Heterochely in *Eriphia gonagra* (Fabricius, 1781) (Crustacea, Decapoda, Xanthidae) of the rocky coast from Praia Grande, Ubatuba (SP), Brazil.

João Marcos de Góes
Adilson Fransozo

Departamento de Zoologia, Instituto de Biociências, UNESP,
Distrito de Rubião Junior, 18618-000, Botucatu (SP) - Brasil.
NEBECC (Núcleo de Estudos em Biologia, Ecologia e Cultivo de Crustáceos)

Aceito para publicação em 30/09/97

Resumo

A heteroquelia varia intensamente nas diferentes espécies de crustáceos decápodos, sendo que tal aspecto pode auxiliar na diferenciação sexual. O objetivo do presente estudo é determinar a ocorrência de heteroquelia para *E. gonagra* entre machos e fêmeas e também em animais de mesmo sexo, além da caracterização quanto a forma dos dentes da quela. Os indivíduos foram coletados no período de janeiro a dezembro de 1993; foram mensurados 465 animais nos quais ocorreu um predomínio da quela direita maior, a grande maioria com dentes molariformes. Os caranguejos são considerados os maiores predadores de moluscos, supondo-se que o "uso das mãos" ocorra pelo fato da maioria das conchas de gastrópodos marinhos serem dextrógiras. Tal condição de heteroquelia, coincide com o

padrão encontrado nas espécies de Xanthidae, diferindo da maioria das outras famílias de Brachyura.

Unitermos: Heteroquelia, Brachyura, Xanthidae, *Eriphia*, Ubatuba (SP).

Summary

Heterochely varies intensively among different species of decapod crustaceans, and this trait may be of help in sex differentiation. The aim of the present study was to determine the occurrence of heterochely between males and females of *Eriphia gonagra* and between animals of the same sex, as well as to characterize the shape of teeth of the chela. Specimens were collected from January to December 1993 and a total of 465 animals were measured. There was a predominance of larger right chelae, most of which presented molariform teeth. Crabs are considered to be the major predators of molluscs, and it may be supposed that the handedness occurs because most of the shells of marine gastropods are dextrogerous. This heterochely condition coincides with the pattern detected in other Xanthidae species and differs from most Brachyura families.

Key words: Heterochely, Brachyura, Xanthidae, *Eriphia*, Ubatuba (SP).

Introduction

The phenomenon of heterochely, that is, a difference in size and in function of chelipods in terms of side, varies considerably among the various species of decapod crustaceans. Therefore, it may be of help in sex differentiation. Heterochely is quite common among Pleocyemata, where it occurs in both sexes but especially in males. The dimorphic growth of these appendages has been interpreted as a consequence of the

common use of chelipeds by males in combat. This is the case for *Aratus pisonii*, studied by Warner (1970), and *Potamon fluviatile* studied by Gherardi et al. (1987). An exhibition function in *Uca* spp. (Crane, 1957), and courtship behavior in *Corystes cassivelaunus* (Hartnoll, 1968), have been reported.

Several authors have studied heterochely (Oliveira, 1940; Alcantara-Filho,1978; Ng and Tan, 1985; Haefner, 1990; Kaiser et al.,1990), but only a few studies are available about the biological aspects of the genus *Eriphia*, among them those reported by Vannini and Gherardi (1988) in *E. smithi* in Somalia, and, more recently, those reported by Nalesso (1993) in *E. gonagra* in the region of Juréia-Iatins, Brazil.

The aim of the present study was to determine the occurrence of heterochely between males and females of *E. gonagra* and between animals of the same sex, as well as to characterize the shape of the teeth of the chelae.

Material and Methods

The crabs used in the present study were collected monthly from January to December 1993 along the rocky coast of Praia Grande (23°28'02" S and 45°03'35" W) in the Ubatuba region, SP. Specimens were collected along the entire extension of the rocky coast, covering an area of approximately 1200 m^2 at low tide.

The measurements were made with the aid of a calipter precision 0.1 mm. Smaller animals were measured with the aid of a light stereomicroscope fitted with a light camera.

Two chelipeds were measured on each individual, in terms of chelar propod height (PH) using the greatest height, and propod length (PL) using the distance from the base of the ventral region to the end of the chelar finger (Figure 1).

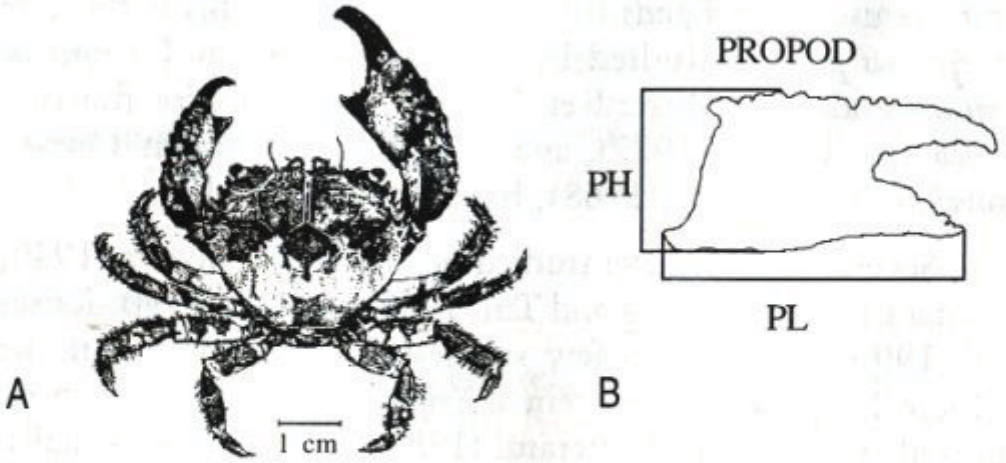

FIGURE 1. A: *Eriphia gonagra*, dorsal view. B: Variables measured.

In order to determine the possible occurrence of heterochely for *E. gonagra*, the percentages referring to the size of the largest chela for males and females, as well as the variation in propod height and length, were calculated. Teeth were also analysed to determine whether the most frequent type detected would be the molariform or the serratiform type.

Student t-test, to analyse the differences in mean male and female cheliped size and the differences between right and left chela between sexes, was used.

Results

The chelar propodus of 465 individuals, 212 males and 253 females, were measured. Mean chelar propodus lengths of right and left chelae were 16.55 ± 7.04 mm and 14.93 ± 6.68 mm, and average chelar propodus heights were 9.34 ± 3.99 mm and 7.98 ± 3.50 mm, respectively. Range and average values of chelar dimensions are shown in table 1 for each sex.

In both sexes, the rigth chela was usually larger. In almost all cases (97.4 %), the right larger chela showed molariform teeth (Table 2).

TABLE 1 - *Eriphia gonagra*. Size ranges related to chelar propod length and height.

Propod	Sex	Right			Left		
		Min	Max	Mean	Min	Max	Mean
Length	M	3.25	35.00	16.22 ±7.43 aA	2.00	35.85	14.82 ±7.35 aB
	F	3.37	32.85	16.77 ±6.73 aA	2.62	30.40	14.99 ±6.10 aB
	Total	3.25	35.00	16.55±7.04 aA	2.00	35.85	14.93±6.68 aB
Height	M	2.00	19.50	9.07 ±4.04 aA	1.50	19.80	7.90 ±3.82 aB
	F	1.07	24.80	9.53 ±3.97 aA	1.50	17.70	8.02 ±3.24 aB
	Total	1.07	24.80	9.34±3.99 aA	1.50	19.80	7.98±3.50 aB

Means followed by same small letters do not differ statistically (within sex comparisons) ($p>0.05$)
Means followed by same capital letters do not differ statistically (within side comparisons) ($p>0.05$)

TABLE 2 - *Eriphia gonagra*. Predominance of the larger chela and its classification in terms of shape of the teeth in males and females.

Sex	Larger chela							
	Right		Left		Molariform		Serratiform	
	N	%	N	%	N	%	N	%
Males	169	79.7	43	20.3	205	96.7	7	3.3
Females	205	81.1	48	18.9	248	98	5	2
Total	374	80.4	91	19.6	453	97.4	12	2.6

Discussion

Heterochely is the term applied to designate the condition of unequally sized chelae. Differences in size may also correspond to different functions, as observed in some brachyuran families such as Calappidae, Portunidae, Xanthidae, Grapsidae and Ocypodidae.

Among brachyuran crabs, the heterochelic condition may reveal cases of sexual dimorphism, as is the case of the genus *Uca*. Patterns of chelae exhibition may differ considerably within species, but chelar display is usually a means of perceptibly enlarging actual chelar size and therefore actual body size as well. During agonistic interactions, chelae are exhibited in horizontal movements so as to maximize the "enlarging" effect (Schöne, 1968; Wright,1968).

In our study, mean chelar propodus length and height of both chelipeds did not differ between sexes ($p>0.05$) in this species. This fact implies that there is no sexual dimorphism regarding cheliped size. However, when we compared the length and height of the right and left propods for males and females, a significant difference ($p<0.05$) was observed. Heterochely in the Xanthidae has also been described by Tweedie (1950), who stated that the right chela is usually larger than the left one in this family.

In the Xanthidae, the major chela bears strong and rounded teeth, commonly designated as molariform, whose main function is crushing. In the minor chelae, sharp teeth, so-called serratiform, are found instead. These teeth are mainly used for cutting purposes. It is worth mentioning that chelar morphology description is extremely important to support studies on the feeding habits of brachyurans, since their size and shape are a result of specific adaptations related to feeding on specific items, such as algae, organic matter in sediment, molluscs, etc. (Warner,1977).

Considering all specimens examined, in 80.4 % of crabs, the right chela was larger and almost always bore molariform teeth specialized in crushing. Similar results obtained by Vannini and Gherardi (1988) were recorded in *E. smithi*, in which 70 % of the population presented a larger right chela regardless of sex. The larger chela can also be differentiated because it is provided with a large tooth located in the inner portion of the chela, near the dactyl insertion (Vermeij, 1977).

Crushing molluscs have been described in *E. verrugosa* by Rossi and Parisi (1973), in *E. sebana* by Zisper and Vermeij (1978) and in *E. squamata* by Bertness and Cunningham (1981). However, in a field study on the xanthid *E. smithi*, Vannini et al. (1989) showed that this particular species should not be regarded as a specialist predator of gastropods. In laboratory experiments, *E. gonagra* preferably preyed on mussels (*Brachydontes solisianus* and small *Perna perna*), barnacles (*Chthamalus bisinuatus*) and green algae (*Ulva lactuca*), the latter identified as a component of its natural diet (Nalesso, 1993).

Considering that crabs are the main predators of molluscs, this utilization of chelae may be regarded as adaptative in handling dextral gastropod shells (Vermeij, 1975). Ethological studies on *Calappa philargius* feeding revealed that handling of gastropod shells involves a "peeling" process following the shell spiral, from the shell aperture to inner shell parts. The species uses its main tooth located at the dactylus' base of major chela in this procedure (Ng and Tan, 1984).

Ng and Tan (1985) reported that major chelipeds provided with a main crushing tooth would efficiently handle a dextral gastropod shell. Otherwise, the crab would encounter problems in manipulating the shell and in orienting itself for the purpose of continuing this process until the mollusc's removal.

Acknowledgments

We are grateful to the "Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq" for the financial support of the first author, and to NEBECC members for their help during the collecting of specimens.

References

Alcantara-Filho, P. de. 1978. Contribuição ao estudo da Biologia e Ecologia do caranguejo-uça, *Ucides cordatus cordatus* (Linnaeus, 1763) (Crustacea, Decapoda, Xanthidae) no manguezal do Rio Ceará (Brasil). **Arq. Ciên. Mar., 18** (1/2): 1-41.

Bertness, M. D.; Cunningham, C. 1981. Crab shell-crushing predation and gastropod architectural defense. **J. Exp. Mar. Biol. Ecol., 50**: 213-230.

Crane, J. 1957. Basic patterns of display in fiddler crabs (Ocypodidae, genus *Uca*). **Zoologica, 42**: 69-82.

Gherardi, F.; Guidi, S.; Vannini, M. 1987. Behavioural ecology of the freshwater crab, *Potamon fluviatile*: preliminary observations. **Investigaçion pesquera, 51** (1): 389-402.

Haefner, P. A. Jr. 1990. Morphometry and size at maturity of *Callinectes ornatus* (Brachyura, Portunidae) in Bermuda. **Bull. Mar. Sci., 46** (2): 274-286.

Hartnoll, R. G. 1968. Reproduction in the burrowing crab, *Corystes cassivelaunus* (Pennant, 1777) (Decapoda, Brachyura). **Crustaceana, 15**: 165-170.

Kaiser, M. J.; Hughes, R. N.; Reid, A. G. 1990. Chelal morfometry, prey-size selection and aggressive competition in green and red forms of *Carcinus maenas* (L.). **J. Exp. Mar. Biol. Ecol., 140**: 121-134.

Nalesso, R. C. 1993. **Comportamento e seleção de presas em *Eriphia gonagra* (Decapoda, Xanthidae) no costão da praia do Rio Verde, E. E. Júreia-Itatins, SP**. Tese de doutorado, Universidade Estadual de Campinas (UNICAMP), Campinas, 135 pp.

Ng, P. K. L.; Tan, L. W. H. 1984. The 'shell-peeling' structure of the box crab, *Calappa philargius* (Linn.) and other crabs in relation to mollusc shell architecture. **Journ. Singapore Nat. Acad. Sci., 13**: 195-199.

Ng, P. K. L.; Tan, L. W. H. 1985. 'Right handedness' in heterochelous Callappoid and Xanthoid crabs - Suggestion for a functional advantage. **Crustaceana, 49** (1): 98-100.

Oliveira, L. P. H. de. 1940. Observações preliminares sobre a biologia dos crustáceos do gênero *Panopeus* Milne Edwards, 1834. **Mem. Inst. Oswaldo Cruz, 35** (1): 153-171.

Rossi, A. C.; Parisi, V. 1973. Experimental studies of predation by the crab *Eriphia verrugosa* on both snail and hermit crab occupants of cospecific gastropod shells. **Boll. Zool., 40**: 117-135.

Schöne, H. 1968. Agonistic and sexual display in aquatic and semi-terrestrial brachyuran crabs. **Am. Zool., 8**: 641-654.

Tweedie, M. W. F. 1950. The fauna of the Cocos-Keeling Islands, Brachyura and stomatopods. **Bull. Raffles Mus., 22**: 105-148.

Vannini, V.; Gherardi, F. 1988. Studies on the pebble crab, *Eriphia smithi* Macleay, 1838 (Xanthoidea, Menippidae): patterns of relative growth and population structure. **Tropical Zoology, 1**: 203-206.

Vannini, M.; Chelazzi, G.; Gherardi, F. 1989. Feeding habits of the pebble crab *Eriphia smithi* (Crustacea, Brachyura, Menippidae). **Mar. Biol., 100**: 249-252.

Vermeij, G. J. 1975. Evolution and distribution of left-handed and planispiral coiling in snails. **Nature, 254**: 419-420.

Vermeij, G. J. 1977. Patterns in crab claw size: the geography of crushing. **Syst. Zool., 26**: 138-151.

Warner, G. F. 1970. Behaviour of two species of grapsid crab during intraspecific encounters. **Behaviour, 36**: 9-19.

Warner, G. F. 1977. **The Biology of Crabs**. Elek Science, London, 202 pp.

Wright, H. O. 1968. Visual displays in brachyuran crabs: field and laboratory studies. **Am. Zool., 8**: 655-665.

Zisper, E.; Vermeij, G. J. 1978. Crushing behavior of tropical and temperate crabs. **J. Exp. Mar. Biol. Ecol., 31**: 155-172.