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ETHOGRAM AND ACTIVITY PATTERN OF *Tamayoa banghaasi* (THIELE, 1927) (PULMONATA, SYSTROPHIIDAE) IN LABORATORY

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Abstract – Studies about land snail's behavior are scarce. The aim of the present study was to verify the activity period and the behavioral displays that of the species *Tamayoa banghaasi*. It were realized direct observations of 30 snails reared at Laboratório de Moluscos do Museu de Malacologia Professor Maury Pinto de Oliveira da UFJF, by the scaning method, registering the behavioral displays at regular intervals of 20 min, totaling 24 h of continuous observation. Eight behavioral acts were registered: rest, dislocate, be buried, bury, explore, feed, emerge and interact. It was verified significantly difference between activity and rest, between the activity displays and the rest displays. The acts that characterize the rest behavior of the animals ("rest" and "bury") were more frequent than other acts. The act "explore" was the third more frequently exhibited by snails, being the most expressive activity display. The species did not present predominantly nocturnal activity period.

Keywords: Behavioral repertoire, Rest, Land snail

Etograma e padrão de atividade de *Tamayoa banghaasi* (Thiele, 1927) (Pulmonata, Systrophiidae) em laboratório

Resumo – Estudos envolvendo o comportamento dos moluscos terrestres são escassos. O objetivo do presente estudo foi verificar o horário de atividade os atos comportamentais que compõem o etograma da espécie *Tamayoa banghaasi*. Foram realizadas observações diretas de 30 moluscos criados em terrários no Laboratório de Moluscos do Museu de Malacologia Professor Maury Pinto de Oliveira da UFJF, através do método de varredura, registrando-se os atos comportamentais a intervalos regulares de 20 min, totalizando-se 24 h de observação contínua. Foram registrados oito atos comportamentais: repousar, deslocar, estar enterrado, enterrar, explorar, alimentar, emergir e interagir. Foi verificada diferença significativa entre atividade e repouso, entre os atos de atividade e entre os atos de repouso. Os atos que caracterizam o comportamento de repouso dos animais ("repousar" e "estar enterrado") foram mais frequentes que os demais atos. O ato "explorar" foi o

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terceiro mais frequente apresentado pelos moluscos, sendo o comportamento de atividade mais expressivo. A espécie não apresentou horário de atividade predominantemente noturno.

Unitermos: Repertório comportamental, Repouso, Molusco terrestre

Introduction

It is known that pulmonate land snails are influenced by enviromental condiditons and relative air humidity. In order to resist against its harmfull effects, they exhibit behavioral strategies that reduces water loss, such as aestivation, aggregation and burial, ensuring succeeding in colonize terrestrial habitats (Cook, 2001; D'ávila & Bessa, 2005c; D'ávila et al., 2004, 2006; Giokas et al., 2005; Storey, 2002; Udaka et al., 2007).

These snails also show behavioral strategies that make population control strategies ineffective, such as retraction of cephalopedal mass and escape, wich assure survival and dispersion (D'ávila et al., 2004; Storey, 2002). Therefore, studing these animals behavior becomes important mainly in crop pest control, besides, it contribute to the development of strategies for the conservation of biodiversity (Agudo, 2012).

Until the present moment, studies on land snails behavior are restricted to a few subjects: ethogram, activity period and pattern (Grimm & Schaumberger, 2002; Junqueira et al., 2003, 2004; Pilate et al., 2012), influence of biotic and abiotic factors (Bailey, 1981; D'ávila, 2003; Gomes, 2006; Hodasi, 1982; Junqueira et al., 2003), feeding behavior (Bailey, 1989; Chatfield, 1976; Chevalier et al., 2000; Iglesias & Castillejo, 1999; Pakarinen, 1992; Raut & Panigrahi, 1990; Stephenson, 1979), aggregative (Bohan et al., 2000; Chase et al., 1980; D'ávila et al., 2006; Dundee et al., 1975; Kleewein, 1999; Lazaridou-dimitriadou & Daguzan, 1981), reproductive (Leahy, 1983; Raut & Panigrahi, 1988), aestivation (Emberton, 1994) and behaviors related to chemical signalization (Cook, 1985, 1992).

Tamayoa (Tamayops) banghaasi (Thiele, 1927) its a small land snail with flattened Shell, belonging to Systrophiidae family, its a soil dweller, that lives buried or under leaves, being registered in Brazilian territory in the states of Rio de Janeiro, Espírito Santo and Paraíba (Conquiliologistas do Brasil, 2012; Monteiro & Santos, 2001). No studies on the behavior of this species were realized yet.

This study aimed to verify the activity period and behavioral displays wich set up the ethogram of *T. banghaasi*, in laboratory conditions.

Material and methods

This study was developed at the Laboratório de Moluscos Arnaldo Campos dos Santos Coelho, Museu de Malacologia Professor Maury Pinto de Oliveira, Universidade Federal de Juiz de Fora.

Laboratory colonies were established from animals collected in field, being 30 adult snails of the species *T. banghaasi* grouped in three groups of 10 snails, with no difference in treatment. These animals were kept in tranparent plastic terraria with capacity for 250 mL, lined with 100 g of sterilized mulch (120° C for one hour), humidified with 10 mL of tap water and then closed with cotton cloth and elastic band. Snails were fed *ad libitum* with poultry feed, enriched with calcium carbonate (proportion 3:1), offered in transparent plastic dishes with 4 cm in diameter (Bessa & Araújo, 1995a,b). Snails were kept in natural conditions of temperature, relative air humidity and photoperiod.

During photophase period (light phase – period between 6 h 00 min and 17 h 59 min) and scotophase (dark phase – period between 18 h 00 min of one day and 5 h 59 min of the next day), it

were realized direct observation of snails trough *scam samplé* method ('Scanning Sample' – *sensu* Altmann, 1974), registering the behavioral displays described by Pilate et al. (2012) at 20 min intervals, totaling 24 h of continuous observation on April 2011.

To compare the mean frequences of behavioral displays we realized the Kruskal-Wallis test, followed by the Student-Newman-Keuls test. To verify the correlation between snails activity and the higher temperature, and between the activity and the relative air humidity, was utilized the Spearman correlation test. It was adopted the significance level of 0.05 in all analysis, and all the analysis were realized with the BioEstat 5.0 software.

Results and discussion

The basic ehtogram of the species was composed by eight behavioral displays registered: "dislocate", "bury", "explore", "feed", "emerge" and "interact", that togheter form the activity acts; and "rest" and "be buried", that togheter for the resting acts, totaling 1370 registers.

During the 24 h of observation, the mean of maximum temperatures were of 24.4º C and of relative air humidity of 86.2%. It was not observed correlation of meand number of acts registered with maximum temperature (rs=-0,10; t=-0,47; p=0,64) or with the relative air humidity (rs=0,07; t=0,35; p=0,73), although it is known that environmental factors affect the activity of land snails, the temperature and relative air humidity were highlighted (Cook, 2001).

There was a significative difference between activity and rest (t=18,25; p<0,01), being the mean frequency of activty of 32%, and of rest of 68%. The mean number os active snails and resting snails, in each hour of the day, during the 24 h period can be visualized in figure 1.

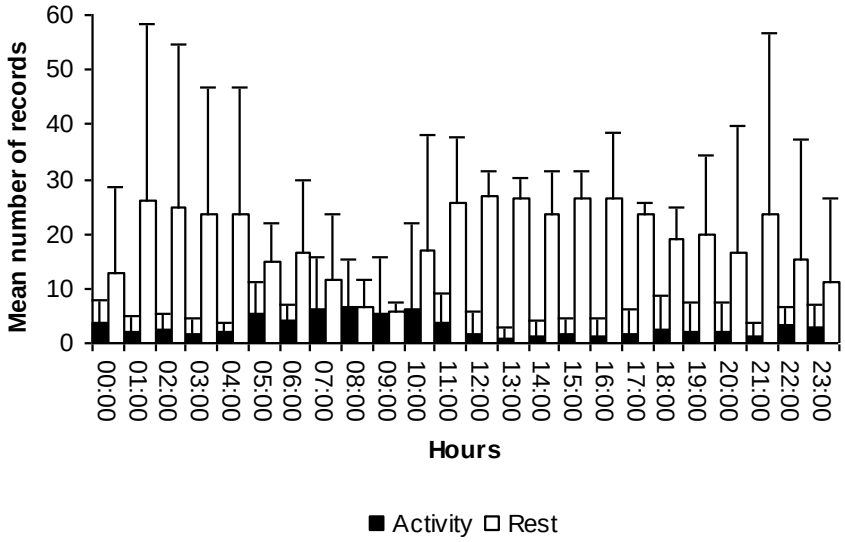

Figure 1: Mean number of registered activity and rest displays of *Tamayoa banghaasi* during 24 h of observation in laboratory conditions.

It was observed significant difference between all behavioral displays (H=117,49; p=0), between activity acts (H=63,74; p=0) and the resting acts of snails (t=17,00; p<0,01). The mean frequency of the behavioral display "resting", in 24h were of 49%; "be buried", 19%; "explore", 17%; "dislocate", 11%; "interact", 3%; "feed", 1%; "bury" and "emerge", less than 1% (figure 2).

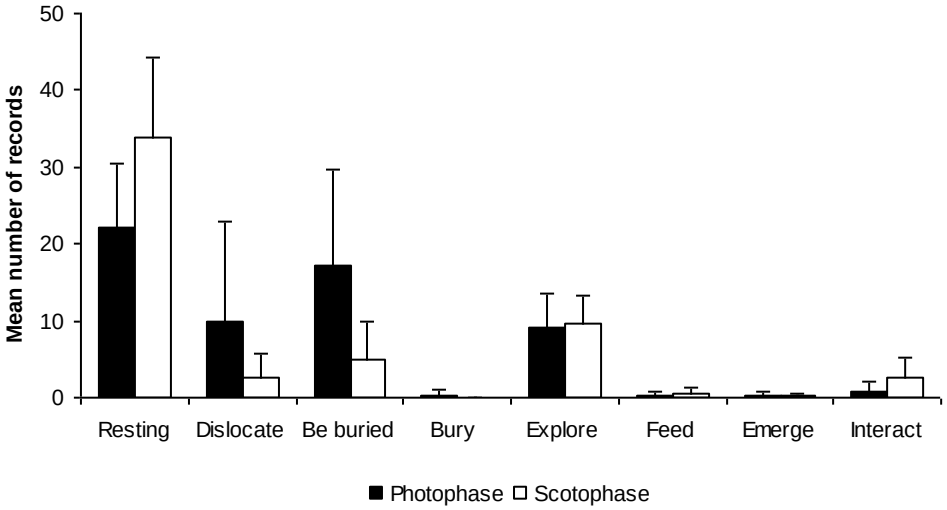

Figure 2: Mean number of registered behavioral displays exhibited by *Tamayoa banghaasi*, during photophase and scotophase, in a 24 h observation period in laboratory conditions.

The rest under and above substract was prevalent, as we expected, once that pulmonate gastropods bury and rest in soil frequently, in vegetation, in tunks and in rocks, in order to protect themselves from desiccation (Giokas et al., 2005; Hyman, 1967; Lazaridou-dimitriadou & Gaguzan, 1981).

The most frequent behavioral activity acts were "explore" (52%) and "dislocate" (35%), being observed significantly difference in the evaluated periods (t=12,71; p<0,01). The exploratory behavior has many functions, such environmental perception, resource search as food and partners, court, copulation and aggregation, once that is known that land snails have a well developed chemoreception (Chase & Tolloczko, 1985; Chevalier et al., 2000; Cook, 1992; Dundee et al., 1975; Hyman, 1967; Iglesias & Castillejo, 1999; Stephenson, 1979). Concerning locomotion, the second activity behavior more expressed by the snails in both photophase (H=61,50; p=0) and scotophase (H=62,45; p=0), is related to the releasing of the excess of water in mucus and to guide the animal to the food, sexual partners and resting sites (Cook, 2001). The mucus secreted in locomotion presents biochemical differences according to the species, being an important source of information about the sexual state and the directions of locomotion, wich could mediate reproduction (Cook, 1992; Gainey, 1976; Skingsley et al., 2000).

Junqueira *et al*. (2003) registered a great interaction between individuals of *Bradybaena similaris* (Férussac, 1821) (Xanthonychidae) in adult snails, suggesting that the search for sexual partners tends to elevate the frequency of this behavior. The present study was also realized with adult snails so it was expected a higher frequency than it was observed for this act (3%).

According Sthephenson (1979), terrestrial pulmonates can recognize volatile chemical compounds by olfaction and non-volatile by the sense of taste. This author verified that taste is a function of the proboscis, lips and of the lateral lobes of the mouth, so as the probable tentacle function to detect volatile and non-volatile chemical compounds in the species *Deroceras reticulatum* (Müller, 1774) (Agriolimacidae). Hodasi (1979) verified that individuals of *Achatina achatina* (Linné, 1758) (Achatinidae) did not feed continuously during the night period, wich support the Cook's theory (2001), according to it, the feeding in terrestrial pulmonate seems to follow a rythm. In *T. banghaasi*, the feed was not regular, probably because of a reduced necessity for food due to the reduced body size of the individuals of this species.

The activity did not differed statistically between photophase (57%) and scotophase (43%) (H=0,05; p=0,82). The same was observed for rest (H=0,71; p=0,40) (figure 3). This study therefore do not evidenced activity period predominantly nocturnal for *T. banghaasi*, result similar to the one found by Pilate et al. (2012) for *Dysopeas muibum* Marcus & Marcus, 1968 (Subulinidae). However it contrasts with the results found by authors that have evidenced predominantly nocturnal habits fot *Leptinaria unilamellata* (d'Orbigny, 1835) (Subulinidae) (Almeida & Bessa, 2001a), *Subulina octona* (Bruguière, 1789) (Subulinidae) (Bessa & Araújo, 1995a,b), *B. similaris* (Almeida & Bessa, 2001b; Junqueira et al., 2003), *A. achatina* (Hodasi, 1979, 1982), *D. reticulatum* (Rollo, 1991), *Laevicaulis alte* (Férussac, 1822) (Veronicellidae) (Panigrahi et al., 1992; Raut & Panigrahi, 1988, 1990), *Sarasinula linguaeformis* Semper, 1885 (Veronicellidae) (Junqueira et al., 2004), *Arion lusitanicus* Mabille, 1868 (Arionidae) (Grimm & Paill, 2001) and *Thaumastus taunaisii* (Férussac, 1821) (Bulimulidae) (Jurberg et al., 1988).

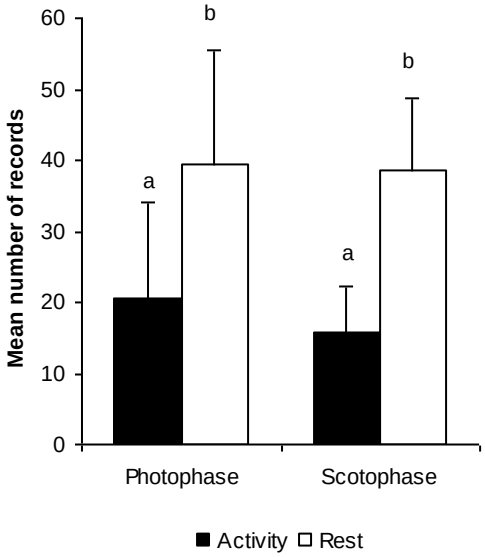

Figure 3: Mean number of activity and resting acts registered of *Tamayoa banghaasi*, during photophase and scotophase during a 24 h observation period in laboratory (different letters indicate sgnificative statistical difference between activity and rest in the same phase (p<0,05)).

Rollo (1991) believes that the activity pattern in the species *D. reticulatum* is derived from a circadian rhythm controled by endogenous and exogenous factors. Another actors such Junqueira et al. (2004) and Pilate et al. (2012) have already studied the distribution of activity during the 24 h of a day in other land snail species, however, there are no consistent studies on the behavior rythm of these animals.

Conclusions

According to the results, the ethogram of *T. banghaasi* is composed by eight behavioral acts: rest, be buried, dislocate, bury, explore, feeding, emerge and interact, this species do not presents activity period predominantly nocturnal, and it shows a trend to remain in rest rather than activity, being the environment exploration the main activity act presented.

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