INTERNATIONAL PACIFIC SALMON
FISHERIES COMMISSION

PROGRESS REPORT

No. 35

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I. V. WILLIAMS

PART II

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ABSTRACT

In most cases of Fraser River sockeye dying prior to spawning, the early part of the spawning migration suffers a higher loss than either the central or late segments. Therefore, sockeye from the early and central segments of the Chilko River population were examined during the spawning migration both in salt and freshwater for differences which could explain this phenomena. Physical parameters, body lipids, blood, plasma cortisol and cortisone and various tissues for histology were sampled. The early fish tended to have higher hematocrits, high plasma cortisol levels, and some gill irritation. Although the number of fish sampled was small, these data do suggest possible areas for further research.

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PART I

INVESTIGATION OF PRESPAWNING MORTALITY
CHILKO RIVER 1971

INTRODUCTION

A number of studies have been made of the problem of prespawning mortalities among the various races within the Fraser River watershed. Most of these studies have concentrated on examination of the fish and the environment on the spawning grounds. It is generally accepted that there are pathogenic bacteria present on the fish which are dying unspawned (Pacha MS 1963, MS 1964; Wood 1965) and that in many cases the environment in which prespawning mortality takes place is not considered ideal, that is, the river temperatures are higher than optimum (Colgrove and Wood 1966). However, even when temperatures are in the range considered ideal (below 57°F maximum during spawning) and one of the most prominent pathogens, Flexibacter columnaris, is not usually pathogenic, there are records of substantial prespawning mortality as in the 1969 Horsefly population (Williams 1973).

In general, it is the early segment of a sockeye population that has the largest percentage prespawning mortality, in many cases approaching 100%. The central and late segments have a much reduced or no prespawning mortality. This suggests that the fish that die prematurely are stressed more than fish that spawn successfully, or that the fish that die prematurely are in some way less tolerant to stress than fish that spawn successfully. In 1964, Colgrove (1966) examined the histological and hematological changes in the early and central Chilko sockeye population as they migrated from the estuary to the spawning grounds. Although there were progressive degenerative changes as the fish approached spawning, it was concluded that there were no differences between the early and central fish. However, the prespawning mortality during this year at Chilko was very small, approximately 2%.

In order to extend our knowledge of the prespawning mortality problem in general, and presupposing a significant mortality in the early Chilko and no mortality in the central Chilko fish, detailed examinations of the early and central segments of the Chilko population were carried out during 1971. The fish were sampled at Lummi Island during their migration in saltwater, upon arrival at the spawning grounds and during spawning. The examinations included physical measurements, histological and endocrinological surveys with some determinations of body constituents as well.

FISH CAPTURE

A total of 138 sockeye was captured at Lummi Island by commercial reef net gear. Of these, 19 males and 23 females captured July 23 comprised the early Chilko samples, and 17 males and 16 females captured August 6 comprised the central Chilko sample. Racial identification was established using scale patterns, migration timing and fish size.

A beach seine was used to obtain fish from the Chilko River spawning grounds. Eleven males and 18 females were sampled from the early segment upon their arrival on August 17. Fifteen males and 15 females were sampled from the central segment upon arrival on August 27. Fifteen males and 32 females were sampled from the spawning sockeye on September 21 (TABLE 1).

TABLE 1 - Summary of Chilko fish sampled.

Date	Segment of Population	Location	No. of Fish Sampled ♂	♀	Total
July 23-24	Early	Lummi	19	23	42
August 6	Central	Lummi	17	16	33
August 17	Early Arrival	Chilko R.	11	18	29
August 26	Central Arrival	Chilko R.	15	15	30
Sept. 21	Mixture Spawning	Chilko R.	15	32	47
Total			77	104	181

SAMPLING

The fish were handled identically at each site. Each fish upon capture was immediately tagged and this number was used for identification of all samples taken.

PHYSICAL MEASUREMENTS

As soon as possible after blood sampling, the fish were measured and weighed. The fork length, total weight and eviscerated body, viscera and gonad weights were recorded for each fish. The female gonads were preserved in Bouin's fluid and the fecundity of each sample was determined at the Sweltzer Creek Research Laboratory.

BODY CONSTITUENTS

A flesh sample was taken from each female sockeye sampled at the spawning grounds, and from selected sockeye sampled from the central segment at Lummi Island. No flesh samples were taken from the early segment at Lummi Island. The samples taken were the section of the body beneath the dorsal fin (FIGURE 1).

The sample was taken as soon as possible after capture, placed in a plastic bag and frozen on dry ice. Twenty-five gram subsamples of flesh were then analyzed at the laboratory for percent water and total lipids using a chloroform-methanol extraction (Folch, Lees and Stanley 1957). Percent protein plus residues (ash) could then be determined by subtraction of water and lipids from 100.

BLOOD SAMPLING

Blood samples were taken from each fish sampled within 5 minutes after initiation of fish capture. Fish which were captured but not sampled within this 5 minutes were released. Approximately 30 cc of whole blood was drawn from the caudal vein of each fish with a heparinized syringe. A hematocrit sample was taken and plasma was then separated and frozen on dry ice.

CORTISOL AND CORTISONE DETERMINATION

The plasma cortisol and cortisone levels were determined for the female sockeye using the method described by Fagerlund (1967). The steroids were isolated by thin layer chromatography. Quantitative analysis of the isolated steroids was carried out using a competitive protein binding method, tagging the sample with tritium and counting with a scintillation spectrometer.

Plasma calcitonin was determined for each fish by the U.B.C. Department of Physiology.

HISTOLOGY

Tissues for histology were sampled as soon as possible after capture and preserved in Bouin's fluid. Samples of gill, liver, head kidney, spleen, kidney and pituitary were taken from each fish. The tissues were routinely sectioned at 6μ and with the exception of the pituitary were stained with hematoxylin and eosin. The pituitaries were stained with Masson's trichrome.

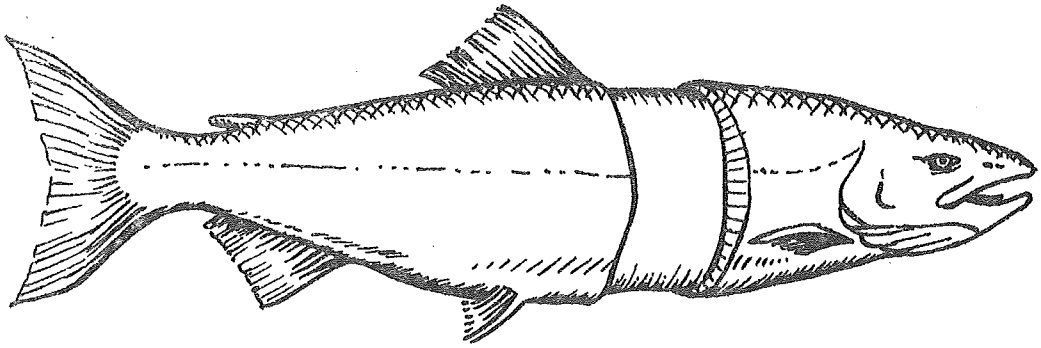

FIGURE 1 - Location of flesh sample taken from Chilko female sockeye.

DESCRIPTION OF THE 1971 POPULATION

The Chilko fish passed through the Lummi fishery from approximately July 15 to August 25 with the peak on August 5. A total of 157,187 fish escaped to the spawning grounds with a total of 57,721 males and 99,466 females. The first fish arrived on the spawning grounds on August 8 with the peak arriving on August 30. Counts were discontinued on October 1 when only 137 fish were counted in. First dead were recovered on September 8 with peak dead recovery on October 9. Last dead were recovered on October 17. The total prespawning mortality was 8.87% ranging from 92.86% in the first dead to 0%. The prespawning mortality for the segments represented during the sampling periods was 20 to 30% for the early and 0% for the central segment (FIGURE 2).

RESULTS

Physical Measurements

The early Chilko fish at both Lummi Island, and at arrival on the spawning grounds, tended to be lighter and were carrying fewer eggs than the central fish. There was a highly significant linear relationship with fecundity and fish size among the early fish both at Lummi Island and upon arrival at the spawning grounds (FIGURE 3). This could explain some of the difference in fecundities of the early and central fish as the early fish at Lummi averaged 1.4 cm shorter and were carrying an average of 351 eggs less than the central fish. However, the early fish at Chilko spawning grounds averaged 0.2 cm longer but still were carrying an average of 127 eggs fewer than the central fish. In addition, there was no significant relationship among the peak fish at Lummi. Therefore size probably only accounts for a part of the fecundity differences observed. The gonadosomatic index (GSI) was similar for early and peak fish and increased from approximately 3.9 at Lummi up to 10.5 upon arrival at the spawning grounds and 14.2 at spawning time (TABLE 2). Individual egg size, however, did not vary significantly between early to central fish, either at Lummi or on the spawning grounds, although the standard deviations of the egg weights in central fish were much higher than the early fish. Average egg size for the central fish increased in a linear relationship with time (FIGURE 4).

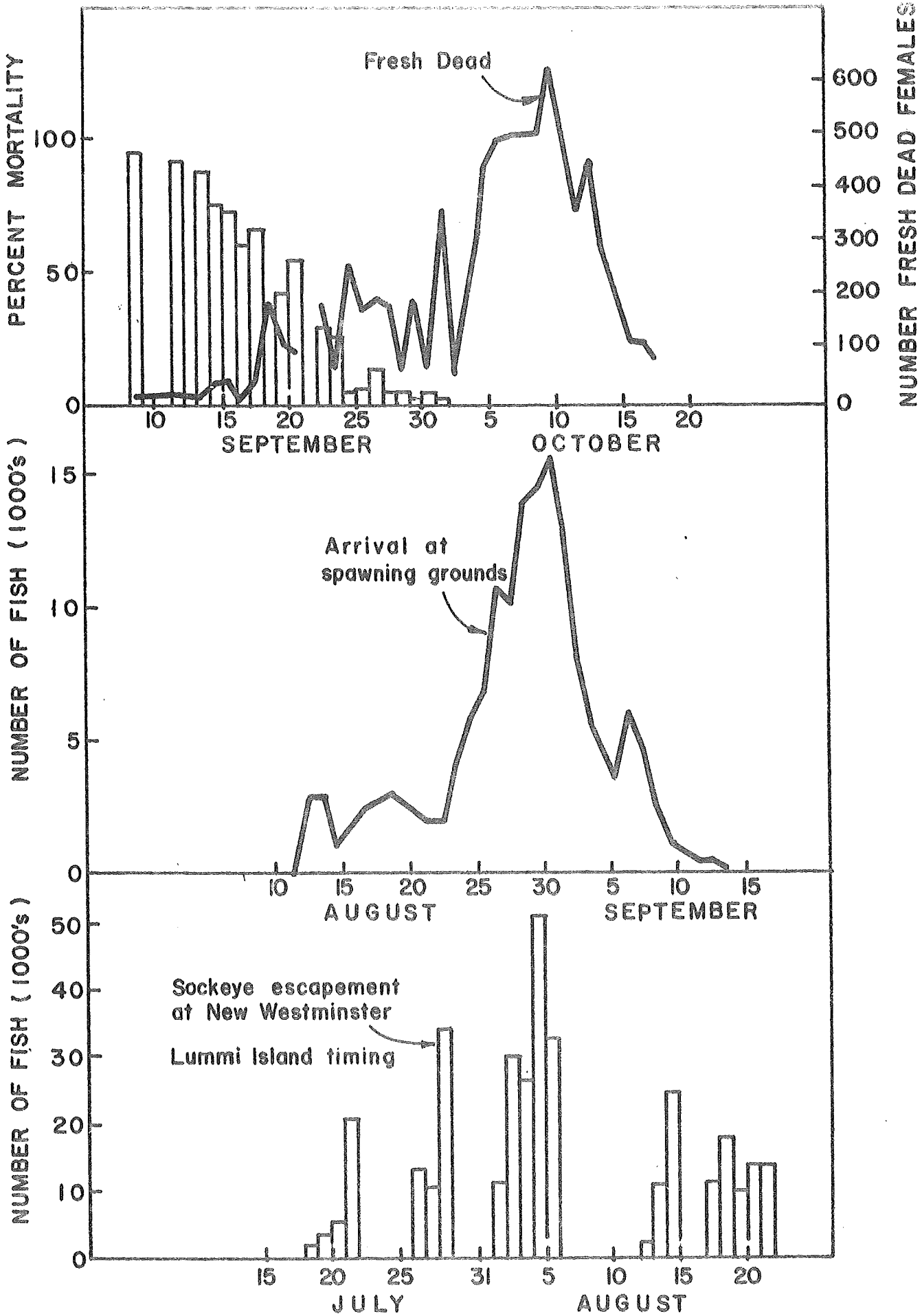

FIGURE 2 - 1971 Chilko sockeye migration and dead recovery.

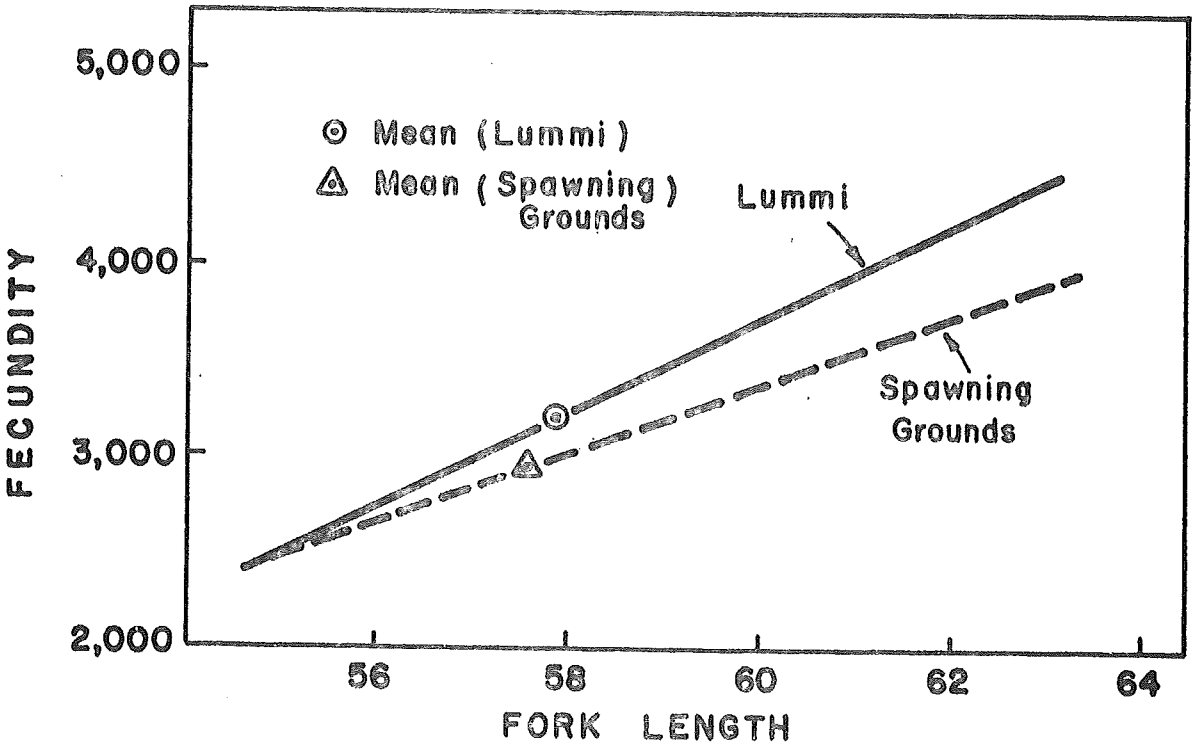

FIGURE 3 - Fecundity and length of early Chilko sockeye at Lummi and spawning grounds.

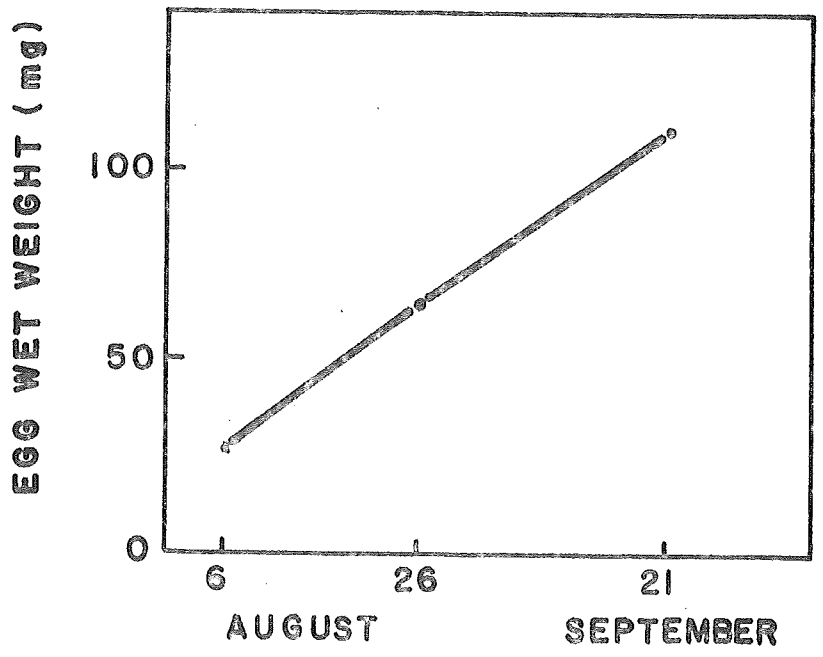

FIGURE 4 - Egg weight of central Chilko sockeye 1971.

TABLE 2 - Physical measurements of Chilko female sockeye salmon.

Date	Sample	Fork Length	SD	Total Wt gm	SD	Total Gonad gm	SD	Egg Wt mgm	SD	Fecund -ity	SD	GSI	SD
Lummi													
July 23-24	Early	57.5	1.12	2,264	174	88.0	14.1	27.7	3.5	3,156	546	3.89	0.52
Aug. 6	Peak	58.9	1.96	2,479	386	97.2	17.6	26.7	10.6	3,507	864	3.92	0.98
Arrival													
Aug. 17	Early	58.1	1.32	1,945	186	194.1	19.6	64.5	8.2	3,047	463	10.00	0.79
Aug. 26	Peak	57.9	1.23	2,032	166	217.3	35.0	64.0	14.3	3,174	640	10.79	2.14
Spawning													
Sept. 21	Prior	58.5	1.95	2,150	292	319.8	66.7	107.5	12.6	2,766	378	14.18	2.59

Body Constituents

The body constituents of the sockeye changed considerably between Lummi Island, and spawning. The average total lipid decreased from 6.41% at Lummi to approximately 2.3% in the fish on the spawning grounds. The total lipid content did not change from arrival on the spawning grounds in mid-August to spawning, sampled September 21 (FIGURE 5). Water content of the fish increased from August 6 at Lummi Island up to spawning on September 21 in a fairly linear relationship with time (FIGURE 6).

The remaining constituents include primarily protein with a small amount of other constituents. The protein decreased from seawater to spawning with the greater decrease from arrival on the spawning grounds to spawning (TABLE 3).

TABLE 3 - Lipid and water content of Chilko sockeye.

Date	Sample	No.	Percent Water	SD	Percent Lipid	SD	Constituents Remaining Protein/Ash
Lummi Aug. 6	Central	6	68.7	0.9	6.41	1.10	24.9
Arrival Aug. 17	Early	10	75.1	1.1	2.39	0.57	22.3
Aug. 26	Central	9	75.8	2.2	2.14	0.54	22.1
Sept. 21	Spawning Prior	10	81.0	4.4	3.07	0.91	15.9
	Spawning	6	79.1	1.6	2.51	0.31	18.4
	Spawned-Out	6	82.5	2.9	1.76	0.71	15.7

Blood Sampling

Hematocrits of the Chilko fish averaged 51.4% for the early segment compared with 45.6% for the central segment at Lummi Island. There was no significant difference between segments upon arrival at the spawning grounds. However, both groups had significantly lower packed cell volume (PCV) than in salt water, probably due to the more difficult nature of maintaining high pO_2 in seawater. Spawning fish showed no appreciable change in PCV (TABLE 4).

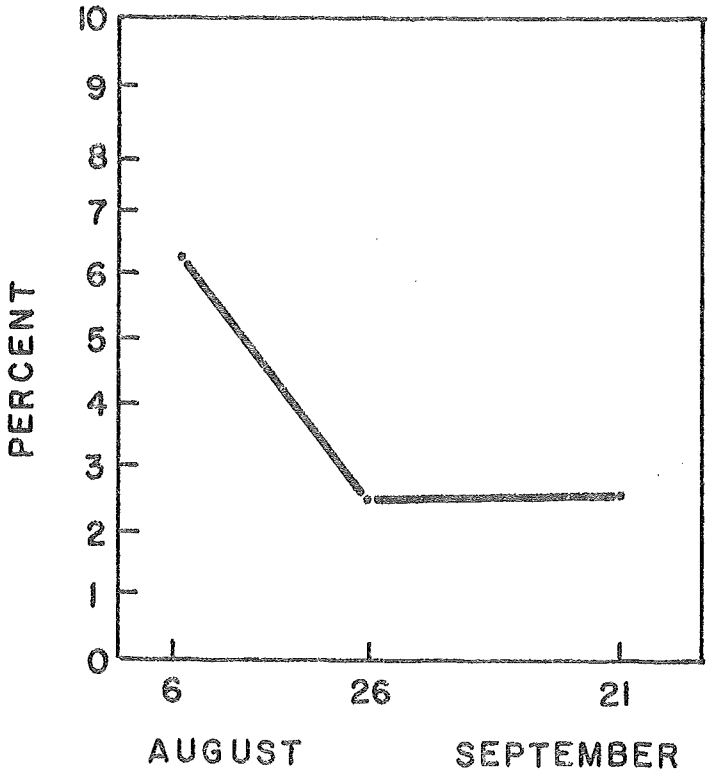

FIGURE 5 - Percent total lipid in flesh of female Chilko sockeye 1971.

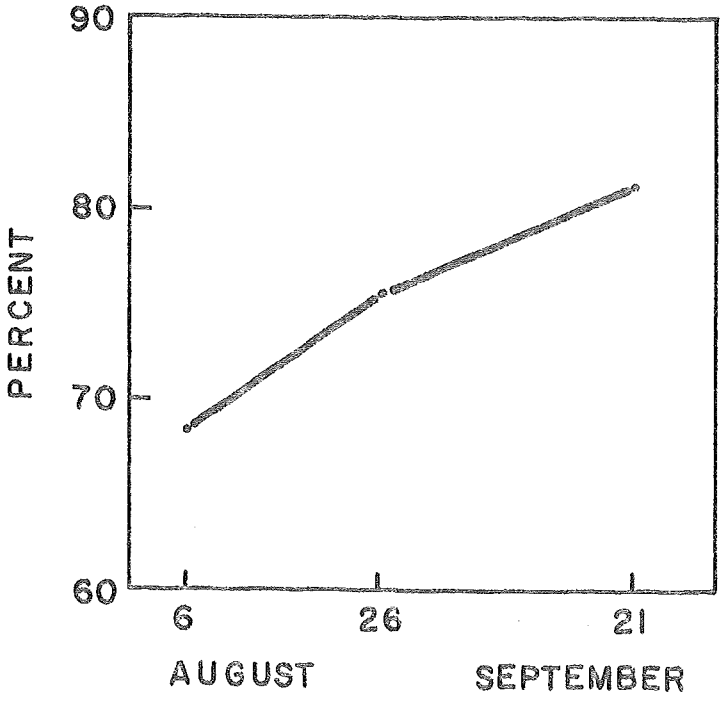

FIGURE 6 - Percent water in flesh of female Chilko sockeye 1971.

There were very few differences in plasma constituents of Chilko fish either between segments or during migration from Lummi to arrival at the spawning grounds. Total plasma solids averaged 9.5% for the early fish sampled at Lummi, somewhat higher than the average of 7.8% for the central fish at Lummi. There was very little difference between segments upon arrival at the spawning grounds, 6.4% for the early and 6.8% for the central fish. The plasma solids dropped considerably when sampled during spawning to a low average of 1.9% in the spawned-out fish.

The average percent plasma water followed a converse pattern with the early Lummi fish having the lowest at 89.2% and the spawned-out fish having the highest at 96.5%. Plasma ions measured included Ca, PO_4, Na and K (TABLE 4). There was very little difference in the plasma levels of ions between segments of the run, with the exception of PO_4. The average PO_4 both at Lummi Island and upon arrival at the spawning grounds was higher among the early fish. Na remained constant between segments and between sampling sites with average values from 150 to 159 Meq/L.

Potassium was somewhat higher upon arrival at the spawning grounds, with averages for both segments approximately 2.0 Meq/L compared with averages of approximately 1.0 Meq/L at Lummi Island.

Average Ca levels varied from 8.2 to 9.7 Meq/L with no consistent differences between sampling sites or segments of the population. There was a general drop in Ca concentrations in the spawning fish with the spawned-out fish having the lowest values at 4.1 Meq/L average (TABLE 4).

Cortisol and Cortisone

The cortisol levels of the early Chilko sockeye were significantly higher than the cortisol levels of the central segment of the population both at Lummi and upon arrival at the spawning grounds. The early segment had higher average cortisol levels in both cases. The cortisol level appeared to drop in the early segment from an average of 10.14 ng/100 plasma at Lummi to 4.88 ng/100 upon arrival at the spawning grounds. However, because of very high standard deviations, statistical analyses indicated no significant difference between locations. The levels of cortisol in the peak segment stayed relatively constant at 2.05 ng/100 ml when sampled at Lummi and 2.51 ng/100 ml at arrival on the spawning grounds (TABLE 5).

TABLE 4 - Blood constituents of 1971 Chilko sockeye.

Date	Location	No.	Hematocrit Percent PCV Av	Hematocrit Percent PCV SD	Percent Total Solids Av	Percent Total Solids SD	Plasma Percent H_2O Av	Plasma Percent H_2O SD	Plasma PO_4 Av	Plasma PO_4 SD	Plasma Na Av	Plasma Na SD	Plasma K Av	Plasma K SD	Plasma Ca
July 23-24 Early	Lummi	10	51.4	4.8	9.5	1.1	89.2	1.0	8.7	2.0	157	5.3	0.8	0.6	9.7
August 6 Central	Lummi	11	45.6	5.9	7.8	2.8	90.0	2.6	6.6	1.0	159	3.5	1.1	0.9	8.3
August 17 Early	Chilko	9	40.8	4.7	6.4	1.0	92.2	0.9	7.0	0.6	150	2.9	2.1	0.7	8.2
August 26 Central	Chilko	10	39.0	3.3	6.8	0.6	91.8	0.6	5.9	1.3	152	4.3	2.2	1.5	9.0
Sept. 21 Prior Spawning	Chilko	10	36.6	13.4	3.8	1.9	94.8	1.9	6.2	2.0	131	21.9	1.0	1.0	6.8
Spawning		9	44.8	7.5	4.7	1.8	93.8	1.7	6.6	1.3	148	13.1	0.5	0.3	7.5
Spawned-Out		6	38.0	5.8	1.9	1.4	96.5	1.3	5.0	0.6	131	11.7	0.9	0.5	4.1

TABLE 5 - Plasma concentrations of cortisol, cortisone and calcitonin.

Date	Location	No.	Cortisol ngm/100 ml Av	SD	Cortisone ngm/100 ml Av	SD	Calcitonin pg/ml Av	SD
July 23-24 Early	Lummi Island	10	10.14	9.22	18.28	7.24	1,061	1,129
August 6 Central	Lummi Island	11	2.05	2.81	11.26	9.95	628	1,261
August 17 Early	Chilko	9	4.88	5.31	11.77	8.31	825	944
August 26 Central	Chilko	10	2.51	2.09	11.46	8.79	794	509
Sept. 21 Prior to Spawning	Chilko	10	13.23	7.62	24.97	7.36	1,314	698
Spawning	Chilko	9	14.61	6.40	22.44	7.52	980	851
Spawned-Out		6	13.18	2.98	16.75	4.60	366	365

The cortisol levels of spawning fish showed a dramatic increase to a mean of 14.61 ng/100 ml on September 21. There was no appreciable difference between fish that were just ready to spawn, spawning or spawned-out.

There were no statistically significant relationships among samples analyzed for cortisone either between segments of the run or between locations.

The standard deviations in the cortisol-cortisone work are very high, indicating a great deal of fluctuation in plasma levels between fish. Therefore the data were broken down into fish with high cortisol levels (>5 ng/100 ml plasma) and fish with low cortisol levels (<5 ng/100 ml).

Sixty-three percent of the early fish sampled at Lummi Island had high cortisol values compared with only 9% of the central fish. Upon arrival at the spawning grounds 56% of the early fish had high cortisol values, although on the whole lower than those recorded for the early fish at Lummi. Only two samples of 10 (or 20%) from the central segment had cortisol values greater than 5.00 ng/100 ml.

During spawning the plasma cortisol levels were generally elevated. Eighty-two percent of the fish prior to spawning had high cortisol values and 100% of the spawning and spawned-out fish had high cortisol values (TABLE 6).

TABLE 6 - Percent of fish sampled with plasma cortisol values greater than 5 ng/100 ml plasma and values less than 5 ng/100 ml plasma.

Date	Sample		Percent of Sample With Cortisol < 5 ng/100 ml	> 5 ng/100 ml
July 23-24	Early	Lummi	30	70
August 6	Central	Lummi	91	9
August 17	Early	Arrival Spawning Grounds	44	56
August 26	Central	Arrival Spawning Grounds	80	20
Sept. 21	Spawning	Prior	18	82
		Spawning	0	100
		Spawned-Out	0	100

Histology

Histological examination of tissues from the pituitary, liver, kidney and adrenocortical tissue indicated no differences between the early and central sockeye sampled at Lummi and on the spawning grounds. The normal degenerative changes occurring with maturation as described by Colgrove (1966, MS 1966) were observed in samples from both early and central samples. However, examination of gill tissue indicated some differences between early and central segments of the population.

The gills of the Chilko female sockeye sampled at Lummi showed indications of irritation, especially among the early fish. There were areas of hyperplasia, epithelial swelling, and some areas of necrosis (FIGURE 7). There were only 3 of 9 samples among the early fish that were considered normal, whereas there were 9 of 11 samples from the central fish that were considered normal (FIGURE 8).

The gills of the fish arriving at the spawning grounds generally showed signs of breaking down. The epithelial tissue was generally in poorer condition than those gills sampled at Lummi Island. The central fish arriving at the

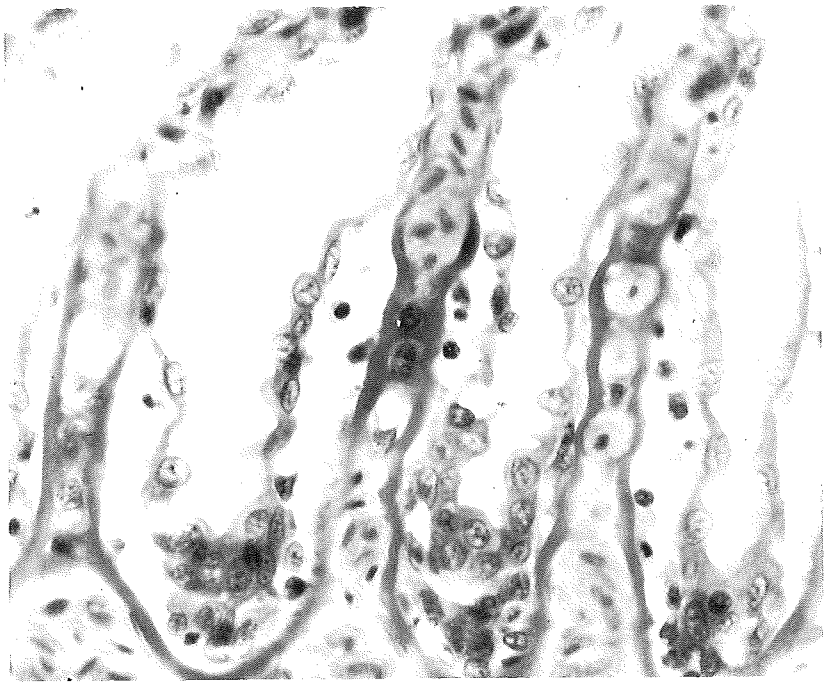

FIGURE 7 - Gill tissue from early Chilko sockeye at Lummi Island showing area of gill irritation.

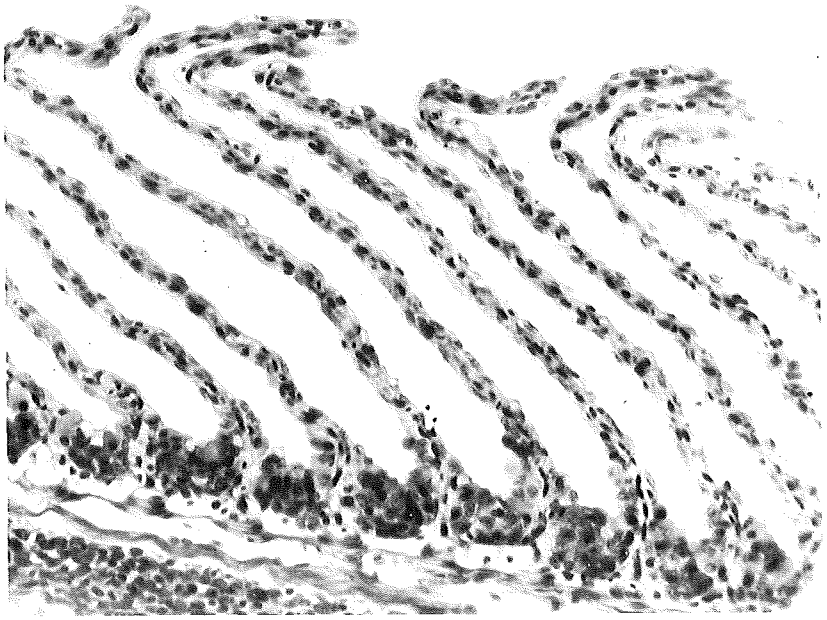

FIGURE 8 - Gill tissue from peak Chilko sockeye at Lummi Island x 500.

spawning grounds generally showed less damage than the early fish (FIGURE 9). The gills of the spawning and spawned-out fish showed fairly extensive damage to the epithelial tissue in most samples (FIGURE 10).

DISCUSSION

Retardation of maturation has been associated with prespawning mortality and consequently the GSI of different segments of a population has been used as an index of maturity (Williams 1973). The GSI of the early (10.06) and central (10.79) segments of the 1971 Chilko population would indicate that the early segment was less developed upon arrival than the central segment. However, the early fish had a lower mean fecundity both at Lummi Island and upon arrival at the spawning grounds. If the fecundities between segments of a population are different, then the GSI cannot be used as an index of maturity.

The data on egg size indicates a linear relationship with time (FIGURE 4). Egg size, therefore, may be a better index of maturity. There was no appreciable difference in egg size between the early fish (64.9 mg) and central fish (64.0 mg) upon arrival at the spawning grounds, suggesting that fish from each segment were at similar stages of maturity during their respective migrations.

The body constituents of Chilko fish from the early and central segments upon arrival at the spawning grounds were very similar. The early fish averaged 2.27% lipids and 75.44% water, whereas the central fish averaged 2.14% lipids and 75.75% water. These data indicate that there was very little difference in energy reserves between early and central fish upon arrival at the spawning grounds, again suggesting no difference in stage of maturity.

The blood sampling data indicated high hematocrits for some of the early fish both at Lummi Island and upon arrival at the spawning grounds. The average hematocrit for the early fish at Lummi was 51.6%, 11% more than the average hematocrit for the central fish. There were two fish which stood out among the early fish with hematocrits of 60 and 56% PCV. Upon arrival at the spawning grounds hematocrits in general dropped, probably due to the difference from salt water to fresh water. However, there were two fish from the early segment with much higher than average hematocrit at 49 and 47% compared with an average of 40.8%. There were no peak fish with hematocrits over 42%.

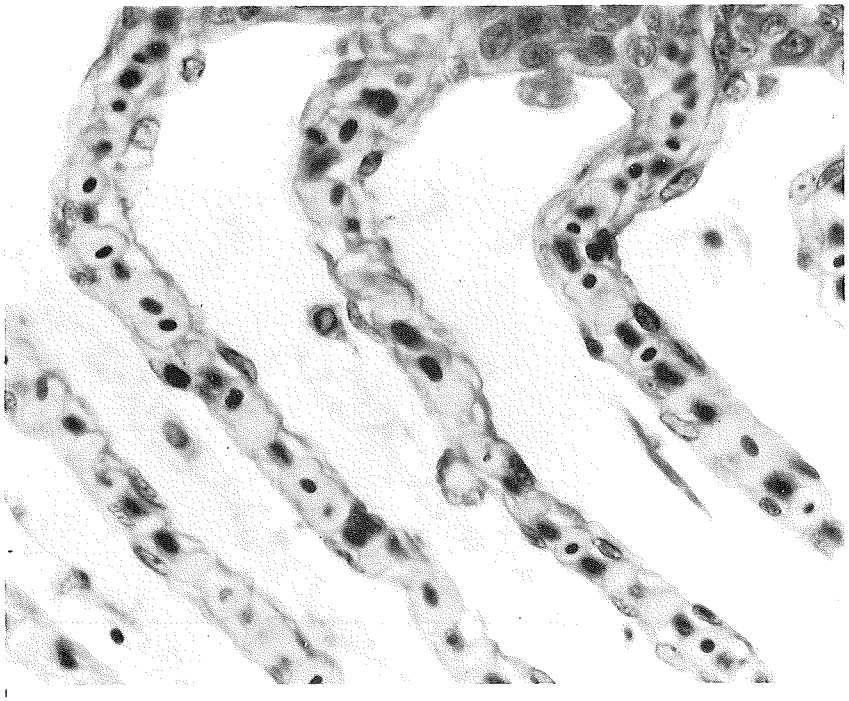

FIGURE 9 - Gill tissue from central Chilko sockeye upon arrival at spawning grounds x 500.

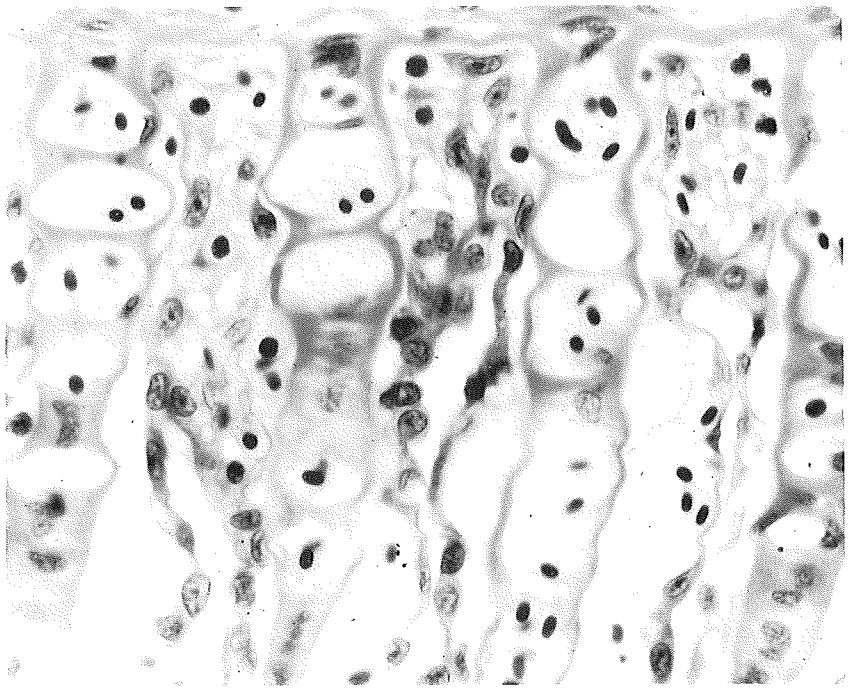

FIGURE 10 - Gill tissue from spawned-out ♀ Chilko sockeye showing poor area of gill section x 500.

Hematocrit in fish is dependent on various parameters. Although increase in temperature will cause an increase in hemoglobin, hematocrit and number of red blood cells (DeWilde and Houston 1967; Miles and Smith 1968), there was very little difference in temperature between the early and central sampling at Lummi Island. However, another factor which can cause increased hematocrit is hypoxia or low oxygen levels either in the water or internally (Phillips 1947; Chiba 1965). In general, then, the hematocrit and hemoglobin level of the blood of fish is directly related to the ease of extracting oxygen from the environment.

The plasma cortisol data also showed a difference between early and central fish. Approximately 63% of the early fish at Lummi Island had plasma cortisol levels greater than 5 ng/100 ml plasma compared with only 9% of the central segment. Upon arrival at the spawning grounds 50% of the early segment had plasma cortisol levels greater than 5 ng/100 ml plasma compared with only 11% of the central segment. Fagerlund (1967) has shown that stressing a salmon will cause an increased plasma cortisol level. Therefore it is possible that the early fish have a lower stress threshold to changes in the environment or that the early fish have encountered a stressor that the peak fish have not.

The steroids were elevated in all fish sampled just prior to spawning, and post-spawning. These data coincide with data of Donaldson and Fagerlund (1968) which indicated a rise in plasma steroids at onset of spawning.

The histological examinations indicated that a high percentage of the early fish at Lummi Island, approximately 66%, showed gill irritation, compared with only 18% for the central sample. The gill pathology was not considered to be serious by itself, in that it probably would not result in premature death if the condition remained static. However, this type of damage to the epithelial layers of the gill lamellae could provide sites for invasion by bacteria leading to serious gill problems at the spawning grounds.

There were no other obvious histological differences between early and central fish, at least in the tissues examined. There was no obvious correlation with changes in interrenal tissue, kidney and liver and high plasma cortisol levels. It has been shown that high cortisol levels have a deleterious effect on tissues of gonadectomized salmon but that androgens and estrogens have a much greater effect (Van Overbeeke and McBride 1971; McBride and Van Overbeeke 1971). The greater effect of the androgens and estrogens in maturing salmon would probably

mask any obvious effect of elevated cortisol levels, making it very difficult to interpret the effect of high cortisol levels on tissue damage.

Each one of the irregularities described, i.e. high hematocrit, high cortisol levels and irritated gills taken by themselves are very difficult to interpret. However, when these values for individual fish are compared it becomes apparent that some of the early fish have a poor overall prognosis. Two of the 10 Chilko females sampled at Lummi Island and 2 of the 9 sampled upon arrival at the spawning grounds had higher than average hematocrits, high plasma cortisol levels, and their gill tissue was considered to be in poor condition compared with the other fish. Another interesting piece of data is that these fish also had the smallest eggs of the fish sampled. The plasma ions were somewhat higher than the average although not enough to be considered significant (TABLE 7).

There were no fish from the central segment with both high plasma cortisol levels and high hematocrits. There was, however, one female sampled during peak of spawning which had a very low hematocrit, very high plasma cortisol level, very poor gill condition and very small eggs compared with the average egg weight for fish just prior to spawning. This fish also had very low plasma Na, PO_4 and Ca and a very high plasma water content indicating serious problems in osmoregulation. Although the number of observations is extremely small and statistically insignificant when considering the total population, these data suggest that some of the early fish, both at Lummi and upon arrival at the spawning grounds, had gill irritations which could lead to an upset in the physiology of the fish. The poor gills were associated with an increase in hematocrit as well as high plasma cortisol levels and indirectly may also have caused the small egg size recorded for these fish.

While these data are not conclusive, they do suggest possible areas for further research.

TABLE 7 - A comparison of individual ♀ sockeye sampled at Lummi Island and Chilko spawning grounds.

Location	Sample Date	Sample No.	Blood HCT % PCV	Plasma % Solids	Plasma % H_2O	Plasma Ca Meq/L	Plasma PO_4 Meq/L	Plasma Na Meq/L	Plasma K Meq/L	Calcitonin pg/ml	Cortisol ng/100 ml	Gill Cond.	Egg Size
Lummi	July 23-24	27	60.0	11.0	87.9	11.6	11.7	-	-	487	9.75	Poor	23.8
		63	56.0	9.1	89.6	11.4	10.1	163	0.60	550	18.57	Poor	21.8
	Average for Lummi Fish		48.5	8.6	90.1	9.0	7.7	158	1.00	755	5.90	-	27.2
Chilko Spawning Grounds	August 17	9	49.0	6.8	91.8	7.9	6.8	149	1.8	296	5.27	Poor	-
		18	47.0	7.8	90.8	8.9	6.6	154	0.6	0	7.21	Poor	52.3
	Average for Arrival Fish		40.0	6.5	92.1	8.5	6.6	151	2.0	807	4.12	-	64.2
Chilko Spawning Grounds	Sept. 21	106	13.0	1.1	97.2	3.0	3.1	98	1.6	0	17.03	Very Poor	54.0
	Average for Fish Prior to Spawning		36.6	3.8	94.8	6.8	6.2	131	1.0	1,314	13.23	-	107.5

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