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Epibiosis and molting in two species of *Callinectes* (Decapoda: Portunidae) from Brazil

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Abstract: The external infestation of *Callinectes ornatus* Ordway, 1863 and *Callinectes danae* Smith, 1869, in particular cirripeds, was studied for two consecutive years in the Ubatuba Bay (SP) (23° 26' S and 45° 02' W). Bryozoans, polychaetes and cirripeds were found on both swimming crab species, but cirripeds were the most abundant and frequent. The number of infested swimming crabs increased proportionally to carapace size, but not surpassing 30 %, suggesting an absence of terminal anecdysis in both species. The establishment of the pernicious organisms on their hosts is influenced by other factors, such as their habit of burying themselves in sediments. The correlation between molting activity in adult specimens of both sexes and the low incidence of epizoonts suggest that *C. ornatus* and *C. danae* may be molting after maturity.

Key words: Epibiosis, infestation, swimming crab, Portunidae, Cirriped, molt.

Epibiosis is a common colonization mechanism widely used by benthic sessile marine organisms (Wahl 1989, Abelló *et al.*1990). According to Gili *et al.* (in prep.) epibiosis allows the survival of many benthic species which have adapted their morphology and population dynamics to the characteristics of the substratum on which they settle. Many epibiont species have short life cycles and high growth and reproductive rates (Jackson 1977, Seed 1985, Gili *et al.*, in prep.).

Finding a suitable substratum to settle on is considered one of the most important problems of sessile benthic organisms. Scarcity of available space is a limiting factor for species in need of hard, stable substrate on which to develop, especially in marine subtidal habitats where mostly soft sediments prevail (Connell and Keough 1985). In these habitats, the colonization of other animals by sessile organisms is one of their few survival options. According to Ross (1983), the decapod crustaceans are one of the animals colonized by these organisms.

Epibiont species may be considered representative organisms of initial stages in a succession, since the periodical renewal of the substrate due to molting does not allow a succession to stabilize (Abelló *et al.* 1990). The size and renewal time of the substrate are factors that affect the distribution patterns of the epibiont population within the host population (Connell and Keough, 1985).

Since a close relationship between the extent of epibiosis and the host population structure must develop. The study of epibiont distribution and occurrence patterns on their hosts can therefore provide valuable information about biological, behavioral and ecological features of the host population.

The life history of the blue crab, *Callinectes sapidus*, has been the subject of many studies (Churchill 1918, van Engel 1958, Jonhson 1980, Cameron 1985, Haefner 1990). The molt from the juvenile to the mature stage has historically been considered the "terminal" or "final" molt for blue crab females. But, there are some doubts as to the existence of the ter-

minal anecdysis in *Callinectes* species based on studies showing a second terminal molt (Abbe 1974, Olmi 1984).

The purpose of this research is to study the external infestation of *Callinectes ornatus* Ordway, 1863 and *Callinectes danae* Smith, 1869 by sessil invertebrates, particularly cirripeds, in order to strengthen the hypothesis of the molt continuity.

MATERIAL AND METHODS

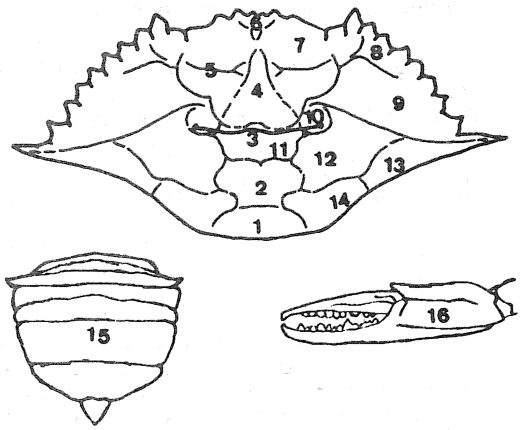
C. ornatus is an essentially tropical species found mainly on sandy and muddy bottoms, at depth of up to 75 meters . Its occurrence in bays and river mouths indicates its tolerance of a broad range of salinities. Therefore, according to Williams (1974) most specimens collected are from areas of high salinities.

C. danae is a common Brazilian species found in muddy estuaries, mangroves, beaches and deeper waters (up to 75 meters). The tolerance levels are not recorded, but the range of salinity, where it can be found, indicates occurrence either in freshwater as well as in salt water and even in hypersaline lagoons (Williams, 1974).

An otter-trawl was used to collect the samples every other month from January 1991 to December 1992 in the Ubatuba Bay (SP) (23° 26' S and 45° 02' W). The identification of the swimming crabs was based on Williams (1974) and confirmed by Gustavo A. S. Melo from the "Museu de Zoologia da Universidade de S„o Paulo", Brazil. Cirripeds were identified by Paulo S. Young from the "Museu Nacional do Rio de Janeiro", Brazil.

In the laboratory, the following data were collected: sex, size and molting stage of the swimming crabs, as well as the occurrence and localization of the fouling organisms. The carapace width (in milimeters), except the lateral spines, was adopted as a swimming crab size. Individuals were then distributed in 10 different size classes. Swimming crabs bearing detrimental organisms were considered infested animals. The number of epibionts and their localization on each portunid were recorded to allow analyses of epibionts site preference on the swimming crab's body. The carapace, the abdomen, and the cheliped were divided into areas (Fig. 1). The infestation percentage for each sample obtained was calculated for each portunid species and the mean rate of infestation in each sex was established. The t test was used to compare infestation rates ($P < 0,05$) (Vieira, 1981).

Using only swimming crabs in intermolt stage, the mean number of epibionts in each size class was also determined.



1 Intestinal
2 Cardiac
3 Metagastric
4 Mesogastric
5 Protogastric
6 Frontal
7 Orbital
8 Hepatic
9 Epibranchial
10 Branchial Lobe
11 Urogastric
12 Mesogastric
13 Postero-lateral
14 Metabranchial
15 Abdome
16 Chelipeds

Fig. 1. Swimming crab body areas as used in this study.

RESULTS AND DISCUSSION

The sessile organisms found attached to both studied species were Bryozoans, Polychaetes and Cirripeds. The Cirripeds were the most abundant and frequent (Figs. 2 and 3). The following were registered: *Chelonibia patula* (Ranzini, 1818) and *Balanus venustus* Darwin, 1854 on *C. ornatus* and only *C. patula* on *C. danae*. The occurrence of these cirripeds has been mentioned on other Brachyuran species in several parts of the Atlantic. In Australia, Phillips and Cannon (1978) found *C. patula* living on *Portunus pelagicus*; in North America, Haefner (1985) registered. *C. patula* and *B. venustus* on *Ovalipes stephensoni*, and van Engel (1987) observed *B. venustus* on *Callinectes sapidus*. This indicates a wide distribution of Cirripeds in the Atlantic, where they can be found living on several shallow water Portunid species.

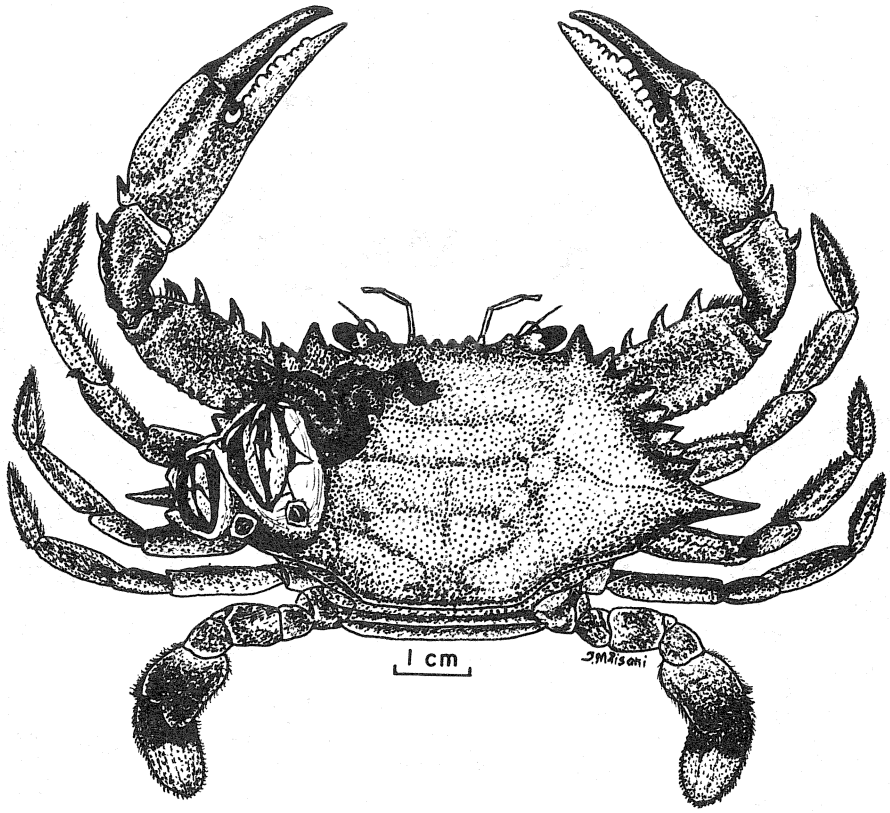


Fig. 2. Dorsal view of the infested swimming crab: Cirripeds and Polychaetes.

Skinner (1985) correctly assumed that during the Brachyuran molt cycle, the intermolt period is the longest such period of its life. As illustrated in Table 1, the highest incidence of infested swimming crabs was during the "C" molt stage (Haefner, 1976) for both studied species. This suggests that epibionts settle on the host during the "B" molt stage, develop in the "C" molt stage and are "discarded" during the E molt stage, in the ecdysis.

Infestation rates obtained for both swimming crab species during the sampling period are presented in Table 2. In *C. ornatus*, the mean percentage of infestation did not differ between sexes, but in *C. danae*, males were more infested than females.

The frequency distribution of *C. ornatus* and *C. danae* is presented in Fig. 4. These swimming crab species are infested to a greater extend in larger size classes.

TABLE 1

Percentage of colonized swimming crab by epizooits in relation to the molt stage

Species	Molt Cycle Stage				
	A	B	C	D	E
C. ornatus	0	6.6	92.9	0.5	0
C. danae	0	7.4	90.4	2.2	0

According to Abelló and Macpherson (1992), since Portunid molting is more frequent during the juvenile phases rather than in the adult phases, the size in which the epibiosis becomes important is probably related to the puberty molt.

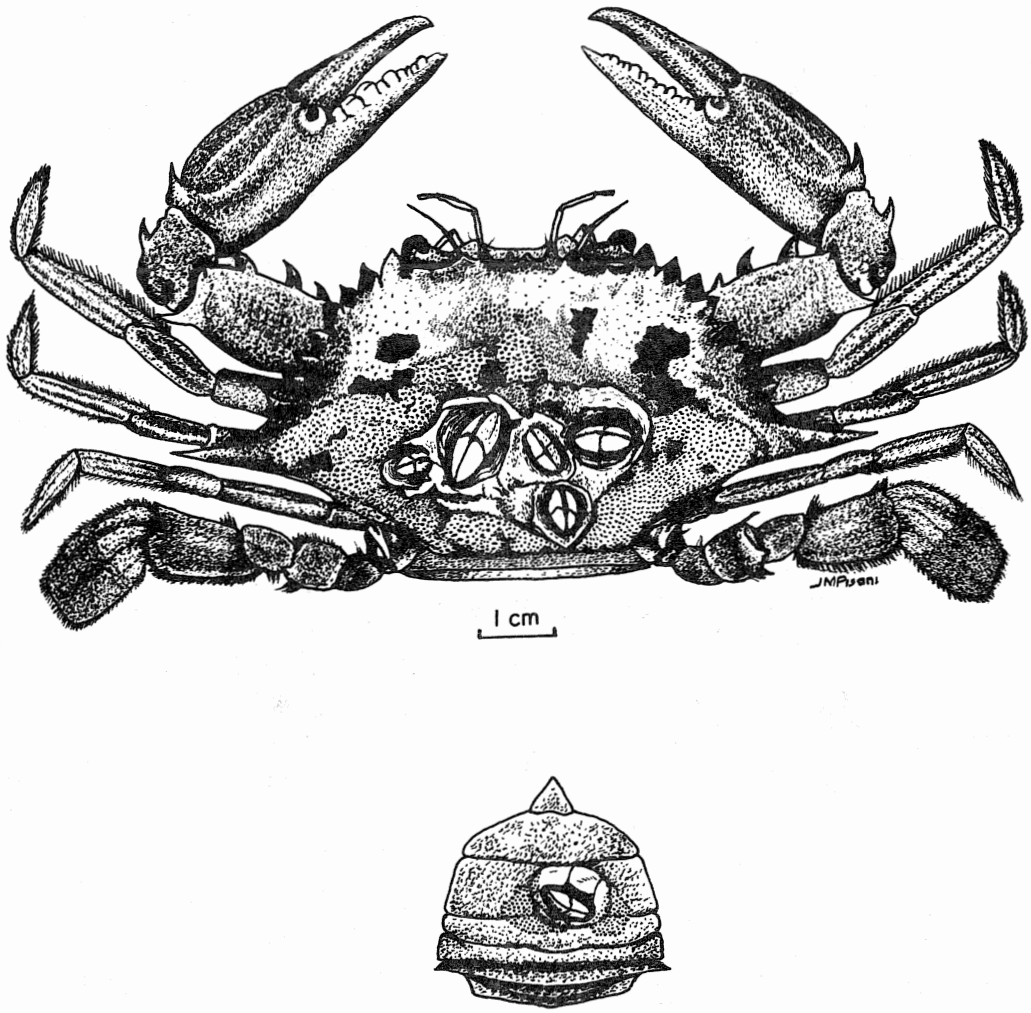


Fig. 3. Dorsal view of the infested swimming crab: Cirripeds and Bryozoans.

TABLE 2

*Infestation rate (%) on swimming crabs by epizooits. For the mean comparison between the sexes, it was utilized 5% of significance level (NS = not significative, *P>0.05)*

Species	Sex	Mean% and standard deviation	Variation Coefficient	Variance	tcal
C. ornatus					
	Males	8.0 ± 5.1	63.38	26.0	
					1.88 NS
	Females	4.1 ± 5.2	127.23	26.68	
C. danae					
	Males	21.5± 19.8	91.98	392.86	
					36.35*
	Females	13.7 ± 12.2	88.8	148.66	

The amount of infested swimming crabs of both species distributed in the size classes increases proportionally to Portunid growth, but not surpassing 30% (Fig.5).

Concerning the localization of epizooits on the body of both portunid species: the most frequent incrustation area is the protogastric area. On *C. danae*, the decreased incidence of epizooits in the metabranchial, posterolateral and epibranchial areas were also registered. On *C. ornatus*, the chelipeds presented the second highest epizooits incidence, followed by epibranchial area. Epizooits are present on the carapace in higher quantities than any other

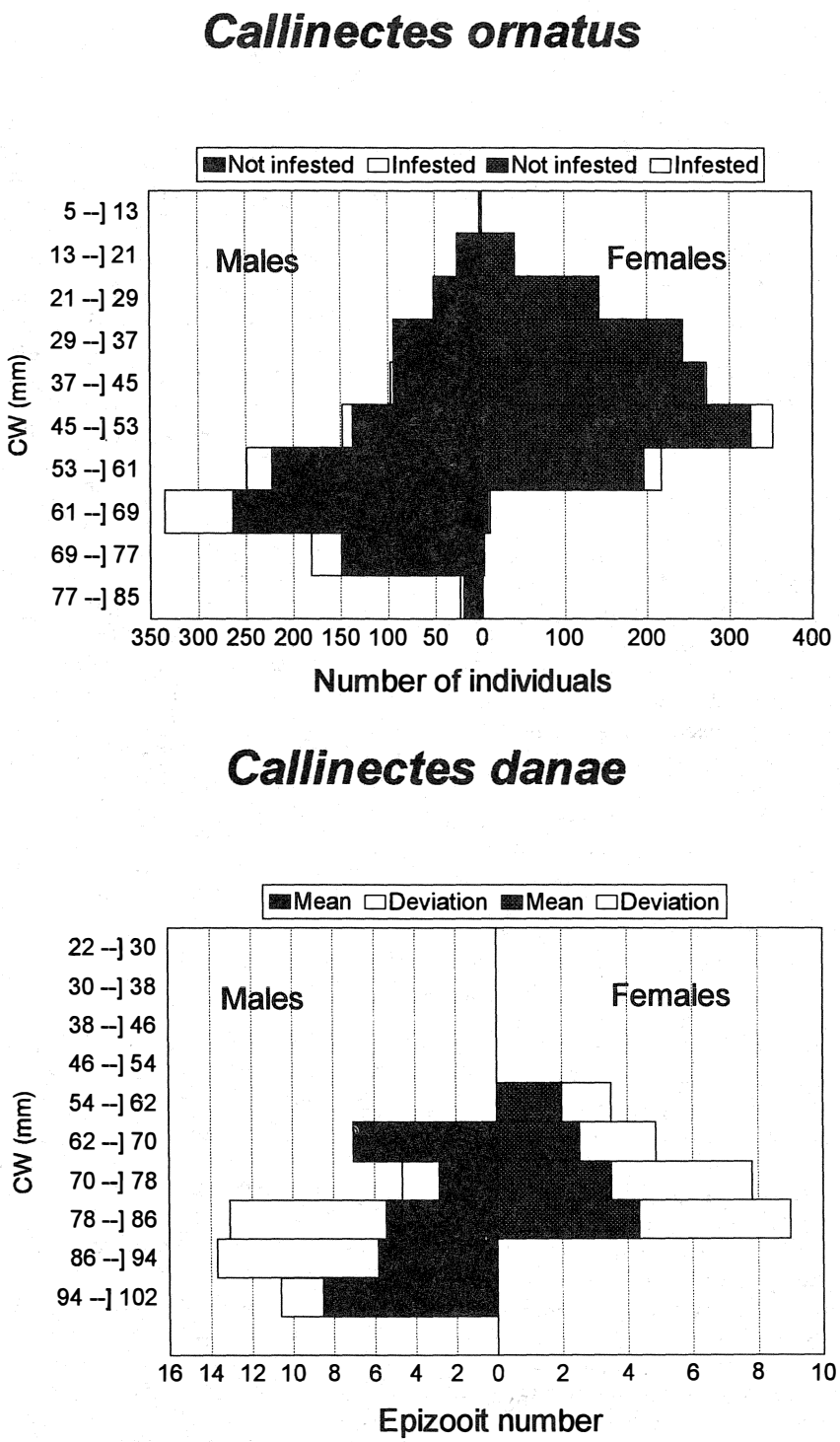


Fig. 4. Frequency distribution of the swimming crabs. (CW = carapace width).

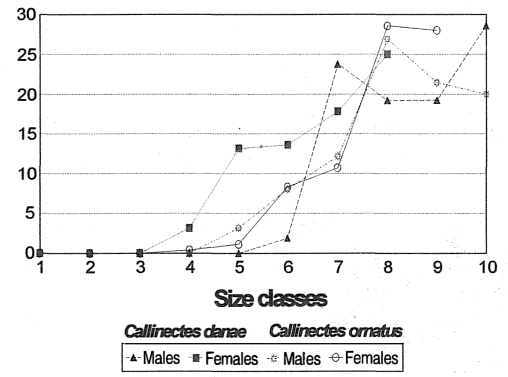


Fig. 5. Infestation rate.

region of body because this is the most exposed area of the crab even when buried.

As in Abelló *et al.* (1990) the incidence of epibiosis is probably directly proportional to the time elapsed since the last molt. Therefore, the epibiont occurrence pattern can be useful in ascertaining the existence of a terminal molt of the host, a process which is not well documented in several Brachyuran species.

A 100% colonization incidence in a Brachyuran by sessile invertebrates undoubtedly points toward terminal anecdyses, as affirmed by Abelló *et al.* (1990). Therefore we cannot assert, based only on the low incidence of infested swimming crabs, that *C. ornatus* and *C. danae* do not have terminal anecdysis. Other factors can prevent the settlement of these detrimental organisms on the host. At times, these portunids bury themselves in the sediment and at others they are highly locomotive. This can be a decisive factor in epizooit settlement and survival .

Fig. 6 indicates that initial size classes do not present epizooits on the swimming crab's body and, in both species, the number of epibionts varies greatly. Though epibiont population apparently increases with swimming crab size, the range of occurrence is extremely variable, indicating that the prevalence of epibiosis is probably more related to the molting frequency rather than to the availability of surface to settle on.

According to Negreiros-Fransozo and Fransozo (1994) *C. ornatus* and *C. danae* present a wide size range of ovigerous female. Therefore, in *C. ornatus* the ovigerous female width varies from 45 —] 53mm to 69 —] 77 mm, while in *C. danae*, they vary from 54 —] 61mm to 82 —] 89mm.

In this study some adult individuals evidenced limb buds. The molt activity, evidenced by the occurrence of the stages A, B, D or E of the carapace consistence in mature specimens, was verified for *C. ornatus* (Mantelatto, pers. com.) and for *C. danae* (Costa, pers. com.).

Havens and McConaugha (1990) in field and laboratory studies on *C. sapidus* assume that female blue crabs may enter a diapause stage at maturity and some may undergo an additional molt after their maturity. This assertion is based on the wide size range of ovigerous females, the capture of mature individuals with limb buds, the fact that there are few individuals with deteriorated carapaces and bearing epizoonts, and continual y-organ functionality in mature female blue crabs.

The low incidence of epizoonts on the studied species, the occurrence of wide size range of ovigerous females, the presence of limb buds in adult individuals, and the possibility of molt in mature females lead us to conclude that these species can be as *C. sapidus*, according to as assumed by Havens and McConaugha (1990). But more detailed physiological and behavioral experiments are necessary to clear up this problematical life history model.

RESUMEN

La infestación externa de *Callinectes ornatus* Ordway 1863 y *Callinectes danae* Smith 1869, por los invertebrados sésiles, con especial referencia a los cirripedios, se estudió en un lapso de dos años consecutivos en la ensenada de Ubatuba (SP) (23° 26' S y 45° 02' W). Briozoos, Poliquetos y Cirrìpedos fueron encontrados en las dos especies de jaibas. Los Cirripedios fueron los más abundantes y frecuentes. La cantidad de portunidos infestados aumentó con la talla del caparazón pero no excedió del 30%. Esto podrìa llevarnos a deducir que la muda terminal (anecdisis) no ocurre en las dos especies. El estabelecimiento de organismos incrustantes en los huespedes, puede estar influenciado por otros fatores como el hábito de las jaibas de enterrarse en el sedimiento. El registro de actividad de muda en

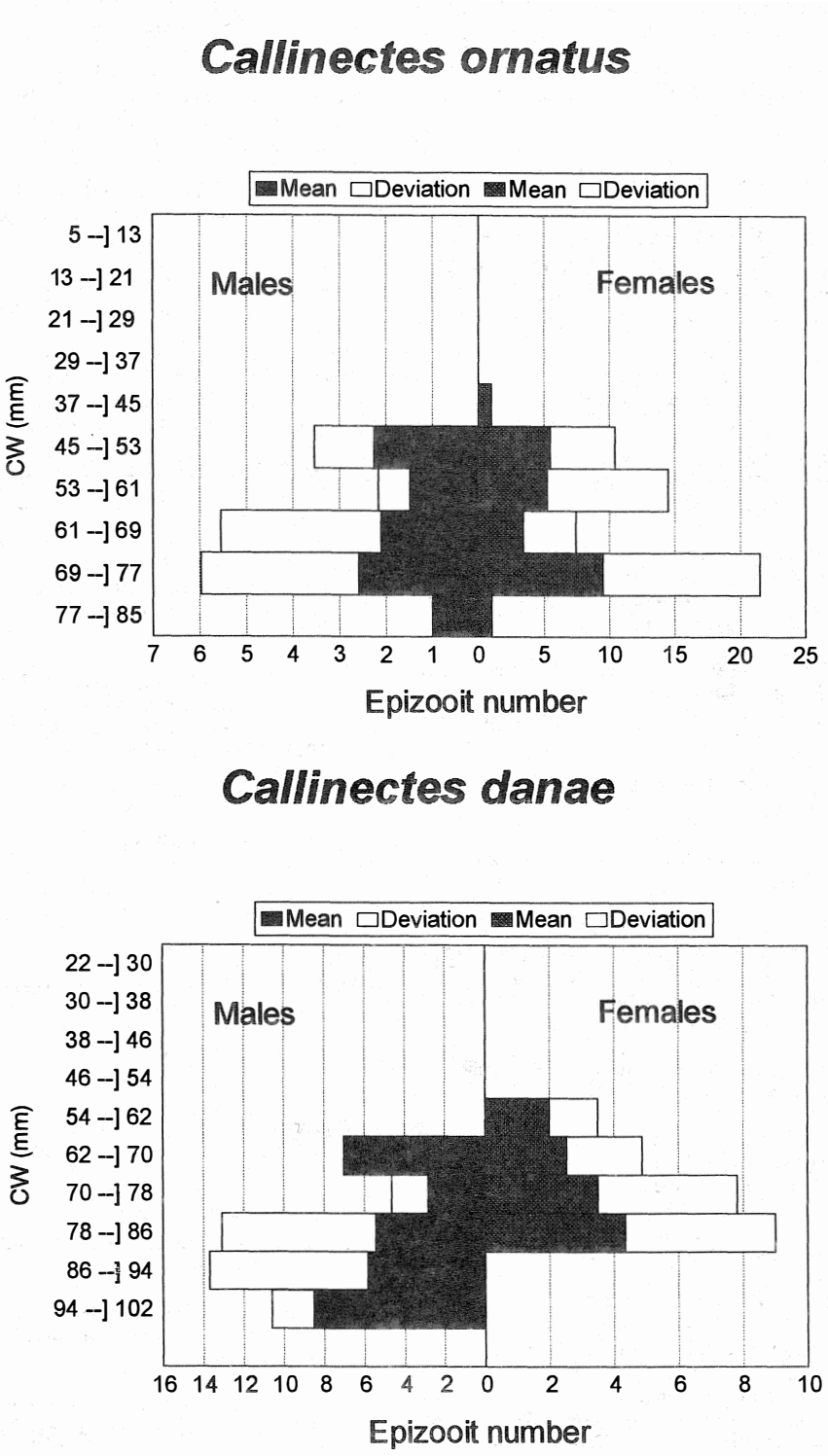


Fig. 6. Epizoit number. (CW = carapace width).

especímenes adultos de ambos sexos, asociado con la baja incidencia de epizoontes, sugiere que estas dos especies pueden continuar sufriendo ecdisis después de la madurez sexual.

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