Relationship of body size with some body structures of three young marine fish species collected from Khor Al-Zubair, Iraq

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Abstract

The relationships between both fish body size versus weight of the otolith, eye lens and liver were studied in *Acanthopagrus latus*, *Therapon theraps*, and *Pelates quadrilineatus* collected from the Khor Al-Zubair area, Iraq. We concluded that it is possible to use the weights of the otolith, eye lens and liver as an age indicator for young individuals of the three fish species in question.

Key words: Marine fish, *Acanthopagrus latus*, *Therapon theraps*, *Pelates quadrilineatus*, Body size, Otolith, Eye lens, Liver, Khor Al-Zubair, Iraq.

Introduction

The most obvious character of the living body is its size, which may be determined by several factors. Within certain physiological and biological limits, the body size of organisms often varies widely due to the effect of ecological factors (Roff, 1986). Several authors have used different parts of the fish body for age determination or for finding its relationship with the weight, growth, and age of fishes.

In addition, they also examined the factors that affect such relationships. The fish otolith is the body part that has been most commonly used in such studies (Mosgaard & Reeves 2001, Mourad 1999, Beamish & Mahnken 2001, Newman 2002). Information from the otolith has been used to indicate feeding level (Johnson et al. 2002), effects of oil pollution (Hashim et al. 1994), and fat and protein deposition (Krivobok & Shatunovskij 1976). On the other hand, the eye lens has also been widely used in fish age determination (Al-Hassan et al. 1992, Crivelli 1980, Carlton & Jackson 1968, Burkett & Jackson 1971). Finally, the weight of the fish liver has been used in several studies. Carneiro et al. (1998) examined the effect of the intensity of aquaculture on the liver weight of Florida red tilapia, Uzars et al. (2001) used liver weight to...
determine the relationship between fish maturity and food availability, and Ferraro et al. (2001) studied the effect of pollution on the relationship between liver weight and body weight.

The aim of the present study is to investigate various relationships between the total body length and weight and the weights of the otolith, eye lens and liver of the juveniles of *Acanthopagrus latus*, *Therapon theraps* and *Pelates quadrilineatus*.

**Materials and Methods**

Fish specimens of *A. latus* (113-245 mm), *T. theraps* (144-159 mm), and *P. quadrilineatus* (122-169 mm) were collected from the Khor al-Zubair area in the northwest region of the Arabian Gulf during January 2000 - April 2001. Different nets of different mesh sizes were used. Fishes were brought fresh as possible to the laboratory in temperature proof container filled with ice and later identified according to Al-Daham (1979) and Froese & Pauly (www.fishbase.org). Fish length and weight were taken to the nearest 0.1 cm and 0.1 g respectively. Fishes were dissected to extract the otolith and the eye lens and to remove the liver. The eye lenses and livers were dried in an ordinary laboratory oven until their weights remained constant to the nearest 0.0001g. The average of the weight of the right and left otolith and eye lens was recorded for each fish specimen. To overcome the effect of the statistical bias, adult fishes were not included. The length range of juveniles of *A. latus* was chosen according to Al-Ariki (2001) while those of *T. theraps* and *P. quadrilineatus* were chosen according to Al-Jadir (2001). SPSS statistical software [software version: 11] was used to calculate correlation coefficients and regression constants, as well as to perform a cluster analysis between body weight and the three body structures mentioned above.

**Results**

Table 1 shows the average body length, the average total body weight, and the average weights of the eye lens, otolith and liver for all three fish species. The three species showed clear differences in the measurements of, and the morphometric relationships between, these three body structures. The correlation coefficients were high and positive between the fish total length and weight for all three species (Table 2).

In *A. latus*, a high positive correlation coefficient was obtained for both the total length and weight with the weights of both the eye lens (r=0.47, 0.53) and the liver (r=0.97, 0.90). In *T. theraps*, a high correlation coefficient was obtained for total body length and weight with the weights of both the eye lens (r=0.57, 0.69) and the otolith (r=0.53, 0.46). In *P. quadrilineatus*, a high correlation coefficients were obtained for both the total body length and weight with the weights of both the otolith (r=0.41, 0.34) and the liver (0.50, 0.67) (Table 2).

Table 3 shows the values of the regression constants a and b for the three species and their three body structures. R2 was significant for the total body length with weight and weight of otolith in *A. latus* (R2 =0.937, 0.947); total body weight with weight and weight of eye lens in *T. theraps* (R2 =0.893, 0.626); and total body with weight and weight of eye lens in *P. quadrilineatus* (R2 =0.74, 0.140). Negative b values were obtained for the following relationships: total body length – weight of eye lens and liver in *A. latus*,

<table>
<thead>
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<th>Measures</th>
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<tbody>
<tr>
<td></td>
<td>A. latus</td>
<td>T. theraps</td>
<td>P. quadrilineatus</td>
<td></td>
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<tr>
<td></td>
<td>mean</td>
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<td>number</td>
<td>mean</td>
<td>S.D.</td>
<td>number</td>
<td>mean</td>
<td>S.D.</td>
<td>number</td>
</tr>
<tr>
<td>Total length(c.m.)</td>
<td>21.14</td>
<td>3.14</td>
<td>49</td>
<td>15.59</td>
<td>0.64</td>
<td>30</td>
<td>14.92</td>
<td>1.81</td>
<td>116</td>
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<tr>
<td>Total weight(g.m.)</td>
<td>233.28</td>
<td>64.43</td>
<td>47</td>
<td>64.47</td>
<td>9.34</td>
<td>30</td>
<td>50.87</td>
<td>20.97</td>
<td>116</td>
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<tr>
<td>Eye weight(g.m.)</td>
<td>0.7011</td>
<td>0.6843</td>
<td>31</td>
<td>0.1145</td>
<td>0.0336</td>
<td>26</td>
<td>1.6993</td>
<td>6.6901</td>
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<tr>
<td>Otolith weight(g.m.)</td>
<td>0.0658</td>
<td>0.0758</td>
<td>29</td>
<td>0.0294</td>
<td>0.0412</td>
<td>12</td>
<td>0.0609</td>
<td>0.0391</td>
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<tr>
<td>Liver weight(gm)</td>
<td>2.441</td>
<td>1.5931</td>
<td>46</td>
<td>0.1293</td>
<td>0.0699</td>
<td>15</td>
<td>0.3251</td>
<td>0.3012</td>
<td>63</td>
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</table>

Table 1. - Total length and total body weight, eye, otolith, liver and heart weight of *A. latus*, *T. theraps* and *P. quadrilineatus* (± S.D.).

Tabla 1. - Longitud total, peso corporal total, peso del ojo, otolito, hígado y corazón de *A. latus*, *T. theraps* y *P. quadrilineatus* (± S.D.).
## Measures

<table>
<thead>
<tr>
<th>Measures</th>
<th>A. latus</th>
<th>T. theraps</th>
<th>P. quadrilineatus</th>
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<tbody>
<tr>
<td></td>
<td>correlation coefficient</td>
<td>correlation coefficient</td>
<td>correlation coefficient</td>
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<tr>
<td>Total length(cm)</td>
<td>0.95*</td>
<td>0.83*</td>
<td>0.51*</td>
</tr>
<tr>
<td>Total weight (gm)</td>
<td>0.95*</td>
<td>0.82*</td>
<td>0.05*</td>
</tr>
<tr>
<td>Eye weight (gm)</td>
<td>0.47*</td>
<td>0.69*</td>
<td>0.34*</td>
</tr>
<tr>
<td>Otolith weight (gm)</td>
<td>0.97*</td>
<td>0.41*</td>
<td>0.50*</td>
</tr>
<tr>
<td>Liver weight (gm)</td>
<td>0.49*</td>
<td>0.29</td>
<td>0.67*</td>
</tr>
</tbody>
</table>

**Table 2** - Correlation coefficient between total length and total, eye, otolith, liver and heart weight of *A. latus*, *T. theraps* and *P. quadrilineatus* (±S.D.).

<table>
<thead>
<tr>
<th>Measures</th>
<th>A. latus</th>
<th>T. theraps</th>
<th>P. quadrilineatus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a</td>
<td>b</td>
<td>R²</td>
</tr>
<tr>
<td>Total weight (gm)</td>
<td>6.72</td>
<td>0.163</td>
<td>0.937*</td>
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<tr>
<td>Eye weight (gm)</td>
<td>3.33</td>
<td>0.070</td>
<td>0.011</td>
</tr>
<tr>
<td>Otolith weight (gm)</td>
<td>0.007</td>
<td>0.085</td>
<td>0.947*</td>
</tr>
<tr>
<td>Liver weight (gm)</td>
<td>3.047</td>
<td>0.041</td>
<td>0.006</td>
</tr>
</tbody>
</table>

**Table 3** - Coefficients of exponential regression equation and (R²) value between total length and each total weight, eye, otolith, liver and heart weight of *A. latus*, *T. theraps* and *P. quadrilineatus* (± S.D.).

**Discussion**

The results of the present study showed that the total body length and weight for the three species in question are highly correlated. This finding is in agreement with the results obtained for other Iraqi marine fish species (Abdullah 2000, Al-Ariki 2001, Al-Jadir 2002). Among the other variables studied, otolith weight has shown a positive correlation with both total body length and weight for the three species studied. Such correlation was recorded in other teleost fishes, including salmon (Beamish & Mahken, 2001), cod (Mosegaard & Reeves, 2001), and pearl perch (Newman, 2002). Thus this correlation was recommended for age determination in the three species in question.

Eye lens weight showed a weak correlation with total body length and weight for *A. latus* and *P. quadrilineatus* while in *T. theraps* such correlation was high. On the other hand, eye lens weight proved to have a high correlation with body length of common carp (Crivelli, 1980) and was also a good criterion to estimate age in *Heteropneustes fossilis* and *Ilisha filigera* (Al-Hassan et al., 1992).

The high correlation recorded for the liver weight and both total body length and weight is in accord with results obtained for other teleost fishes such as carp (Mahboob & Sheri, 2001, Ferraro et al., 2001). Such a
relationship was shown to be directly connected with food availability in channel catfish, *Ictalurus punctatus* (Gaylord & Gathini 1998) and with the period of reproduction of *Symphodus tinca* (Ouannes-Ghorbel et al. 2002).

The relationship between the weights of the body structures studied showed that they are suitable for aging fish of less than three years of age. At the same time, they seem not to be suitable for aging older fish due to the irregularities that may occur in the weight of such structures during growth beyond three years of age. This finding is in support with the results obtained by Carlton & Jackson (1968) and Burkett & Jackson (1971). This interaction may also be connected with the stages of sexual maturation (Crivelli 1980).

Newman (2002) and Mosegaard & Reeves (2001) have recorded a linear relationship for both the total body length and weight and otolith weight. On the other hand, curvilinear relationships were recorded for those variables by Cruz & Rebelo (2000) and Mourad (1999) and with the weight of the eye lens by Crivelli (1980). The curvilinear relationships obtained by these authors are in agreement with those of the present work.

In conclusion, the weight of some body structures such as the otolith and eye lens may be indirectly related to the growth of the juveniles of the three fish species studied.

References


