As late as May 3 the ice cover on Upper Fire Lake measured 30 inches, but only 11 days later 21 inches of ice remained (TABLE 1). Ice breakup occurred on May 23 this year, while in 1962 breakup occurred on May 15. Ice formation began early in November and reached a maximum measured depth of 34 inches during April.

FIRE LAKE HATCHERY

The pipeline which supplies water to Fire Lake Hatchery from Upper Fire Lake is 8 inches in diameter, above ground and uninsulated. Water temperatures recorded immediately upon entering the troughs ranged from 34°F to 59°F. throughout the year (FIGURE 2). The annual mean water temperature in 1963 is approximately 1°F. lower than the average annual temperature in 1962 (FIGURE 1, ADFG, 1962). The manipulation of the intake pipe on Upper Fire Lake and/or the adjustment of the discharge rate of water through the bypass valve maintained adequate hatching and rearing water temperatures throughout the winter and summer months. The bypass valve was open from July through October and supplied water to the wooden rearing tanks at approximately 50 gallons per minute. The supply of water to the tanks was maintained to rear and hold the marked coho salmon which will be transplanted in Bear Lake.

There was little difference in dissolved oxygen between the head of the troughs (Station 2) and the foot of the lower trough (Station 3) from February to October 1963. No samples were taken from November 1963 through January 1964, due to change of operation of the hatchery. The silver salmon eggs were all placed in incubators and only one trough (without eggs) had running water so that temperatures could be recorded. No tests were made at Station 3 as there was no water at this station. In early summer, aluminum trough aerators (FIGURE 7, ADFG, 1962) were installed at the heads of each trough occupied by fish, primarily to remove dissolved gases in the hatchery water.

The pH readings did not vary considerably between the head and the foot of the troughs during the year (TABLE 6). Maximum pH readings (7.8) occurred during the summer months, while minimum readings (6.7) were recorded in the winter.

TABLE 1. Air temperatures, snow depth and ice depth expressed in degrees fahrenheit and inches at Station 1 on Upper Fire Lake from February 7, 1963 to January 21, 1964.

<u>Date</u>	<u>Air Temp.</u>	<u>Snow Depth</u>	<u>Ice Depth</u>
February 7, 1963	12	6.5	30.5
February 14, 1963	26	9.5	31.5
February 20, 1963	30	6.0	31.0
February 27, 1963	40	3.0	32.0
March 7, 1963	38	0.0	31.0
March 13, 1963	28	3.0	31.0
March 20, 1963	30	5.0	31.0
March 28, 1963	22	2.0	33.0
April 4, 1963	42	2.0	33.0
April 11, 1963	34	4.0	34.0
April 18, 1963	30	9.0	34.0
April 25, 1963	46	1.0	32.0
May 3, 1963	51	0.0	30.0
May 14, 1963	55	0.0	21.0
August 16, 1963	64	-	-
September 25, 1963	53	-	-
October 11, 1963	40	-	-
November 26, 1963	2	1.5	16.0
December 4, 1963	30	2.5	17.0
December 27, 1963	24	0.0	21.0
January 3, 1964	23	4.0	22.0
January 21, 1964	-12	4.5	25.0
Annual Mean	32	3.3	28.2

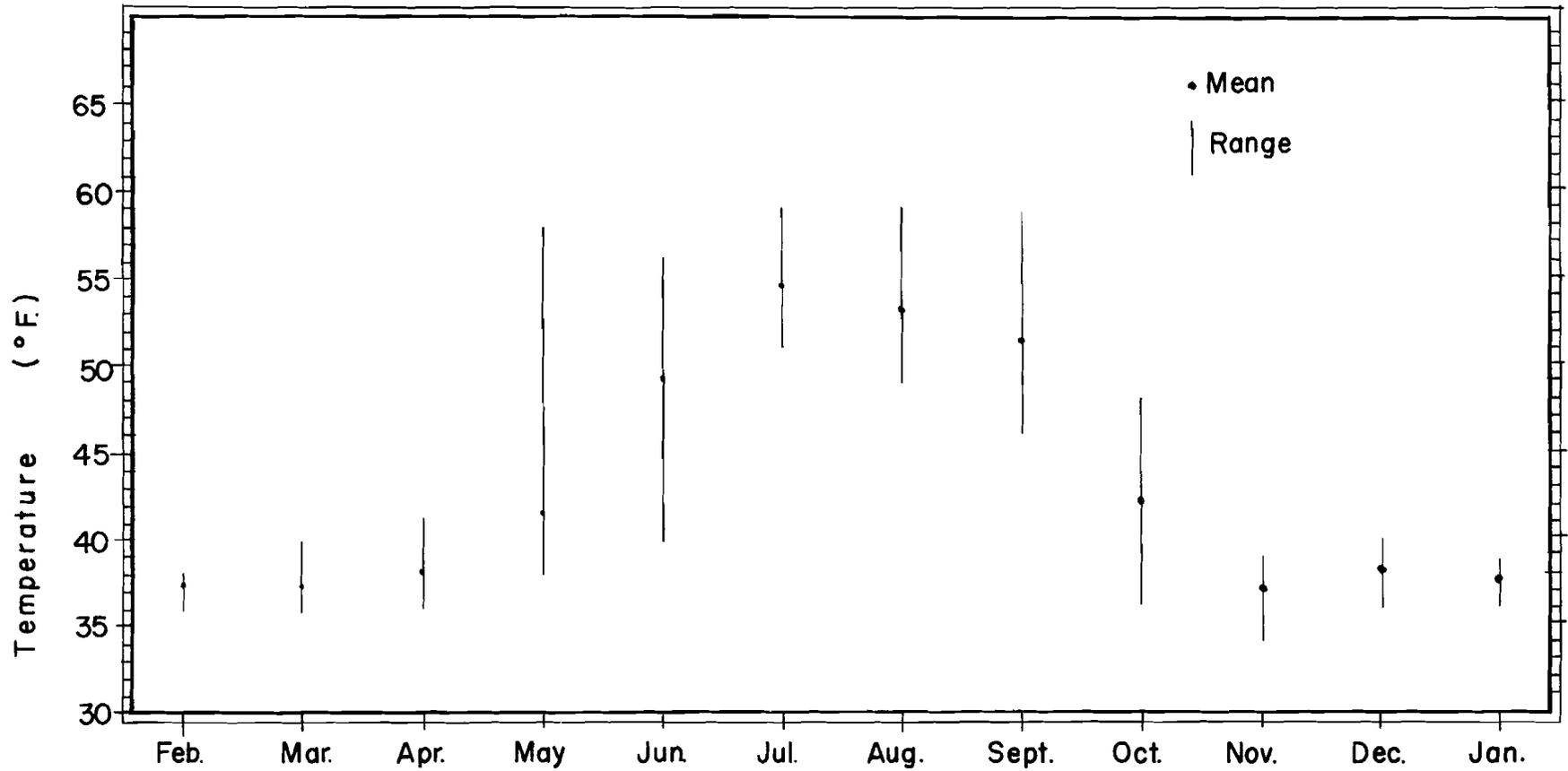


Figure 2. Monthly range and mean water temperature at Fire Lake Hatchery from February 1963 to January 1964.

The mean air temperatures were recorded during each water sample period on Upper Fire Lake (TABLE 1). Normal seasonal variations are indicated.

The analysis of the data for dissolved oxygen collected from 5 depths on Upper Fire Lake revealed that during the winter and spring of 1963 the concentrations gradually declined at the 15- and 20-foot depths (TABLE 2). Low dissolved oxygen concentrations at these two depths were recorded in mid-April. There was little variation at the other three depths. During the spring turnover, the lake rapidly took on oxygen and averaged about 10 ppm during the summer. A high of 12.9 ppm occurred on August 16 at the 15-foot depth. Dissolved oxygen concentrations gradually diminished again after the fall turnover.

The high pH readings on Upper Fire Lake occurred at the shallower depths during the summer months, while the low readings were recorded at the 20-foot depth during the winter and spring months (TABLE 3). An annual pH differential of 0.2 occurs between the surface and at the 20-foot level with the higher readings recorded at the surface.

The carbon dioxide concentrations at all depths in Upper Fire Lake ranged from 0 to 12 ppm throughout the year (TABLE 4). The highest annual mean concentrations were recorded at the 20-foot level, while the lowest readings occurred at the surface. Carbon dioxide was highest at all depths just prior to spring turnover.

Total alkalinity tests performed on the water samples from Upper Fire Lake revealed that the fluctuation of concentration levels correspond similarly to the carbon dioxide levels (TABLE 5).

Turbidity concentrations measured from water samples taken at Upper Fire Lake were negligible throughout the year. A high of 25 units was recorded on December 4 at the 15-foot depth.

Snow depths on Upper Fire Lake fluctuated between each sample period because of new snowfall and melting or settling of the existing snow. The deepest snow depth was 9.5 inches recorded on February 14, 1963 (TABLE 1).

TABLE 2. Dissolved oxygen concentrations from five depths at Station 1 from February 7, 1963 to January 21, 1964, expressed in parts per million.

Date	D E P T H (f e e t)				
	0	5	10	15	20
February 7, 1963	8.5	7.9	6.6	5.3	5.4
February 14, 1963	8.5	8.0	6.5	5.6	4.7
February 20, 1963	7.7	7.5	7.0	5.8	5.2
February 27, 1963	8.0	7.9	6.5	5.2	3.2
March 7, 1963	8.4	8.7	6.8	4.8	3.3
March 13, 1963	9.9	9.2	8.5	5.5	4.3
March 20, 1963	9.7	8.9	9.2	5.8	3.5
March 28, 1963	10.3	9.9	7.1	4.3	3.0
April 4, 1963	10.7	11.2	6.8	5.0	2.9
April 11, 1963	10.0	10.0	5.4	3.6	1.8
April 18, 1963	10.1	11.3	5.8	3.5	2.7
April 25, 1963	10.9	12.0	7.3	3.9	3.4
May 3, 1963	9.2	9.6	8.0	7.0	3.7
May 14, 1963	8.1	11.5	12.7	6.5	3.7
August 16, 1963	10.7	12.6	12.8	12.9	6.9
September 25, 1963	11.0	11.2	11.1	10.0	9.0
October 11, 1963	8.0	7.8	7.8	7.6	7.4
November 26, 1963	8.0	7.5	7.5	7.4	7.3
December 4, 1963	7.6	7.7	7.5	7.3	7.2
December 27, 1963	7.8	7.1	6.5	6.3	6.3
January 3, 1964	7.5	7.0	6.3	6.0	5.6
January 21, 1964	8.7	7.9	7.9	7.2	6.7
Annual Mean	9.1	9.2	7.8	6.2	4.9

TABLE 3. Hydrogen-ion (pH) concentrations from five depths at Station 1 from February 7, 1963 to January 21, 1964, expressed in parts per million.

Date	D E P T H (f e e t)				
	0	5	10	15	20
February 7, 1963	7.1	7.1	7.0	7.0	7.0
February 14, 1963	7.0	7.0	6.9	6.9	6.8
February 20, 1963	7.4	7.3	7.3	7.2	7.2
February 27, 1963	7.3	7.3	7.2	7.1	7.0
March 7, 1963	7.2	7.2	7.1	7.0	6.9
March 13, 1963	7.1	7.2	7.1	7.0	7.0
March 20, 1963	7.2	7.4	7.3	7.1	7.0
March 28, 1963	7.2	7.2	7.1	7.0	6.9
April 4, 1963	7.2	7.3	7.1	7.0	6.8
April 11, 1963	7.1	7.2	7.0	6.9	6.8
April 18, 1963	7.1	7.3	7.0	6.9	6.9
April 25, 1963	7.4	7.6	7.3	7.1	7.1
May 3, 1963	7.2	7.2	7.2	7.2	7.1
May 14, 1963	6.9	7.6	7.8	7.5	7.1
August 16, 1963	7.8	7.8	7.8	7.8	7.3
September 25, 1963	7.8	7.8	7.8	7.5	7.4
October 11, 1963	7.3	7.2	7.2	7.2	7.2
November 26, 1963	7.2	7.2	7.2	7.2	7.2
December 4, 1963	7.2	7.2	7.2	7.2	7.2
December 27, 1963	7.2	7.2	7.2	7.2	7.2
January 3, 1964	7.5	7.4	7.4	7.4	7.4
January 21, 1964	6.9	6.9	6.9	6.9	6.8

TABLE 4. Carbon dioxide concentrations from five depths at Station 1 from February 7, 1963 to January 21, 1964, expressed in parts per million.

Date	D E P T H (f e e t)				
	<u>0</u>	<u>5</u>	<u>10</u>	<u>15</u>	<u>20</u>
February 7, 1963	7	6	6	7	9
February 14, 1963	6	7	10	9	10
February 20, 1963	5	6	6	7	9
February 27, 1963	6	6	6	7	7
March 7, 1963	5	5	7	10	12
March 13, 1963	8	9	11	9	10
March 20, 1963	4	4	5	8	10
March 28, 1963	3	4	4	5	6
April 4, 1963	5	5	6	7	7
April 11, 1963	3	5	5	6	7
April 18, 1963	4	4	6	9	9
April 25, 1963	2	2	4	6	6
May 3, 1963	4	4	6	6	6
May 14, 1963	1	2	1	-	12
August 16, 1963	0	0	0	0	7
September 25, 1963	0	0	0	1	2
October 11, 1963	4	2	3	3	4
November 26, 1963	5	3	4	4	4
December 4, 1963	3	4	4	4	3
December 27, 1963	4	3	4	6	3
January 3, 1964	3	3	5	4	4
January 21, 1964	3	3	2	3	3
Annual Mean	4	4	5	6	7

TABLE 5. Total alkalinity* concentration from five depths at Station 1 from February 7, 1963 to January 21, 1964, expressed in parts per million.

<u>Date</u>	<u>0</u>	<u>5</u>	<u>10</u>	<u>15</u>	<u>20</u>
February 7, 1963	72	70	70	71	72
February 14, 1963	73	71	70	70	70
February 20, 1963	79	80	82	83	85
February 27, 1963	75	79	77	76	82
March 7, 1963	77	78	73	75	75
March 13, 1963	70	70	67	85	75
March 20, 1963	73	82	81	111	111
March 28, 1963	71	78	78	79	81
April 4, 1963	70	70	70	73	76
April 11, 1963	67	78	88	87	91
April 18, 1963	70	73	75	74	80
April 25, 1963	60	70	73	75	72
May 3, 1963	48	64	78	92	90
May 14, 1963	36	72	98	-	90
August 16, 1963	66	64	68	72	80
September 25, 1963	70	71	69	70	74
October 11, 1963	75	73	74	72	78
November 26, 1963	80	76	75	76	77
December 27, 1963	74	76	74	70	72
January 3, 1964	80	74	75	74	73
January 21, 1964	79	76	75	75	74
Annual Mean	70	74	76	78	80

* As CaCO₃

The concentration of carbon dioxide entering the hatchery troughs ranged from 0 to 11 ppm in 1963 (TABLE 7). The table indicates that slightly larger amounts of carbon dioxide were present at the foot of the troughs.

The annual mean total alkalinity was higher at the foot of the troughs during the year (TABLE 7). Highest concentrations were recorded at both stations during the spring months, coinciding with the lowest annual dissolved oxygen readings (TABLE 6) and the highest carbon dioxide concentration (TABLE 6).

Water flow measurements were made and recorded periodically in Fire Creek, the bypass pipe, through the hatchery and below the hatchery. The bypass pipe is located about 90 feet above the hatchery building and supplies water to the four wooden rearing tanks during the summer months. The water flow through the bypass pipe ranges from 40 to 100 gallons per minute. Water flowing through the hatchery varies with the season of year. An average flow of 200 gpm is used in the hatchery during May, June, July and August to meet the demands of fish being raised at that time. This amount drops off to approximately 75 gpm during the incubation of coho salmon eggs from October through January. Total Fire Creek water flows were calculated from the discharge weir next to the hatchery. Total flow measurements included bypass amounts when applicable. The runoff recorded through the weir in Fire Creek ranged from 373 to 1,445 gpm. Measurements at the weir had to be discontinued in early May due to the installation of the upstream-downstream traps. After this time, two periods of streamflow (breakup and freshet) exceeding the maximum recorded flow over the weir was observed.

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TABLE 6. Dissolved oxygen and hydrogen-ion concentrations expressed in parts per million and pH at two stations in the Fire Lake Hatchery, February 7, 1963 to January 21, 1964.

Date	Dissolved Oxygen		pH	
	Station 2*	Station 3**	Station 2	Station 3
February 7, 1963	6.5	6.4	7.0	7.0
February 14, 1963	5.4	5.5	6.8	6.8
February 20, 1963	5.5	5.5	7.2	7.2
February 27, 1963	4.6	4.5	7.1	7.1
March 7, 1963	5.0	5.0	7.0	7.0
March 13, 1963	5.3	5.5	6.9	7.0
March 20, 1963	5.2	6.2	7.0	7.1
March 28, 1963	5.3	6.0	7.0	7.0
April 4, 1963	5.5	5.3	7.1	7.0
April 11, 1963	5.3	5.6	6.9	6.9
April 18, 1963	6.6	6.6	7.0	7.0
April 25, 1963	6.7	7.0	7.2	7.3
May 3, 1963	7.4	7.5	7.2	7.2
May 14, 1963	12.3	12.0	7.8	7.8
September 25, 1963	11.1	10.7	7.8	7.8
October 11, 1963	8.0	7.3	7.3	7.2
November 26, 1963	8.1	-	7.2	-
December 4, 1963	8.1	-	7.2	-
December 27, 1963	6.7	-	7.3	-
January 3, 1964	6.9	-	7.4	-
January 21, 1964	7.4	-	6.7	-
Annual Mean	6.8	6.7		

* Head of Trough

** Foot of Trough

TABLE 7. Carbon dioxide and total alkalinity* concentrations expressed in parts per million at two stations in the Fire Lake Hatchery, February 7, 1963 to January 21, 1964.

Date	Carbon Dioxide		Total Alkalinity	
	Station 2**	Station 3***	Station 2	Station 3
February 7, 1963	6	8	71	73
February 14, 1963	10	4	70	75
February 20, 1963	7	8	85	91
February 27, 1963	7	8	83	80
March 7, 1963	10	11	73	74
March 13, 1963	9	10	73	75
March 20, 1963	5	6	104	120
March 28, 1963	6	7	85	78
April 4, 1963	6	8	84	85
April 11, 1963	5	5	72	84
April 18, 1963	6	7	76	77
April 25, 1963	6	6	71	74
May 3, 1963	6	6	81	81
May 14, 1963	3	2	78	74
September 25, 1963	0	0	67	72
October 11, 1963	4	4	75	74
November 26, 1963	5	-	76	-
December 4, 1963	4	-	-	-
December 27, 1963	4	-	76	-
January 3, 1964	6	-	75	-
January 21, 1964	4	-	80	-
Annual Mean	6	6	78	80

* As CaCO₃

** Head of Trough

*** Foot of Trough

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