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STATE OF ALASKA

William A. Egan, Governor



ANNUAL REPORT OF PROGRESS, 1962 - 1963

FEDERAL AID IN FISH RESTORATION PROJECT F-5-R-4

SPORT FISH INVESTIGATIONS OF ALASKA

Alaska Department of Fish and Game

Walter Kirkness, Commissioner

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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-4, "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. While some studies are of a more general nature and deal with gross investigational projects, others have been developed to evaluate specific problem areas. These include studies of king salmon, silver salmon, grayling and State Access requirements. The information gathered will provide the necessary background data for a better understanding of local management problems and development of future investigational studies.

The assembled progress reports may be considered fragmentary in many respects due to the continuing nature of the respective studies. The interpretations contained therein, therefore, are subject to re-evaluation as work progresses and additional information is acquired.

## JOB COMPLETION REPORT

## RESEARCH PROJECT SEGMENT

State: ALASKA Name: Sport Fish Investigations of Alaska.

Project No. F-5-R-4 Title: Investigation of Anadromous Dolly Varden Populations in the Lake Eva-Hanus Bay Drainages, Southeastern Alaska.

Job No: 3-B

Period Covered: July 1, 1962 through December 31, 1962.

## Abstract:

This report covers the first years operation of a project designed to study the life history of the Dolly Varden char, Salvelinus malma (Walbaum). The entire out-migrating population (38,264) of Dolly Varden, utilizing a typical Southeast Alaska lake-stream system, were enumerated and marked. The fall immigration (92,618) of this species was enumerated and checked for identifying marks. Sampling in other freshwater systems revealed migrations as far as 50 miles. Studies were also conducted to gather information on food and feeding habits, age and growth, sex ratio, spawning requirements, fecundity and freshwater rearing requirements.

## Recommendations:

To narrow the following years objectives to a degree whereby specific areas of importance can be investigated as thoroughly as possible.

To include the migratory habits and fresh water rearing requirements of Dolly Varden as the two major areas of study for the 1963 season.

The 1962 investigation revealed the migratory habits and fresh water rearing requirements as the phases which will be the most difficult to study and where an almost complete void of knowledge exists. For these reasons a thorough study in these two areas should be undertaken. It is recommended studies in these two areas begin in the following manner:

Migratory Habits:

1. The entire out-migration of Dolly Varden from the Eva lake system should be marked. Numbered tags should be affixed to as many Dolly Varden as possible and the remaining population marked by fin clipping.
2. A temporary weir should be installed on Saook creek ten miles west of Eva creek.
3. Dolly Varden in-migrations at both weirs should be checked for tags and fin clips.
4. In addition to the numbered tags recorded on the Dolly Varden entering Saook creek an additional sample of in-migrant chars should be tagged or marked.

Fresh Water Rearing Requirements:

1. The areas in which the Lake Eva Dolly Varden young are rearing should be determined.
2. Habitat preferences by age groups within the general rearing areas should be determined.
3. Feeding habits and competition between the young Dolly Varden and associated species should be determined.
4. The migratory habits within the general rearing areas should be investigated.

Based on the difficulty of study and the lack of present information the following phases of the Dolly Varden's life history is presented, in order of importance, as areas which

should be investigated in the future.

1. The spawning habits and requirements.
  - a) will require men at Lake Eva after the middle of November and probably through December.
  - b) fecundity of mature specimens.
  - c) spawning areas.
  - d) sex-ratio on the spawning grounds.
  - e) gravel size preference and nest measurements.
2. Age and growth studies.
  - a) will require a stratified and a random sample of both the downstream migrants and upstream migrants conducted from the beginning to the end of each migration period.
  - b) age at maturity - determined from collections made on the spawning grounds.
  - c) the aging should be determined from the otoliths and the suitable sample size calculated - considering about 20% of the otoliths to be unreadable.
3. Food and feeding habits.
  - a) the sample size of the Dolly Varden migrating to and from Eva creek can be reduced over the 1962 investigation.
  - b) more concentrated studies should be made in saltwater and prior to the time of the downstream migration.

4. Mortality and holdover in freshwater.
  - a) all or a suitable percent of the upstream migrating Dolly Varden should be marked.
  - b) all outmigrant Dolly Varden the following spring should be examined for marks.
  - c) extensive sampling in Lake Eva should be conducted after the downstream migration period to determine if a holdover exists.

Complete counts of all migrating fish (young salmon outmigrant counts can be determined by a percent sample - marking and re-release upstream) should be made every year.

#### Introduction:

The Dolly Varden is an important sport fish throughout Southeastern Alaska. In the more populated areas a reduction in the numbers of this species is becoming apparent. As very little is known of the life history of the Dolly Varden, this study was undertaken. To gather the necessary data, a weir was constructed on Eva Creek, Baranof Island in the spring of 1962. This location was felt to be typical of the lake-stream systems utilized by Dolly Varden of this area. The weir was in constant operation from May 1st to November 13th. During this period, a total of 130,882 Dolly Varden were enumerated and studied. Other species passing the weir were 3,276 cutthroat trout, 182 rainbow (steelhead) trout, 13,847 adult red salmon, 911 adult coho salmon, 649 adult chum salmon and 175 adult pink salmon.

#### Objectives:

To measure and evaluate anadromous Dolly Varden populations in a typical Southeast Alaska lake-stream system.

To determine the extent, timing, and purpose of Dolly Varden migrations in this type of drainage.

To determine the food habits of anadromous Dolly Varden in relation to inter-species competition.

To determine the age and size composition of anadromous Dolly Varden in this type of drainage.

To determine the spawning habits and requirements of anadromous Dolly Varden.

To determine the fresh water rearing requirements of Dolly Varden.

#### Techniques:

Background information from prior studies, conducted by the Alaska Department of Fish and Game and other agencies was reviewed.

A weir with upstream-downstream trapping facilities was constructed on the Lake Eva outlet stream. The weir is 160 feet long and 3 feet high. At no time did the stream exceed the height of the weir. The weir is of the panel type using 5/8 inch hardware cloth to halt the passage of fish. One downstream and two upstream traps were incorporated into the weir. Each trap section enclosed an area 10 x 15 feet. The entrance to the downstream trap was of the "Wulf" type which measured 3 feet wide. Entrances to the upstream traps consisted of a "V" type on one and a wire funnel on the other. The fish appeared to be able to find and enter these traps with little trouble or delay. Each trap is capable of holding 4,000 to 6,000 fish, depending on water depth, with no apparent detrimental effects.

A cabin capable of housing four men was constructed adjacent to the weir. Laboratory and storage space was added which yielded a building 10 feet wide by thirty-six feet long. A 2500 watt generator provided cabin and weir illumination for night work.

To expedite handling, all trout and chars were anesthetized with Tricaine Methanesulfonate (MS 222) or Quinaldine. Salmon were passed by dip nets and by removal

of a weir panel and tally counting. All outmigrating Dolly Varden were given an identifying mark by removal of a fin. All immigrating chars were carefully checked for missing fins. Periodically a random sample of chars was removed and examined to provide data on age and growth, food habits and sex ratios. To supplement this information, test netting was conducted in Lake Eva and Hanus Bay.

Throughout the summer, 14 different watersheds were sampled by sports gear to determine their utilization by Eva Creek marked Dolly Varden.

Periodic surveys of the Eva Creek watershed were made to determine spawning areas.

Findings:

Downstream Migrants:

On May 1, 1962 the weir was completed to the point of stopping any migrating Dolly Varden. By May 8 the traps were completed and fishing. It is not known whether any Dolly Varden downstream migrants passed the weir site prior to May 1. This is believed doubtful as: (1) no Dolly Varden were observed or caught on hook and line in Eva Creek prior to this date (2) the ice breakup on Lake Eva did not begin prior to May 1 and (3) the first week of operation showed a gradual increase in the number of downstream migrating Dolly Varden.

Upon entering the downstream trap the Dolly Varden were transferred to holding buckets, anesthetized with MS 222 and marked by the removal of a fin. The right ventral fin was removed from 34,726 Dolly Varden above 150 millimeters in fork length, and the adipose fin was removed from 3,538 Dolly Varden under 150 millimeters. No Dolly Varden returning from salt-water were under 150 millimeters in length, therefore, it was assumed these small fish were migrating to sea for their first time. The entire outmigration of 38,264 Dolly Varden were marked.

The downstream migration of Dolly Varden occurred from May 8 to July 20th. The peak migration period occurred the

third week in May when 13,391 Dolly Varden passed the weir. The greatest number of Dolly Varden passing the weir on any single day occurred May 22 when 4,271 entered the downstream trap. Total outmigration counts for monthly periods are as follows: May - 33,347; June - 4,876 and July - 41. (see table 1). The majority of the downstream migrating Dolly Varden entered the trap during the daylight hours. Water fluctuations had no apparent effect on the migrants during their major migration period in May, however in June the greatest numbers appeared during periods of high water. The daily water temperature did not fluctuate more than one or two degrees from day to day. The water temperature was 38° F. at the beginning of the migration, remained about 41° F. during the peak migration period and by the end of the migration period (July 20th) had risen to 55° F.

No counts were attempted for the outmigrant pink, chum, sockeye and coho smolts. A fry trap was kept in operation below the weir to determine if any small Dolly Varden were passing through the 5/8 inch screen mesh. Although numerous pink, chum and sockeye smolts were caught no Dolly Varden young entered the trap.

A total of 1,594 downstream migrant cutthroat trout passed the weir between May 9 and August 22nd. During the month of May many sexually mature cutthroat were caught in the downstream trap and spawned out cutthroat were found migrating back upstream in late June and early July. This indicates that a certain portion of the cutthroat migrate out of Lake Eva, spawn below the weir sometime in late May or early June and return to the lake. Whether these fish eventually migrate to sea was not determined.

A small number of rainbow trout smolts (160) passed the weir from June 6 to July 24th. The majority (149) of these fish migrated during the month of June. Four adult steelhead trout (avg. about 7 lbs.) entered the downstream trap on July 23rd.

Table 1. Monthly Downstream Migrant Weir  
Counts for Eva Creek - 1963

Month	Dolly Varden			Cutthroat	Rainbow
	Adult	Initial Migrants	Total		
May	31,037	2,310	33,347	510	---
June	3,650	1,226	4,876	790	149
July	39	2	41	245	7
August	---	---	---	49	4
<b>Total</b>	<b>34,726</b>	<b>3,538</b>	<b>38,264</b>	<b>1,594</b>	<b>160</b>

Upstream Migrants:

All upstream migrating Dolly Varden returning from salt-water, were trapped then transferred to holding buckets, anesthetized with Quinaldine or MS 222 and examined for missing fins. A total of 92,618 Dolly Varden were so counted. Out of this total 77,1962 (83%) were non-clipped; 13,789 (15%) had been right-ventral fin clipped and 1,667 (2%) had been adipose fin clipped in the spring.

The migration to fresh water began in mid-June and attained a peak during the second week in September when 13,050 Dolly Varden were trapped passing the weir. The majority of the char returned during the months of August (43,454) and September (30,046). A few Dolly Varden (less than 50 per day) were still entering the upstream traps when the weir was closed for the season on November 13th.

From the 38,264 marked downstream migrant Dolly Varden, 40.4% (15,456) returned to Eva Creek. Of the 34,726 right ventral fin clipped chars, 39.7% (13,789) returned and from the 3,538 adipose fin clipped chars, 47.1% (1,667) returned to Eva Creek.

TABLE 2. MONTHLY UPSTREAM MIGRANT WEIR COUNTS FOR EVA CREEK 1962

Month	Dolly Varden <sup>1</sup>			Total	Pink	Chum	Red	Coho	Cutt.	Rainbow	Total
	N.C.	R.V.	Adp.								
May	-	-	-	-	-	-	-	-	-	22	22
June	31	1	-	32	-	-	12,311	-	11	-	12,354
July	8,673	3,017	499	12,189	2	339	1,265	-	114	-	13,909
August	37,897	4,695	862	43,454	110	295	259	33	220	-	44,371
September	25,487	4,261	298	30,046	63	14	12	643	1,127	-	31,905
October	3,995	1,459	7	5,461	-	1	-	217	188	-	5,867
November	1,079	356	1	1,436	-	-	-	18	22	-	1,476
Total	77,162	13,789	1,667	92,618	175	649	13,847	911	1,682	22	109,904

<sup>1</sup> N.C. = Not clipped; R.V. = Right Ventral Clip; Adp. = Adipose Clip

The majority of the upstream migrating Dolly Varden entered the traps during the hours of darkness. Peak periods of migration correlated with the periods of high water. The water temperature was 44° F. at the beginning of the upstream migration, gradually increased to 58° F. on August 4th and then gradually declined throughout the remainder of the migration period to reach 42° F. on November 13th.

Other upstream migrating fish passing the Eva Creek weir included red salmon (13,847), silver salmon (911), chum salmon (649), pink salmon (175), cutthroat trout (1,682) and steelhead trout (22). For the monthly counts of these fish see table 2.

#### Recovery of Marked Chars:

During mid-July reports from a logging company at Rodman Bay indicated that fin-clipped Dolly Varden were being caught on sport gear in Rodman creek. To verify the reports that marked Eva Creek Dolly Varden were entering other stream systems a recovery program was instigated on July 14, 1962. Several stream systems were sampled in Peril Straits and outlying areas. Streams under 20 miles from Eva Creek were visited by boat and those over 20 miles distant were traveled to by air. Each stream was sampled once, above tidal influence, for about two hours, by two department biologists using sport gear.

Fourteen different stream systems were sampled between July 14 to August 9th. Ten of these stream systems ranging from 10 to 52 miles from Eva Creek were found to contain Dolly Varden that had been marked at the Eva Creek weir during their downstream migration (see table 3). The recoveries showed the Dolly Varden leaving Eva Creek in the spring will migrate in all possible directions (see figure 1). Dolly Varden marked at Eva Creek were found in both stream and lake-stream systems.

With the exception of one adipose fin clipped Dolly Varden recovered in Patterson Bay Creek all clipped chars were missing the right ventral fin. The highest percent of marked fish were recovered in Saook creek (ten miles west of Eva Creek) where eight out of the fifteen Dolly Varden caught had

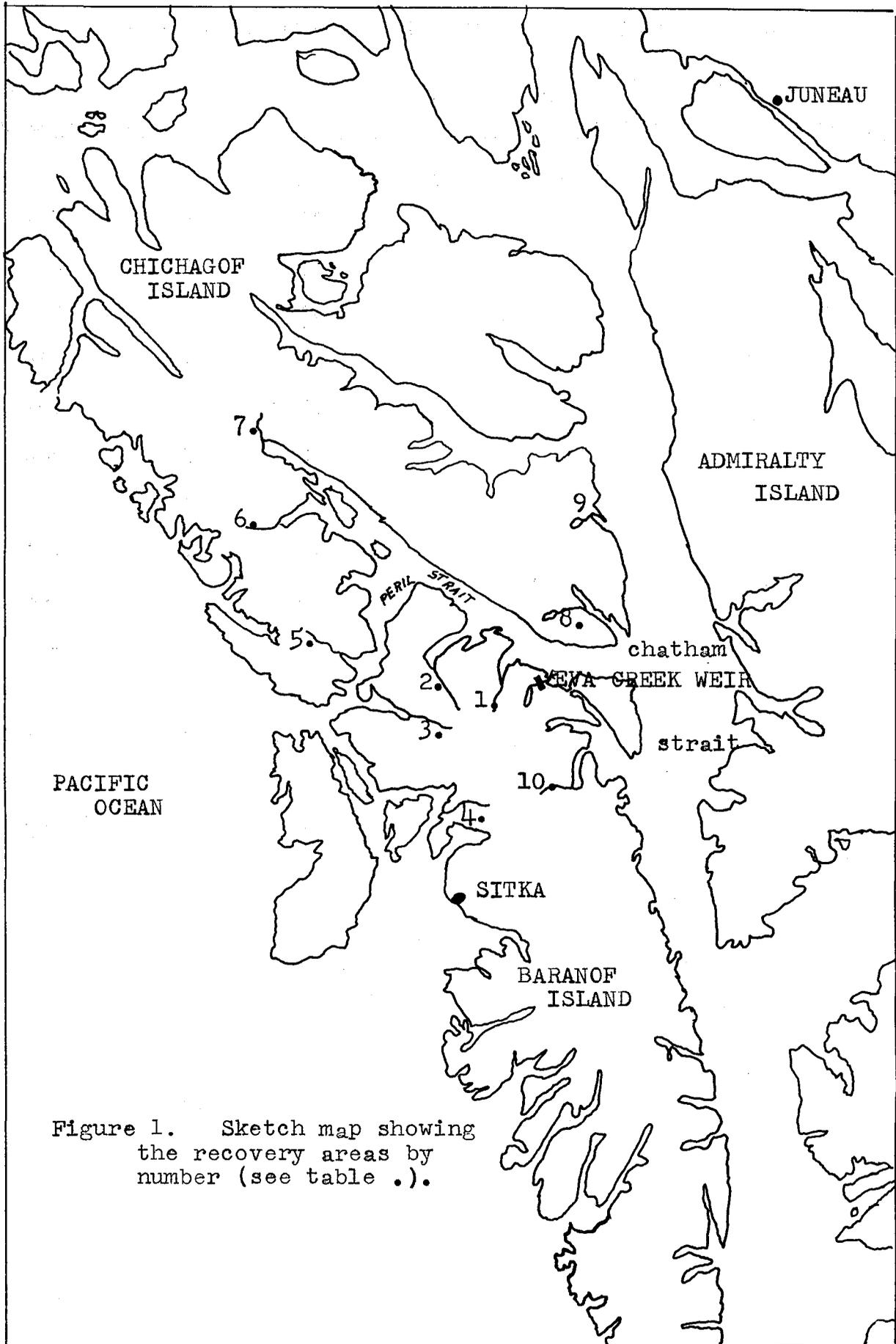


Figure 1. Sketch map showing the recovery areas by number (see table ..).

TABLE 3 . RECOVERIES OF DOLLY VARDEN MARKED AT THE EVA CREEK WEIR IN 1962

No.	Stream	Date	Miles from Miles Caught		No. Caught	No. Marked	% Marked
			Eva Creek	Above Tide			
<u>Streams Sampled by Dept. Biologists</u>							
1.	Saook	7/14	10	1½	15	8	53%
2.	Rodman	7/15	16	4½	23	6	26%
3.	Fish Bay	8/2	38	½	17	4	23%
4.	Nakwasina	8/2	52	¼	15	2	13%
5.	Deep Bay	7/24	29	¼	11	2	18%
6.	Patterson	7/24	30	1	10	2	20%
7.	Hortniff	7/24	34	¼	13	1	8%
8.	Sitkoh	7/17	12	½	7	1	14%
9.	Basket Bay	7/19	23	½	23	1	4%
10.	Clear	7/21	27	½	19	2	10%
<u>Recoveries Reported but not Observed</u>							
2.	Rodman	7/14	16	?	12	10	83%
2.	Rodman	7/11	16	?	?	5	-
5.	Deep Bay	7/22	29	?	7	5	71%

the right ventral fin missing. The longest migration of recovered marked fish occurred to the Nakwasine river, 52 miles west of Eva Creek. No recovery trips were made further than this point.

No fin clipped fish were recovered in Gut Bay Creek (35 examined) or Red Bluff Bay Creek (115 examined) on the south-east side of Baranof Island. Also, no marked fish were recovered in Whitewater Bay Creek (9 examined) or in a creek in the South Arm of Hood Bay (105 examined) on the west side of Admiralty Island.

#### FOOD AND FEEDING HABITS

Stomach contents from 1,622 char captured in the Lake Eva-Hanus Bay area between May 8 to August 21, 1962 were examined. The Dolly Varden were captured in three major areas (1) Lake Eva (2) Eva Creek weir and (3) Hanus Bay.

##### Downstream Migrants:

Stomach contents from 519 downstream migrant Dolly Varden were analysed between May 5 and June 17, 1962. The char were captured at the weir and examined as soon as possible. Of the 519 stomachs examined 482 (92.9%) were empty and 37 (7.1%) contained food. Table 4 gives the percentage occurrence of food items found in the stomachs. Insects were the most frequently occurring food item; being found in 56.8 percent of the stomachs with food. Gastropods were second in abundance, occurring in 13.5 percent of the feeding char. Young salmon fry were found in only one of the Dolly Varden examined.

Dolly Varden were repeatedly observed swimming around and through large schools of sockeye salmon smolts in front of the weir. At no time during these observations were Dolly Varden chasing or feeding on the young sockeye smolts.

##### Saltwater Feeding Habits:

Food habits of 145 adult and subadult individuals of the Dolly Varden collected in the Hanus Bay region between

TABLE 4 . STOMACH CONTENT OF 1,622 DOLLY VARDEN EXAMINED IN THE LAKE EVA -

HANUS BAY AREA, 1962

Stomach Content	Downstream Migrants (Weir)		Saltwater Hanus Bay			Upstream Migrants (Weir)		Lake Eva	
	% occur. feeding fish	% occur. total fish	% occur. feeding fish	% occur. total fish	% total volume	% occur. feeding fish	% occur. total fish	% occur. feeding fish	% occur. total fish
Fish									
Salmon young	2.7	0.2	21.6	15.2	28.1	-	-	-	-
Capelin	-	-	9.8	6.9	21.7	-	-	-	-
Herring	-	-	5.9	4.1	17.1	-	-	-	-
Sand Lance	-	-	2.0	1.4	1.9	3.4	0.3	-	-
Liparids	-	-	2.9	2.1	2.3	-	-	-	-
Stickleback	-	-	-	-	-	1.7	0.1	-	-
Fish Material									
Salmon Eggs	-	-	-	-	-	17.2	1.3	18.6	6.3
Fish Remains	-	-	25.5	17.9	11.7	22.4	1.7	3.4	1.1
Crustacea									
Mysids	-	-	17.6	12.4	9.0	3.4	0.3	-	-
Euphausiids	-	-	8.8	6.2	2.0	3.4	0.3	-	-
Amphipods	-	-	12.7	9.0	2.9	3.4	0.3	-	-
Tanaidacea	-	-	7.8	5.5	0.4	-	-	-	-
Isopods	-	-	3.9	2.8	1.1	-	-	-	-
Decapods	-	-	2.0	1.4	0.1	-	-	-	-
Unid. Crustacea	-	-	2.9	2.1	0.2	-	-	-	-
Insects									
Insects	56.8	4.0	-	-	-	12.1	0.9	22.0	7.4
Miscellaneous									
Gastropods	13.5	1.0	1.0	0.7	-	8.6	0.6	64.4	21.6
Polychaete Worms	-	-	2.9	2.1	0.8	5.2	0.4	-	-
Wood, Rocks	2.7	0.2	-	-	-	12.1	0.9	1.7	0.6
Unid. Material	24.3	1.7	5.9	4.1	0.5	19.0	1.4	1.7	0.6
Number Empty	482			43		724		117	
Number Feeding	37			102		58		59	
Total Examined	519			145		782		176	

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May 31, to August 5, 1962 were examined. The char were captured by gill net (49%) and by rod and line (51%). Each of the above methods of capture proved to be identical in the percent of individuals without food.

Of the 145 stomachs of the Dolly Varden examined, 43 were empty. The 102 individuals with food ranged in size from 121 millimeters to 490 millimeters; mean, 274 millimeters and .03 pounds to 3.01 pounds; mean .66 pounds.

The principal foods by volume were salmon young (28.1%) capelin (21.7%), Pacific herring (17.1%) and Mysidacea (9%) (table 4). The principal foods by frequency of occurrence were salmon young (21.6%), Mysidacea (17.6%), Amphipods (12.7%) and capelin (9.8%).

Young salmon were available to the Dolly Varden in Hanus Bay throughout the study period. During this period young of the pink, chum and coho were repeatedly observed. Pink and chum salmon young were collected by beach seine in Hanus Bay at various intervals throughout the study period. Although these two species appeared to grow rapidly (table 5) they did not attain lengths during the study period that would render them invulnerable to predation by the Dolly Varden. An estimated total of 56 pink and chum salmon remains were identified in twenty-two (21.6%) char. No coho salmon young were identified in any of the stomachs examined.

The capelin occurred in about one of every ten specimens studies. Although only 20 capelin were found in ten char the total volume (21.7%) was second highest. This is due to the relatively large size (87 millimeters to 153 millimeters) of the capelin eaten making it the largest fish consumed by the Dolly Varden.

The Pacific herring occurred in greater numbers than any other fish eaten by the Dolly Varden (182). However, as the Pacific herring was eaten as larvae the total volume was not as great as the larger salmon young and capelin. Their remains were identified in six (5.9%) char.

The only other fish found in the Dolly Varden stomachs were the Pacific sand lance and an unidentifiable member of

the Family Liparidae, or snailfishes. Two of the chars examined contained fourteen Pacific sand lances which resulted in a total volume of 1.9 percent and a frequency of occurrence of 2.0 percent. Seven snailfish were found in three Dolly Varden. Their total volume was 2.3 percent and they occurred in 2.9 percent of the stomachs studied. The lobefin snailfish was frequently obtained by beach seine in Hanus Bay and this was probably the species observed in the chars stomachs.

The principle crustacean eaten by the Dolly Varden was a member of the Family Mysidacea (1,269). They occurred in 18 of the Dolly Varden stomachs examined. Other members of the crustacea found included Amphipods (157), Euphausiids (147), Isopods (66), Tanaidacea (53) and Decapods (16).

The only other food material found were six polychaete worms for three Dolly Varden and one Gasteropod.

Table 5. The Average Fork Length of Pink and Chum Salmon Young Sampled in Hanus Bay - 1962

Date	Pink		Number	Chum	
	Number	Mean Length (mm)		Mean Length (mm)	
6/21	27	51.10	62	49.10	
6/28	6	61.50	71	60.90	
7/5	41	76.72	85	72.09	
7/12	12	87.25	48	83.27	

Twelve cutthroat trout were sampled along with Dolly Varden taken in Hanus Bay. Of the 12 stomachs examined 3 (25%) were empty. The identifiable food items by volume were salmon young (36.1%), capelin (13.9%), Scorpaenidae (8.3%), Amphipods (3.3%), insects (3.3%), Pacific sand lance (2.8%), and Euphausiids (1.1%). The identifiable food items by

frequency of occurrence in the feeding trout were Amphipods (44.4%), salmon young (22.2%), capelin, Pacific sand lance, Scorpaenidae, insects and Euphausiids occurred in 11.1% of the feeding fish respectively.

#### Upstream Migrants:

A total of 782 upstream migrating Dolly Varden were examined for food habits between July 16 and August 16, 1962. The char were captured at the weir and examined as soon as possible after entering the upstream traps. Of the 782 stomachs examined 724 (92.6%) were empty and 58 (7.4%) contained food.

Fish remains, the principal food item, were found in 13 (22.4%) of the feeding Dolly Varden. The remains appeared to be from fish that were fed upon before the char entered Eva Creek.

Salmon eggs were found in 10 (17.2%) of the feeding Dolly Varden. An additional fourteen Dolly Varden were picked because of an apparent stomach full of salmon eggs and did not enter into the normal random sample. From these fourteen char 766 salmon eggs were counted for an average of 54.7 eggs per fish. Small groups (6-15) of Dolly Varden were repeatedly observed in close proximity to spawning pairs of pink and chum salmon near the weir. No Dolly Varden were observed entering the nest during the actual spawning act. However, whenever a female salmon would exhibit her normal digging motion the char would immediately congregate around her. It is possible that these char were feeding on the eggs dislodged by the salmon's digging actions.

Diptera larvae were found in 7 (9.7%) of the feeding Dolly Varden. These appeared to be maggots found in and around decaying salmon flesh and were probably washed off into the creek during periods of high water.

Gastropods were found in 5 (6.9%) of the feeding Dolly Varden. These, along with one stickleback were the only other food items likely to have been picked up in fresh water.

The Pacific sand lance, Euphausiids, Mysids and Amphipods were found in 2 (2.7%) of the feeding Dolly Varden respectively. These items along with polychaete worms, which occurred in 3 (4.2%) of the char, were no doubt picked up in salt water before the fish entered Eva Creek.

#### Lake Eva:

Stomach contents of 176 Dolly Varden collected in Eva Lake were examined between August 6-21, 1962. Of the 176 stomachs examined 117 (66.5%) were empty. The char were captured by fyke net (73.7%) and by rod and line (26.3%).

Gastropods were the most frequently occurring food item; being found in 64.4% of the stomachs containing food. Insects (Trichoptera) occurred in 22.0%; salmon eggs in 18.6% and fish remains in 3.4% of the feeding Dolly Varden.

The three-spined stickleback and sockeye salmon fry were repeatedly observed and taken by beach seine in large numbers throughout Lake Eva during the sample period, however, neither of these species were found in the Dolly Varden stomachs examined.

Sixty-four cutthroat trout were sampled along with the Dolly Varden. Of the 64 stomachs examined 22 (34.4%) were empty. The identifiable food items by frequency of occurrence (feeding fish only) were salmon young (50%), insects (33.3%), stickleback (4.8%), gastropods (4.8%), and salmon eggs (2.4%). A total of 64 salmon young were counted in 21 of the feeding cutthroat trout. About 62% of the salmon young were sockeye salmon young and about 38% were young of the coho salmon. Fifteen sockeye salmon fry was the greatest number of fish found in any single cutthroat trout examined.

#### Rate of Digestion:

Eighteen Dolly Varden returning from the sea were captured at the weir and starved for 48 hours. They ranged in length (fork length) from 216 millimeters to 280 millimeters with an average of 247 millimeters. The weight ranged from .21 pounds to .47 pounds and averaged .33 pounds. At a recorded time,

each Dolly Varden was force fed two freshly killed sockeye salmon fry of equal size (43 millimeters). At specific intervals of time, two Dolly Varden were sacrificed and the state of decomposition of the sockeye salmon fry was noted. (see table 5). The water temperature remained a constant 56° F.

Digestion did not begin until 4 hours after feeding. The fry were identifiable to species up to 6 hours after feeding and to family up to 12 hours. At 16 hours after feeding the fry were classified as unidentifiable fish remains and by 24 hours most digestion had been completed.

Table 5. Rate of Digestion in the Dolly Varden and Observed Condition of Food at the Indicated Times After Feeding.

Time in Hours	Observed Condition of Sockeye Salmon Fry
2	Little or no digestion has taken place. Parr marks easily recognizable. Fry are identifiable to species.
4	Digestion beginning in the posterior part of the stomach. The head of the fry are now partly digested. Skin and scales most intact, parr marks still visible. Fry are identifiable to species.
6	Some skin and scales have been digested. One fry head completely digested, other still intact. Parr marks still visible. Fry are identifiable to species.
8	Skin and scales mostly digested on two fry. Parr marks still visible on other two fry. Heads mostly digested. Fry are identifiable to genera.

- 10 Skin and scales mostly or partly digested on all fry. Parr marks no longer visible. Flesh is soft and there is present a fair amount of jelly-like flesh. Fry are identifiable to family.
- 12 Skin and scales completely gone. Flesh is soft. Fry identifiable to family.
- 16 Flesh mostly digested. Bone structure still present. Identified as fish remains.
- 20 A small amount of bone structure present. Flesh almost completely digested. Identifiable as fish remains.
- 24 In one fish the fry were completely digested with only a small amount of jelly-like substance remaining. The other fish contained only a few bones.

#### AGE - GROWTH - SEX RATIO

To determine the age, growth and sex ratio of the Lake Eva Dolly Varden 35 samples a day were taken at the weir during their major downstream and upstream migration periods. A random sample was obtained by crowding the trapped Dolly Varden and capturing the char by dip net. The char were then killed and examined for length, weight and sex. Otoliths were obtained from these fish for age determination.

#### Age Studies:

A total of 1,310 sets of otoliths were obtained for age determination from the downstream and upstream migrating Dolly Varden. This total included 693 downstream migrants and 617 upstream migrants. Twenty-one percent (152) of the downstream migrant samples and twenty-three percent (141) of the upstream migrant samples were discarded as unreadable. The otoliths were read as whole mounts. They were placed in a small watch-glass filled with water and examined directly with a binocular microscope using reflected light. The otoliths were stored dry and no further preparation was necessary.

Under reflected light the hyaline zones (winter growth) showed up as dark bands and the opaque zones (summer growth) as white bands. The age was determined by counting the number of dark (hyaline) bands from the center to the outer edge of the otolith. The development of the otolith from the 0 age group<sup>1</sup> and the formation of the opaque zone (summer growth) was easily followed throughout the season. From this it is felt that otoliths are a valid and accurate means for age determination of the Dolly Varden.

Many of the otoliths from the 0 age group were found to contain a hyaline (dark) center therefore, the dark center appearing in many of the older age groups was not regarded as a winter check.

All age groups presented in the following discussion refer to the number of winter (hyaline) bands counted.

#### Age Composition:

Eight age groups (age group II to age group IX) were found among the downstream and upstream migrating Dolly Varden. From table 6 it is indicated that the majority of the migrating Dolly Varden fall into the age groups III, IV and V. Two possible reasons for this may be (1) the majority of the Lake Eva Dolly Varden begin their initial migration to sea in their third and fourth year (a study of the age groups present in the rearing population substantiates this); (2) the Lake Eva Dolly Varden suffer a high mortality during their sixth winter in fresh water.

The apparent difference in age composition between the upstream migrating clipped and non-clipped char is not clearly understood. The high percent of age group III among the non-clipped Dolly Varden may indicate that these fish are initial outmigrants from other stream systems and are entering Lake Eva for the winter.

1. For a discussion of the younger age groups see the section on the freshwater rearing requirements.

Table 6. Age Composition of Dolly Varden  
 Passing the Eva Creek Weir - 1962

Age Group	Downstream Migrants	Upstream Migrants	
		Clipped	Not Clipped
II	0.4%	0.0%	1.2%
III	10.0%	14.4%	42.2%
IV	41.0%	47.0%	30.7%
V	40.0%	34.6%	13.3%
VI	5.7%	3.6%	10.0%
VII	1.2%	1.6%	1.2%
VIII	1.2%	0.0%	1.2%
IX	0.2%	0.0%	0.6%

Number = 508      Number = 306      Number = 166

### Growth

By comparing the mean length and weight by age group of the downstream migrant to the upstream migrant clipped fish, an average length and weight increment was determined (see table 7). Only age groups III, IV and V contained a large enough sample for a valid comparison. The growth increment may not be representative of normal growth due to the possibility that fin-clipping may retard growth rates. Until it can be determined where the non-clipped fish are coming from no comparisons will be attempted with this group.

The downstream migrant Dolly Varden averaged 245.35 millimeters and .32 pounds. The returning upstream migrating clipped Dolly Varden averaged 271.49 millimeters and .52 pounds. The average growth increment while at sea was 26.14 millimeters and .20 pounds. By age group the growth increment

was as follows: age group III = 49.18 millimeters, .12 pounds; age group IV = 54.05 millimeters, .27 pounds; and age group V = 18.89 millimeters, .24 pounds.

Table 7. Mean Length, Weight and Growth Increment by Age for Dolly Varden Passing the Eva Creek Weir - 1962

Age Group	Downstream Mean Length (mm)	number	Clipped Upstream Mean Length (mm)	number	Length Increment (mm)
II	169.50	(2)	-	-	-
III	149.00	(51)	198.18	(44)	49.18
IV	210.73	(210)	264.78	(144)	54.05
V	279.76	(203)	298.65	(106)	18.89
VI	339.03	(29)	333.90	(11)	-5.13
VII	374.83	(6)	367.60	(6)	-7.23
VIII	447.83	(6)	-	-	-
IX	481.00	(1)	-	-	-
Total Mean	245.35	(508)	271.49	(311)	26.14

Age Group	Downstream Mean Weight (lbs)	Clipped Upstream Mean Weight (lbs)	Weight Increment (lbs)
II	.09	-	-
III	.07	.19	.12
IV	.17	.44	.27
V	.42	.66	.24
VI	.79	.94	.15
VII	1.08	1.27	.19
VIII	1.54	-	-
IX	2.23	-	-
Total Mean	.32	.52	.20

#### Sex Ratio

A total of 699 downstream migrating Dolly Varden and

399 upstream migrating clipped and 218 non-clipped char were sexed. The sex ratio was in favor of the females in all three groups. They were as follows: downstream migrants - 60% females, 40% males; the upstream migrant clipped and non-clipped groups were identical with 56% females and 44% males respectively.

The sex ratio by age group has been analysed for the downstream migrant population (see table 8). The upstream migrating population had not been analysed by sex ratio and age group at this time. Among the downstream migrant age groups, number III was the only group containing a ratio in favor of the males (41% females : 59% males).

Table 8. Sex Ratio By Age Groups of the Downstream Migrant Dolly Varden Passing the Eva Creek Weir - 1962

Age Group	No. Female	No. Male	%Female	%Male
II	1	1	50	50
III	21	30	41	59
IV	122	88	58	42
V	138	65	68	32
VI	17	12	59	41
VII	4	2	67	33
VIII	0	6	0	100
IX	0	1	0	100
Total	412	287	60	40

SPAWNING REQUIREMENTS

Actual spawning of Dolly Varden chars was not observed

in the Eva Lake system. Several surveys of streams adjacent to Lake Eva were made throughout September, October and early November. At that time no adult Dolly Varden could be found in these streams. In these same tributaries during August Dolly Varden fry still with the yolk sac scar were found.

During October many upstream migrating Dolly Varden passing the weir were found upon examination to be spawned out. Since little spawning area is available below the weir, the possibility exists that these fish spawned in other systems, dropped back down to salt water and then migrated on up to Lake Eva for the winter.

Fecundity:

Egg counts were made on eight maturing female Dolly Varden taken in Lake Eva on August 7, 1962 (see table 9). By actual counts the total number of eggs per fish ranged from 885 to 3,437 per female. An average of 998 eggs per left ovary, 963 per right ovary and a total average of 1,961 eggs per fish. An average of 1,198 eggs was produced per pound of fish. The females ranged in age from five to nine years.

Table 9. Fecundity of Maturing Dolly Varden  
Taken at Lake Eva - 9/7/62

Age of Fish	Weight of Fish (lb)	Length of Fish (mm)	No. Eggs Lft. Ovary	No. Eggs Rt. Ovary	Total No. Eggs	No. Eggs lb. Fish
?	0.79	335	549	610	1,159	1,467
5	0.95	341	506	491	997	1,049
6	0.85	332	473	412	885	1,041
7	1.70	404	814	944	1,785	1,034
7	1.71	424	1,065	909	1,974	1,154
7	2.05	446	1,125	1,275	2,400	1,171
7	2.49	482	1,881	1,556	3,437	1,380
9	2.56	493	1,569	1,512	3,081	1,204
Average	1.64	407	998	963	1,961	1,198

## FRESHWATER REARING REQUIREMENTS

During August an attempt was made to locate the rearing areas of Dolly Varden young in the Lake Eva drainage. The young char were located in all the tributary streams to Lake Eva and in one small tributary to Eva Creek below the weir. They were captured by dip netting in the shallow areas, by baited minnow traps and fyke nets in the deeper water areas. Extensive sampling by beach seine, fyke net and minnow traps did not reveal any young char rearing in Lake Eva.

Other species of fish found in the same areas as the young Dolly Varden were coho fry, cutthroat fry, rainbow fry, threespined stickleback, prickly sculpin and coastrange sculpin.

### Habitat

The young char were found in areas of still and moving water with both gravel and muddy substrata. They were found in areas of dense vegetation to areas of open water with little or no vegetation. No attempt was made to determine a habitat preference.

### Age

A total of 137 young char were captured in the Rat-sneep creeks area. These fish were measured and otoliths were taken for age determination. Seventeen of these otoliths were unreadable, leaving a sample size of 125. Four age groups (age group 0 to age group III) ranging in fork length from 21 millimeters to 110 millimeters were found rearing in this area. (see figure 2). Observations on the young char in the Fragnasle creek area indicated similar age and size groups present. Only age group 0 could be found in the Wahini creek area.

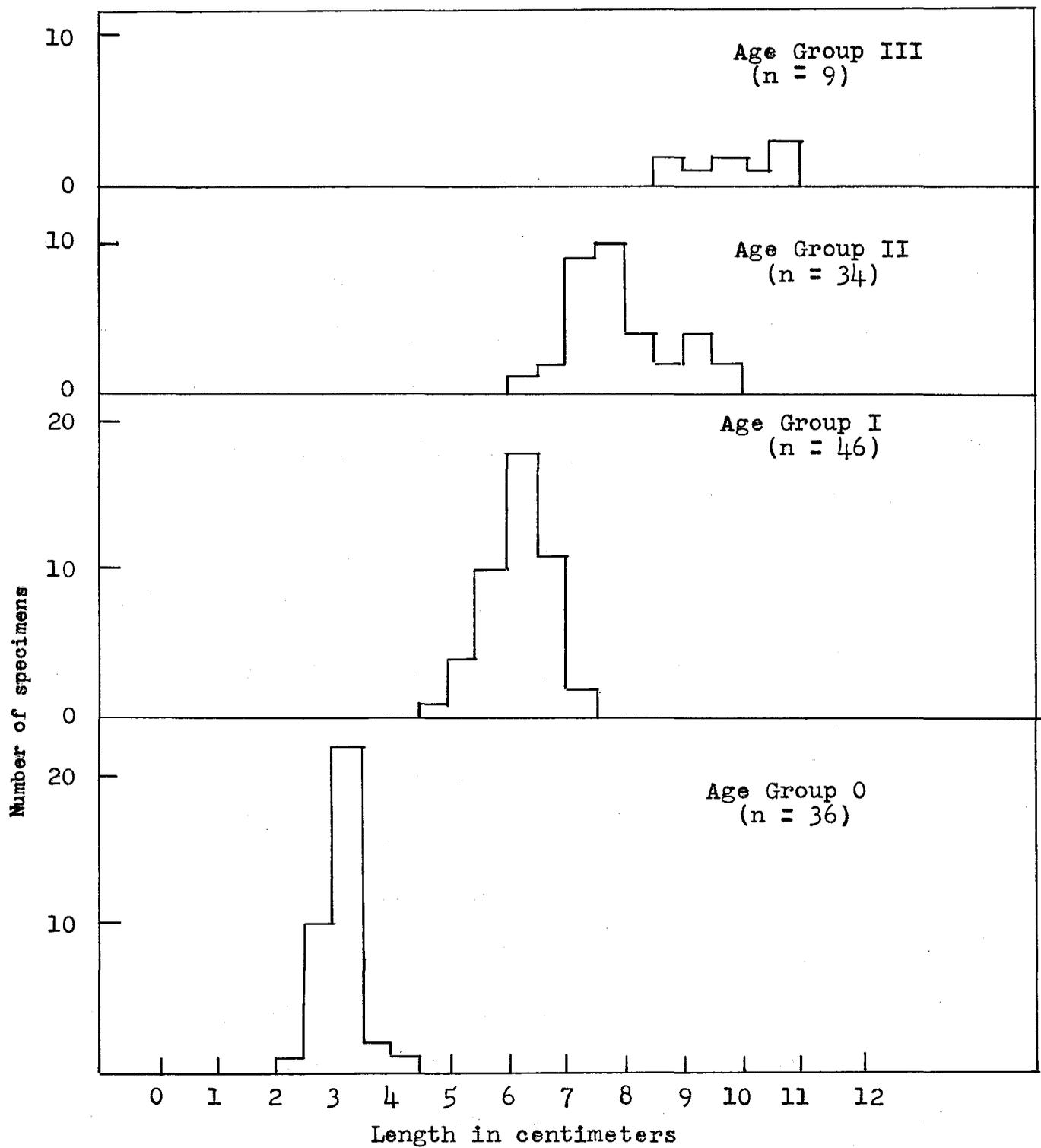


FIGURE 2. LENGTH FREQUENCY DISTRIBUTIONS OF DOLLY VARDEN CHARS BY AGE GROUP FROM THE RATSNEEP CREEK AREA

COMMON AND SCIENTIFIC NAMES OF FISHES  
FOUND IN THIS REPORT

<u>Common Name</u>	<u>Scientific Name</u>
Pacific herring	<u>Clupea harengus pallase</u> Valenciennes
Pink Salmon	<u>Oncorhynchus gorbuscha</u> (Walbaum)
Chum Salmon	<u>Oncorhynchus keta</u> (Walbaum)
Coho Salmon	<u>Oncorhynchus kisutch</u> (Walbaum)
Sockeye Salmon	<u>Oncorhynchus nerka</u> (Walbaum)
Cutthroat Trout	<u>Salmo clarki</u> Richardson
Rainbow (Steelhead) Trout	<u>Salmo gairdneri</u> Richardson
Dolly Varden Char	<u>Salvelinus malma</u> (Walbaum)
Capelin	<u>Mallotus villosus</u> (Müller)
Threespine Stickelback	<u>Gasterosteus aculeatus</u> Linnaeus
Prickly Sculpin	<u>Cottus asper</u> Richardson
Coastrange Sculpin	<u>Cottus aleuticus</u> Gilbert
Lobefin Snailfish	<u>Polypera greeni</u> (Jordan & Starks)
Pacific Sand Lance	<u>Ammodytes hexapterus</u> Pallas
Rockfishes	Scorpaenidae

## APPENDIX NUMBER I

### Annotated Bibliography

The following annotated bibliography represents the background information on the Dolly Varden that has been reviewed to date. It should not be considered complete; however, it is felt that the majority of the more intensive studies are included in this list. Additional references known to contain Dolly Varden information, but which were unavailable to the writer at the time of the report, are also included.

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