Age and growth of blue spot mullet, Valamugil seheli (Forskal) from Mangalore

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ABSTRACT
Length-weight relationship, condition, age and growth and mortality rates of Valamugil seheli from Mangalore region were studied during April 1998 and March 1999. The combined length-weight relationship derived was log W = -1.4257 + 2.6207 logL and the growth was found to be allometric. Seasonal variation in condition factor showed higher values from September to December, while the mean values of K, showed an increasing trend with size. Studies on age and growth revealed that males grow faster than females and the von-Bertalanffy growth equation was \( L_t = 601.76 \left[ 1 - e^{-0.2309(t+0.6934)} \right] \) for males and \( L_t = 534.53 \left[ 1 - e^{-0.2853(t+0.5632)} \right] \) for females. The instantaneous total, natural and fishing mortality were found to be 1.5060, 0.9713 and 0.5347 for males and 1.3384, 0.9004 and 0.4380 for females respectively.

Introduction
Mullets form one of the important fisheries in the coastal waters of India (Payne, 1976). Though, the catch of mullets is negligible (0.25-0.30%) in the total marine fish production of India, they are highly valuable as a table fish of great demand. The population characteristics of a particular species is useful in fishery resources management. The noteworthy contributions are that of Sarojini (1957, 1958), Luther (1963) along east coast of India; Kurup and Samuel (1992), Babu and Neelakantan (1983), Baburaj (1987) along west coast of India and Wijeyaratne and Costa (1987), Borafy and Soliman (1988); Al-Daham and Wahab (1991) outside Indian waters. The present study was undertaken to investigate length-weight relationship, condition, age structure, growth pattern and mortality rates of one of the most commonly available mullet species, Valamugil seheli in Mangalore waters.

Materials and methods
Specimens of V. seheli were obtained at weekly intervals from the commercial catches landed by cast net, seine net and gill net from estuarine regions of Gurupur-Netravati, Pavanje and Shambavi Rivers from April, 1998 to March, 1999. A total of 1392 fishes (731 males and 661 females) were examined for the study. In the laboratory, the total length (mm), weight (g) and sex of individual fish were recorded. Total length of the fish was measured to the nearest
mm and weight to the nearest 0.1g. The parabolic equation $W = aL^b$ representing the length-weight relationship in fishes (Le Cren, 1951) was used for the study. The data for both the sexes were treated separately. Analysis of co-variance technique (Snedecor and Cochran, 1967) was used to test the homogeneity of length-weight relationship. The pattern of growth was tested by $t$-test. The relative condition factor $Kn = W_o/W_c$ where $W_o$ is the observed weight and $W_c$ is the calculated weight.

Age and growth were determined by Scale method. Scales were removed from the base of the pectoral fin region and cleaned in 10% ammonium hydroxide. The number of annuli were counted using a slide projector and back calculation of total length at each annulus was calculated by $L_x = \frac{S}{S_t} \times L_t$ (Van Oosten, 1929) where $L_t$ is the standard length of fish at capture. Petersen and Bhattacharya method (1967) were also followed to find the age. The expected lengths of $V. seheli$ at different ages were determined by employing Von Bertalanffy (1957) growth equation. The total instantaneous mortality coefficient ($Z$) was estimated following cumulative catch curve method (Jones and Van Zalinge, 1979) and the instantaneous natural mortality ($M$) by employing Rikhtor and Efano (1976) equation.

**Results**

The estimated length-weight relationship obtained during the study period was Males: $\log W = -0.4289 + 2.6294 \log L$ (or $W = 0.0372 L^{2.6294}$) Females: $\log W = -1.2991 + 2.5283 \log L$ (or $W = 0.0502 L^{2.5283}$).

Comparison of the regression coefficients using the $F$-ratio indicated no significant difference in length - weight
relationship between the sexes (Table 1). Hence, a common regression equation is derived.

\[ \log W = -1.3574 + 2.5728 \log L \]  

The t-test employed showed that the \( b \) value differed significantly from 3 indicating a negative allometric form of growth.

The seasonal variation and size dependent fluctuations in relative condition factor are shown in figures 1 and 2. In males, the condition was higher than the weighted average (1.0174) during June and from September to December, while in females, it was higher than the weighted average (1.0274) from August to December. The mean \( K_n \) values of each size group of males and females showed a gradual increase with size of the fish except at 241-260 mm size group.

The mean lengths at different ages by using scale method were calculated separately for male and female. Since it was not possible to age the fish directly by Petersen method (Fig 3.) and Bhattacharya method, the length range obtained using the scale method was taken into account and the length components were arranged in such a way that the component having mean lengths of 150-240 mm was assigned to first year, 241-310 mm to second year, 311-360 mm to third year and more than 360 mm to fourth year. Lengths at different ages obtained by using various methods are presented in Table 2. A close proximity among the values computed from different methods is evident, especially between those estimated by Scale method and Von Bertalanffy growth equation.

From the biological point of view, to understand any fish population, it is necessary to fit the growth equation with respect to length or weight. The mean length at age data obtained by Scale method was used to estimate the parameters of Von Bertalanffy growth equation using least square method.
The fitted growth equations are:

Males: \( L_t = 601.76 \left[ 1 - e^{-0.2309(t+0.5632)} \right] \).

Females: \( L_t = 534.53 \left[ 1 - e^{-0.2853(t+0.5632)} \right] \).

The estimated values of total (Z), natural (M) and fishing (F) mortalities were 1.506, 0.9713 and 0.5347 for males and 1.3384, 0.9004 and 0.438 for females respectively.

**Discussion**

The length-weight relationship of *V. seheli* showed negative allometric growth. The regression coefficient of females was found to be lower than that of males. Similar observations were also made by Wijeyaratne and Costa (1987) in *V. cunnesius* from Sri Lanka and Baburaj (1987) in *V. spleglerti* from Mangalore waters. Contrary to the findings of present work, Borafy and Soliman (1988) recorded positive allometric growth in case of *V. seheli* (\( b = 3.508 \) in males and 3.462 in females) from UAE. The present study clearly indicates the cube law, \( W = aL^3 \) will not be a proper representation of the length-weight relationship for *V. seheli* inhabiting the estuarine waters of Mangalore region.

The coefficient of condition has often been used to indicate the condition, fatness or general well being of fish. Data on the seasonal variation in condition of the fish showed...
that \( K_n \) values are more or less similar in both the sexes. The high condition exhibited by both the sexes during October may be due to gonadal development and high feeding intensity, while, during June in males, and February in females may be due to feeding activity only. The fall in condition of fish till December in both the sexes might be due to spawning stress. The relatively lower condition of fish observed during January to May in males and February to June in females may be due to spawning activity only. The fluctuation in condition with respect to size indicated more or less an increasing trend with increase in size of the fish. The increase in \( K_n \) value from 141-160 mm size group indicates that the fish start maturing around 221-240 mm, whereas a sudden decrease at 241-260 mm size group indicate that both the sexes in this size group are probably in the spawning stage. After 260 mm size, the increase in \( K_n \) value is more rapid in female than in the male fish indicating the possibility of recovery from spawning (Hart, 1946). Sarojini (1957), Reddy (1985) and Baburaj (1987) opined that the point of inflexion on the curve showing a diminution of \( K_n \) with increasing length is a good indication of the length at sexual maturity.

The lengths at age data obtained by Von Bertalanffy growth plot indicates that the growth rate is slightly faster in males than in females. The mean length at 3+ and 4+ age data obtained by Petersen and Bhattacharya method did not give a true picture as the sample size was low in those size groups. In Mangalore waters, \( V. \) spegleri was found to attain 177.8, 239.6 and 271.4 mm at 1, 2 and 3 years respectively (Baburaj, 1987). Wijeyaratne and Costa (1987) in Negombo lagoon, Sri Lanka recorded the mean length of \( V. \) buchanani to be 110, 180, 240, 288 and 333 mm at I to V age groups respectively, while for \( V. \) cunnesius 104, 160 and 200 mm at ages 1+, 2+ and 3+ respectively. Borafy and Soliman (1988) observed 5th age groups in females and 4th age groups in males of \( V. \) seheli in UAE waters. They also observed a faster growth rate in females which is contrary to the present investigation. The difference in rate of growth could be attributed to ecological factors affecting the biological activities of the fish in two different environments. The

### Table 2. Mean length (mm) of \( V. \) seheli at different ages obtained by various methods

<table>
<thead>
<tr>
<th>Age (Year)</th>
<th>Sex</th>
<th>Scale method (mm)</th>
<th>Peterson method (mm)</th>
<th>Bhattacharya method (mm)</th>
<th>Von-Bertalanffy growth equation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>195.88</td>
<td>189.17</td>
<td>197.41</td>
<td>194.73</td>
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<tr>
<td></td>
<td>F</td>
<td>192.10</td>
<td>198.00</td>
<td>198.67</td>
<td>192.32</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>277.65</td>
<td>277.17</td>
<td>264.90</td>
<td>278.68</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>277.12</td>
<td>273.36</td>
<td>279.83</td>
<td>277.26</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>348.62</td>
<td>350.50</td>
<td>330.50</td>
<td>345.29</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>341.56</td>
<td>330.50</td>
<td>330.50</td>
<td>341.14</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>398.60</td>
<td>390.50</td>
<td>-</td>
<td>398.18</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>389.14</td>
<td>397.17</td>
<td>-</td>
<td>389.14</td>
</tr>
</tbody>
</table>

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asymptotic length \( (L_\infty) \) obtained is 601.8 mm TL for males and 534.5 mm TL for females. The Asymptotic length of \( V. \) sperigleri in Mangalore waters was 493.2 mm (Baburaj, 1987). Wijayaratne and Costa (1987) reported that the asymptotic lengths of \( V. \) buchanani and \( V. \) cunnesius are 586 mm and 300 mm respectively from Negombo lagoon, Sri Lanka.

The natural and fishing mortality coefficients were higher for males than the females. The higher natural mortality over fishing mortality gives an indication that there is further scope for increasing fishing in estuaries of Mangalore region.

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