Age and growth of brushtooth lizard fish *Saurida undosquamis* (Richardson, 1848) occurring in Parangipettai southeast coast of India

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Abstract

Growth parameters on brushtooth lizardfish *Saurida undosquamis* which along with other lizard fishes were calculated based on the length frequency data using FISAT software using tools such as Powell-Wetherall method, ELEFAN and von Bertalanfly growth estimates. Based on the progression of modes in the length-frequency data, these tools calculate the growth parameters \( L_\infty, K \) and \( t_0 \). \( L_\infty, K \) and \( t_0 \) in the case of males were 305.55 mm, 0.66 y\(^{-1}\) and -0.611 y\(^{-1}\) respectively. Above parameters in females were 346.5 mm, 0.72 y\(^{-1}\) and -0.517 years respectively. Growth performance index (\( \Theta' \)) was 4.898 in males and 4.655 in females. Life span of both the sexes was found to be 4+ years. These growth parameters can be used effectively in studying the population dynamics, stock assessment and ecological pathway (ECOPATH) for ecosystem based management of the fishery constituted by this lizard fish.

[Keywords: *Saurida undosquamis*, VBG parameters, longevity, Parangipettai ]

Introduction

Data on age and growth of fish are vital in both culture and capture fisheries, for the understanding of biological traits (e.g. lifespan, age at sexual maturity, etc.) and the study of population demographic structure and dynamics\(^1\). Lizardfishes constitute about 9.5\% of the total demersal finfish landings of 56,480 tonnes during 2010\(^2\). These are caught as bycatch by shrimp trawlers. In Parangipettai waters the fishery is supported by *Sauridatumbil*, *S. undosquamis*, *Synodus indicus* and *Trachinocephalus myops*. Among these, *S. undosquamis* commonly known as brushtooth lizardfish is the second dominant species (44\%) with the first being *S. tumbil*.

*S. undosquamis* is found to inhabit the muddy bottoms of continental shelf (20 – 200 m) and found beyond the distributional range of *S. tumbil* (20-60 m depth). It is mainly a piscivore, but feeds also on crustaceans and other invertebrates. It is a total spawner. It occurs throughout the year and forms good fishery between the months of September and December. Detailed information is available on various aspects of fishery and biology of *S. tumbil* from the west and east coasts of India\(^3\). However studies on *S. undosquamis*, especially on its age and growth have not been attempted in the southeast coast of India.

The specimens were collected from the Mudasalodai (lat: 11º21’ N; long: 79º50’ E) (Fig. 1) landing centre situated close to Parangipettai in the southeast coast of India where 82 single day trawlers are currently operated at the depth of 15-80 mts with the cod end mesh size of 10-20mm.

Fig. 1 - Map showing the study area
Materials and Methods

Monthly samples were collected during September 2010 – August 2011; however no sampling was done in May due to fishing holiday declared by the government.

The samples were brought to the laboratory and cleaned in tap water. Male and female individuals were identified by examining the gonads by cutting opening the body cavity. The total length (TL) was measured to the nearest millimetre from the tip of the snout to the tip of the caudal fin using a measuring board. Length frequency data were collected from a total of 510 males ranging in length from 70 to 320mm and 611 females ranging from 90 to 300mm and grouped into 10mm class interval. Various growth parameters besides life span were estimated by employing FiSAT computer program.

The growth performance index (Ø’) was calculated by employing the following equation of Pauly and Munro.

$$\Omega’ = \log_{10} K + 2\log_{10} L_\infty$$

Longevity was estimated from the equation of Pauly.

$$T_{max} = \frac{3}{K}$$

The longevity was calculated following the Pauly’s method using the equation $t_{max} = 3/K$.

Results

Powell-Wetherall method

Powell-Wetherall plots for the estimation of $L_\infty$ and $Z/K$ of males and females of *S. undosquamis* are given in Fig.2. $L_\infty$ values obtained for males and females of *S. undosquamis* were 287.45 mm [$r = 0.990$; $185.81 + (0.646)x$] and 300.01 mm [$r = 0.998$; $189.36 + (0.829)x$] respectively. The alignment of points on the straight line was quite satisfactory ($r=0.962$).

ELEFAN

This routine searches the growth curve that will fit the peaks in the length-frequency data and achieves an optimum fit under the given conditions. Life span of both males and females appear to be 4+years as evident through the number of lines in the histogram (Figs.3&4). Optimized growth parameters ($L_\infty$ and K) and $L_\infty$ and K values obtained using the automatic scan routine of ELEFAN I were 305.55mm and 1.1 respectively in males and 346.5mm and 0.810 in females. Goodness of fit (Rn) in the case of male was 0.190 and in female 0.150.

Von Bertalanffy plot

The results of Von Bertalanffy plot for the estimation of K and $t_o$ for males and females of *S. Undosquamis* are shown in (Tables 2 & 3). The values of the intercept (a), obtained were 0.413 for males and 0.614 for females. The slope b, which is equal to the K value was 0.66 yr$^{-1}$ for males and 0.72 yr$^{-1}$ for females. The ‘$t_o$’ values estimated for males and females of *S. Undosquamis* were - 0.611yr and - 0.517 yr respectively.

Estimation of growth performance index

The estimated growth performance (Ø’) value which is an index for comparing the growth performance of organisms was 4.898 and 4.655 respectively for males and females of *S. undosquamis*.

Estimation of longevity

Longevity ($t_{max}$) of males and females of *S. Undosquamis* was 4.218 and 4.545 years respectively. The longevity ($t_{max}$) calculated from the reverse von Bertalanffy equation for males and females of *S. Undosquamis* was 3.912 and 4.094 years respectively.
<table>
<thead>
<tr>
<th>S. No</th>
<th>$L_\infty$ (mm)</th>
<th>$K$ (y)</th>
<th>$t_0$ (y)</th>
<th>Localilty</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>335 (U)</td>
<td>1.21</td>
<td>-</td>
<td>Indonesia</td>
<td>Diwopongo et al.\textsuperscript{13}</td>
</tr>
<tr>
<td>2</td>
<td>346 (U)</td>
<td>0.87</td>
<td>-</td>
<td>Off Mumbai</td>
<td>Metaret et al.\textsuperscript{14}</td>
</tr>
<tr>
<td>3</td>
<td>395 (U)</td>
<td>0.31</td>
<td>-</td>
<td>Off Visakhapatnam</td>
<td>Rajkumar et al.\textsuperscript{15}</td>
</tr>
<tr>
<td>4</td>
<td>339 (U)</td>
<td>0.51</td>
<td>-</td>
<td>Off Maharstra</td>
<td>Chakraborty et al.\textsuperscript{16}</td>
</tr>
<tr>
<td>5</td>
<td>355 (U)</td>
<td>0.64</td>
<td>-</td>
<td>Karnataka coast</td>
<td>Muthiah\textsuperscript{17}</td>
</tr>
<tr>
<td>6</td>
<td>305 (U)</td>
<td>0.80</td>
<td>-</td>
<td>Philippines</td>
<td>Ingles and Pauly\textsuperscript{18}</td>
</tr>
<tr>
<td>7</td>
<td>420 (U)</td>
<td>0.51</td>
<td>-0.29</td>
<td>Eastern Mediterranean Sea</td>
<td>Gokce et al.\textsuperscript{19}</td>
</tr>
<tr>
<td>8</td>
<td>368 (M); 380 (F)</td>
<td>0.13 (M); 0.12 (F)</td>
<td>-</td>
<td>Off Australia</td>
<td>Tai Shiang et al.\textsuperscript{20}</td>
</tr>
<tr>
<td>9</td>
<td>355 (U)</td>
<td>0.26</td>
<td>-1.059</td>
<td>Suez Gulf, Egypt</td>
<td>El – Halfawyet et al.\textsuperscript{21}</td>
</tr>
<tr>
<td>10</td>
<td>305 (M); 346.5 (F)</td>
<td>0.66 (M); 0.72 (F)</td>
<td>-0.611 (M); -0.517 (F)</td>
<td>Parangipettai</td>
<td>Present study</td>
</tr>
</tbody>
</table>

Table 1 - Growth parameters of *Sauridaundosquamis* obtained in the present study and earlier investigations

Fig. 3 - ELEFAN I growth curve of male *Sauridaundosquamis*
Fig. 4 - ELEFAN I growth curve of female Saurida undosquamis

Table 2 - Estimation of $K$ and $t_0$ with the von Bertalanffy plot for male Saurida undosquamis

<table>
<thead>
<tr>
<th>Age</th>
<th>Length (Lt)</th>
<th>$Lt/L_\infty$</th>
<th>$1-Lt/L_\infty$</th>
<th>$-\ln(1-Lt/L_\infty)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>135</td>
<td>0.3896</td>
<td>0.6103</td>
<td>0.4936</td>
</tr>
<tr>
<td>2</td>
<td>225</td>
<td>0.6493</td>
<td>0.3506</td>
<td>1.0479</td>
</tr>
<tr>
<td>3</td>
<td>290</td>
<td>0.8369</td>
<td>0.1630</td>
<td>1.8310</td>
</tr>
</tbody>
</table>

Table 3. Estimation of $K$ and $t_0$ with the von Bertalanffy plot for female Saurida undosquamis

<table>
<thead>
<tr>
<th>Age</th>
<th>Length (Lt)</th>
<th>$Lt/L_\infty$</th>
<th>$1-Lt/L_\infty$</th>
<th>$-\ln(1-Lt/L_\infty)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>125.36</td>
<td>0.4102</td>
<td>0.5897</td>
<td>0.5821</td>
</tr>
<tr>
<td>2</td>
<td>150</td>
<td>0.4909</td>
<td>0.5090</td>
<td>0.6751</td>
</tr>
<tr>
<td>3</td>
<td>230</td>
<td>0.7527</td>
<td>0.2472</td>
<td>1.3973</td>
</tr>
<tr>
<td>4</td>
<td>260</td>
<td>0.8509</td>
<td>0.1490</td>
<td>1.9032</td>
</tr>
</tbody>
</table>

Discussion

Dwipongo et al.\textsuperscript{13} estimated $L_\infty$ and $K$ values to be 335 mm and 1.21 yr\textsuperscript{-1} respectively. In the present investigation $L_\infty$ estimated was found to be slightly higher than the above (349.40 mm for males and 363.60 mm for females). However the $K$ values (1.01 for males and 0.77 yr\textsuperscript{-1} for females) were low.

The $L_\infty$ and $K$ values obtained in the present investigation agree with the observations made in the coastal waters of Mumbai\textsuperscript{14}, Rajkumar et al.\textsuperscript{15} reported $L_\infty$ and K values of 395 mm and 0.31 yr\textsuperscript{-1} from the coast off Visakhapatnam. Chakraborty et al.\textsuperscript{16} and Muthiah\textsuperscript{17} reported lower growth rates of 0.51 and 0.64 yr\textsuperscript{-1} for S. Undosquamis respectively from the coasts of Maharashtra and Karnataka.

Ingles and Pauly\textsuperscript{18} observed $L_\infty$ and $K$ for this species to be 305 mm and 0.80 yr\textsuperscript{-1} in the Philippine waters. $L_\infty$, $K$ and $t_0$ values (42 cm, 0.51 year\textsuperscript{-1} and -0.29 yrs) observed by Gokce et al.\textsuperscript{19} in the Iskenderun Bay (Eastern Mediterranean Sea) were found to be on the higher side compared to the present study. Tai Shiang et al.\textsuperscript{20} reported slower growth rate of 0.13 and 0.12 yr\textsuperscript{-1} respectively in the case of males and females from Australian waters. El-Halfawy et al.\textsuperscript{21} obtained $L_\infty$, $K$ and $t_0$ values of 355 mm, 0.26 yr\textsuperscript{-1} and -1.059 yr from the Gulf of Suez, which also indicated slower growth rate. Regional differences in the growth rate for the fish stocks were reported by Wright et al.\textsuperscript{22}. 
Variations in growth rates are attributed to the prevailing environmental conditions, availability and competition for food and exploitation. Growth performance index reported for various species globally varied from 2.65 to 5.29. The values observed presently come within this range. Growth performance index ($\Omega'$) reported by Rajkumar et al\textsuperscript{15} for S. undosquamis from the Vishakhapatnam coast was 3.61 which is lower than the present values (4.8 & 4.6). These growth parameters can be used effectively in studying the population dynamics, stock assessment and ecological pathway (ECOPATH) for ecosystem based management of the fishery constituted by this lizard fish.

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