PROGRESS REPORT ON CANADIAN STUDIES ON CHUM SALMON SCALES FOR 1961

by

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1. INTRODUCTION

In previous studies on chum salmon scales (Sato, et al., 1958; Bilton, et al., 1958; Bilton and Shepard, 1959; and Tanaka, et al., 1960) attempts have been made to use differences in counts and spacing of circuli of chums originating in different coastal areas to identify the continental origin of fish on the high seas. To date the reports have been concerned only with coastal samples for the years 1956 to 1958 and with high-seas samples of 4- and 5-year-old fish collected in 1956 and 1957. The present document is a progress report on Canadian scale studies in 1960-61, incorporating data for coastal samples taken in 1959 and for 3-year-olds taken on the high seas in 1956 and 1957.

2. RESULTS

Scales of chums taken in various coastal fishing areas adjacent to spawning grounds and on the spawning grounds during 1956 to 1959 have now been examined. Counts of circuli and annulus measurements are now available for fish of all ages from the brood years 1952, 1953 and 1954. In Figures 1 and 2, data for the latter two brood years are shown. As described in earlier reports, fish originating in the streams of British Columbia (Canada) and the State of Washington (United States) had many closely packed circuli and large annulus widths, whereas those from Central and Western Alaska and along the North American shores of the Bering Sea and Arctic Ocean had fewer and more sparsely spaced circuli but about the same annulus widths as those from the more southerly parts of North America. Those from Siberia in the U.S.S.R. had the smallest of all circulus counts and annulus widths. Southward to Hokkaido, Japan,
circulus counts and annulus widths increased again. Second-year band circulus counts and annulus measurements were quite similar throughout North America. Second-year measurements for stocks of the U.S.S.R. and Japan were similar to each other, and tended to be significantly smaller than those for North American fish. In 1958 scales from chums originating in the Amur River region of the U.S.S.R. were obtained for the first time. These proved to have characteristics intermediate between those of the more northerly U.S.S.R. runs and those of Japan (see Figure 3). Although their scale characters were intermediate, they tended more towards the Northwestern than the Southwestern scale type. For both brood years, there was a tendency for 5-year-olds to exhibit smaller annulus measurements (in both the first and second year bands) than 4-year-olds, which in turn exhibited smaller measurements than 3-year-olds. This suggests an association between growth and age of return with larger fish tending to mature at a younger age.

In Table I, for fish of all ages from each of 4 general regions (Southeastern Region - including the States of Washington and Oregon in the United States, British Columbia in Canada and Southeastern Alaska as far north as the Taku River; Northeastern Region - Central, Western and Northern Alaska; Northwestern Region - the U.S.S.R.; Southwestern Region - Hokkaido and Honshu in Japan), the ranges of measurements and counts for various characteristics are shown. The ranges were determined as described by Tanaka, et al., 1960. The data indicate that variations in measurements and counts did not vary greatly from brood year to brood year. Using the ranges derived in Table I, as outlined by Tanaka, et al., 1960, attempts were made to identify the origin (by Region) of 3-year-old chums sampled on the high seas in 1956 and 1957. The results are summarized in Tables II to V. Sampling areas indicated in the tables are shown in Figure 4.
In general, the results of examination of the scales of 3-year-olds parallel those for 4- and 5-year-olds described in the earlier report. In Figures 5 to 7, data for all 3 age classes are combined for the years 1956 and 1957. Briefly the results indicate the following distribution patterns.

(a) Apparent high-seas distribution of Asian chums

Chums with scale patterns similar to those sampled in northern U.S.S.R. coastal areas were well represented in most samples taken westward from 175°W (see Figure 5). Some samples taken further east, including several taken in the Gulf of Alaska, also contained substantial proportions of "Northwestern" fish. The appearance of such fish in samples of mature fish taken immediately offshore from the coast of British Columbia (10% of the fish sampled early in the season in the vicinity of 135°N, 55°W were mature fish designated as originating in the Northwestern Region) indicates the probability of considerable error in the methods. Because these fish were maturing, the possibility that they were truly Asian fish bound for rivers some 5,000 miles distant within a period of no more than 3 months must be discounted. It is more likely that they were North American fish of a type not well represented in the North American coastal standards. Despite this apparent source of error, contrasts in the proportions of fish of "Northwestern type" in different areas provides a reasonable picture of the distribution of northern U.S.S.R. stocks in the mid-ocean area. During May and June most chums sampled in both the Bering Sea and North Pacific Ocean contained 20% or more of the Northwestern type and very few of any other (see Figures 6 and 7). Samples immediately to the eastward contained less than 10% and larger proportions of fish of North American types, suggesting a rather sharp division between areas occupied mainly by fish originating in the northern U.S.S.R. and those from other areas. At this time of year most of the fish sampled, especially closer to the coastline, were maturing fish.
Late in the season (July to September - see Figure 5) sampling was more widespread and included a good coverage of the Gulf of Alaska as well as of the western part of the study area. As the season progressed it would be expected that mature chums destined to spawn during the summer months would rapidly emigrate from the high seas, leaving behind immature fish and populations of later spawning fish. The stocks of northern Asia are summer spawners and their distribution pattern as indicated by the scale studies, reflects their movement away from the central Bering Sea toward the Asian coast. The proportions of identifiable Northwestern chums were very high along the Kamchatka coast (about the same as in the early season) and almost everywhere else considerably lower than they had been in the spring. Samples throughout most of the western North Pacific and Bering Sea contained moderate proportions of Northwestern fish and large proportions of unidentifiable fish, suggesting that the residual populations there could be made up of a high proportion of late spawning southern Asian fish (which are impossible to identify because of their intermediate scale characters).

The representation of so-called Northwestern fish in the Gulf of Alaska both early and late in the sampling season may be attributable to error as suggested above. However, it is worthy of note that with the exception of the early season samples taken off the British Columbia coast, of 151 fish sampled eastward from 160°W designated as originating in the Northwestern Region all but 5 were immatures. Because these immature fish still had from 8 months to several more years of ocean life before returning to their spawning grounds, it is possible that at least some were truly Asian fish and not misclassified fish of North American origin.

(b) Apparent high-seas distribution of North American chums

During May and June fish designated as originating in Central and Western Alaska (the "Northeastern Region") were best represented in samples taken in
the East Bering Sea and south of the Aleutians near 165°W (Figure 6). A few were also found in the mid-ocean area between 175°E and 180°. Early season sampling in the Gulf of Alaska was very sparse; fish designated as originating in the Southeastern Alaska-British Columbia area ("Southeastern Region") were found in concentration only in the large samples taken immediately off the British Columbia coast (Figure 7).

In the late part of the season, identifiable northern Alaskan fish appeared in greatest proportions in samples in the east Bering Sea and in the North Pacific between 155°W and 165°W. They also contributed significantly to samples taken throughout the western Gulf of Alaska. Mature fish of Southeastern origin were concentrated against the eastern shore of the Gulf, but also occurred in smaller proportions along the northern rim of the Gulf westward to about 170°W.

3. LITERATURE CITED


Tanaka, S., M. P. Shepard and T. H. Bilton. 1960. Scale characteristics of chum salmon (Oncorhynchus keta) in coastal areas and on the high seas of the North Pacific Ocean. INPFC Doc. 405.
Table I. Ranges of scale circulus counts and annulus measurements for chum samples taken in the 4 major regions. Percentages of the total number of observations made included within the designated limits for each of the single characters are shown for each region.

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<th>Brood year</th>
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<th>N.E.</th>
<th>N.W.</th>
<th>S.W.</th>
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<td></td>
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</tr>
<tr>
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<td>86-150</td>
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</tr>
<tr>
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<tr>
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Table II. Numbers of chum salmon from various high-seas areas designated as originating in the 4 major coastal regions and, more generally, in North America and Asia - 3-year-olds sampled early in 1956 (May and June).

<table>
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<th>Month</th>
<th>Designated region of origin</th>
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<td>North-eastern</td>
</tr>
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<td>A1</td>
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</tr>
<tr>
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<td>June</td>
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<td>June</td>
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</tr>
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<td>June</td>
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</tr>
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</tr>
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<td>June</td>
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</tr>
<tr>
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<td>June</td>
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<tr>
<td><strong>Total</strong></td>
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\(^1\) Includes fish designated as originating in the Southeastern and Northeastern Regions specifically as well as those for which it was possible only to designate the continent of origin.

\(^2\) Includes fish designated as originating in the Southwestern and Northwestern Regions as well as those for which it was possible only to designate the continent of origin.

\(^3\) Total number of fish for which neither the precise region nor continent of origin could be designated.
Table III. Numbers of chums from various high-seas areas designated as originating in the 4 major coastal regions and, more generally, in North America and Asia - 3-year-olds sampled late in 1956 (July to September).

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<tr>
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</tr>
<tr>
<td>B2</td>
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</tr>
<tr>
<td>B3</td>
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<tr>
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</tr>
<tr>
<td></td>
<td>Sept.</td>
<td>4</td>
</tr>
<tr>
<td>B7</td>
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<tr>
<td></td>
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<tr>
<td>B11</td>
<td>Aug.</td>
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|               | Sept. | 15           | 4            | 25                 | 9            | 0            | 9                  | 32                 | 66    | continued -
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<th>South-western</th>
<th>Total Asia</th>
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1Includes fish designated as originating in the Southeastern and Northeastern Regions specifically as well as those for which it was possible only to designate the continent of origin.

2Includes fish designated as originating in the Southwestern and Northwestern Regions as well as those for which it was possible only to designate the continent of origin.

3Total number of fish for which neither the precise region nor continent of origin could be designated.
Table IV. Numbers of chums from various high-seas areas designated as originating in the 4 major coastal regions and, more generally, in North America and Asia - 3-year-olds sampled early in 1957 (May and June).

<table>
<thead>
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<th>Sampling area</th>
<th>Month</th>
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Total  27 25 55 79 4 93 573 721

<sup>1</sup>Includes fish designated as originating in the Southeastern and Northeastern Regions specifically as well as those for which it was possible only to designate the continent of origin.

<sup>2</sup>Includes fish designated as originating in the Southwestern and Northwestern Regions as well as those for which it was possible only to designate the continent of origin.

<sup>3</sup>Total number of fish for which neither the precise region nor continent of origin could be designated.
Table V. Numbers of chums from various high-seas areas designated as originating in the 4 major coastal regions and, more generally, in North America and Asia - 3-year-olds sampled late in 1957 (July to September).

<table>
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<th>North-eastern</th>
<th>Total&lt;sup&gt;1&lt;/sup&gt; North America</th>
<th>North-western</th>
<th>South-western</th>
<th>Total&lt;sup&gt;2&lt;/sup&gt; Asia</th>
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<th>Total&lt;sup&gt;1&lt;/sup&gt; North America</th>
<th>North-western</th>
<th>South-western</th>
<th>Total&lt;sup&gt;2&lt;/sup&gt; Asia</th>
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<sup>1</sup>Includes fish designated as originating in the Southeastern and Northeastern Regions specifically as well as those for which it was possible only to designate the continent of origin.

<sup>2</sup>Includes fish designated as originating in the Southwestern and Northwestern Regions as well as those for which it was possible only to designate the continent of origin.

<sup>3</sup>Total number of fish for which neither the precise region nor continent of origin could be designated.
Figure 1 Annulus widths in the first and second years, and circulus counts in the first and last halves of the first year for scales of chums of the 1953 brood year from different areas of the North Pacific.

- $L_1$ - annulus width of the first year band.
- $L_2$ - annulus width of the second year band.
- $C_a$ - circuli in the first half of the first year.
- $C_b$ - circuli in the last half of the first year.

Black bars indicate frequencies for $3_1$ fish, white for $4_1$'s and cross-hatched for $5_1$'s.
Figure 2. Annulus widths in the first and second years, and circulus counts in the first and last halves of the first year for scales of chums of the 1954 brood year from different areas of the North Pacific.

- $L_1$ - annulus width of the first year band.
- $L_2$ - annulus width of the second year band.
- $Ca$ - circuli in the first half of the first year.
- $Cb$ - circuli in the last half of the first year.

Black bars indicate frequencies for $3_1$ fish, white for $4_1$'s and cross-hatched for $5_1$'s.
Figure 3. Comparison of scale characteristics of chum salmon from the Northwestern Region, the Amur River and the Southwestern Region.
Figure 4. Sampling areas for 3-year-olds taken in May and June in 1956 and 1957.

Sampling areas for 3-year-olds taken from July to September in 1956 and 1957.
Figure 5. Percentage contribution of chums (age 3 to 5) designated as originating in the "Northwestern Region" (northern U.S.S.R.) in the early and late parts of the years 1956 and 1957.
Figure 6  Percentage contribution of chums (age 3 to 5) designated as originating in the "Northeastern Region" (Central and Western Alaska) in the early and late parts of the years 1956 and 1957.
Figure 7 Percentage contribution of chums (age 3 to 5) designated as originating in the "Southeastern Region" (British Columbia-Southeastern Alaska) in the early and late parts of the years 1956 and 1957.