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NEW DATA ON THE BIOLOGY OF *SINOPLA PERPUNCTATUS* SIGNORET, 1864 (HEMIPTERA: HETEROPTERA: ACANTHOSOMATIDAE)

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Abstract

Coloration changes in *Sinopla perpunctatus* Signoret, 1864 are described and associated with the cryptic habits of the species. Green coloration was reported for reproduction (spring) and emergence (fall) times and orange coloration for overwintering. Females have an additional coloration change from orange to light green, which is associated with the hutching process, and after turns dark green. The oviposition process and maternal care is also described for the first time for this species.

Keywords: Seasonal coloration change, crypsis, maternal care, Acanthosomatidae, *Sinopla perpunctatus*.

Nuevos datos sobre la biología de *Sinopla perpunctatus* Signoret, 1864 (Hemiptera: Heteroptera: Acanthosomatidae)

Resumen

Se describen cambios de coloración en *Sinopla perpunctatus* Signoret, 1864, asociados con los hábitos crípticos de la especie. La coloración anaranjada es asociada al periodo de diapausa invernal mientras que la coloración verde es usada después de este en primavera y luego en la emergencia de los adultos en otoño. Una coloración adicional es reportada para las hembras, las que son verde claro durante el proceso de reproducción y posterior crianza. El proceso de oviposición y cuidado maternal son descritos por primera vez para esta especie.

Palabras clave: Cambios de coloración estacionales, cuidado maternal, Acanthosomatidae, *Sinopla perpunctatus.*

Introduction

Acanthosomatidae is one of the least diversified families within Pentatomoidea and it includes about 200 species of 54 genera (Kment, 2005). There is little information about Acanthosomatidae in the Neotropics; much of what is known comes from the results of old expeditions, and for many of the species the only known data come from original descriptions, and no recent revision has been published (Faúndez, 2009a). Many aspects of the biology of Neotropical Acanthosomatidae remain unknown.

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Sinopla perpunctatus Signoret, 1864 is one of the best known Acanthosomatidae species in South America (Faúndez, 2009b). The immature stages of this species have been described by Martínez *et al.* (2003). It is the only South American species for which all their five nymphal stages are known (Osorio, 2009). *Sinopla perpunctatus* feeds on several *Nothofagus* species (Nothofagaceae; see Faúndez, 2007b), with a preference for *N. antarctica* (G. Forster) Oersted. The cryptic habits of *S. perpunctatus* have been reported associated with this plant (Faúndez, 2007a).

Sinopla perpunctatus inhabits the Southern part of South America. There are few records from Southern Argentina (Neuquén and Río Negro provinces), and a large distribution area is known in Chile – from Vilches Alto (Maule Region) to Bertrand Island (Magallanes Region) (Osorio, 2009).

Sinopla perpunctatus is known as a green shield bug; however, in this contribution we report different coloration changes and for the first time describe the oviposition process. The life cycle of this species is not well known, and here we deliver a first approach.

Material and methods

Field observations were made in the "Carl Skottsberg" botanical garden (53°08' S, 70°53' W; 6 m.a.s.l.; Instituto de la Patagonia, Punta Arenas, Chile) on *N. antarctica* trees (years 2007-2010); laboratory observations were made in wooden boxes with *N. antarctica* fruits and leaves maintained at outdoor temperature and photoperiod in the botanical garden. Some specimens were also placed in glass bottles at outdoor photoperiod and 20°C temperature within the laboratory.

Results

The life cycle of *S. perpunctatus* is not well known, and all the authors have contributed to understand only parts of it. At least in Magallanes we observed that the species is univoltine, reproduction occurs in spring, immediately after overwintering, and they breed in late spring and summer; after that, green adults emerge in late summer and fall. After the emergence, a dormancy period is observed until the next spring; during this cycle we observed the following coloration changes:

Orange coloration (Figure 6): at the beginning of spring and late in the fall we observed some orange specimens; this coloration is present uniformly in the body, like the green coloration. The orange adult were observed for two weeks in both spring and fall (it is variable each year, *i.e.* spring specimens might be found the last week of September and some years it is possible only in the second week of October; on the other hand, the fall specimens might be collected from about the second week of March to the second week of May). In four opportunities in 2007–2010 we observed specimens which remained orange for about three extra weeks and have been collected in copula with green specimens [Figure 6] (three times orange males were copulating with green females and one time an orange female copulated with green males; we never found two orange adults in copula).

Figures 1-3. *Sinopla perpunctatus*, copulating specimens, females of light green coloration, males of dark green coloration. Figure 1 and 2, field specimens. Figure 3, laboratory specimens.

Figuras 1-3. *Sinopla perpunctatus*, especímenes en copula, hembras de coloración verde claro, machos de coloración verde oscuro. Figura 1 y 2, especímenes en terreno. Figura 3, especímenes en laboratorio.

Figures 4-5. *Sinopla perpunctatus*. Females of light green coloration. Figure 4, a female covering an egg batch. Figure 5, a female covering first instars nymphs.

Figuras 4-5. *Sinopla perpunctatus*. Hembras de coloración verde clara. Figura 4, una hembra cubriendo un grupo de huevos. Figura 5, una hembra cubriendo ninfas de los primeros instares.

We collected orange specimens on the first week of October in 2007 and kept them in the laboratory at outdoor temperature and photoperiod with *N. antarctica*; after two weeks they gradually turned green (Figure 7).

Light green coloration (Figures 1-5): females have a very light green coloration during the copulation time (Figures 1-3), which begins practically after overwintering and lasts until the second week of December; copulation period varies depending on the timing of the end of winter. Usually these females have an orange line in the lateral margins. This coloration was observed in about 90% of coupling specimens (more than 50 couples observed in 2007– 2010) and remains unchanged until the female oviposits a clutch of about 50 eggs. She then guards the eggs until the nymphs hatch (Figures 4-5). When the nymphs reach 4th or 5th instars, females usually remain with the group of nymphs, turning dark green like the males. Females produced only one egg mass in the season.

Discussion and conclusions

In Pentatomoidea, ontogenetic coloration changes have been reported in adults of some Pentatomidae, and are believed to be associated with seasonal changes (often with winter diapause) and controlled by photoperiod and, at least in some cases temperature (McPherson, 1974, 1975a, 1975b, 1976, 1978; Musolin *et al.*, 2007; Musolin & Numata, 2003, 2004). Nothing is known about coloration changes in Acanthosomatidae, but it was supposed as a possible explanation for the coloration variability observed in long series of collected specimens of *Acrophyma cumingii* (Westwood, 1837) by Faúndez (2009a).

Sinopla perpunctatus has been defined as a total cryptic (*i.e.* specialized to live using the cryptic protection) by Faúndez (2007c), thus the species adapted its life cycle and feeding habits to their cryptic habits. In this case, the seasonal coloration changes are associated with the cryptic habits of the species; the specimens are protected by the green coloration when leaves are green on the trees while the orange coloration is useful in the fall, when leaves turn orange, reddish and yellowish. When leaves fall down, the orange coloration is also useful for the specimens in the litter, for protection during winter diapause.

The light green coloration of the females might be associated with maternal care, because the light green coloration reminds the lower cuticle of leaves (see Figure 4) on the trees, where females and nymphs tend to stay. Therefore females protect their eggs hiding the batch with its cryptic coloration. Maternal care has not been reported in any Neotropical Acanthosomatidae species, but it is a common strategy in some Northern Hemisphere acanthosomatids (Cobben, 1968; Kudo, 2006).

The maternal care in Heteroptera has been reviewed by Tallamy & Schaefer (1997) but it has never been reported associated with cryptic coloration and/or coloration changes in mothers.

We believe that coloration change strategy evolved in cryptic species, which exploit it for hiding; thus the total cryptics, such as *S. perpunctatus*, have a very complex coloration change strategy. Recently emerged adults of both sexes are dark green. Then they turn orange for overwintering.

Figures 6-7. *Sinopla perpunctatus*. Figure 6, copulating specimens, a female of orange coloration. Figure 7, laboratory female in the middle of the coloration change process (orange to green, after overwintering).

Figuras 6-7. *Sinopla perpunctatus*. Figura 6, especimenes en copula, una hembra de coloracion naranja. Figura 7, hembra en laboratorio en medio del proceso de cambio de coloración (naranja a verde, después de la diapausa invernal)

In spring, males turn dark green and die after copulation. At the same time females turn light green for the maternal care process and stay with the nymphs until nymphs reach the last instars. Further research is needed to know if the females die before overwintering or can live more seasons.

In partial cryptics, coloration changes could be present, but in a less complex sense (*i.e.* probably with more general colorations and not exactly as one plant because they frequent a lot of different plants and need intermediate colours).

The coloration change in the cryptic care is probably not regulated by the photoperiod because it affects only females and is probably induced hormonally by the reproduction process. The light green coloration is present in both males and females when adults recently changed colour in spring, but in males the process continues until they are dark green.

Probably this process is stopped in females, and further research is needed in order to explain how coloration change process is paused to be utilized in this special kind of maternal care.

These observations also need to be confirmed in different places across the longitudinal distribution of *S. perpunctatus* because in some areas, such as in Magallanes, the species is strongly dependent on the harsh climatic conditions (*i.e.* low temperatures, low thermal sensation, strong winds, short summers, etc.). The species is univoltine, and females oviposit only one batch of eggs, but in northern localities with milder climatic conditions the species might be multivoltine, with more generations per season.

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