ONSET OF SEXUAL MATURITY WITH RELATION TO MAXIMUM SIZE IN BRACHYURAN CRABS: A REVIEW

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ABSTRACT - Fueron utilizados datos de 21 especies de cangrejos, pertenecientes a seis familias (Majidae = 2; Ocypodidae = 6; Xanthidae = 2; Grapsidae = 7; Gecarcinidae = 1; e Portunidae = 3), para verificar si existe diferencia entre los porcentajes del tamaño al inicio de la madurez sexual en relación al tamaño máximo de la población (M%). Las medias de M% por hábitat (acuático y semiterrestre), sexo y familia fueron confrontadas por ANOVA, no siendo verificada cualquier diferencia estadística ($p>0.05$). Los datos obtenidos indican que frente a la inexistencia de análisis específicos para la determinación del tamaño al inicio de la madurez sexual de braquiuros, el mismo puede ser establecido como 45% del tamaño del mayor espécimen obtenido en el área de estudio.

PALABRAS-CLAVES: Madurez sexual, Reproducción, Crustacea, Brachyura.

KEYWORDS: Sexual maturity, Reproduction, Crustacea, Brachyura.

The onset of sexual maturity in brachyuran crabs have been well documented in the literature. Most part of the studies about this subject have focus on commercial species (BROWN & POWELL, 1972; PINHEIRO & FRANSOZO, 1998).

Sexual maturity size in decapod crustacean can be estimated by two methods. One of them is based on gonad maturation in relation to size (physiological maturity), and the other one established by detection of the secondary sexual characters, like propodus chelar length and abdomen width (morphological maturity), according to HARTNOLL (1982) and PINHEIRO & FRANSOZO (1998). Growth and size at sexual maturity are important components in the reproductive dynamics with significant indirect effects on population recruitment of the commercially fished crustaceans (COBB & PHILLIPS, 1980).

There are few information about the onset of maturity in brachyuran populations. In this subject, HINES (1989) verified geographic influence in female's size on *Hemigrapsus nuds*, *H. oregonensis*, *Pachygrapsus crassipes* and *Panopeus herbstii*, the same occurring to grapsid crab *Helice crassa* studied by JONES & SIMONS (1983). A recent study was published by OVERTON

& MACINSTOSH (2002), with elucidation of the size at sexual maturity for two sympatric population of mud crab (*Scylla olivacea* and *S. paramamosian*) in Thailand mangrove forests.

The aim of the present study was to establish the percentage of the size at onset sexual maturity in relation to maximum size registered to each species, as well as determine differences between each ones by habitat, sexes or family.

All data were registered by literature review about brachyuran sexual maturity. It was chose only studies that describe the size at onset sexual maturity and the individual maximum size in the population. In articles with two sexual maturity sizes (physiological and morphological maturity), the larger value was established as a standard.

The percentage of the size at onset sexual maturity in relation to the specimens maximum size found was calculated to each species (M%). The M% analyses was clustered by habitats (aquatic or semi-terrestrial) where the species were collected, and than separated by sex and family. The M% average was calculated for sexes, family and habitat and subjected by one-way ANOVA ($\alpha = 0.05$).

It was obtained data corresponding to 21 brachyuran species, distributed in six crab families: two species of Majidae (*Chionoecetes opilio* and *Maja squinado*), two of Xanthidae (*Trapezia ferruginea* and *Eriphia gonagra*), six of Ocypodidae (*Uca vocator*, *Uca thayeri*, *Ocypode quadrata*, *Ocypode ceratophthalmus*, *Ucides occidentalis* and *Ucides cordatus*), seven of Grapsidae (*Sesarma reticulatum, Sesarma cinereum, Sesarma rectum, Armases angustipes, Aratus pisonii* and *Goniopsis cruentata*), three of Portunidae (*Callinectes ornatus*, *Arenaeus cribrarius* and *Portunus spinimanus*), and only one of Gecarcinidae (*Cardisoma guanhumi*).

The results reveal the size at onset sexual maturity would be associated to another factors beyond the environmental patterns. No significant difference ($P>0.05$) was observed in a M% comparison between habitats (aquatic and semi-terrestrial). For sexes, males that living in aquatic and semi-terrestrial habitat showed no significant difference ($P>0.05$), with the same pattern occurring for females specimens ($P>0.05$) (Tab. I). Independent of the sexes, the values of M% appears to be influenced by endogenous factors, with delay or anticipation of the maturation size by genetic function present in the species population.

The environmental parameters from aquatic habitat can be considered more stable than semi-terrestrial (e.g., mangrove forest and rocky coast), however, it was not possible to see any association habitat *vs.* M%. In relation to brachyuran families was verify a M% pattern, independent of their habitat. HINES (1989) described that some abiotic factor like temperature and temperature-photoperiod interactions can promote influence in the size at onset sexual maturity. This patterns are due to latitudinal clines producing variation in metabolic rates, growth, and size, generating

slower growth, older individuals and delayed maturity at higher latitudes. This author mentioned the existence of others important factors (e.g., predation pressure). Therefore, at low latitudes some invertebrates can get a smaller size at sexual maturity with negative consequence like the reduce maximum size when compared to populations encountering in low intensity of predation (WALLERSTEIN & BRUSCA, 1982). The predation pressure was not analyzed in our study, but KOGA *et al.* (2001) verify that ocypodid spend more time exposed, with major predation susceptibility, than other species that shows a cryptic habits. However, neither the Ocypodidae nor the other brachyuran families studied showed a significance difference between the M%, indicating that some factors related the species' biology would carry more influence in the start of sexual maturity.

The knowledge about environmental and genetic factors are necessary to determine the influence of the size at sexual maturity. Besides these factors, we have to attempt to ecological points, like trophic relationship between sympatric animals. HARTNOLL & GOULD (1988) and HINES (1989) mentioned that the size and the age at onset sexual maturity are characters of a large influence on population growth rates and brachyuran reproductive output.

According to OVERTON & MACINSTOSH (2002), the establishment of a minimum legal size of capture based on the size at first maturity it's a common intervention in fisheries management. In despite of the variation between species, the size at onset of maturity size in brachyuran crabs can be estimated with base on 45% of the maximum specimen size at natural population when another specific analyses are available.

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Table I – Minimum, maximum, average values and standard deviation of the percentage difference of the size at onset sexual maturity and the maximum individual size (M%) between sex and habitat.

Habitat	Males				Females			
	N	Min.	Max.	$x \pm s$	N	Min.	Max.	$x \pm s$
Aquatic	8	31.9	52.2	41.9 ± 7.4 a	7	32.7	59.2	41.5 ± 10.1 a
Semi-terrestrial	30	21.8	64.2	45.0 ± 10.8 a	33	14.1	61.6	38.9 ± 11.4 a
Total	**38**	**21.8**	**64.2**	**44.4 ± 10.1**	**40**	**14.1**	**61.6**	**39.4 ± 11.1**

*Average values in a single column followed by the same letter are not statistically different (P>0.05).

Table II – Minimum, maximum, average values and standard deviation of the percentage difference of the size at onset sexual maturity and the maximum individual size (M%) between brachyuran families.

Family	Males				Females			
	N	Min.	Max.	$x \pm s$	N	Min.	Max.	$x \pm s$
Majidae	4	31.9	39.2	36.1 ± 3.4 a	3	32.7	44.4	37.5 ± 37.5 a
Xanthidae	2	52.2	62.9	57.6 ± 7.6 a	2	59.2	61.6	60.4 ± 60.4 a
Ocypodidae	20	21.8	54.2	42.8 ± 9.1 a	21	14.1	50.0	36.9 ± 36.9 a
Grapsidae	8	24.7	64.2	48.9 ± 13.1 a	9	24.6	61.2	36.8 ± 36.8 a
Gecarcinidae	1	39.7	39.7	...	2	32.0	40.9	36.5 ± 36.5 a
Portunidae	3	41.1	51.3	46.1 ± 5.1 a	3	32.9	50.0	39.6 ± 39.6 a
Total	**38**	**21.8**	**64.2**	**44.4 ± 10.1**	**40**	**14.1**	**61.6**	**38.3 ± 38.3**

*Average values in a single column followed by the same letter are not statistically different (P>0.05).