Age, Growth and Reproduction of the Tub Gurnard, *Chelidonichthys lucerna* (Linnaeus, 1758) from the Egyptian Mediterranean waters off Alexandria

1Sabry, S. El-Serafy, 2Fahmy, I. El-Gammal, 2Sahar, F. Mehanna, 1Nasr-Allah, H. Abdel-Hamid and 2El-Sayed, F.E. Farrag  
1Zoology Department, Faculty of Science, Benha University, Benha,  
2Population Dynamics Lab, Fisheries Division, National Institute of Oceanography and Fisheries, Suez, Egypt

**Abstract:** The biology of the tub gurnard, *Chelidonichthys lucerna* (Linnaeus, 1758), has been studied based on data collected between August (2009) and July (2010) from the Egyptian Mediterranean water in front of Alexandria. A total of 873 specimens ranged between 10.6 and 28.2 cm TL and from 10.2 to 232.5 g total weight, were sampled. The age, growth, length-weight relationship, sex ratio, length and age at first sexual maturity and reproduction period were estimated. Total lengths of males ranged from 12.6 to 23.2 cm and of females from 11.8 to 28.2 cm. The maximum age observed was 4 and 5 years for males and females respectively. Length-weight relationships for males and females were estimated as $W = 0.0043*L^{3.264}$ and $W = 0.0042*L^{3.2651}$, respectively indicating an allometric growth. The von Bertalanffy growth equations were $L_t = 29.77(1-e^{-0.274(t+1.36)})$ and $L_t = 32.36(1-e^{-0.255(t+1.09)})$ for males and females respectively. The growth performance index value ($\Phi_L$) was computed as 2.39 for males and 2.44 for females. Length at first sexual maturity was 15 cm (1.21 years) in males and 15.2 cm (1.40 years) in females. The male: female ratio was 1:1.67. The Gonado-Somatic Index (GSI) values indicated that the spawning season starts from November to February with a peak in January for both sexes.

**Keywords:** Alexandria, *Chelidonichthys lucerna*, gurnard, growth, reproduction.

**INTRODUCTION**

The tub gurnard, *Chelidonichthys lucerna* (Linnaeus, 1758) is a demersal marine fish thatis distributed in the Mediterranean Sea, Black Sea and the Atlantic Ocean from Norwrayo Senegal (Tortonese, 1975). *Chelidonichthys lucerna* is one of the three major gurnard species landed in the area of Alexandria; the other two are *Chelidonichthys lastoviza* and *Lepidotriglacavillione*. *C. lucerna* lives mostly on sand or gravel bottoms at depths ranging from 20 to 300 m, often forming shoals (Ben Othmen, 1973). The tub gurnard exhibits a particular pattern of migratory movement within its overall depth range during the year; it shows a pronounced concentration the shallow depths in spring and summer and then moves progressively to deeper waters in winter (Ismen and Ismen, 2004).

The biological characteristics of tub gurnard was investigated in Mediterranean French coast (Priot, 1932) and (Baron, 1985); Catalan Sea (Mouneimne, 1971); Greece waters (Papaconstantinou, 1984) and (Tsimenides et al., 1992); northeastern Mediterranean Sea (Bingel et al., 1993), (Ismen and Ismen, 2004) and (Ciciek et al., 2008); Ionian Sea (Matarrese et al., 1994); Egyptian Mediterranean water off Alexandria (Faltas, 1996) and (Faltas and Abdallah, 1997); Spanish coasts (Morte et al., 1997); Sea of Marmara (Eryilmaz and Meric, 2005); Izmir Bay (Uckun and Togulga, 2007, 2005); Gulf of Gabe’s, Tunisia (Boudaya et al., 2008); Libyan coast (Ahmed, 2012).

The present study is proposed to provide information about age, growth, length-weight relationship and reproduction of *C. lucerna* in the Egyptian Mediterranean waters off Alexandria. Such information should be considered as a prerequisite for an effective fisheries management of the stock of this species in the area of study.

**MATERIAL AND METHODS**

A total of 873 specimens of Tub gurnard, *Chelidonichthys lucerna* were collected monthly from Alexandria landing centers from August (2009) to (July) 2010. After sample collection, fish were brought to the laboratory and the Total Length (TL) and the Total Weight (TW) were measured to the nearest 1.0mm and 0.1 g, respectively. The gutted weight was used to avoid any bias resulted from weights of gonads and stomachs. Weight of gonads was recorded to the nearest 0.01 g. The sex and maturity stages of each fish were detected.
Sagittalotolith was removed, cleaned and stored dry in small laboratory envelops for later age determination. Age was read from the whole otoliths immersed in glycerin and xylol and viewed with a binocular microscope under reflected light against a black background. Opaque and transparent rings were counted and one opaque zone together with one transparent zone has been considered as annual growth.

The growth parameters of the von Bertalanffy growth model \( L_\infty \) and \( K \) were computed by Ford (1933)-Walford (1964) and Guland (1969). While \( t_0 \) was estimated by the equation: \( t_0 = t + (1/K) \times (L_\infty - L_t)/L \). Growth was expressed in terms of the von Bertalanffy equation: \( L_t = L_\infty \times (1-e^{(t-t_0)/K}) \) and \( W_t = W_\infty \times (1-e^{(t-t_0)/K})^2 \) where \( L_t \) and \( W_t \) are the fish length and weight at age \( t \); \( L_\infty \) and \( W_\infty \) represent the asymptotic length and weight, \( k \) is a relative growth coefficient and \( t_0 \) the theoretical age when the fish length is zero.

The allometric growth equation, \( W = a \times L^b \) was used to describe the length-weight relationship (Ricker, 1975), where \( W \) is the total weight (g) and \( L \) is the total length (cm) and \( a \) and \( b \) are constants whose values were estimated by least square method.

Maturity stages of \( C. \) lucerna were classified according to Nikolsky (1963) into six maturity stages [I and II: immature stage, stage III: mature, stages IV and V: mature/ripe and running and VI: spent]. The length at first sexual maturity was obtained as the length of which 50% of all individuals are sexually mature (Pitt, 1970). Gonado-somatic index values GSI = (Gonad weight/Gutted weight)*100. Sex ratio was determined as the percentage of Males to Females (M: F). According to Moreau et al. (1986), the following equations were adopted to estimate the growth performance of \( C. \) lucerna. \( \Phi L = \log k + 2 \log L_\infty \) (for length) and \( \Phi W = \log K + 2/3 \log W_\infty \) (for weight).

**RESULTS**

**Length composition:** Of the 873 specimens measured, 302 were male (34.59%) and 498 were female (57.04%). The total length of males ranged from 12.6 to 23.3 cm, while it was higher for females and ranged from 11.8 to 28.2 cm (Fig. 1).

**Growth in length:** The maximum life span of \( C. \) lucerna was four years for males and five years for females, age group II was the most frequent group in the catch, constituting 40.73% for males and 42.57% for females. Growth in length and the average back calculated lengths by age groups were identified for \( C. \) lucerna as 14.13, 17.87, 20.78 and 22.91 cm for 1st, 2nd, 3rd and 4th year for males and 13.33, 17.60, 20.97, 23.60 and 25.52 cm for 1st, 2nd, 3rd, 4th and 5th year for females, respecting the growth of \( C. \) lucerna had a high rate during the first year of life, then the annual growth rate rapidly drop (Table 1).
Table 2: Back calculated weights with age of *C. lucerna* from the Egyptian Mediterranean water off Alexandria

<table>
<thead>
<tr>
<th>Age (Year)</th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Observed weight (g)</td>
<td>Calculated weight (g)</td>
<td>% of increment</td>
</tr>
<tr>
<td>I</td>
<td>89</td>
<td>29.050</td>
<td>24.460</td>
<td>20.67</td>
</tr>
<tr>
<td>II</td>
<td>123</td>
<td>64.020</td>
<td>52.570</td>
<td>23.75</td>
</tr>
<tr>
<td>III</td>
<td>79</td>
<td>90.600</td>
<td>85.990</td>
<td>28.24</td>
</tr>
<tr>
<td>IV</td>
<td>11</td>
<td>124.35</td>
<td>118.34</td>
<td>27.34</td>
</tr>
<tr>
<td>V</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 3: Parameters of the vonBertalanffy growth equation and Φ values of *C. lucerna*

<table>
<thead>
<tr>
<th>Sex</th>
<th>No</th>
<th>L∞</th>
<th>K</th>
<th>t₀</th>
<th>W∞</th>
<th>ΦL</th>
<th>ΦW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>302</td>
<td>29.77</td>
<td>0.274</td>
<td>-1.36</td>
<td>278.22</td>
<td>2.39</td>
<td>1.07</td>
</tr>
<tr>
<td>Females</td>
<td>498</td>
<td>32.36</td>
<td>0.255</td>
<td>-1.09</td>
<td>357.77</td>
<td>2.44</td>
<td>1.13</td>
</tr>
</tbody>
</table>

Length-weight relationship: The total length of males ranged between 12.6 and 23.3 cm in size and from 13.6 and 123.3 g in weight, while females ranged from 11.8 to 28.2 cm in length and from 12.6 to 232.5 g in weight. The most abundantly captured specimens ranged from 16.0 to 19.0 cm and from 15.0-19 cm for males and females respectively. Positive allometric growth was observed for both males and females (Fig. 2). The relationships obtained were, \( W = 0.0043 \times L^{3.2644} \) for males and \( W = 0.0042 \times L^{3.2651} \) for females.

Growth in weight: The calculated weights by age groups were 24.46, 52.57, 85.99 and 118.38 g for the 1st, 2nd, 3rd and 4th year of life for males. While back calculated weights for females were 20.20, 49.04, 86.85, 127.65 and 164.76 g for 1st, 2nd, 3rd, 4th and 5th year of fish life. The growth rate in weight was much slower during the first year of life and then the annual growth increment in weight increased reaching its maximum at the end of the third and fourth year of life for males and females respectively (Table 2).

Growth parameters and growth performance: The estimated vonBertalanffy growth parameters for *C. lucerna* were; \( L_\infty = 29.77 \) cm, \( W_\infty = 278.22 \) g, \( K = 0.274/\text{y} \) and \( t_0 = -1.36 \) y for males and \( L_\infty = 32.36 \) cm, \( W_\infty = 357.77 \) g, \( K = 0.255/\text{y} \) and \( t_0 = -1.09 \) y for females. The growth performance (ΦL) for length was found to be 2.39 and 2.44 for males and females respectively. On the other hand, the growth performance for weight (ΦW) was found to be 1.07 and 1.13 for males and females, respectively (Table 3).

Gonado-somatic index: Figure 3 shows the monthly variation of the Gonado-somatic index values, the lower values were recorded in July (0.61 and 0.70 for males and females, respectively). Meanwhile the higher values which obvious the spawning season found to be from November to February with a peak in January (3.19 and 8.10 for male and female respectively), generally, the average values of gonado-somatic index of females are much greater than those of males.

Length and age at first maturity: In all individual, fish less than 13 cm length are immature. Larger fishes show an increasing in the frequency of mature specimens, while fish longer than 20 cm are fully mature. Length at 50% of maturity for males and females found to be at the total length of 15 and 15.2 cm, respectively. This length corresponds to 1.21, 1.40 years for males and females respectively (Fig. 4).

Sex ratio: The fluctuation in the sex ratio was examined in the different months of the year and the
DISCUSSION

Females of *C. lucerna* of the Egyptian Mediterranean waters off Alexandria reach greater lengths than males. This difference is the most common pattern found in other locations (Table 4). Papaconstantinou (1984) declared that, females up to 77 cm, while males were no longer than 35 cm TL. The length at age and von Bertalanffy parameter estimates showed that *C. lucerna* is a relatively fast-growing and moderately long-living species, like other triglid species (Boudaya *et al.*, 2008).

The oldest fish recorded in the present study was 4 years old for males and 5 years for female. The study material shows that, females seem to have a slower growth rate and larger maximum length and age than males; the males of *C. lucerna* were attaining approximately 62% of its maximum adult size during the first year of life compared with 52% for the females. After completion of the first year, the annual growth rate drops rapidly in both sexes. A similar result

---

**Fig. 5:** Monthly variation of *C. lucerna* from the Egyptian Mediterranean water, off Alexandria

data available are given in (Fig.5), it is concluded that, females were higher in occurrence than males throughout the whole period of investigation, representing with 62.53% of the total fish with sex ratio (M/F = 1:1.67). The chi-square value was (50.63; p<0.05).

**Table 4**: Maximum length of *C. lucerna* from different locations

<table>
<thead>
<tr>
<th>Location</th>
<th>Max.L (males)</th>
<th>Max.L (females)</th>
<th>Max.L (combined)</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Sea</td>
<td>60</td>
<td>70.0</td>
<td></td>
<td>Banaruseu (1964)</td>
</tr>
<tr>
<td>Morocco</td>
<td>36</td>
<td>61.0</td>
<td></td>
<td>Collignon (1968)</td>
</tr>
<tr>
<td>Cataln Sea</td>
<td>20</td>
<td>25.0</td>
<td></td>
<td>Mouneimne (1971)</td>
</tr>
<tr>
<td>Adriatic Sea</td>
<td>60</td>
<td>70.0</td>
<td></td>
<td>Soljan (1975)</td>
</tr>
<tr>
<td>Thermaikos Gulf</td>
<td>34</td>
<td>76.7</td>
<td></td>
<td>Papaconstantinou (1984)*</td>
</tr>
<tr>
<td>Douarnenez Bay</td>
<td>70.0</td>
<td></td>
<td></td>
<td>Baron (1985)</td>
</tr>
<tr>
<td>Yumotalik Bay</td>
<td>26.9</td>
<td></td>
<td></td>
<td>Eryilmaz and Meric (2005)</td>
</tr>
<tr>
<td>Tuscany Coast</td>
<td>70.0</td>
<td></td>
<td></td>
<td>Uckun and Togulga (2007)*</td>
</tr>
<tr>
<td>Iskenderun Bay</td>
<td>21.2</td>
<td>30.3</td>
<td></td>
<td>Serena <em>et al.</em> (1998)</td>
</tr>
<tr>
<td>Sea of Marmara</td>
<td>36.5</td>
<td>41.5</td>
<td></td>
<td>Ismen and Ismen (2004)</td>
</tr>
<tr>
<td>Izmir bay</td>
<td>29.9</td>
<td>34.4</td>
<td></td>
<td>Eryilmaz and Meric (2005)</td>
</tr>
<tr>
<td>Gulf of Gabes</td>
<td>26.0</td>
<td>36.0</td>
<td></td>
<td>Uckun and Togulga (2007)*</td>
</tr>
<tr>
<td>Egyptian Mediterranean</td>
<td>23.3</td>
<td>28.2</td>
<td></td>
<td>Boudaya <em>et al.</em> (2008)</td>
</tr>
</tbody>
</table>

**Table 5**: Average length (cm) at different age groups of *C. lucerna* in different locations

<table>
<thead>
<tr>
<th>Authors</th>
<th>Location</th>
<th>Sex</th>
<th>0</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Papaconstantinou, 1984*</td>
<td>Thermaikos (Greece)</td>
<td>F</td>
<td>14.57</td>
<td>18.19</td>
<td>22.60</td>
<td>26.39</td>
<td>31.70</td>
<td>35.66</td>
<td>38.40</td>
<td>43.27</td>
<td>--</td>
<td>61.10</td>
<td></td>
</tr>
<tr>
<td>Baran, 1985</td>
<td>Douarnenez (France)</td>
<td>M</td>
<td>15.24</td>
<td>18.26</td>
<td>21.84</td>
<td>26.05</td>
<td>30.33</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Faltas and Egyptian</td>
<td>Tuscany (Italy)</td>
<td>M</td>
<td>11.79</td>
<td>18.84</td>
<td>24.33</td>
<td>28.23</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Abdallah, 1997</td>
<td>Mediterranean</td>
<td>F+M</td>
<td>13.20</td>
<td>19.10</td>
<td>24.00</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Ismen and Ismen, 2004</td>
<td>Iskenderun Bay (Medit.)</td>
<td>M</td>
<td>13.20</td>
<td>19.60</td>
<td>24.60</td>
<td>30.30</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Meric, 2005</td>
<td>Sea of Marmara</td>
<td>M</td>
<td>15.20</td>
<td>17.31</td>
<td>24.97</td>
<td>31.93</td>
<td>39.93</td>
<td>41.50</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Uckun and Togulga, 2007*</td>
<td>Izmir Bay (Aegian Sea)</td>
<td>F</td>
<td>13.70</td>
<td>18.15</td>
<td>23.62</td>
<td>27.50</td>
<td>31.27</td>
<td>34.40</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>This study</td>
<td>Mediterranean</td>
<td>M</td>
<td>14.13</td>
<td>17.87</td>
<td>20.78</td>
<td>22.91</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>

*FL: Forked Length*
was reported by Papaconstantinou (1984) for *C. lucerna* and for the other triglid species (Staples, 1972; Elder, 1976; Hecht, 1977; Papaconstantinou, 1981, 1982, 1983; Baron, 1985; Booth, 1997; Wood-McPhail, 1997). Despite differences in ageing methodology, the overview of growth patterns in triglids reveals that most species reach at least 50% of their maximum size before sexual maturation and then show a decrease in growth (McEachran and Davis, 1970; Elder, 1976; Hecht, 1977; Papaconstantinou, 1982, 1983, 1984; Booth, 1997).

According to the studies carried out in different areas, it was determined that *C. lucerna* is mostly distributed between the age groups I-V. Resembling the present study, the majority of these populations are formed by these age groups. Papaconstantinou (1984) and Tsimenides *et al.* (1992) stated that the larger fish migrate to greater depths and this is more evident among females, mainly because of their greater length and life-span. Mean length values per age group are given in (Table 5).

The asymptotic length value (L_*∞*) is related to size of the largest individual in the area. The differences in growth rates between areas were probably related to different bio-ecological conditions, age determinations method and sampling depths and also fishing mortality. A comparison of growth performance values for males (2.39) and female (2.44) show that *C. lucerna* of the Egyptian Mediterranean waters off Alexandria had a slow growth performance compared with other studies except the study of Boudaya *et al.* (2008). He showed that, the growth performance for males and females of *C. lucerna* was 2.00 and 2.04, respectively. Growth performance and growth parameters values were compared with those observed by other studies in Table 6.

The length-weight relationship equation parameters for males and females from different studies are given in Table 7.

The overall sex ratio is in favor of females and no males were found in a size class higher than 23 cm TL.
The number of females was more than the number of males in all age groups, the predominance of females has also been observed in other studies. Considering that this findings may be related to the migration of older fish to deeper regions. According to Froglia (1976); Papaconstantinou (1984); Baron (1985); Serangeli et al. (1985) and Colloca et al. (1994), a clear relationship between size and depth has been observed. Juveniles of C. lucerna are distributed in shallow waters, where food is abundant (Colloca, 1999). Furthermore, the depth migration of juveniles during growth is very common in fishes (Helfman, 1978), particularly in sea-robin species (Lewis and Yerger, 1976; Richards et al., 1979). However, variation in size of the sexes can be explained by differences in growth and mortality (Turner et al., 1983; Kartas and Quignard, 1984).

Concerning reproduction, the gonado-somatic index values were computed in the present study, the reproduction of this species took place from November to February with peak in January for both sexes. Serena et al., (1998) reported that there is a clear shift of timing for the reproductive processes of C. lucerna between the Mediterranean and North Atlantic waters. These differences in spawning season may reflect different temperature regimes among these areas (Kashiwagi et al., 1987).

Generally, triglid males mature at a younger age and smaller size than females (Papaconstantinou, 1984; Baron, 1985 and Wood-McPhail, 1997). C. lucerna was maturing in males and females at 15.0 cm (1.21y) and 15.2 cm (1.40y), respectively. Papaconstantinou (1984) reported that maturity in males begins on completion of the third year while in females the fourth. Altun et al. (1997) stated that gurnards in Yumurtalik Bay achieve sexual maturity from the first year. Ismen and Ismen (2004) indicated that C. lucerna males mature at about 18 cm and females about 20 cm, when they are about 2 years old. Eryilmaz and Meric (2005) reported that males and females matured in their third year of life when they have a total length of 18.5 and 19.0 cm, respectively. This can be attributed to the average size of maturation being directly related to the population density and ecological conditions, particularly temperature that stimulates sexual maturation (Nikolsky, 1963; Kashiwagi et al., 1987).

In conclusion, control of fishing activity is achieved by enforcement of the current system and cover restrictions on species, fish sizes, mesh sizes, locations, breeding seasons, etc. The length frequency distribution of C. lucerna from the Egyptian Mediterranean waters off Alexandria suggests that this area is an important nursery ground for the species and, so such, should receive special consideration in any program for management of the fisheries in this zone. Also, the available data suggest that, C. lucerna smaller than 15cm must not be caught and fishing should be restricted between November and February.

REFERENCES


