

Volume 6

1964-1965

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ANNUAL REPORT OF PROGRESS, 1964 - 1965

FEDERAL AID IN FISH RESTORATION PROJECT F-5-R-6

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-6, "Sport Fish Investigations of Alaska."

The project during this report period is composed of 23 separate studies designed to evaluate the various aspects of the State's recreational fishery resources. Of these, eight jobs are designed to pursue the cataloging and inventory of the numerous State waters in an attempt to index the potential recreational fisheries. Four jobs are designed for collection of specific sport fisheries 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 and an egg take program.

A report concerning the residual effects of toxaphene accumulates the findings of a three-year study. The report presented here terminates this segment and is a final report. The information gathered from the combined studies will provide the necessary background data for a better understanding of local management problems and will 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-6 Title: Investigations of Anadromous Dolly Varden Populations in the Lake Eva - Hanus Bay Drainages, Southeastern Alaska.

Job No.: 2-B

Period Covered: January 1, 1964 through December 31, 1964.

## ABSTRACT

This report presents information obtained primarily during the third year's operation of a project designed to study the life history of the Dolly Varden char, Salvelinus malma (Walbaum). Two phases of the life history, spawning habits which were studied at Lake Eva in 1964 and a summary of the migratory habits which were investigated from 1962 through 1964, are discussed.

The major emphasis of study at Lake Eva in 1964 was to determine the degree of usage of the Lake system for Dolly Varden spawning. Specific data on spawning habits and requirements were to be collected if the spawning areas of a sufficient number of spawners entering the Lake system could be located. Daily random and stratified sampling of a total of 4,450 in-migrant Dolly Varden at the Eva Creek weir indicated only slight usage of the Lake system for spawning purposes compared to the number of fish wintering in the Lake. Additional sampling, observations and periodic foot surveys of non-lake creeks, located 16 miles from Lake Eva, indicated that a considerably higher percentage of the fish within these systems rather than in the Lake, at the time of sampling, was 1964 spawners. A high percentage of these spawners had been fin-clipped at Eva Creek. The October and November movement into Lake Eva of Dolly Varden that had completed spawning coincided with spawning in September.

Three years' data on migratory habits into and out of Lake Eva are amazingly consistent as to timing, rate of return of marked fish and number and types of migrants. The majority of in-migrants in each of the three years were non-marked fish. These char were probably entering the Lake for the first time after rearing for three or four years in a non-lake system. The high percentage of marked in-migrant fish which

migrate out of the Lake in the spring of the following year indicated an excellent winter survival.

#### RECOMMENDATIONS

The information obtained in 1964 clearly indicates a definite need to study Dolly Varden in a non-lake stream system. Only by conducting a thorough study of this sort can the life history of the Dolly Varden be determined and proper management techniques evolved. Therefore, it is recommended that the Lake Eva study be temporarily discontinued and the major emphasis of study be conducted in a non-lake stream system in 1965.

A nearly complete void of specific knowledge of the spawning habits and requirements of Dolly Varden exists. Study of this important phase of the species' life history must be accomplished prior to future Dolly Varden management. Therefore, it is further recommended that the 1965 study be primarily concentrated on spawning habits and requirements of the species.

Specific objectives recommended for the 1965 study are:

1. Determine the degree of usage of a non-lake stream system for spawning purposes.
2. Location of natural spawning sites in a non-lake system.
3. Determine the adaptability of Dolly Varden to hatchery techniques and methods of capture for taking spawn from native stocks.
4. Determine the exact timing of spawning in the non-lake system.
5. Determine reproductive behavior by observation of natural spawning fish and supplemental live-box studies of induced spawning.
6. Determine the physical and chemical conditions of the spawning site.
7. Determine the success of egg deposition, fertility and potential egg survival.
8. Determine the embryological development in relation to temperature units and time of hatching under natural and hatchery conditions.
9. Determine the age composition and growth rates of rearing fish in the non-lake system.

## INTRODUCTION

This report will consist primarily of two segments of investigation; the spawning habits and requirements study conducted at Lake Eva in 1964 and a summary of the migratory habits that have been studied at the Lake from 1962 through 1964. The sampling information of 1964, plus data collected on Dolly Varden tagged in 1963 and returning to the Lake in 1964, awaits IBM tabulation and subsequent analysis. For this reason only a small portion of the data that has been analyzed is included in this report.

The study of the Dolly Varden's life history was begun at Lake Eva in the spring of 1962 when the Eva Creek weir was placed in operation in the Lake outlet. Since then, substantial information has been collected on age and growth, migration habits and food and feeding habits. A description of the Lake Eva facility and the results of some of these prior studies are discussed in previous reports (Armstrong, 1963, 1965a, 1965b).

Information on age and growth has been analyzed for a Master's thesis at Humboldt State College. Publication of this thesis in the Department's Research Report Series is planned. This phase of investigation is now considered to be nearly complete and only additional data on the age at maturity was obtained in 1964.

The migration study was continued only as needed to substantiate previous studies conducted in 1962 and 1963. Information collected in 1964 pertained to numbers, timing and homing tendencies of Dolly Varden migrants. This information is summarized in this report and is now considered complete for the lake-stream system. Migration habits of Dolly Varden utilizing the non-lake stream environment will be investigated in the future.

Only slight additional information on the food and feeding habits of Dolly Varden was collected in 1964. A separate report of this aspect of the life history has been published (Armstrong, 1965b).

During the 1964 field season, determination of the degree of usage of the Lake system for Dolly Varden spawning was emphasized. If the spawning areas of a sufficient number of spawners entering the system could be located, specific data on spawning habits and requirements would be obtained.

## OBJECTIVES

1. To determine the numbers, timing and purpose of Dolly Varden and other migrating species from and to Lake Eva.

2. To determine the fecundity, age at maturity and spawning habits and requirements of Dolly Varden.
3. To determine the habits and requirements of Dolly Varden previous to their first migration to sea.
4. To acquire additional information on the feeding habits of Dolly Varden while in salt water and Lake Eva.
5. To determine the out-migrant fry population of all species from this system.
6. To determine the correlation of physical factors to migrations.

Information was not collected on objective No. 3 and only slight data was obtained on objective No. 4 in 1964. Objective No. 3 has been incorporated into the future study outline and will be investigated in conjunction with the spawning habit and requirement segment. Objective No. 4 was not thoroughly investigated in 1964, since the previous year's data is adequate for present needs.

#### TECHNIQUES USED

##### Spawning Habits and Requirements

Collection of adequate information on the spawning habits of Dolly Varden required three prerequisites. The first of these was to determine if the Lake Eva system was utilized by a sufficient number of spawning fish for a study of this type. The second was to locate concentrations of potential spawners, trace their movements to spawning sites and to be able to make observations of spawning habits on the sites. The third prerequisite required a location, utilized by spawning fish, that would be suitable for the collection of biological and physical data during the spawning period.

Random and stratified sampling, tagging and periodic foot surveys during the entire fall in-migration at Eva Creek were the techniques used to obtain these preliminary data. Supplemental information was obtained on non-lake systems within 16 miles of Lake Eva by hook and line sampling and surveys throughout the spawning period. A map showing the location of study sites is presented in Figure 1.

##### Sampling

The daily in-migrant random sample size was obtained by an average of three independent estimates of the number of fish in each trap of the weir. Five percent of the average trap estimate was dip netted from the trap without fish

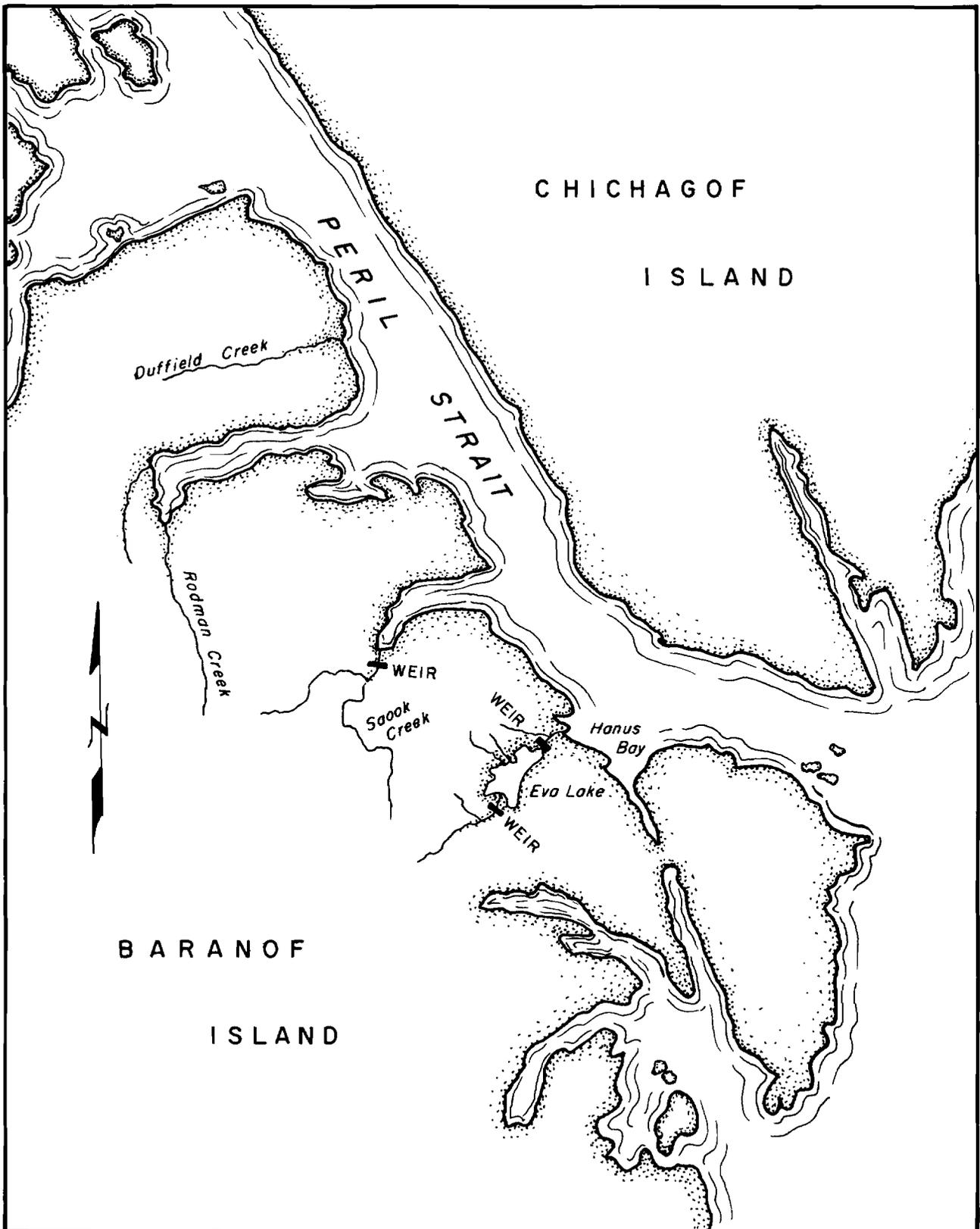


Figure 1. Sketch Map Showing Location of the Study Areas (approx. scale: 1" = 4 mi) The spawning habits study in 1964 was conducted at Lake Eva with use of both inlet and outlet weirs. Supplemental information was obtained from Rodman and Duffield creeks. The migration study involved collection of data at the Lake Eva outlet weir from 1962 through 1964 and the Saook Creek weir in 1963.

selection prior to any enumeration and tagging. These fish were anaesthetized in a MS-222 solution and immediately examined. Previous marks, fork length, weight, sex, degree of gonad development and ovary weights and egg diameters of the females were recorded. Otoliths for age determination were collected from all fish considered mature. All data were recorded on forms appropriate for IBM key punching.

A weekly stratified sampling of 32 fish was begun in August to supplement the random sampling in providing additional fish in the larger length increments. Stratification was by 50 mm length increments of fish over 250 mm in fork length. These fish were collected from the traps after completion of all other sampling, enumeration and tagging procedures.

Data identical to that of the random sample were recorded for each fish of the stratified sample. IBM processing of this sample will also be identical to the random sample, but with separate outputs.

Periodic hook and line sampling in tributaries of Lake Eva and non-lake systems was also conducted. Occasional samples were obtained from a partial weir in the main Lake inlet. Data collected included fork length, sex, presence or absence of sexual dimorphic characteristics and degree of gonad development.

Criteria used for determination of degree or stage of gonad development (maturity) were the following:

- I. Completely Undeveloped Gonad (Immature)  
Female egg follicles present, slight or no egg development. Males testes present only as ducts with little or no tissue growth.
- II. Developing Gonad (Maturing)  
Will be developed by spawning period in 1964. Female ova appear to be approaching an advanced stage of maturity. Oil droplets present in eggs and presence of a well-developed vessel structure in ovarian tissue. Male testes pink-gray or milky-white, fleshy and appears to be approaching maturity.
- III. Completely Developed (Mature)  
Gonads have reached a degree of "ripeness" - sex products easily stripped from gonads. Definitely mature.
- IV. Spawned Out  
Completed spawning - only vestiges of sex products remaining.

As the sampling progressed a fifth degree of gonad development could be determined, although it was not always distinct, especially in the males, and often classification varied with individual judgment. This stage considered to be between one and two was:

V. Undeveloped (Immature, but with a degree of development)

Gonads do not appear as if they would be developed by 1964, but development is definitely greater than degree one and might possibly be developed by 1965. Egg development in the females greater than stage I, but less than II.

Measurements of sampled fish included fork length to the nearest millimeter and body weight to the nearest tenth of a pound. Sex was determined by internal visual examination of the gonads. Ovaries dissected from the females were weighed separately to the nearest tenth of a gram and placed in a petri dish containing normal physiological saline solution. Eggs were dissected from the ovarian sac and each egg in the sample was immediately measured with the micrometer scale of a binocular microscope. Five eggs were selected from various locations throughout the length of each ovary of the fish. A mean egg diameter of each set of ten measurements was computed and recorded as the average egg diameter of both right and left ovaries. Fecundity specimens were wrapped individually in cheese cloth and preserved in ten percent formalin for later analysis.

Tagging

After the completion of random sampling, all fish caught in the in-migrant traps were measured and enumerated. Fish 250 mm in fork length or longer were placed in a holding pen within the trap. Twenty percent of these fish were dip netted without selection from the holding pen, anaesthetized in an MS-222 solution, measured, tagged, returned to the holding pen until recovered and released upstream.

Petersen disc tags of 5/8-inch diameter attached by wire pins through the dorsal musculature directly below the dorsal fin were used throughout the tagging. Each fish was tagged with a numbered tag on one side of the body and a blank of corresponding color on the opposite side. Tags were color coded with four distinct colors, each representing a monthly period of the in-migration.

Information recorded at the time of tagging included tag number, fork length to the nearest millimeter, previous marks, if present, and sex and stage of development when external characteristics were unmistakable. All data were recorded on forms appropriate for IBM key punching.

Recovery of tagged fish was by a weir constructed in the main inlet to the Lake and by periodic surveys for observation of tagged fish in the Lake and tributary streams. Attempts were made daily to trace movements of tagged fish from the Eva Creek weir upstream and into the Lake and inlet creeks where spawning was thought to possibly occur.

### Surveys

Periodic foot surveys of the tributaries of Lake Eva were conducted by at least two observers. Surveys were made only when optimum conditions for observation were present. The number of Dolly Varden observed, estimated distance from the mouth of inlet and tag types and color were recorded. Areas where spawning was thought likely were scrutinized for concentrations of fish or any spawning activity.

Surveys were also made of non-lake systems 16 miles from Lake Eva in conjunction with sampling. These surveys were confined to observations of numbers of fish, spawning activity and possible locations of suitable areas for biological and physical assessments of spawning habits and requirements.

### Migration Habits

All 1964 Dolly Varden out-migrants were netted from the traps of the Eva Creek weir, anaesthetized in an MS-222 solution and examined for dart tags which had been attached in 1963. Data obtained from tagged fish included tag number, previous fin clip (1962, 1963), fork length, degree of fin-regeneration and condition of tag. The Dolly Varden without dart tags were marked by removal of the left maxillary bone. Previous fin clips of these fish were recorded.

In-migrant Dolly Varden were examined for tags and tag recovery data were recorded in an identical manner used for the out-migrants. With the exception of the tagging procedures conducted in conjunction with the spawning habits study, there was no further marking of in-migrant Dolly Varden.

### FINDINGS

#### Spawning Habits and Requirements

Collection of specific data on spawning habits of Dolly Varden was not accomplished in 1964. However, the sampling, tagging, surveys and observations of the fall in-migration of Dolly Varden at Lake Eva yielded information useful as a basis for future work on the spawning habits and requirements of the species. Tabulation by IBM and subsequent analysis of much of the data has not been completed and only a

preliminary and incomplete summary of those results which are obviously apparent are presented in this report.

The 1964 migration of 83,961 Dolly Varden into Lake Eva began in July and was completed by the end of November with a peak of movement in August and September. A monthly summary of the numerical composition of the in-migration is presented in Table 1.

In general, the in-migration of Dolly Varden can be described as being composed of three types of migrants - initial, consecutive and non-consecutive. The initial migrants are those fish entering the system for the first time. For three successive years the entire out-migration has been marked or tagged; thus, it can be assumed that the majority of non-marked fish are initial migrants. The consecutive migrants are considered as fish which have spent the winter in the Lake, migrated to the sea in the spring and returned to the Lake in the fall of 1964. The non-consecutive migrants are fish which have been marked at Lake Eva but have not returned to the Lake in the fall and have spent one or possibly two winters in some other area before returning again to the Lake. In Table 1, the unmarked fish are representative of initial in-migrants, the maxillary-clipped Dolly Varden of consecutive in-migrants and the fish with marks other than the maxillary clip of non-consecutive in-migrants.<sup>1</sup> The previously tagged fish are composed of both consecutive and non-consecutive in-migrants as well as possibly a few initial migrants from Saook Creek where a small number of fish were tagged in 1963.

A uniform pattern of movement characterizes the Lake Eva in-migration with little variation apparent during the past three years of study. These characteristics may be summarized briefly for 1964 by percentages of the total and monthly total in-migration. Tagged fish are excluded.

#### JULY

<u>Total Migration</u>	<u>Initial Migrants</u>	<u>Consec. Migrants</u>	<u>Non-consec. Migrants</u>	<u>Potential 1964 Spawners</u>	<u>Completed Spawning</u>
5.29%	56.48%	40.37%	3.15%	3.75%	0.00%

Beginning of the in-migration with the majority of the fish as initial migrants of age groups III+ and IV+ and under 250 mm in fork length.

<sup>1</sup>A marked and tagged fish which has lost its tag between out- and in-migrations would be counted as a non-consecutive migrant when actually it was not. Tag loss between migrations averages about 6.3 percent, so there is error in this particular classification.

TABLE 1. - Numerical Composition of Lake Eva 1964 In-Migration

<u>Month</u>	<u>Number Enumerated</u>	<u>Number Estimated*</u>	<u>Passage Into Lake**</u>	<u>Unmarked</u>	<u>Marked Other Than Maxillary</u>	<u>Maxillary Clipped</u>	<u>Previously Tagged</u>
July	4,391	-	4,171	2,356	131	1,684	220
August	34,301	-	32,169	27,718	592	5,535	456
September	33,469	-	31,500	21,622	1,000	10,082	765
October	9,732	897	9,889	3,695	1,084	4,031	922
November	<u>1,047</u>	<u>124</u>	<u>1,045</u>	<u>193</u>	<u>151</u>	<u>556</u>	<u>147</u>
TOTAL	82,940	1,021	78,774	55,584	2,958	21,888	2,510

Total In-Migration - 83,961

Total Mortality and Sample - 5,187

\* During four days in October and three days in November, the weir was inoperative and estimates of the number of fish passing upstream were computed based on counts four days before and after this period. Estimates of clipped, unmarked and tagged fish are not included.

\*\* Includes both enumerated and estimated fish minus trap mortalities and sample fish.

AUGUST

<u>Total Migration</u>	<u>Initial Migrants</u>	<u>Consec. Migrants</u>	<u>Non-consec. Migrants</u>	<u>Potential 1964 Spawners</u>	<u>Completed Spawning</u>
41.36%	82.00%	16.30%	1.70%	2.79%	0.00%

In-migration greatly increased with the peak of movement towards the end of this month. Majority of fish are initial migrants.

SEPTEMBER

<u>Total Migration</u>	<u>Initial Migrants</u>	<u>Consec. Migrants</u>	<u>Non-consec. Migrants</u>	<u>Potential 1964 Spawners</u>	<u>Completed Spawning</u>
40.35%	66.11%	30.83%	3.06%	2.31%	0.00%

Movement decreasing in intensity towards end of month. Increase in consecutive and non-consecutive migrants of age groups V+ through X+ and lengths greater than 250 mm.

OCTOBER

<u>Total Migration</u>	<u>Initial Migrants</u>	<u>Consec. Migrants</u>	<u>Non-consec. Migrants</u>	<u>Potential 1964 Spawners</u>	<u>Completed Spawning</u>
11.73%	41.94%	45.75%	12.31%	1.59%	Oct. 7-21 13.8%
					Oct. 22-31 79.3%

Consecutive migrants exceed the number of initial migrants and most of the fish are now of the older age groups. The first "spawned out" fish enter the system and rapidly increase in number.

NOVEMBER

<u>Total Migration</u>	<u>Initial Migrants</u>	<u>Consec. Migrants</u>	<u>Non-consec. Migrants</u>	<u>Potential 1964 Spawners</u>	<u>Completed Spawning</u>
1.27%	21.44%	61.78%	16.78%	0.00%	93.00%

Migrants primarily consecutive and non-consecutive Dolly Varden that have completed spawning and are returning to the Lake to winter. Potential 1964 spawners are no longer present. The in-migration is completed by the end of November.

Sampling

Daily random sampling of an estimated five percent of the 1964 in-migration was conducted to determine numbers of potential 1964 spawners entering the Lake Eva system and to

determine degree or stage of development based on gonad size and condition, ovary weights and egg diameters. A total of 3,981 migrants was examined in the random sample. A graphical representation of the monthly sample size compared to total migrants enumerated is shown in Figure 2. The number of fish sampled was only 166 less than an actual five percent of the enumerated migrants. The information available from the random sample at this time is briefly summarized in Table 2.

Sex ratio of the 98 potential spawners was 55 percent female and 45 percent male. Approximately 1,136 females of the total of 82,940 enumerated migrants could be expected to spawn in 1964.

The random sample was primarily composed of fish classified as stage V (undeveloped gonads) until October and November. From October 22 to 31, the sample contained 79.76 percent fish of stage IV (spawned out) and in November, 92.31 percent of stage IV. External examination at the weir of all in-migrants showed 79.27 percent of the fish to have completed spawning in October and 92.55 percent to be "spawned out" in November. The external characteristics of Dolly Varden that are "spawned out" are unmistakable and no error exists in classification. The precision of the sample estimates of the number of fish in stage IV that were present in the in-migration compared to the actual count indicates a random and therefore valid sampling technique. The female-to-male sex ratio of fish in the random sample that had completed spawning was 85 percent female to 15 percent male during the later part of October. In November the ratio was 68 percent female to 32 percent male. The higher ratio of female "spawned out" fish could possibly indicate either that females leave the spawning sites sooner than the males or that there is a selective mortality of males after spawning.

The stratified sample of 469 Dolly Varden contained 27.20 percent 1964 spawners in August and 9.80 percent in September. Only fish of stage IV and V were present in October and November. The stratified sample, composed only of fish greater than 250 mm in fork length, indicates that the spawning segment of the in-migration was primarily of the larger fish that had entered the Lake in August.

The age composition of potential 1964 spawners and of fish that have completed spawning is presented in Table 2. Although the sample sizes are small, these age determinations do substantiate the stratified sample in showing that the Dolly Varden spawners are usually longer than 250 mm and older than five years. The fish in stage IV of Table 3 are not necessarily representative of the age at maturity. Selective mortality could possibly occur among fish that have completed spawning prior to movement into Lake Eva.

Figure 2. Number of Fish Enumerated, Sampled, and Tagged at The Eva Creek Weir- Immigration 1964.

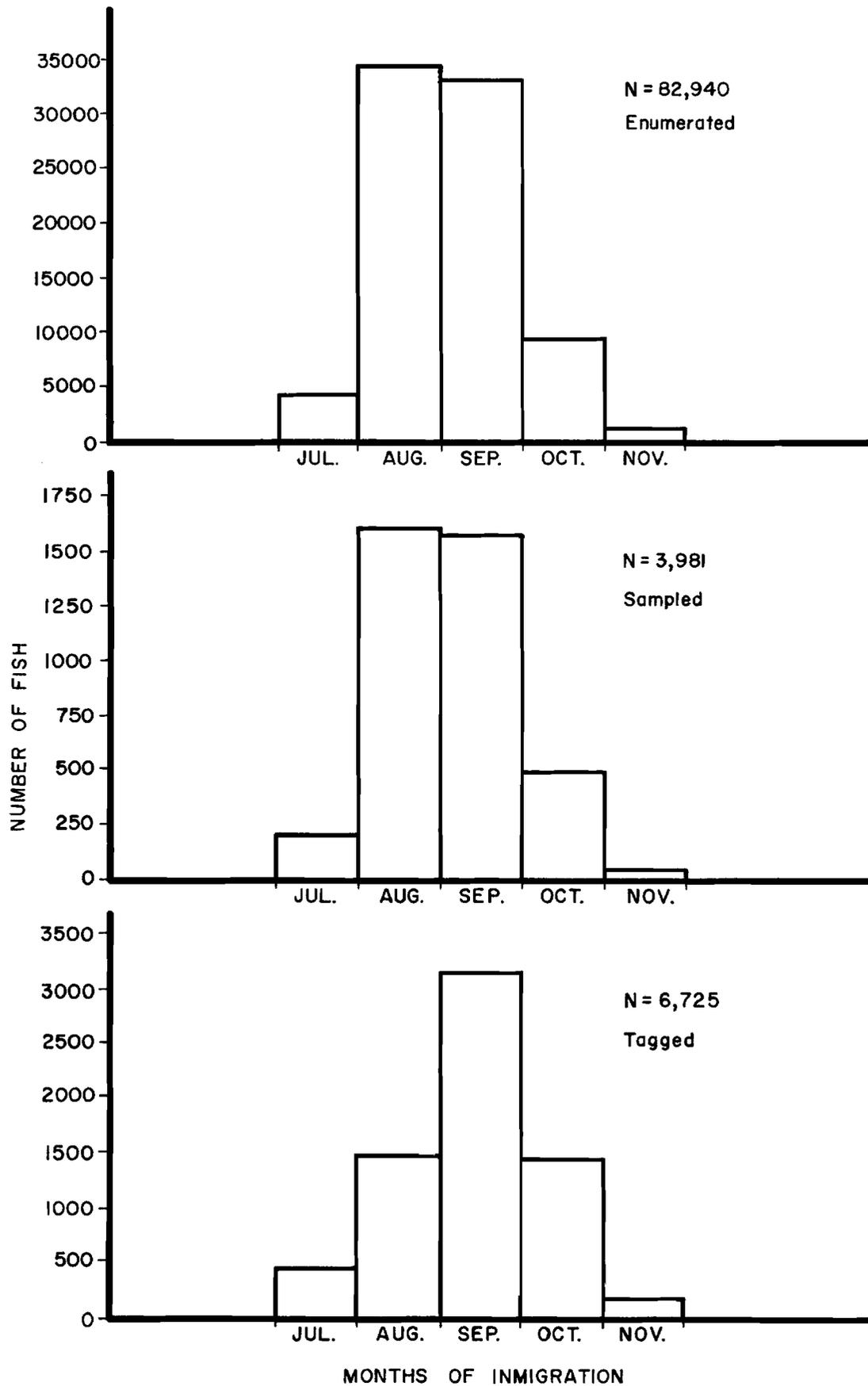


TABLE 2. - Number of Potential 1964 Spawners Entering Eva Creek

<u>Month</u>	<u>Total Enumerated</u>	<u>Number Sampled</u>	<u>Number Spawners</u>	<u>Percent Spawners</u>	<u>Total Potential Spawners</u>
July	4,391	213	8	3.75	165
August	34,301	1,613	45	2.79	957
September	33,469	1,601	37	2.31	773
October	9,732	502	8	1.59	165
November	<u>1,047</u>	<u>52</u>	<u>0</u>	<u>0.00</u>	<u>0</u>
TOTAL	82,940	3,981	98	2.46	2,060

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TABLE 3. - Age Composition of Stage II and IV Migrants - Eva Creek, 1964

<u>Stage</u>	<u>AGE GROUP</u>									<u>Total</u>
	<u>II</u>	<u>III</u>	<u>IV</u>	<u>V</u>	<u>VI</u>	<u>VII</u>	<u>VIII</u>	<u>IX</u>	<u>X</u>	
II (1964 Spawners)	0.00%	1.80%	3.60%	46.40%	33.90%	10.70%	1.80%	0.00%	1.80%	56
IV (Completed Spawning)	0.00%	0.00%	1.02%	25.51%	38.78%	22.45%	7.14%	2.04%	3.06%	98

The mean length and body weight of 143 female migrants, and ovary weights of 122 of these fish within the random sample are given in Table 4. The 1,430 egg diameter measurements for the three stages of development in the random sample have not yet been tabulated. Although analysis of this data has not begun, several points are noteworthy. First, there is a definite difference of mean measurements among the three stages. The increase in ovary weight shown in Table 4 is partly due to a corresponding increase in size of fish sampled from July to October. However, the ovary growth of fish classified as 1964 spawners was extremely rapid and greater than that of the undeveloped (immature) fish. The third point is an obvious greater weight of the left ovary of the potential 1964 spawners. Further analysis of this data, egg diameters and of fecundity should provide some of the most interesting information of the 1964 study.

In August, 27 Dolly Varden were sampled from the trap of the Lake Eva inlet weir. The sample contained only four fish classified as 1964 spawners. A hook and line sample taken from a concentration of an estimated 200 to 500 Dolly Varden in the Lake at the mouth of the Wahine Creek inlet in September yielded five fish classified as 1964 spawners and ten fish with undeveloped gonads.

Sampling by hook and line in two non-lake creeks 16 miles from Lake Eva in August, September and October indicated that a high percentage of the fish within these systems, at the time of sampling, was of 1964 spawners. The sampling results are presented in Table 5. The samples collected from Rodman Creek (Figure 1) in 1963 and 1964 indicated that immature Dolly Varden leave the system before spawning begins, leaving primarily mature fish in the stream. The spawning period in the non-lake creeks that were sampled was from mid-September to mid-October.

Of the total fish (3,898) examined in Saook Creek in 1963, 68 percent wintered in Lake Eva that year. Nearly three percent of these fish had spawned in Saook Creek. In Rodman Creek the samples collected in 1964 contained 73.65 percent fin-clipped fish from Lake Eva. In Duffield Creek (Figure 1), 26.67 percent of the sampled fish were fin-clipped. These high percentages of fin clips indicate that many of the 1964 Dolly Varden spawners in the non-lake creeks had spent one or more winters in Lake Eva.

### Tagging

A total of 6,725 Dolly Varden in-migrants was tagged with Petersen disc tags at the Eva Creek weir. Comparison between the number of fish tagged and those enumerated is shown in Figure 2. The increase in larger fish entering the system is evident from the greater number tagged (20 percent over 250 mm) in September, October and November with respect to total

TABLE 4. - Mean Length, Mean Body Weight and Mean Ovary Weights of States I, V and II Dolly Varden In-Migrants - Eva Creek, 1964

<u>Measurements</u>	<u>STAGES</u>		
	<u>Undeveloped</u>		<u>1964 Spawners</u>
	<u>I</u>	<u>V</u>	<u>II</u>
$\bar{x}$ Fork Length (mm)	228.75	283.57	336.95
$\bar{x}$ Body Weight (lbs)	0.30	0.53	0.91
Sample Size	4	96	43
<u>Right Ovary Weight</u>			
$\bar{x}$ Weight (g.)			
July	0.40	0.91	3.74
August	0.59	1.42	7.85
September	-	-	14.03
October	-	-	28.96
Sample Size	4	75	43
<u>Left Ovary Weight</u>			
$\bar{x}$ Weight (g.)			
July	0.46	0.99	3.79
August	0.56	1.37	8.63
September	-	-	14.23
October	-	-	36.11
Sample Size	4	75	43

TABLE 5. - Hook and Line Sampling in Two Non-Lake Creeks, 1964

Creek	Date	Sample Size	Potential 1964 Spawners		Ripe Fish		Non-Spawners	
			Number	Percent	Number	Percent	Number	Percent
Rodman	August 21, 22	26	12	46.15	0	0.00	14	53.85
	September 27	25	19	76.00	4	16.00	2	8.00
	October 25	6	3	50.00	3	50.00	0	0.00
Duffield	August 22	20	17	85.00	0	0.00	3	15.00
	September 26	25	13	52.00	10	40.00	2	8.00
	October 24	0*	-	-	-	-	-	-

\* On October 24, Duffield Creek was sampled for nine man-hours in the same location where previous samples had been collected. No fish were caught or observed.

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TABLE 6. - Tag and Recovery Data - Lake Eva In-Migration, 1964

Time Period	Color Code	Number Tagged	Number Recovered	Recovery Location
July 14 - Aug. 17	Red	1,273	3	Wahine Weir
Aug. 18 - Sep. 17	White	1,621	1	Wahine Weir
Sep. 18 - Oct. 16	Yellow	3,191	2	Wahine Weir
Oct. 17 - Nov. 24	Green	640	0	
TOTAL		6,725	6	

enumerated. The tag total and duration of tagging for each color code and tag recovery is shown in Table 6. The Wahine Creek weir was ineffective much of the time. However, if any concentrations of Dolly Varden spawners had entered the Creek, a greater recovery than six tagged fish would be expected. Monthly foot surveys of the inlet substantiated that usage for spawning was slight. Only six disc tagged fish were observed in the Creek throughout the season.

Upstream movement of tagged fish into the Lake was observed to be rapid, usually taking less than a day to negotiate 1/4 mile of stream and falls between the Eva weir and Lake. Observations of schools of tagged fish in the Lake were made without difficulty. Tagged fish tended to concentrate in the Lake at the confluence of the outlet and Lake and the mouth of the main inlet. In August the inlet school contained 5 to 20 Dolly Varden. By September the school had increased to an estimated 200 fish including approximately 20 disc tagged Dolly Varden. These fish were observed until a high water period on September 22. The area to which movement occurred was not located.

Between October 1 and 16, 94 female Dolly Varden that had completed spawning were tagged. Males that had completed spawning were not present in the tagging sample until October 21, and for the remainder of the month were considerably fewer than the females. From October 17 to 31, 285 (64.18%) "spawned out" females and 81 (18.24%) "spawned out" males were present in the tagging sample. In November the tagging sample of 196 fish contained 93.31 percent that were "spawned out" of which 41.49 percent were males and 58.51 percent females. The higher ratios of females possibly indicates earlier departure of females from the spawning sites or a selective mortality of males after spawning. The high percentage of "spawned out" fish in the random tagging sample in October and November is further verification of spawning Dolly Varden being five years of age or older.

### Surveys and Observations

Periodic foot surveys and concentrated efforts to locate spawning Dolly Varden in the Lake Eva system in 1964 failed to yield a single observation or indication of spawning activity. However, three surveys made of Rodman and Duffield Creeks (non-lake systems) in August, September and October indicated numerous mature or "ripe" Dolly Varden that were brightly colored and often paired for the apparent purpose of spawning in the creeks. The survey made in August showed that mature fish were approaching final development prior to spawning. In September the fish were brilliantly colored, sexual dimorphic characteristics were distinct, and many were congregated in pairs and in a "ripe" condition. By October spawning activity had ceased in Duffield Creek and the presence

of Dolly Varden could not be detected. In Rodman Creek the number of spawners had decreased, and a few fish that had completed spawning were present in the sample, but some activity was still apparent. A specific observation of three males and one female engaged in what was believed to be spawning activity was recorded in Rodman Creek in October. Observation notes on this activity are listed below:

Characteristics of the Spawning Site

Water temperature 42° F.  
 Water color clear  
 Water depth 4 feet  
 Estimated water flow 2 fps  
 Bottom material 75% rubble, 25% sand  
 Observation distance 15-20 feet  
 Observation time 1300

<u>Time</u>	<u>Observation</u>
1305	Three males, bright coloration, distinct from female. Aggressive behavior towards each other. Largest male dominant. Female on shallow nest-like depression (redd?) - remains stationary, but occasionally digs with anal and lower lobe of caudal fin. Digging lasts 3 to 4 seconds.
1309	Female leaves redd. Males chase each other - large male dominant.
1310	Female returns to redd. One other pair observed ten feet away - no activity.
1315	Female digging periodically. Aggressive actions of males (charging and biting).
to	
1320	
1322	Female and male press bodies together for 1-2 seconds. Bodies quiver.
1324	Body pressing repeated for 1 second.
1325	Smallest male presses against female followed by the other males pressing one after the other.
1328	Female moved about one foot from redd.
1329	Female moved back over redd.
1333	Active digging by female. Male presses against her side.
1340	Smaller males chase each other, but not the larger male.

Note - Sex products could not be found in the redd after these observations. Possibly the female had previously spawned elsewhere. One of the males was examined and found to be "ripe."

Concentrations of spawning Dolly Varden were not located in 1964. Observations in Rodman and Duffield Creeks indicate that spawning occurs in scattered groups or pairs. A school of 200 to 300 Dolly Varden, thought to be engaged in spawning activity, had been observed in the Nakwasina River (located about 10 miles north of Sitka) on October 6. Egg pumping of 30 points (17 random and 13 selected) on November 9 and 10, in the exact area where the fish were reported did not yield a single Dolly Varden egg. These negative results are perhaps indicative of spawning behavior patterns, such as digging and aggressive actions of the males being observed, and not actual spawning resulting in extrusion of sex products.

Sexual dimorphism of Dolly Varden spawners is distinct. The males develop a hooked lower jaw more pronounced than the slighter hook of the female. The ovipositor of the female becomes extended and swollen. The males are brightly colored with red on the ventral body surface and black on the head and a darkening of the lateral and dorsal body surfaces. The lateral spots become a brilliant orange-red. The ventral fins of the males are fringed with a streak of white along the leading edges. The rest of the fin is red and black. Females are considerably less colored than the males and the white fringe along the edges of the ventral fins is duller and lacking in contrast compared to the males. The difference in this sexual characteristic enables exact identification of males and females observed in the water. Both sexes become flabby and of poor condition after completion of spawning. In fact, "spawned out" males examined at the Eva Creek weir were in such poor condition and had developed dimorphism to such an extreme that a high rate of mortality after spawning was indicated.

### Migratory Habits

#### The Numbers and Timing of Dolly Varden Migrating From and To Lake Eva

Since early May 1962, complete or nearly complete counts of all Dolly Varden passing the Eva Creek weir have been recorded (Tables 7 and 8). Dolly Varden migrating from Lake Eva to the sea usually begin their migration in March and end in early August. The in-migration period normally begins in June and is completed by early December. No movement of fish in or out of Lake Eva has been recorded from mid-December to mid-March.

The numbers of Dolly Varden migrating from and to Lake Eva, with the exception of the 1962 out-migration, have remained relatively constant. The number of out-migrants by year are: 1962 - 38,957; 1963 - 93,303 and 1964 - 73,786. The number of in-migrants by year are: 1962 - 92,618; 1963 - 101,814 and 1964 - 83,961.

TABLE 7. - Total Number of Dolly Varden Enumerated at the Eva Creek Weir for 1962, 1963 and 1964 (By Month)

Month	Out-Migration				In-Migration			
	1962	1963	1964	Total	1962	1963	1964	Total
January	-	-	0	0	-	-	0	0
February	-	-	0	0	-	-	0	0
March	-	64	25	89	-	0	0	0
April	-	11,236 <sup>a</sup>	235	11,471	-	0	0	0
May	33,978	77,449	41,734	153,161	0	2	0	2
June	4,938	4,372	29,734	39,044	32	42	0	74
July	41	182	2,028	2,251	12,189	18,799	4,391	35,379
August	0	0	30	30	43,454	16,660	34,301	94,415
September	0	0	0	0	30,046	52,759 <sup>b</sup>	33,469	116,274
October	0	0	0	0	5,461	10,774 <sup>c</sup>	10,629 <sup>d</sup>	26,864
November	0	0	0	0	1,436	2,765	1,171 <sup>e</sup>	5,372
December	-	0	-	0	-	13	-	13
TOTAL	38,957	93,303	73,786	206,046	92,618	101,814	83,961	278,393

a Count includes an estimated 2,300 Dolly Varden missed during a flood on April 29 and 30.

b Count includes an estimated 1,000 Dolly Varden missed when a trap screen broke on September 9.

c Count includes an estimated 2,250 Dolly Varden missed during a flood from October 20 to 25.

d Count includes an estimated 897 Dolly Varden missed during a flood from October 17 to 21.

e Count includes an estimated 124 Dolly Varden missed during a flood on November 7, 16 and 17.

- Weir not in operation.

TABLE 8. - Percentage of Dolly Varden Enumerated, by Month, at the Eva Creek Weir for 1962, 1963 and 1964

Month	Out-Migration				In-Migration			
	1962	1963	1964	Total	1962	1963	1964	Total
January	-	-	0.0	0.0	-	-	0.0	0.0
February	-	-	0.0	0.0	-	-	0.0	0.0
March	-	0.1	0.0*	0.0*	-	0.0	0.0	0.0
April	-	12.0	0.3	5.6	-	0.0	0.0	0.0
May	87.2	83.0	56.6	74.3	0.0	0.0*	0.0	0.0*
June	12.7	4.7	40.3	19.0	0.0*	0.0*	0.0	0.0*
July	0.1	0.2	2.8	1.1	13.2	18.5	5.2	12.7
August	0.0	0.0	0.0*	0.0*	46.9	16.4	40.8	33.9
September	0.0	0.0	0.0	0.0	32.4	51.8	39.9	41.8
October	0.0	0.0	0.0	0.0	5.9	10.6	12.7	9.7
November	0.0	0.0	0.0	0.0	1.6	2.7	1.4	1.9
December	-	0.0	-	0.0	-	0.0*	-	0.0*
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

- Weir not in operation.

\* Dolly Varden enumerated but numbers were too low to compute percentages.

The relative numbers of Dolly Varden migrating from and to Lake Eva by month also shows similarity from one year to the next. For all years combined the majority of the fish migrated out of the Lake in May (74.3 percent) while the majority of the fish entered Lake Eva in August (33.9 percent) and September (41.8 percent).

Marked Dolly Varden Returning to Lake Eva

All Dolly Varden migrating from Lake Eva to sea have been marked during all study years. The percentage return of these marked fish to Lake Eva has been relatively constant in each year with a 40.4 percent return in 1962, a 43.5 percent return in 1963 and a 34.1 percent return in 1964 (Table 9).

TABLE 9. - The Numbers of Dolly Varden Marked and Returning to Lake Eva in 1962, 1963 and 1964<sup>2</sup>

<u>Year</u>	<u>Number Marked</u>	<u>Number Returning in the Same Year</u>	<u>Percent Return in the Same Year</u>
1962	38,264	15,456	40.4
1963	89,467	38,908	43.5
1964	64,255	21,888	34.1

From the number of marked fish that entered Lake Eva in 1962, 93.8 percent migrated out of the Lake in 1963 and from the ones entering the Lake in 1963, 71.1 percent migrated to sea in 1964. These figures indicate a high winter survival and that the majority of the Dolly Varden that enter the Lake in the fall migrate to sea in the following spring.

Non-marked Dolly Varden Entering Lake Eva

All Dolly Varden leaving Lake Eva in 1962, 1963 and 1964 were either marked or had been previously marked. Despite this fact, the majority of the Dolly Varden entering the system each year have been non-marked fish. Out of a total 1962 in-migration of 92,618 fish, 83.3 percent (77,162) were non-marked; the 1963 in-migration of 101,814 consisted of 60.7 percent (61,770) non-marked Dolly Varden and of the 1964 in-migration of 83,961 fish, 66.2 percent (55,584) were non-marked.

<sup>2</sup> All figures for returning fish refer only to those fish marked during the out-migrations and returning during the in-migration of the same year. Some Dolly Varden return after being away from the system for more than one year; these fish have not been included pending further data analysis.

Prior studies conducted on non-lake stream systems (Armstrong, 1965) and unpublished data on the age and growth of Dolly Varden has shown that the majority of these non-marked fish entering Lake Eva have originated from these other systems. It has been documented (Armstrong, 1965) that the majority of these fish are probably entering Lake Eva for the first time after rearing for three or four years in a non-lake system.

Only 2.46 percent of the 1964 in-migration were considered to be potential spawners for the year. Also, prior year studies show that the total number of migratory Dolly Varden originating from the Eva system is few when compared to the numbers of fish that enter and leave the system each year. This indicates that the primary usage of Lake Eva is for a wintering area by fish originating from the many stream systems located in and around the vicinity of Peril Strait.

### Migratory Patterns<sup>3</sup>

Twenty-five stream systems throughout Southeastern Alaska were found to contain marked Dolly Varden from the Eva Creek system during 1962, 1963 and 1964. This information was compiled from actual recoveries made by biologists stationed at Lake Eva, from tag returns and by observations of tagged fish from reliable sources.

The overall migratory patterns of Dolly Varden after they leave Eva Creek are presented in Figure 3. The names of the recovery areas, their distance from Eva Creek and the numbers of fish recovered and observed are presented in Table 10. As shown in Figure 3, the Dolly Varden, after leaving Eva Creek, migrate in all possible directions. They have been recovered in streams with and without an accessible lake in the system. They have been recovered or observed in streams as far as 47 miles to the north, 72 miles to the northwest, 32 miles to the northeast, 30 miles to the south, 64 miles to the southwest, 27 miles to the southeast and 29 miles to the west of Eva Creek. The farthest known distance traveled was by one tagged fish recovered off Point Adolphus, 95 miles north of Eva Creek in Icy Strait. The recoveries made on the east side of Chichagof Island and on the west side of Admiralty Island show that Dolly Varden do not always follow the coastline. To reach these areas the fish would have to cross an open body of water from 3 to 10 miles wide.

<sup>3</sup> All distances from Eva Creek refer to the shortest route a fish would have to travel to reach a given place.

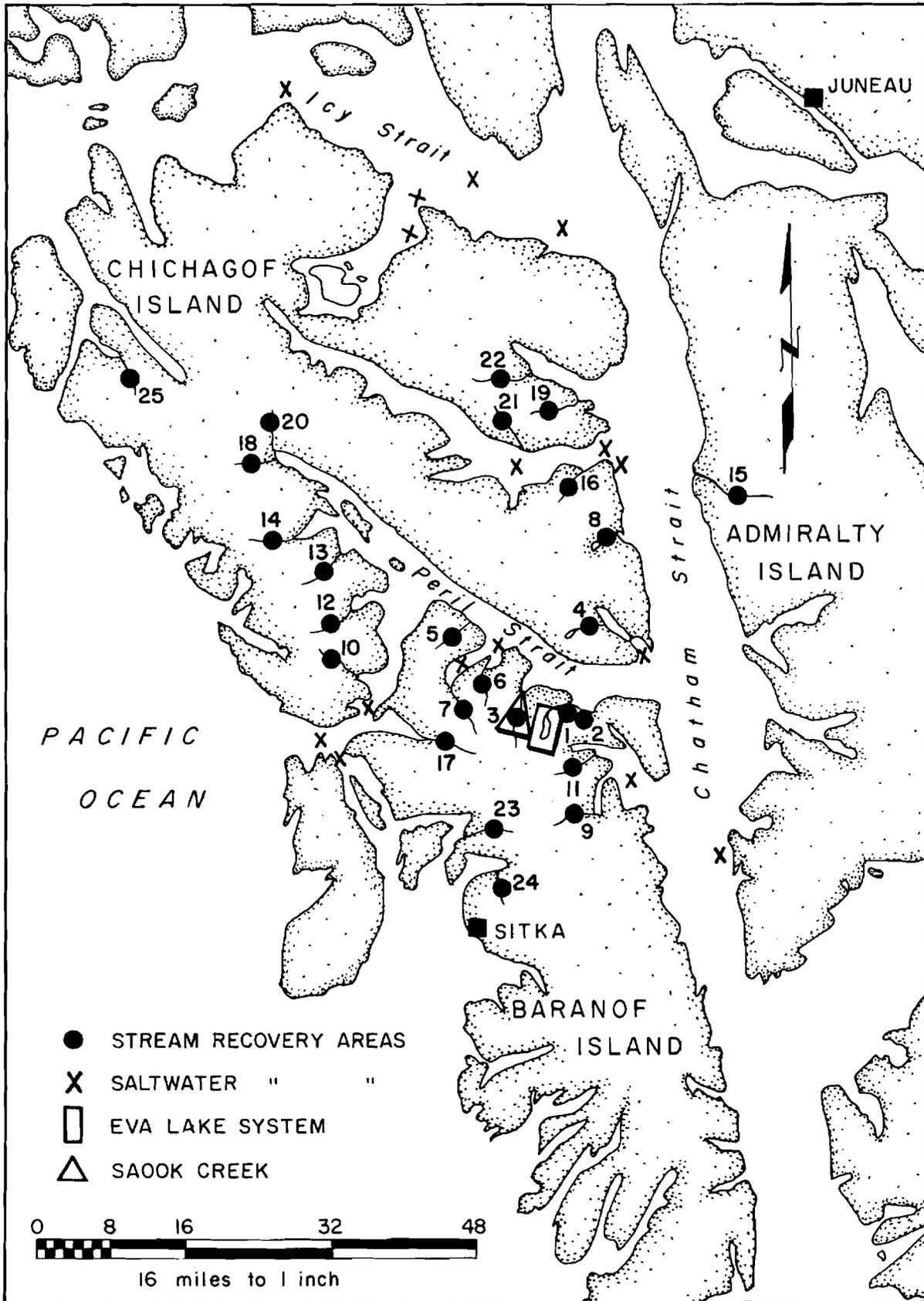


Figure 3. Sketch Map Showing Recovery Areas by Number.  
(see table 10)

TABLE 10. - Dolly Varden Recovery Areas by Number for 1962, 1963 and 1964  
(Streams Only)

Number	Streams	Date	Number of Miles From Eva Creek	Tag Recovery	Fin Clip Recovery	Observed	Total Recovered and Observed
1	Little Eva	7/30/63	1/2	1	0	0	1
2	Bunglers	7/30/63	1	1	1	8	10
	"	8/ 3/63	"	1	0	2	3
	"	8/ 6/63	"	0	2	3	5
	"	8/ 8/63	"	0	2	1	3
3	Saook	7/14/62	10	-	8	-	8
	"	1963a	"	745	1,239	+	1,984
4	Sitkoh	7/17/62	12	-	1	-	1
5	Duffield	?/ ?/63	13	0	0	+	+
	"	8/22/64	"	0	5	0	5
	"	9/10/64	"	1	0	0	1
	"	9/26/64	"	2	8	0	10
6	Appleton	8/ ?/63	13	4	0	0	4
7	Rodman	7/11/62	16	-	5	-	5
	"	7/14/62	"	-	10	-	10
	"	7/15/62	"	-	6	-	6
	"	8/24/63	"	0	0	26	26
	"	10/22/63	"	6	0	+	6
	"	1963b	"	265	+	+	265

TABLE 10. (Cont.) - Dolly Varden Recovery Areas by Number for 1962, 1963 and 1964 (Streams Only)

<u>Number</u>	<u>Streams</u>	<u>Date</u>	<u>Number of Miles From Eva Creek</u>	<u>Tag Recovery</u>	<u>Fin Clip Recovery</u>	<u>Observed</u>	<u>Total Recovered and Observed</u>
7	Rodman	5/ ?/64	16	1	0	0	1
	"	6/14/64	"	2	0	0	2
	"	6/17/64	"	5	0	0	5
	"	8/ 2/64	"	9	0	0	9
	"	8/21/64	"	1	16	0	17
	"	9/27/64	"	4	21	0	25
	"	10/25/64	"	0	4	0	4
8	Basket Bay	7/19/62	23	-	1	-	1
	" "	7/10/63	"	1	0	0	1
9	Clear	7/21/62	27	-	2	-	2
	"	6/30/63	"	4	9	1	14
10	Deep Bay	7/22/62	29	-	5	-	5
	" "	7/24/62	"	-	2	-	2
	" "	6/29/63	"	1	0	0	1
11	Midarm	6/30/63	30	3	3	3	9
12	Ushk Bay	6/29/63	30	0	1	0	1
	" "	8/18/63	"	0	0	1	1
	" "	8/25/63	"	0	0	14	14
	" "	8/ ?/63	"	0	0	12	12

TABLE 10. (Cont.) - Dolly Varden Recovery Areas by Number for 1962, 1963 and 1964  
(Streams Only)

<u>Number</u>	<u>Streams</u>	<u>Date</u>	<u>Number of Miles From Eva Creek</u>	<u>Tag Recovery</u>	<u>Fin Clip Recovery</u>	<u>Observed</u>	<u>Total Recovered and Observed</u>
13	Fick Cove	8/19/63	30	0	0	3	3
	" "	8/26/63	"	0	0	8	8
	" "	8/ ?/63	"	1	0	0	1
14	Patterson	7/24/62	30	-	2	-	2
15	Fishery	?/ ?/63	32	1	0	0	1
16	Trap Bay	8/10/63	37	0	0	1	1
17	Fish Bay	8/ 2/62	38	-	4	-	4
	" "	8/18/63	"	0	0	1	1
18	Granite	7/29/63	41	0	0	3	3
19	Pavlof	?/ ?/63	42	1	0	0	1
20	Hortniff	7/24/62	42	-	1	-	1
	"	8/19/63	"	0	0	15	15
21	Indian	?/ ?/63	43	1	0	0	1
22	Kennel	?/ ?/63	47	0	0	6	6

TABLE 10. (Cont.) - Dolly Varden Recovery Areas by Number for 1962, 1963 and 1964  
(Streams Only)

<u>Number</u>	<u>Streams</u>	<u>Date</u>	<u>Number of Miles From Eva Creek</u>	<u>Tag Recovery</u>	<u>Fin Clip Recovery</u>	<u>Observed</u>	<u>Total Recovered and Observed</u>
23	Nakwasina	8/ 2/62	52	-	2	-	2
	"	?/ ?/64	"	1	0	0	1
	"	7/ 9/64	"	1	0	0	1
	"	7/13/64	"	1	0	0	1
	"	7/14/64	"	1	0	0	1
24	Katlian	9/ 8/63	64	1	0	0	1
25	Stag Bay	6/29/63	72	0	0	1	1

a Represents total recoveries at the weir and by hook and line for 1963.

b Returns by sport fishermen for 1963.

+ Actual numbers unknown.

- No tagged fish available.

The Relative Abundance of Anadromous Fish Using Eva Creek

Records were kept on the numbers of adult salmon, cutthroat and steelhead passing the Eva Creek weir. In addition, partial counts were kept on out-migrant salmon smolts which were obtained in eight downstream migrant traps located behind the weir.

From Tables 11 and 12 it may be concluded that the numbers of anadromous fish using Eva Creek, in a decreasing order of abundance, are Dolly Varden, red salmon, pink salmon, cutthroat trout, coho salmon, chum salmon and steelhead.

TABLE 11. - Out-Migrant Fish Counts at the Eva Creek Weir for 1962, 1963 and 1964

<u>Year</u>	<u>Dolly Varden</u>	<u>Cutthroat</u>	<u>Rainbow Smolt</u>
1962	38,957	1,594	160
1963	93,303	1,184	115
1964	<u>72,678</u>	<u>1,233</u>	<u>136</u>
TOTAL	204,938	4,011	411

TABLE 12. - In-Migrant Fish Counts at the Eva Creek Weir for 1962, 1963 and 1964

<u>Year</u>	<u>Dolly Varden</u>	<u>Pink</u>	<u>Chum</u>	<u>Reds</u>	<u>Coho</u>	<u>Cutthroat</u>	<u>Steelhead</u>
1962	92,618	175	649	13,847	911	1,682	22
1963	101,814	13,259	291	2,925	506	1,183	19
1964	<u>83,961</u>	<u>1,018</u>	<u>720</u>	<u>1,428</u>	<u>928</u>	<u>1,339</u>	<u>15</u>
TOTAL	278,393	14,452	1,660	18,200	2,345	4,204	56

The information presented in Table 13 should not be considered accurate. Attempts to determine total out-migrant salmon young by marking (dying) and recapture failed due to difficulty encountered in finding valid release points. Therefore, the counts represent the actual number of salmon young enumerated. This study was conducted incidental to other work and the effort and time needed to accomplish an accurate investigation of this sort was lacking. The counts

are presented to give an indication of the timing and magnitude of the out-migrant salmon young from the Eva Creek system.

TABLE 13. - Partial Counts, By Month, of Out-Migrant Salmon Young Passing the Eva Creek Weir in 1964

<u>Month</u>	<u>Pink</u>	<u>Chum and Red*</u>	<u>Coho</u>
February	12	0	0
March	1,059	4	0
April	9,478	10	1
May	25,397	23	460
June	50	87	532
July	<u>0</u>	<u>4</u>	<u>85</u>
TOTAL	35,996	128	1,078

\* Chum and red salmon are combined because of possible mis-identification between these two species.

#### SUMMARY

1. The study of the Dolly Varden's life history was begun in Lake Eva in the spring of 1962, when the Eva Creek weir was placed in operation in the Lake outlet. Since that time substantial information has been collected on age and growth, migration habits, and food and feeding habits. The major emphasis of study at Lake Eva during the 1964 field season was determination of the degree of usage of the Lake system for Dolly Varden spawning and to attempt to collect specific information on spawning habits and requirements at the Lake.
2. Daily random sampling of an estimated five percent of the 1964 in-migration of Dolly Varden at Eva Creek showed that about 1,136 females of the total of 82,940 enumerated migrants could be expected to spawn in 1964.
3. Dolly Varden that had recently completed spawning began entering Eva Creek in early October. From mid-October to the end of the month, 79 percent of the random sample were "spawned out" fish. In November, 92 percent of the sample was composed of fish that had completed spawning.
4. Age and length determinations of potential 1964 spawners and of fish that have completed spawning

indicate that Dolly Varden spawners are longer than 250 mm in fork length and older than five years.

5. Studies conducted on non-lake creeks indicate that the majority of the immature Dolly Varden entering these systems leave the system before spawning begins, leaving a population consisting mostly of mature fish.
6. The spawning period in the non-lake creeks that were sampled was from mid-September to mid-October. After spawning, many of these fish re-enter salt water and migrate to Lake Eva.
7. Periodic foot surveys and concentrated efforts to locate spawning Dolly Varden in the Lake Eva system failed to yield a single observation or indication of spawning activity.
8. Surveys of two non-lake systems (Rodman and Duffield Creeks), located 16 miles northwest of Eva Creek, indicated the presence of numerous mature or "ripe" Dolly Varden that were brightly colored and often paired for the apparent purpose of spawning. A specific observation of possible spawning activity in Rodman Creek indicated that shallow redds are dug by the female in coarse gravel, followed by egg deposition and fertilization by one or more males.
9. Concentrations of spawning fish were not located and the observations indicated that spawning occurs in scattered groups or pairs.
10. Extreme sexual dimorphism among Dolly Varden was found which enabled unmistakable identification of the sexes during and after the spawning period.
11. Spawned out male Dolly Varden examined at the Eva Creek weir were in such poor condition and had developed dimorphism to such an extreme, that a high rate of mortality after spawning was indicated. The sex ratio of "spawned out" fish in both the random and tagging samples at the Eva Creek weir indicated that possibly male Dolly Varden remain on the spawning site longer than the females or are subjected to a selective mortality.
12. Records of the number of migrating Dolly Varden leaving and entering Lake Eva in 1962, 1963 and 1964 show that they begin their migration to sea in March, peak in May and end in early August. Dolly Varden begin entering Lake Eva in June. The majority enter the system in August and September, and by mid-December

their migration is completed. No movement of fish in or out of Lake Eva has been recorded from mid-December to mid-March.

13. From the numbers of out-migrant Dolly Varden marked at the Eva Creek weir, 34 to 44 percent have returned to Eva Creek in each of the three years of marking.
14. The high percentage of in-migrant marked fish which migrate out of Lake Eva the following year indicates a high winter survival.
15. Despite the fact that all Dolly Varden leaving Lake Eva in 1962, 1963 and 1964 are either marked or have been marked, the majority of the fish entering the system each year are non-marked fish. It has been shown that the majority of these fish are entering Lake Eva for the first time after rearing for three or four years in a non-lake system.
16. It may be concluded that Lake Eva is being utilized as one of the wintering areas by fish originating from the many stream systems located in the vicinity of Peril Strait.
17. Marked fish from Eva Creek have been recovered in 25 stream systems throughout Southeastern Alaska. After leaving Eva Creek, they have been found to migrate in all possible directions.
18. The numbers of anadromous fish using Eva Creek in a decreasing order of abundance are Dolly Varden, red salmon, pink salmon, cutthroat trout, coho salmon, chum salmon and steelhead.

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