Growth and Mortality of Dagaa *(Rastrineobola argentea, Fam. Cyprinidae)* in Lake Victoria

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(1982). In the late 1980s, more ecologically oriented research has been started (Wanink 1988a, 1988b; Wanink and Goudswaard 1989; Wandera, in press).

In this paper we present some basic data on growth, mortality and recruitment of dagaa, based on length-frequency analysis. We have investigated two populations, one in the Ugandan and the other in the Tanzanian part of Lake Victoria. For comparison, we have estimated the growth parameters of the population studied by Proude and Stoneman (1973) from the information in Rufli and van Lissa (1982).

In Mwanza, Gulf data were collected by surface trawling during 1988. The cod end of the net amounted to 5-mm stretched mesh. Between 19.30 and 21.30 hours, four trawlshots of 15 minutes each were made, using a 7-m long open boat with a 25 hp outboard engine. Samples were stored in 4% formalin immediately after collection.

**Laboratory Work**

At the laboratory, a subsample of the catch or the total catch when numbers were low, was taken to establish the length-frequency distribution. Standard length was measured to the nearest mm. The Ugandan samples were grouped into 4 mm classes with midpoints at 10 mm, 14 mm, etc. Since some of the samples from Mwanza Gulf showed overscores for sizes such as 10 mm, 15 mm and 20 mm, all values have been lumped into 5-mm length classes (midpoints at 10 mm, 15 mm, etc.) before further analysis was performed.

**Analysis**

The length-frequency distributions were analyzed using the ELEFAN I and ELEFAN II computer programs (Pauly 1987), in order to estimate parameters describing growth, mortality and recruitment.

**Results**

**Growth**

The original length-frequency data (Tables 1 and 2) were restructured with ELEFAN I (Fig. 1). This program also
fitted the curves (Fig. 1) from which the growth parameters, as presented in Table 3, were determined. To compare the two populations, we have calculated a growth performance index $\phi$ using the formula of Pauly and Munro (1984):

$$\phi = 2 \log_{10} L_\infty + \log_{10} K \quad \text{...1}$$

where $L_\infty$ is the asymptotic length in cm and $K$ is a growth constant, per year. The values of $\phi$ amounted to 1.62 for Buvuma Channel and 1.66 for the Mwanza Gulf, a difference of only 2.5%.

**Mortality**

Natural mortality ($M$) was estimated from the equation of Pauly (1980):

$$\log(M) = -0.0066 - 0.279 \log(L_\infty) + 0.6543 \log_{10}(K) + 0.4634 \log_{10}(T) \quad \text{...2}$$

where $T$ is water temperature in °C. The value $T = 23$ was entered for both populations. This resulted in an estimated $M$ of 2.5 year\(^{-1}\) for Buvuma Channel and 2.6 year\(^{-1}\) for the Mwanza Gulf.

Total mortality ($Z$) was estimated from a length-converted catch curve. Before this curve was drawn, the ELEFAN I program was used to determine the selectivity characteristics of the gear. The results of this analysis are summarized in Table 4. The difference in mesh size between the beach seine used in Uganda and the trawl net operated in Tanzania is reflected in the length at which dagaa enters the corresponding fishery (L-50). The catch curves are presented in Fig. 2. Total mortality amounted to 3.9 year\(^{-1}\) in Uganda and to 4.4 year\(^{-1}\) in Tanzania.

**Fig. 1. Length-frequency distributions (standard length) of two Rastrolebola argentea populations from Lake Victoria. A. Beach seine catches from Buvuma Channel, Uganda (Dec. 1987-Sept. 1988). B. Nightly surface trawl catches from Mwanza Gulf, Tanzania (Jan.-Nov. 1988). ELEFAN I has been used to restructure the distributions from Tables 1 and 2 to the form presented here, and to perform the curve fitting. The growth parameters are summarized in Table 3.**
Fig. 2. Catch curves for dagaa populations from the Ugandan (A) and the Tanzanian (B) part of Lake Victoria. Sampling done by beach seine in Uganda and by surface trawl in Tanzania. Gear selectivity is presented in Table 4. The estimated mortality is given in the text.

Table 3. Growth parameters of *Prista argentea* as determined by the ELEFAN I program in fitting the curves presented in Fig. 1.

<table>
<thead>
<tr>
<th>Location</th>
<th>( L_\infty ) (mm)</th>
<th>( K ) (year(^{-1}))</th>
<th>Starting length</th>
<th>Starting sample</th>
<th>( R_s )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buvuma Channel</td>
<td>65</td>
<td>0.99</td>
<td>44</td>
<td>1</td>
<td>0.418</td>
</tr>
<tr>
<td>Mwanza Gulf</td>
<td>65</td>
<td>1.08</td>
<td>37.5</td>
<td>9</td>
<td>0.785</td>
</tr>
</tbody>
</table>

Table 5. Performance of some East African small pelagic freshwater fishes. Relationships between standard, fork and total length of *dagaa* (Wanink 1988b) have been used to recalculate the size of all species to standard length. Symbols are explained in the text.

<table>
<thead>
<tr>
<th>Species</th>
<th>( L_\infty ) (cm)</th>
<th>( K ) (year(^{-1}))</th>
<th>( \phi )</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. sarda</em></td>
<td>11.0</td>
<td>2.58</td>
<td>2.49</td>
<td>Ruffi and van Lissa (1982)</td>
</tr>
<tr>
<td><em>E. sarda</em></td>
<td>11.0</td>
<td>2.89</td>
<td>2.54</td>
<td>Ruffi and van Lissa (1982)</td>
</tr>
<tr>
<td><em>S. tanganica</em></td>
<td>8.5</td>
<td>2.53</td>
<td>2.44</td>
<td>Proude and Stoneman (1973)</td>
</tr>
<tr>
<td><em>R. argentea</em></td>
<td>6.5</td>
<td>1.04</td>
<td>1.65</td>
<td>This study</td>
</tr>
</tbody>
</table>

Recruitment

The annual recruitment patterns for the two populations have been combined in Fig. 3. In both areas only one major breeding period per year was found. In Ugandan waters the breeding peak occurred during October/November, while in Tanzania the highest values were found four months later.

Discussion

Growth

Since the growth parameters of the two studied populations were almost identical, the mean values for \( L_\infty \) (65 mm standard length) and \( K \) (1.04 year\(^{-1}\)) will be used to describe the growth curve of *dagaa* in Lake Victoria. The growth rate of *dagaa* is low compared to some other small pelagic fishes from East Africa. Values of \( K = 2.58 \) to 2.89 year\(^{-1}\) (for \( L_\infty = 138 \) mm total length) have been established for the clupeid *Stolothrissa tanganica* (Roest 1977).

Unfortunately, the early work on the growth of *Prista argentea* in the Ugandan part of Lake Victoria (Proude and Stoneman 1973) has never been published. However, Ruffi and van Lissa (1982) have cited a maximum fork length of 105 mm from this manuscript. The growth rate of *dagaa* was said to resemble the values found by Ruffi and van Lissa (1982) for *Engraulicypris sardella*. Therefore, we have assumed a \( K \) value of 2.74 year\(^{-1}\) (the mean of two values given for *E. sarda*) for the *dagaa* population studied by Proude and Stoneman (1973). \( L_\infty \) (105 mm fork length) observed by Proude and Stoneman was transformed to standard length (95 mm) using Wanink’s (1988b) relationship between the two parameters. Subsequently \( L_\infty \) could be estimated (100 mm SL) from \( L_\infty /0.95 \) L (Taylor 1958). The recalculated values for \( L_\infty \) and \( K \) were then used to compute the growth performance index of the *dagaa* population described by Proude and Stoneman (Table 5). Also the growth performance of *Engraulicypris sardella*, *Stolothrissa tanganica* and the average value of the *dagaa* populations described in this paper have been calculated (Table 5). Our value appeared to be the lowest by far.

Apparently the growth rate and the maximum length of *dagaa* in Lake Victoria has decreased significantly over the last 15 years. Dwarfing has been reported for the Mwanza Gulf, where the modal length of adult *dagaa* decreased by 18% between 1982 and 1987 (Wanink 1988a; Wanink and Goudsward 1989). The same phenomenon has been observed in *dagaa* populations from Lake Kyoga (Uganda) and the northern part of Lake Victoria (Wandera, in press).

Mortality

The estimated total mortality for *dagaa* (\( Z = 3.9 \) - 4.4 year\(^{-1}\)) is high, compared to the value published for
the Nile perch population of the Mwanza Gulf (Z = 1.1 - 1.2 year\(^{-1}\)) (Ligtvoet 1988). However, a high mortality rate is a normal phenomenon in small pelagic species. Turner (1982) gave values ranging from 2.2 to 5.0 for Engraulicypris sardella in Lake Malawi. For Stolothrissa tauganicae from Lake Tanganyika, a total mortality of 5.5 year\(^{-1}\) has been reported by Roest (1977).

**Recruitment**

The single recruitment peak per year found both in Uganda and Tanzania resembles the reproduction pattern of the small zooplanktivorous haplochromine cichlids from the Mwanza Gulf (Witte 1981). On the other hand, both Engraulicypris sardella (Rufli and van Lissa 1982) and Stolothrissa tauganicae (Roest 1977) have more than one spawning peak during a year. To date we do not know the underlying factors determining the reproductive cycle of dagaa. The main recruitment seasons determined by ELEFAN II are in agreement with the period in which high numbers of ripe and running animals were found in Uganda (Wandera, in press) as well as in Tanzania (Wanink 1988b).

**Size Selective Sampling**

Due to the sampling design, the analyses for both populations were performed on the larger size classes only. The mesh size of the beach seine was too large for catching juveniles. The surface trawl net could have caught small dagaa when operated by day, since in the Mwanza Gulf size related daily vertical migration of dagaa has been reported (Wanink, in press; Wanink and Berger, in prep.). At night only the adult cohort is found near the surface, while during the day mainly juveniles and cestode infected adults occupy the top layer (Wanink, in press). In this first attempt to assess the growth parameters of dagaa in Lake Victoria we have selected night catches only, in order to achieve the best cohort separation.

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**References**


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