

Thanatosis in the freshwater crab *Trichodactylus panoplus* (Decapoda: Brachyura: Trichodactylidae)

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Abstract

Thanatosis behavior was tested in 18 individuals of *Trichodactylus panoplus*, 10 males and 8 females. The crabs were induced into thanatosis in containers with and without water, and the time that they remained still was measured. Regardless of gender, 88% of the individuals remained still while in the dry containers, and 77.77% remained still in the water-filled containers. The overall mean duration of this behavior, including males and females, was 59.91 seconds in the dry containers, and in water it was 10.85 seconds. Females remained longer in thanatosis than males in both treatments. We found no significant influence of the size of an animal on the time that it remained still. This behavior is possibly selected for, because it may reduce the rate of predation on the crabs.

Key words: animal behavior, death-feigning, immobility, predation defense, thanatosis.

Introduction

Freshwater crabs are found in the tropics and subtropics in most parts of the world, and occur in a wide variety of aquatic and terrestrial habitats. These decapods are present in almost all freshwater bodies, from clear, fast-flowing streams to sluggish streams and rivers (Yeo *et al.*, 2008). Most species are detritivorous omnivores, and feed on plant matter; some are opportunistic carnivores and consume both living and dead prey (Ng, 1988). In South America, this group is represented by the family Trichodactylidae, among others. This family is composed by small to medium-sized animals, with nocturnal habits; they remain hidden during the day in burrows, holes in submersed logs, among aquatic vegetation, or under stones (Magalhães, 1999; Yeo *et al.*, 2008). The distribution of the genus *Trichodactylus* encompasses Brazil, Uruguay, and Argentina, in coastal basins from northeastern Brazil to Uruguay and the Paraná and Uruguay river basins (Magalhães, 2003). Despite their ecological importance, being part of the diet of fish, amphibians, birds, and mammals (Bonetto *et al.*, 1963; Oliva *et al.*, 1981; Beltzer, 1983,

1984; Beltzer and Paporello, 1984; Lajmanovich and Beltzer, 1993; Massoia, 1976; Bianchini and Delupi, 1993), there is little information about the biology and ecology of the species of this genus.

Some animals have a choice of two defensive behaviors, running away or death-feigning, when they face a danger. Which behavior the animal adopts may depend on the costs and benefits for the individual at that particular time (Miyatake, 2001). Thanatosis (death-feigning) is a defense against predators that is used by many groups, including vertebrates (Francq, 1969; Sargeant and Eberhardt, 1975; Howe, 1991; Gehlbach, 1970), insects (Allen, 1990; Miyatake, 2001; Hozumi and Miyatake, 2005; King and Leach, 2006) and crustaceans (Field, 1990; Hazlett and McLay, 2005a; Fedotov *et al.*, 2006; Bergey and Weis, 2006). This behavior is defined as a state of immobility in response to external stimuli (Miyatake *et al.*, 2004).

Few studies have addressed this behavior in decapod crustaceans, and only marine species have been studied. Some examples are the species *Heterozius rotundifrons* (Hazlett *et al.*, 2005; Hazlett and McLay, 2005a; Field, 1990), *Halicarcinus in-nominatus* (Hazlett and McLay, 2000), *Cyclograpsus*

lavauxi (Hazlett et al., 2005), *Petrolisthes elongatus* (Hazlett et al., 2005), *Notomithrax ursus* (Hazlett et al., 2005), and the genus *Uca* (Backwell et al., 1998; Bergey and Weis, 2006).

The aim of the present study was to observe the occurrence of thanatosis in the crab *T. panoplus*, and to assess whether this behavior changes when the animals are or are not submerged.

Material and Methods

Individuals of *Trichodactylus panoplus* were collected in March 2008 in a tributary of the Vacacaí-Mirim River (29°41'44"S-53°41'07"W) in the municipality of Santa Maria, Rio Grande do Sul, Brazil. In the laboratory, the animals were measured (carapace length) using a digital vernier caliper (0.01 mm precision) and acclimated for five days at a mean temperature of 23°C and under constant aeration. They were fed with fish fillets every two days.

Eighteen individuals, ten males and eight females (mean size in mm of males and females: 21.05 ± 2.68 and 17.57 ± 1.19 , respectively), were used to induce thanatosis. Each individual was shaken by hand ten times, and then placed in a glass container with its dorsal side down. Each crab was submitted to two procedures: in the first, after thanatosis induction, the individuals were placed in a container holding water; in the second procedure, after a 20-minute rest, thanatosis was again induced in the crabs and they were placed in

a container without water. The experiments always took place at the same time (11 AM), with constant air temperature (23°C) in a lighted environment.

After the induction of thanatosis, the duration of the behavior was recorded. If the individual did not show the thanatosis behavior, it was again shaken, up to three times. If it did not respond to the three series of stimuli, the individual was classified as not having the thanatosis response.

The difference between treatments and genders was analyzed through a repeated measures ANOVA ($p < 0.05$). A simple regression ($p < 0.05$) was used to assess the possible influence of size (expressed as carapace width) on the duration of thanatosis.

Results and Discussion

When immersed, 88% of the individuals showed thanatosis, and 77.77% showed it when emerged. However, the duration of death feigning was longer in a dry environment, regardless of gender (ANOVA $F = 5.200$; $p = 0.037$) (Table I). This may be associated with a possible additional risk of predation when a crab is out of water. A similar, significant difference was not observed by Hazlett and MacLay (2005b) when studying the intertidal crab *Heterozius rotundifrons*. However, these authors believed that some variation in thanatosis between the dry and aquatic environments is normal, because in the air the crabs are exposed to an additional risk of desiccation.

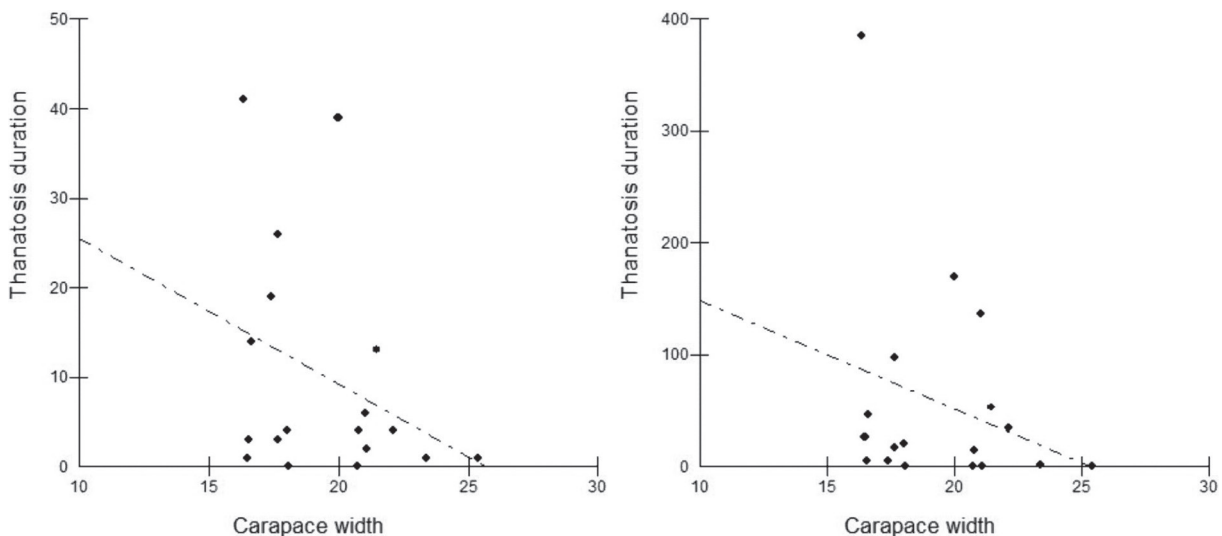


Figure 1. *Trichodactylus panoplus*: regression analyses between carapace width (mm) and thanatosis duration (seconds) of crabs in water (a) and in air (b).

Table I. *Trichodactylus panoplus*: Number of animals studied (N), thanatosis percentage (%) and time remaining in thanatosis (T = seconds), in males and females, under different environmental conditions.

Environment	Male					Female				
	N	%	Thanatosis duration			N	%	Thanatosis duration		
			Maximum	Minimum	Mean			Maximum	Minimum	Mean
Water	10	90	13	0	3.7	8	87.5	41	0	18
Air	10	70	146	0	26.2	8	87.5	385	0	93.625

Females remained longer in death-feigning (ANOVA $F = 8.156$; $p = 0.011$), regardless of the treatment. This may be because they are less aggressive and thus more vulnerable to predation. It is also possible that with this kind of behavior the females, who invest more energy in producing and incubating eggs, may guarantee the survival of the species by avoiding confronting predators (Barreto and Dos Anjos, 2002).

The overall mean duration of *T. panoplus* thanatosis, including immersed and emersed males and females, was 33.11 seconds. Bergey and Weis (2006), working with five species of *Uca* (Brachyura: Ocypodidae), found the following means for duration of death-feigning: *Uca chlorophthalmus*, 170.9 seconds; *Uca vocans*, 105 seconds; *Uca tetragonon*, 123.2 seconds; *Uca pugilator*, 83.9 seconds; and *Uca pugnax*, 45.1 seconds. In our study, we observed a shorter mean duration than the lowest mean found by these authors, possibly because of the different method used to induce thanatosis. Bergey and Weis (2006) suggested that the difference in the mean times of this behavior may be associated with age, the size of the crab, or the induction technique. With *T. panoplus*, we found no significant influence of the size of the crab on the duration of thanatosis (Immersed: $r^2 = 0.1105$, $p = 0.1750$; Emersed: $r^2 = 0.0725$, $p = 0.2796$) (Fig. 1), which may be a function of the technique employed to induce it.

Thanatosis is an important mechanism to promote the survival of many species. According to Zimmermann *et al.* (2009), who observed the behavioral repertoire of *T. panoplus*, this species is most active in the period of lowest light, indicating a preferentially nocturnal habit. Also according to these authors, this behavior represents a defense strategy against visually oriented, diurnal predators such as birds, fish, and mammals. The death-feigning behavior would be an additional tactic against these predators, because the crabs would avoid predation if they were found during the day. A similar situation was reported for the coleopteran *Cylas*

formicarius (Miyatake, 2001), where individuals show low frequency and shorter duration of thanatosis at night, because their predators are diurnal hunters. However, further studies are necessary to clarify this matter.

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Submitted: 31/03/2009

Accepted: 05/05/2009