Mitt. internat. entomol. Ver.	Frankfurt a.M.	ISSN 1019-2808
Band 36 · Heft 3/4	Seiten 99 – 105	15. Dezember 2011

Seasonal change in the nesting site of an aggregation of a sphecid wasp in the southeastern Brazil

(Hymenoptera: Apoidea: Sphecidae)

SANDOR CHRISTIANO BUYS

Abstract: A pattern of seasonal changing in nesting site of an aggregation of the cockroach-hunting solitary wasp *Penepodium luteipenne* (Fabricius, 1804) is described and its relation with thermal environment is discussed. The study was conducted in an area covered with Tropical Atlantic Forest in the southeastern Brazil.

Key words: Hymenoptera, *Penepodium luteipenne*, wasp, behaviour, biology, ecology, seasonality, thermoregulation, Neotropical Region

The nesting activity of apoid wasps has been related with thermal constraints and insolated areas since the early pioneer observations on their behaviour (see EVANS & WEST-EBERHARD 1970, BOHART & MENKE 1976). Afterwards, it was demonstrated that the time that apoid wasps expose to the sun could be part of complex hygrothermic regulation behavioural mechanisms and that several biological aspects of these insects are closely tied with thermal environment (e.g. WILLMER 1985a,b, LARSSON 1990, COELHO 2001, COELHO *et al*. 2007).

Penepodium luteipenne (Fabricius, 1804) (Hymenoptera: Sphecidae) is a solitary cockroach-hunting apoid wasp that digs unicellular nests in compacted clay soil (Williams 1928, Buys 2009). The females constitute nesting territories where they excavate several close each other nests, which are defended from co-specific females (Sandor BUYS unpublished). Herein a pattern of seasonal changing in nesting site of an assemblage of

P. luteipenne is described and its relation with thermal environment is discussed.

Material and methods

The study was conducted in a 200m section of an abandoned unpaved road that crossed an area covered by the Atlantic Forest in the Biological Reserve of Poço das Antas (Rio de Janeiro State, city of Silva Jardim, southeastern Brazil), which was monthly visited from December 1994 to June 1996. The road was predominantly shaded by the adjacent vegetation (Fig. 1), but a 100m section was exposed to the sun throughout the daylight hours (Fig. 2), because the adjacent portions were covered with grasses alone. In order to quantify the nesting activity, a 100m section of the shaded portion of the road was defined adjacently to the exposed area; the number of new nests excavated in the shaded area and in the exposed area was separately counted in one sunny day per month from March 1995 to June 1996. The statistic package BioStat 5.0 (AYRES et al. 2007) was used to analyse numeric data. A climatic diagram based on data from the climatic station of the Biological Reserve of Poço das Antas in the years of 1995 and 1996 is depicted in the Fig. 3.

Results

Nesting females were observed throughout the year. The total number of nests constructed per day in the section of 200m of the road varied from 2 to 6 (Fig. 4). Seasonal changing in the nesting area was observed in the three studied years, as follows: from November to May the females nested exclusively in the shaded area, and from June to October the females nested exclusively in the exposed area. This change in the nesting site coincides with the tendency of seasonal temperature changing in the area, as depicted in the Fig. 3. The number of nests was significantly higher in the sheltered area (June/1995 to October/1995 = 2-6; November/1995 to June/1996 = 2-3. Mann-Whitney: $U = 94.00$; $p = 0.04$), suggesting a tendency of the nesting activity be more intense in the hotter period of the year. A brief transitional period in the changing of the nesting site was distinguishable. Behavioural observations revealed that females in hotter days in the final of the coldest season (October), although nesting in the exposed area, dig their nests under small tufts of grass in the middle of the road. Thus, they seem to benefit of a more attenuated microclimatic condition.

Figs. 1-2: Exposed (1) and shaded (2) areas from the unpaved road at the Biological Reserve of Poço das Antas (southeastern Brazil) where the nesting females of *Penepodium luteipenne* were studied.

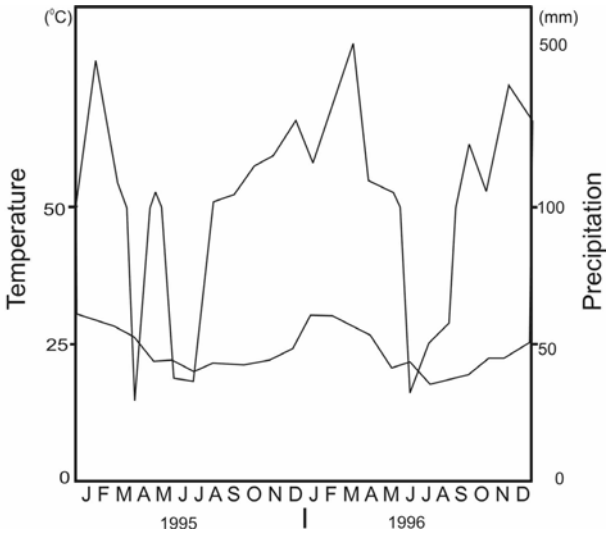

Fig. 3: Climatic diagram based on data from the climatic station of the Biological Reserve of Poço das Antas (southeastern Brazil) in the years of 1995 and 1996.

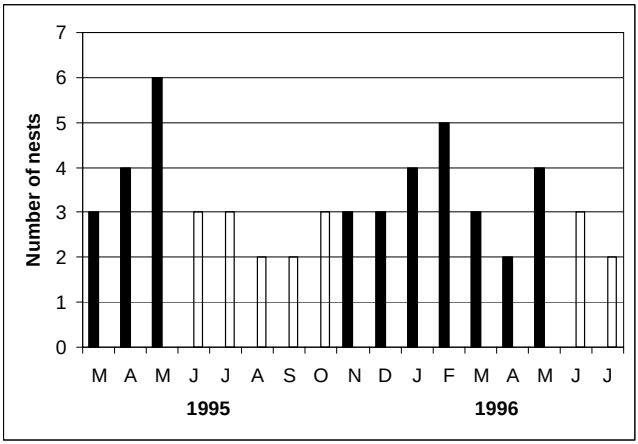

Fig. 4: Number of nests of *P. luteipenne* constructed in one random day of each month from March 1995 to July 1996 in a 200m section of an unpaved road. White bars = number of nests dug in the insolated area; black bars = number of nests dug in sheltered area.

Discussion

Regular change in nesting site has been scarcely reported in Sphecidae or related families; the few studies have correlated changes in nesting site with factors as avoidance of molestation of patrolling males or nest parasites (e.g. EVANS et al. 1986). The seasonal change in the nesting area observed in *P. luteipenne* is sharply related with the time of exposition to the sun of the nesting females. From November to February the females nest in sheltered sites probably to avoid the risk of a corporal overheat; on the other hand, in the colder months the females nesting exclusively in the open area, so that they can supply their necessities of heat, exposing to the sun. The observation that the nesting females search for sheltered microclimatic situation in the final of colder period of the year corroborate this hypothesis.

WILLMER (1985a) observed that the microclimate inside the multicellular nests of the ground nesting crabronid wasp *Cerceris arenaria* (Linnaeus) (Hymenoptera: Apoidea) is more constant than the external environment and that the females organize its time inside the nest and outside the nest as a thermoregulatory behaviour. From this observation, one can suppose that in general lines ground-nesting wasps that dig unicellular nests are more sensible to thermal constraints than those that dig multicellular nests; this is because they remain a long time exposed to the environmental conditions of the nest surroundings during the excavation, provisioning and closing of the nests. On the other hand, species that dig multicellular nests are subjected during a longer time to the buffered climatic conditions of the nest interior during the nesting activities; therefore, they are more independent of external environmental conditions. Females of *P. luteipenne*, besides constructing unicellular nests, constitute territories where they nest for several consecutive days. Therefore, the females remain a long time working in the nesting site and remain only for very brief moments insides the nest. Thus, the climate seems to have an important role in the selection of the territory, nesting site and seasonal occurrence. This could explain in part the sensibility of *P. luteipenne* to the climatic conditions that made an entire assemblage of reproductive females to change the nesting area. Remarkably, the heterogeneity of the habitat related to the insolation allowed this species to remain nesting locally throughout the year, maintaining stocks of females that quickly colonized two adjacent areas, as the environmental conditions were suitable.

Acknowledgements

I am grateful to Sérvio Túlio AMARANTE for identifying *P. luteipenne*, Fernando F. F. FERRAZ for providing the climatic diagram, Instituto Brasileiro do Meio Ambiente e Recursos Naturais Renováveis (IBAMA) for the license to work in the Biological Reserve of Poço das Antas and Fundação Carlos Chagas de Amparo à pesquisa do Estado do Rio de Janeiro (FAPERJ) for the post-doctoral grant.

Literature

AYRES, M., AYRES-JR, M., AYRES, D.L. & SANTOS, A.A.S. (2007): BioStat. Aplicações estatísticas nas áreas das ciências bio-médicas. 364 pp. – Available at http://www.mamiraua.org.br/download/. Accessed on May 9, 2011.

BOHART, R.M. & MENKE, A.S. (1976): Sphecid wasps of the world. A generic revision. – University of California Press, Berkeley, Los Angeles, London, 665 pp.

BUYS, S.C. (2009): Larval behavior and development of *Penepodium luteipenne* (Fabricius, 1804) (Hymenoptera, Sphecidae). – Mitteilungen des Internationalen Entomologischen Vereins **34**: 33–40.

COELHO, J.R. (2001): Behavioral and physiological thermoregulation in male cicada killers (*Sphecius speciosus*) during territorial behaviour. – Journal of Thermal Biology **26** (2): 109–116.

COELHO, J.R., HOLLIDAY, C.W., HASTINGS, J.M., MATYA, E., SWIGART, M. & MENDELL, A. (2007): Thermoregulation in male western cicada killers (*Sphecius grandis* Say) in the Chihuahuan desert. – Journal of Thermal Biology **32**: 270–275.

EVANS, H.E. & WEST-EBERHARD, M.J. (1970): The Wasp. – Devon, David & Charles Abbot Press, 265 pp.

EVANS, H.E., O'NEILL, K.M. & O'NEILL, R.P. (1986): Nesting site changes and nocturnal clustering in the sand wasp *Bembecinus quinquespinosus* (Hymenoptera: Sphecidae). – Journal of the Kansas Entomological Society **59**: 280–286.

LARSSON, F.K. (1990): Thermoregulation and activity patterns of the sand wasp *Steniolia longirostra* (Say) (Hymenoptera: Sphecidae) in Costa Rica. – Biotropica **22**: 65–68.

WILLIAMS, F.X. (1928): Studies in tropical wasps – their hosts and associates. – Bulletin of the Experimental Station of Hawaiian Sugar Planter's Association (Entomological Series) **19**: 1–179.

WILLMER, P.G. (1985a): Size effects on the hygrothermal balance and foraging patterns of a sphecidae wasp, *Cerceris arenaria*. – Ecological Entomology **10**: 469–479.

WILLMER, P.G. (1985b): Thermal ecology, size effects, and the origins of communal behaviour in *Cerceris* wasp. – Behaviour, Ecology and Sociobiology **17**: 151–160.

Author

Laboratório de Biodiversidade Entomológica,
Instituto Oswaldo Cruz,
Fundação Oswaldo Cruz,
Avenida Brasil 4.365,
Pavilhão Mourisco, sala 201, Manguinhos, 21.045-900,
Rio de Janeiro, RJ, Brazil.
E-mail: sbuys@biologia.ufrj.br, sandor.buys@gmail.com