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REPORT ON EULACHON INVESTIGATION

April - May, 1940

by

J. L. McHugh

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FISHERIES RESEARCH BOARD

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At the request of the Dominion Department of Fisheries the investigation of the life-history of the eulachon, commenced in the spring of 1939, was continued during the current year. The investigation was pursued along the lines suggested in last year's report, and included the examination of samples from localities other than the Fraser river. In addition, the spawning grounds of the eulachon in the Fraser river were located, and studies were made of the eggs and larvae.

Samples were secured from various localities through the co-operation of the following officers: from the Nass river through Mr. Boyd, from Rivers inlet through Mr. Lord, from Kingcome and Knight inlets through Mr. Cameron, and from the Fraser river through Mr. MacLeod. These were examined for length, weight, sex and sexual condition, number of vertebrae, and age. During the period May 8-15, the Fraser river was visited and an extensive programme of dredging for eggs and towing for larvae was carried out.

RESULTS

Details of the samples examined are presented in the following table:

Locality	Date.	Method of Capture	Number of Fish ♂	Number of Fish ♀	Av. Length in mm. ♂	Av. Length in mm. ♀
Nass river	Mar. 27	Bag net	131	77	164	164
Rivers inlet	Apr. 23	Dip net	89	9	173	162
Kingcome inlet	Apr. 15	Dip net	104	38	180	175
Knight inlet	Apr. 17	Dip net	72	34	182	173
Fraser river:						
at New West'r.	May 11	Dead on beach	96	30	159	160
Barnston is.	May 9	Dead on beach	97	3	162	153
Whonnock	May 9	Bag net	82	18	168	162
Gill net 1 1/8"	Apr. 23	Gill net	123	35	163	160
Gill net 1 3/8"	Apr. 23	Gill net	21	24	168	164

The lengths of the Rivers inlet sample were corrected for shrinkage due to salting. The frozen and iced samples were treated as fresh fish.

Length distribution

Difficulty was again experienced this year in obtaining random samples from the Fraser river. General observations made during the course of the investigation indicate that the spent fish are unable to hold their own against the current, and that although they still retain the tendency to swim upstream they gradually drift in a seaward direction. Large numbers of these weakened individuals become stranded on the sandbars along the river bank and it seemed probable that a random sample of these fish would provide a true picture of the whole population. However, a comparison of samples of dead fish from two points in the river and a third taken with a bag net anchored in the stream shows that differences do exist, the fish apparently being of greater average size as they are taken farther upstream. Consequently the samples from the various rivers, although taken by comparable methods, must be compared with caution.

According to the observations of the fishermen, the fish taken in all localities in 1940 are larger than in previous years. This is borne out in the case of the Fraser river by a comparison of samples of dead fish taken opposite New Westminster on approximately the same date in 1939 and 1940. Samples from a 1 1/8" mesh gill net in the two years indicate a considerable difference in average length, but there is some reason to doubt the reliability of the 1939 sample.

In average length the sample from the Nass river compares closely with those taken in the Fraser. On the other hand, the fish from the central area are apparently considerably larger. It seems unlikely that a difference of

this magnitude can be entirely the result of limitations in the sampling method.

When the length frequency distributions for the various samples are plotted, a tendency is observed for two modes or humps to appear. This suggests the presence of more than one age group of fish.

Age determinations

A study of the scales of fish from each of the five localities throws doubt on the reliability of age determinations made from the scales of this species. Scales taken from various parts of the body differ considerably in pattern, and although growth checks may be observed which are similar to those described for other smelt species, two complicating factors are present. The first is due to a lack of knowledge concerning the amount of scale material laid down during the first year's growth, and can only be determined by obtaining a complete series of young fish for examination. The second is caused by absorption of the scale edges in the spawning fish. In most cases the outer portion of the scale is badly eroded, and it is possible that checks may be obliterated in this way. However, in order to keep the scale readings consistent, the criteria of age determination adopted in 1939 were again followed this year. By this method it appears that the bulk of the run to each locality in 1940 was composed of fish in their second year, with a small proportion of individuals in their third year of life.

The scales of one fish from the Nass river were found to have a definite spawning mark. It therefore appears that a very small percentage of the fish may survive to spawn a second time.

Racial studies

Average vertebral counts of the samples examined are presented in the following table:

Locality	Sex	Mean vert. count	σ	σ_M	$S(x-\bar{x})^2$	No. Fish
Fraser river	♂	67.782	0.774	0.065	84.23	142
Knight inlet	♂	68.236	0.928	0.109	60.99	72
Kingcome inlet	♂	68.293	0.862	0.087	72.50	99
Rivers inlet	♂	68.202	0.933	0.099	76.36	89
Nass river	♂	68.563	0.721	0.066	61.30	119
Fraser river	♀	68.107	0.780	0.104	33.36	56
Knight inlet	♀	68.382	0.698	0.120	16.03	34
Kingcome inlet	♀	68.526	0.942	0.153	32.80	38
Rivers inlet	♀	-	-	-	-	8
Nass river	♀	68.492	0.832	0.103	44.25	65

The reliability of these figures depends to a great extent on the accuracy of the age determinations. It has been shown for other species that average vertebral number may differ significantly from year to year in fish from the same locality. Thus, of more than one year class is represented in a fishery, variations in the proportions of the various year classes may lead to apparent differences in vertebral count. However, assuming the age determinations reported here to be correct, a single year class is overwhelmingly predominant in all the samples, and the small proportion of older fish can have little effect on the average vertebral number.

Significant differences are found to exist between the Fraser river and all other samples. The sample from the Nass differs significantly from those taken in Knight and Rivers inlets, and exhibits a difference from the Kingcome inlet sample which borders on significance. The smaller differences between the samples taken in the central area (Knight, Kingcome, and Rivers inlets) are not statistically significant.

It therefore appears that the runs of eulachon to the Nass, to the Fraser, and to the central area tend to form local populations, and it is probable that intermingling between populations is restricted to some extent.

Sexual differences

Considerable structural differences between the sexes were noted in the 1939 report. It was observed that this sexual difference apparently extended to average vertebral number. A study of the 1940 material shows that in all samples with the exception of that from the Nass river the vertebral count for the females averages higher than that for the males. However, the difference is statistically significant only in the case of the Fraser river sample. The general tendency appears for the difference in vertebral count between male and female to decrease in a northerly direction.

Spawning grounds

An account of the discovery of the spawning grounds in the Fraser river, and a description of the eggs and larvae has been published in Progress Report No. 44 of the Pacific Biological Station. The muddy nature of the river water made it impossible to observe directly the spawning process. The spawning grounds were therefore located by dragging the bottom with a dredge constructed of a heavy rectangular iron frame to which was attached a bag of sacking. Each dredging was examined carefully in the field for any sign of eggs deposited among or attached to the gravel. Series of three dredgings each were taken at intervals up the river from New Westminster to Cotton island, near the mouth of the Sumas river. Samples of sand were also examined at intervals along the shore.

No evidence of spawning was found below Mission bridge, but above this point eggs were present in some of the samples. In all cases they were found attached to particles of coarse sand of a rather uniform size. The selection of a specific type of bottom for the deposition of eggs has been described for certain other smelts. Since the bottom deposits in the Fraser become increasingly finer in a downstream direction, the limits of spawning may well be determined by the size of the sand grains. The heaviest concentration of eggs was found at a depth of approximately twenty-five feet off Nicomen island, about four miles upriver from Mission. From here, eggs were found in varying numbers to a point off Cotton island. Here the current becomes swifter and the investigation was not continued farther upstream. No evidence of shore spawning was discovered. The area over which spawning is known to take place therefore includes about eight miles of river bottom between Mission and Chilliwack. It is believed that this is the first published record of the spawning of eulachons in the Fraser river.

Young fish were captured by towing with a plankton net of fine-meshed marquisette. Tows were taken at intervals from Mission to the mouth of the Fraser, and in all cases the fish taken were in a very early stage of development. Since the newly-hatched fish are relatively weak swimmers, they are apparently carried to the sea in a short space of time after emerging from the egg. A rough estimate of the speed of the river current indicates that the newly-hatched larvae would drift from Mission to the sea in less than twenty-four hours.

The egg becomes attached to sand grains in the river bottom in a rather peculiar manner, and the process appears to be very similar to that described for the European smelt, Osmerus eperlanus. The mature egg as it leaves the

female has a double outer membrane. The outer layer is easily broken, separates from the inner covering, and becomes turned inside out. The break is probably caused by pressure from within, due to the absorption of water by the egg. Since the two membranes remain attached over a small area, a short stalk or peduncle is formed. The free edges of the broken membrane are extremely adhesive and readily become attached to the particles of sand.

The newly-hatched larva is very similar in appearance to that of the Pacific herring. Several points of difference exist, however, the eulachon larva being readily recognized by the more posterior attachment of the yolk sac and the anterior position of the anus.

Abundance of fish

Reports from all localities indicate that the run of eulachons in 1940 was the heaviest encountered for many years. In the previous report it was stated that a downward trend had been evident in the annual catch for the Fraser river over a period of years. During this period, however, the total yearly catch has fluctuated widely, and the greater abundance of fish in 1940 does not necessarily mean that the trend has reversed. Total annual catch, of course, may not be a good index of the relative abundance of fish from year to year. Other factors enter into the picture, and the total catch is influenced by such agents as the number of nets operating, the intensity of the fishing effort, and various economic considerations. For the proper regulation of the fishery it is necessary that a method be developed to determine the relative strength of each year's run. This can only be accomplished by the collection of adequate catch and marketing statistics. Forms to be filled in by fishermen and buyers would provide the necessary information. Each fisherman should be

asked to keep a record of his daily operations, to include a description of his nets (size of mesh, length, and depth) and the amounts of fish caught by each, and the time and location of each drift made. Buyers' records should include particulars of each lot of fish delivered, and of each lot sold.

RECOMMENDATIONS

If it is the wish of the Department that the eulachon investigation be continued, it is recommended that the work proceed along the following lines:

(1) Further experimental sampling of the runs in order to devise a method which will provide results comparable from year to year.

(2) A thorough study of methods of age determination. The investigation of length frequencies and racial characters is definitely limited in value when the age composition of a population is incompletely understood. A search should therefore be made for the young fish in order that a complete study of scale development can be made.

(3) It may be possible to correlate the relative abundance of adult fish with such conditions as temperature and river run-off during the period of incubation of the eggs. Investigation of this phase of the problem will be carried out as time permits.

(4) The collection of detailed fishery statistics will provide most of the information necessary for the intelligent regulation of the fishery. This can only be done with the co-operation of all parties concerned - the fishermen, the buyers, and the fisheries officers. It is recommended that forms similar to the appended samples be distributed to each fisherman and buyer. Accuracy and completeness in the filling out of these forms cannot be stressed too strongly.

EULACHON CATCH RECORD

Name of Fisherman _____ License No. _____

Description of Nets:

Size of Mesh	Length	Depth

Date	Time of Drift	Location of Drift	Weight of Fish in Each Net				
			1"	1 1/8"	1 1/4"	1 3/8"	1 1/2"

EULACHON BUYER'S RECORD

Name of Buyer _____ Date _____

Record of Fish Bought

Name of Fisherman	License No.	Amount Delivered	Where Caught	Price

Record of Fish Sold

Sold To	Amount Sold	How Used (Fresh, Salted, Fox Food)	Price