# Population structure of Aegla castro Schmitt, 1942 (Crustacea: Anomura: Aeglidae) from Itatinga (SP), Brazil.

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**ABSTRACT: Population structure of Aegla castro Schmitt, 1942 (Crustacea: Anomura: Aeglidae) from Itatinga (SP), Brazil.** The population structure and the reproductive period of Aegla castro were studied herein aiming to acquire a better knowledge of this group and its role in limnic ecosystems. The anomurans residing Itaúna river at Itatinga, São Paulo, Brazil (23º 08' S and 48º 39' W) were monthly sampled from January to December, 1991. A total of 732 specimens were captured, 382 males and 350 females from which 17 were ovigerous. As far as their sex and carapace length are concerned (CL), mean animal size did not differ between sexes although males achieved greater dimensions. Ovigerous females occurred only during May and June characterizing a discontinuous reproductive cycle, while the recruitment of juveniles took place in October and November. Sex-ratio follows 1 : 0.92 (males:females). Comparatively, A. castro presents a similar population structure to its congenera species and as for the reproductive periodicity, it seems to decrease its period as latitude gets lower.
**Key-words:** population biology, recruitment, Aegla, Anomura.

**RESUMO: Estrutura populacional de Aegla castro Schmitt, 1942 (Crustacea: Anomura: Aeglidae) em Itatinga (SP), Brasil.** Este trabalho teve por objetivo estudar a estrutura populacional e o período reprodutivo de Aegla castro Schmitt, 1942, para um melhor conhecimento da biologia deste grupo, além de uma melhor compreensão de seu papel nos ecossistemas límnicos. Os anomuros foram coletados mensalmente, no Córrego Itaúna, município de Itatinga, São Paulo, Brasil (23º 08' S e 48º 39' W) durante o período de janeiro a dezembro de 1991. No laboratório, os espécimes foram separados quanto ao sexo e mensurados quanto ao comprimento da carapaça (CC). Obteve-se 732 exemplares, sendo 382 machos e 350 fêmeas, das quais 17 eram ovígeras. O tamanho médio não diferiu entre os sexos, porém os machos alcançaram maiores dimensões. A presença de fêmeas ovígeras em somente dois meses do ano (maio e junho) caracterizou um ciclo reprodutivo descontínuo. O recrutamento de jovens ocorreu nos meses de outubro e novembro, em consequência da presença de fêmeas ovígeras nos meses de inverno. A razão sexual para o total de indivíduos amostrados foi de 1 : 0,92 (macho:fêmea). Comparativamente, A. castro apresenta uma estrutura populacional similar às demais espécies do gênero e em relação ao período reprodutivo observa-se que existe uma nítida restrição deste período com a diminuição da latitude.
**Palavras-chave:** biologia populacional, recrutamento, Aegla, Anomura.

## Introduction

Anomurans of the family Aeglidae are represented only by one genera named Aegla, which is constituted by approximately 70 species. These organisms are endemic of the South American Neotropical region with geographic distribution in Brazil, Argentina, Chile, Uruguay and Bolivia (Martin & Abele, 1988; Bond-Buckup & Buckup, 1994).

The aeglids are the only one group of anomurans inhabiting continental waters. This fact makes those organisms very interesting for phylogenetic studies and adaptation

inferences. They are considered very important in the food chain of limnic environments, once they feed on insects and organic matter and are part of the food diet of amphibians and fishes.

There are just a few studies related with the biological aspects of Aegla in the literature, outstanding the papers of Bahamonde & Lopez (1961) with the reproductive, development and growth characterization of Aegla laevis laevis (Latreille, 1818); Lopez (1965) on the reproduction and migration of Aegla paulensis Schmitt, 1924 and Rodrigues & Hebling (1978) who studied some biological and morphometric aspects of Aegla perobae Hebling & Rodrigues,1977. Bond-Buckup et al. (1996), Bueno & Bond-Buckup (1996; 2000) and Bueno et al. (2000), studied, respectively, the biological aspects of Aegla prado Schmitt, 1924; Aegla violacea Bond-Buckup & Buckup, 1994 and Aegla platensis Schmitt, 1924 at Rio Grande do Sul. More recently, Pérez-Losada et al. (2002) studied the phylogenetic relationships among Aegla species of Chile. With reference to A. castro Schmitt, 1924 focused on the reproductive biology and ecological distribution in Ponta Grossa region (PR) were studied by Swiech-Ayoub & Masunari (2001 a and b), considered its south limit.

This study characterizes the population structure and reproductive period of the aeglid Aegla castro inhabiting the Itaúna river, Itatinga (SP), Brazil.

## Material and methods

Aegla castro Schmitt, 1942 is distributed restrictedly in the States of São Paulo and Paraná, with occurrence from Itatinga (SP) to Ponta Grossa (PR) (Bond-Buckup & Buckup, 1994). The present study was performed in Itaúna river near the city of Itatinga, São Paulo, Brazil (23º 08' S and 48º 39' W) in a headstream stretch in the "Cuesta" of Botucatu then it flows into Jurumirim reservoir, Paranapanema river (Uieda et al., 1997). The mean values of water physical and chemical parameters can be obtained in Afonso (1993).

Monthly samples were made from January to December 1991. A 1 kilometer stretch was covered by three people for a period of 2 hours, using a net (with a mesh of 4mm of pore) close to the rocks and leaves. The riparian vegetation is shaped by a shrubby vegetation, by pools (with 1m mean depth sandy bottom, deposition of plant detritus and water low speed) and riffles (with a mean depth of 30 centimeters, stony bottom and water high stream).

The specimens were kept in alcohol 70% and in the laboratory, they were sexed and measured for their carapace length (CL) including the rostrum, using an optic stereomicroscope. Crustaceans were classified in four groups of interest: males, adult females, ovigerous females and juvenils (based on the smallest ovigerous females size).

The sex-ratio was compared statistically by means of Goodman test (1964 and 1965). This analysis is based on the binomial proportion comparison for contrasts between and within multinomial population (Cury & Moraes, 1981). These results were analyzed at the 5% significance level. Median size differences in each month were tested using confidence intervals (5% ).

## Results

A total of 732 individuals were sampled during the studied period, including 382 males, 153 young, 180 adult females and 17 ovigerous, which were collected on May and June. The largest specimen had a 27.02 mm CL, nevertheless, the mean size for adult males and females was quite the same and around 17.00 mm of CL. The ovigerous females size ranged from 11.80 to 23.26 mm of CL (Tab. I)

The frequency distribution in size classes of the population is shown in Fig. 1 and Tab.II. The recruitment in the studied area, represented by the specimens of both sexes belonging to the size-classes 1 to 4, (from 1.5 to 11.5 mm CL), occurred only from October to December (Fig. 2 and 3).

The sex-ratio considering all the specimens was not significantly different ($p>0.05$), being close to 1:1 (1 male to 0.92 females). Monthly sex ratio values was significantly different on May, June, July and August (biased to males) and on January and September (biased to females) (Tab. III). The proportion of males in different size classes is shown in Fig. 4, with significantly differences mainly in the last classes.

Table I: Number of specimens (N) of Aegla castro and minimum and maximum sizes in each class interest group (total males, total females, juvenile females, adult females and ovigerous females) (sd = standard desviation).

| Interest class | N | Minimum (mm) | Maximum (mm) | Mean ± sd (mm) |
|---|---|---|---|---|
| Total males | 382 | 3.30 | 27.02 | 12.54 ± 5.71 |
| Total females | 350 | 3.30 | 25.50 | 12.88 ± 5.43 |
| Juvenile females | 153 | 3.30 | 11.50 | 7.64 ± 2.37 |
| Adult females | 180 | 11.56 | 25.50 | 17.00 ± 3.14 |
| Ovigerous females | 17 | 11.80 | 23.26 | 16.61 ± 3.53 |

Table II: Total number of collected specimens of Aegla castro by size class in the interest groups.

| Size classes (mm) | Males | | Young females | | Adult females | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Non ovigerous | | Ovigerous | | | |
| | N | % | N | % | N | % | N | % | N | % |
| 1.5 ---| 4.0 | 7 | 0.97 | 6 | 0.83 | 0 | 0 | 0 | 0 | 13 | 1.78 |
| 4.0 ---| 6.5 | 49 | 6.70 | 48 | 6.56 | 0 | 0 | 0 | 0 | 97 | 13.25 |
| 6.5 ---| 9.0 | 61 | 8.33 | 51 | 6.97 | 0 | 0 | 0 | 0 | 112 | 15.30 |
| 9.0 ---| 11.5 | 75 | 10.25 | 48 | 6.56 | 0 | 0 | 0 | 0 | 123 | 16.80 |
| 11.5 ---| 14.0 | 68 | 9.29 | 0 | 0 | 42 | 5.74 | 5 | 0.68 | 115 | 15.70 |
| 14.0 ---| 16.5 | 39 | 5.33 | 0 | 0 | 27 | 3.69 | 3 | 0.40 | 69 | 9.43 |
| 16.5 ---| 19.0 | 24 | 3.28 | 0 | 0 | 72 | 9.84 | 3 | 0.40 | 99 | 13.52 |
| 19.0 ---| 21.5 | 14 | 1.91 | 0 | 0 | 25 | 3.42 | 5 | 0.68 | 44 | 6.00 |
| 21.5 ---| 24.0 | 30 | 4.10 | 0 | 0 | 12 | 1.64 | 1 | 0.14 | 43 | 5.88 |
| 24.0 ---| 26.5 | 14 | 1.91 | 0 | 0 | 2 | 0.27 | 0 | 0 | 16 | 2.20 |
| 26.5 ---| 29.0 | 1 | 0.14 | 0 | 0 | 0 | 0 | 0 | 0 | 01 | 0.14 |
| Total | | 382 | 52.20 | 153 | 20.90 | 180 | 24.60 | 17 | 2.30 | 732 | 100 |

Table III: Proportion between males and females of Aegla castro during the studied period.

| Month | Proportion (%) | |
|---|---|---|
| | Males | Females |
| January | 38.1 A | 61.9 B |
| February | 44.9 A | 55.1 A |
| March | 56.7 A | 43.3 A |
| April | 50.8 A | 49.2 A |
| May | 67.4 B | 32.6 A |
| June | 61.0 B | 39.0 A |
| July | 70.0 B | 30.0 A |
| August | 65.1 B | 34.9 A |
| September | 37.5 A | 62.5 B |
| October | 43.2 A | 56.8 A |
| November | 53.1 A | 46.9 A |
| December | 52.8 A | 47.2 A |

* Each line with least one same letter did not differ statistically ($p > 0.05$).

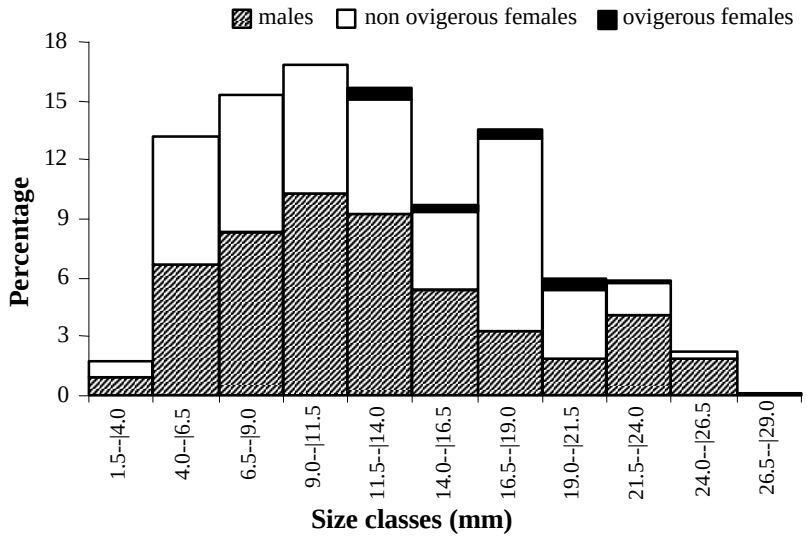


Figure 1: Total size frequency distribution (%) for the specimens Aegla castro for both sexes, sampled in Itatinga river.

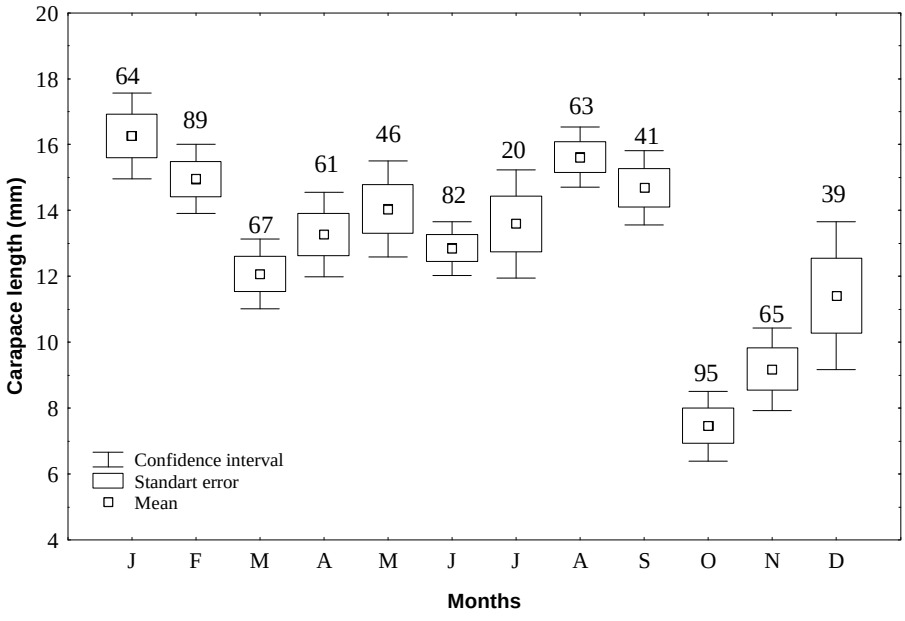


Figure 2: Box plot of the mean, standard error and confidence interval ($p<0.05$) for the carapace length of Aegla castro (the values above the boxes indicate the number of specimens for each collecting month).

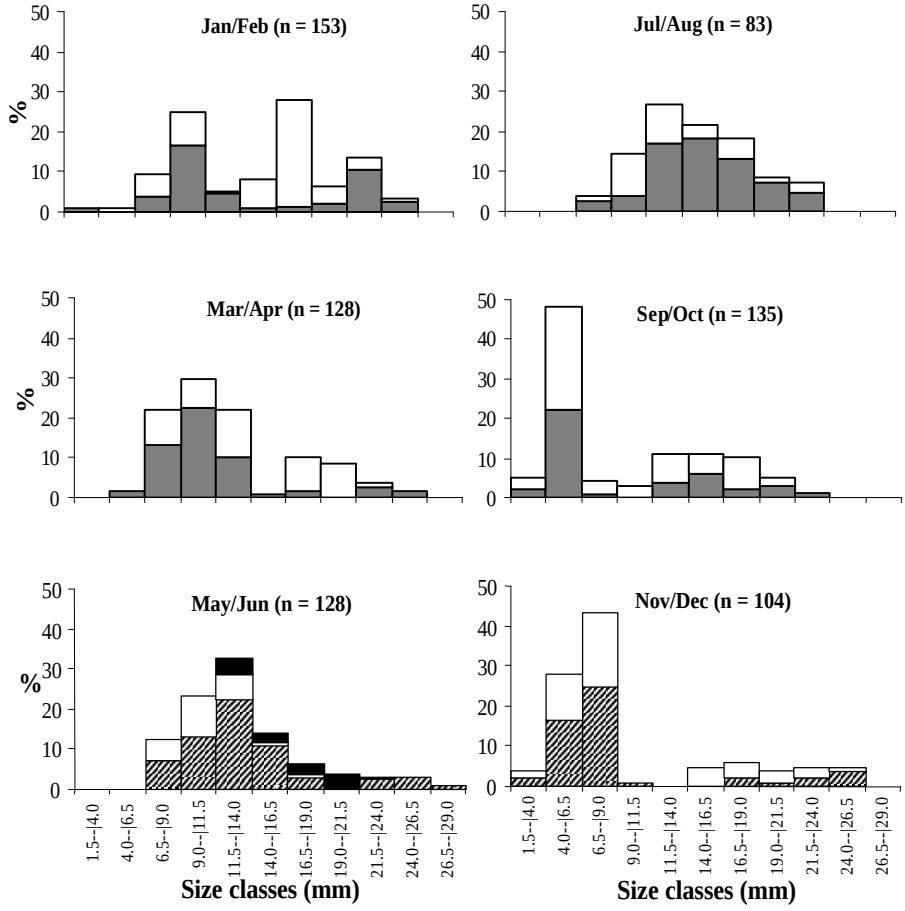


Figure 3: Seasonal size-class frequency distribution of specimens of **Aegla castro** (males ▨; non ovigerous females □; ovigerous ■).

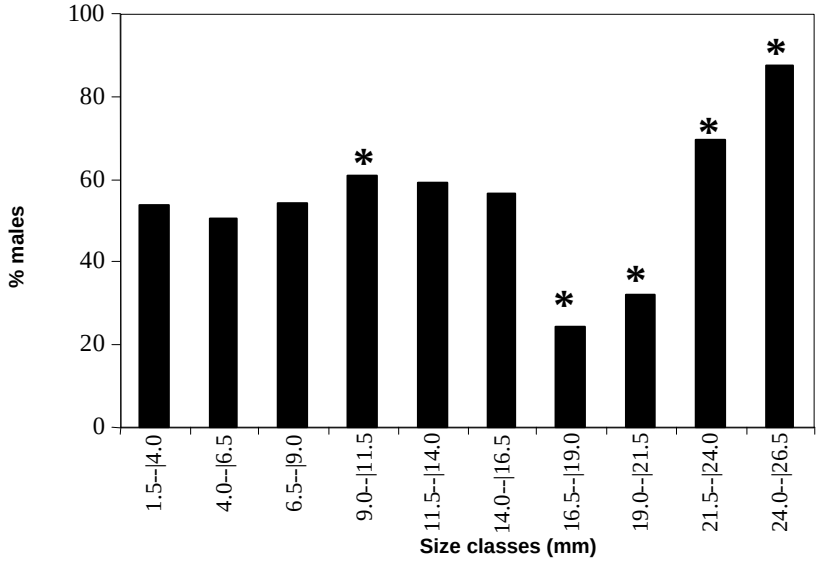


Figure 4: Sex ratio of Aegla castro as a percentage of males in relation to size. * significant deviation

## Discussion

As observed by Swiech-Ayoub & Masunari (2001a) A. castro was also collected in shading and sheltered sites in the stream, which occurred mainly under rocks and close to plant fragments.

The frequency distribution of A. castro did not show unimodality for both the total of specimens and seasonal aspects. According to Díaz & Conde (1989), bimodality and/or polymodality generally reflects recruitment pulses, different mortality rates between sexes and/or behavioral differences (e.g. cryptic habitat, migration). Different patterns of size distribution were found for males and females in the present study. Such patterns and the biased sex ratio probably can be attributed to such factors as differential mortality and growth rates between sexes and migration (Wenner, 1972; Hartnoll, 1982) with males reaching larger sizes.

The natural selection may favor larger males if they have an advantage over small ones, either in competition for receptive females and/or more frequent successful copulation (Abrams, 1988). As for A. castro, males also presented a maximum size amplitude higher than females, as it was found in studies performed on other species of Aeglidae, such as A. laevis laevis, A. perobae, A. platensis and A castro, respectively by Bahamonde & Lopes (1961), Rodrigues & Hebling (1983), Bueno et al. (2000) and Swich-Ayoub & Masunari (2001a). These species may be considered as having the intermediate size when compared to those of same genera (e.g. A. parana may achieve 52.3 mm of carapace length, according Bond-Buckup & Buckup, 1994).

These species of Aegla are of similar size independently of sex, and thus there is no evident sexual dimorphism, which is usually observed in hermit crabs such as Petrochirus diogenes and Paguristes erythrops, respectively studied by por Bertini & Fransozo (1999) and Garcia & Mantelatto (2001). Probably, the small difference concerning size, between males and females, is inherent from different energetic wastes attributed to reproductive and growth activities. Females produce and incubate their eggs while males go more towards growth (Reigada & Santos, 1997; Fransozo & Mantelatto, 1998). Aegla presents epimorphic development (which is characterized by the hatching as juvenil forms) with females showing parental care (Rodrigues & Hebling, 1978), who found A. perobae under maternal abdome 8 to 12 days after hatching, and just then, living freely in the water.

According to Wenner (1972) most of crustaceans present a 1:1 sexual ratio. These difference may be related to differential growth and mortality, restriction of nutrition, behavioral differences, reproductive migration and differential use of habitat by each sex (Fransozo & Mantelatto, 1998). The mean sexual size of A. castro was close to the expected value; thus, we can infer the studied population is well-established and stable in such area, mainly in terms of migration and mortality rates of specimens. The occurrence of greater numbers of males than females in the some months, coinciding with the period of more ovigerous females, may be explained by behavioral differences such as greater male exposition during this period.

The size classes sexual ratio showed no charge up to the 6$^{th}$ class (14.0 to 16.5 mm), after which a modification favoring females occurred until the 8$^{th}$ class, and the last three classes, in which males prevailed. For A. castro, the pattern of sex-ratio changed according to season and size classes. It is an indicative that this sex-ratio pattern can be related to environmental features. Such variations were also reported to other Aegla species (Bueno & Bond-Buckup, 2000; Swiech-Ayoub & Masunari, 2000).

Studies performed on species of hermit crabs belonging to a same genus revealed there is no general pattern for the sex ratio. The explanation for the occurrence of such deviation in some classes can be due to the segregation of one the sexes, as observed by Gherardi & Nardone (1997).

Due to the fact of the specimens studied herein have been collected in this species geographical north limit (Bond-Buckup & Buckup, 1994), the environmental conditions may be influencing the reproductive period, mainly when compared with species from

other latitudes. The occurrence of ovigerous females on May and June only, characterize a discontinuous reproductive cycle. This restriction of A. castro was also reported to other congenera species studied by Bahamonde & Lopes (1961) and Rodrigues & Hebling (1978).

As far as the samples of Swich-Ayoub & Masunari (2001a) are concerned, the reproductive period is extended from May to October, in Ponta Grossa region, characterizing two young recruitment picks, one in the spring and the other in the summer. The occurrence of the recruitment in the spring period demonstrate a discontinuous establishment of the population with a peak of incidence around three months after the peak of ovigerous females. Similar results to A. paulensis and A. platensis were found by Lopez (1965), Bueno & Bond-Buckup (2000) and Bueno et al. (2000). Nevertheless, Bueno and Bond-Buckup (2000), studying A. platensis, found a reproduction practically continuous, with a greater capture of ovigerous females in winter months and none on November and December. This can be explained by the fact that this study was conducted in a region with lower temperatures, which might be favoring the continuity of physiological processes, once the genera Aegla is restricted to subtropical and temperate regions meaning that the increase of reproductive period would be related to the increase of latitude. In this sense, the Aeglidae have high plasticity in their biological process, marked by different strategies adopted by population of the same species in different localities.

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