A new estimation of the salmon return rate and its use in life history studies for Korean chum salmon

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The rapid increases in catch and in spawning abundance in the 1980s and the early 1990s were a result of good management, enhancement programs, and a favourable environment (Beamish et al., 1997).
Marine survival from unfed fry released in 1950-1960 averaged 1.2%. Survival improved to 2.3% after 1966 as the percentage of fed fish increased (Isaksson, 1988)

Between 1979 and 1989, smolts of steelhead entering the ocean at larger sizes subsequently experienced significantly higher levels of survival (Ward et al., 1989)

These papers emphasized the importance of growth or feeding during the early stage to the survival rate in the ocean.
In Korean hatchery, the return rate was estimated based on the total return after 3 yr. relative to the total release. The return rate is calculated as:

\[
\text{Return rate} = \frac{\text{Total return after 3 yr.}}{\text{Total release}}
\]
The survival rate of 1985 stock

\[ \text{total return at 1988} = \frac{\text{total release at 1985}}{\text{total release at 1985}} \]
• PART 1
  <survival of Korean chum salmon>
  ➔ To estimate the re-calculated return rate for Korean chum salmon.

• PART 2
  <The comparison of the early growth and the return rate of Korean chum salmon>
  ➔ To provide the plausible relationship between the early growth and homing success of salmon.
Part 1: Survival of Korean chum salmon
Materials and Methods

- Period: 1984~1994
- Number: 4,782 adult female salmon
- Location: Yangyang Namdae Stream (hatchery)
- Age structure using scale
The old estimation in Korea

The old estimation of the return rate of Korean female chum salmon in the Namdae River between 1983~1990
The accumulated number of survival of Korean female chum salmon between 1983~1990
The re-calculated estimation of the return rate of Korean female chum salmon in the Namdae River between 1983~1990
The old and re-calculated estimation of the return rate of Korean chum salmon in the Namdae River between 1983~1990
Part 2: The comparison of the early growth and the return rate of Korean chum salmon
✓ Scale size is usually proportional to fish length.

✓ We assumed that the distance between scale rings indicates the growth of the fish at a certain age.

If a fish grows fast in a specific year, the distance between the rings would be wide.
Transition from estuarine area to regional ocean
Changes of growth of Korean female chum salmon in (a) estuarine area and (b) regional ocean. Growth information was derived from returning female salmon to mother stream at age-2 through age-5 during 1984-1994. The x-axis represents the year of growth.
The early growth during stages, $r_c$ and $r_1-r_c$.
The comparison between the early growth and the return rate of Korean female chum salmon

Mean growth (mm)

The return rate

\( r_c \)

\( r_{1-r_c} \)
The comparison between the early growth and the return rate of Korean female chum salmon

<table>
<thead>
<tr>
<th>Correlation</th>
<th>$r_1-r_c$</th>
</tr>
</thead>
<tbody>
<tr>
<td>The old return rate</td>
<td>0.415</td>
</tr>
<tr>
<td>The re-calculated return rate</td>
<td>0.494</td>
</tr>
</tbody>
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The graph shows the correlation between mean growth (mm) and the return rate from 1983 to 1990.
The return rate for Korean chum salmon was re-calculated based on age structure of returning salmon.

The re-calculated estimation shows a periodic pattern with time.

Seo et al. (in press) demonstrated that zooplankton biomass was the controlling factor for chum salmon growth.

In this research, based on re-calculated estimation of the return rate, we can say the homing success of Korean chum salmon in the 1980s was dependent on the early growth during first summer through winter.
Thank you!