



The Neuroptera of São Tomé e Príncipe

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ABSTRACT

Two new entomological surveys were carried out in the República Democrática de São Tomé e Príncipe in 2019 (earlier surveys were in 1956 and 2001). Of 16 species of Neuroptera identified, only one, a Mantispidae, appears endemic to the archipelago. Chrysopidae and Hemerobiidae account for the majority of species and individuals collected, concentrated here in plantations and anthropized environments, and known to be widely distributed in Africa and even worldwide. Unusually, the family Coniopterygidae is again absent, this time on natural terrains, confirming its earlier absence in 2001 on anthropized and plantation terrains. The findings and ecological distribution support the hypothesis that Hemerobiidae and Chrysopidae were introduced with cash crop cultivation, some of them as late as the 19th century. Their isolation in island environments is probably too recent to have allowed speciation mechanisms to generate endemic species in São Tomé.

Background

The *República Democrática de São Tomé e Príncipe* is a volcanic archipelago with a mountainous landscape located in the Gulf of Guinea (Figure 1). The climate is equatorial with an annual average temperature of 18°C and generally humid conditions year round. Nonetheless, significant rainfall variation occurs depending on elevation, geographical location - typically 5,000 mm on the south west coast but only 1,000 mm on north eastern areas - and season, June to September being relatively drier months. The archipelago consists of two main islands 150 km apart; São Tomé, with an area of 850 km², and Príncipe, with an area of 142 km², together with several smaller islands; Cabras, Sete Pedras, Santana and Quixiba to the east, and Rolas to the south, which is located on the Equator. The *Pico de São Tomé* at 2,024 m above sea level is the highest point of the archipelago. With a total area of 1,001 km, São Tomé e Príncipe is the smallest state of Africa.

The islands were uninhabited when Portuguese sailors landed in December 1470, and were subsequently colonized and populated by different groups of Africans. The total population in 2020 was 220,000, settled in a limited number of population centres along the coast because of the uninhabitability of the mountainous terrain. After the introduction first of sugar cane, coffee was introduced in 1787, and

cocoa in 1822 to replace sugar cane which could no longer compete with the sugar production in Brazil. Following independence in 1975, the colonial plantation economy collapsed and was gradually replaced by family-based cultivation of smaller plots. At present, also - and importantly - 30 per cent of the total area has been classified under natural conservation zones.

Past records of Neuroptera in São Tomé

The fauna of São Tomé and Príncipe has been poorly investigated, especially with respect to Neuroptera.

The first record is by Kimmins (1952), who designated two specimens preserved in the British Museum and collected in 1932 on the island of São Tomé (without precise date and locality as paratypes of a new species *Anopochrysa africana* (currently a synonym of *Apochrysa leptalea* Rambur, 1842).

In June 1956, the *Museum national d'Histoire naturelle* in Paris conducted a survey of the islands of the Gulf of Guinea as part of an oceanographic expedition on board the *Calypso*, Cousteau's well-known ship. The mission collected 2♀ Mantispidae at Traz-os-Montes on the island of São Tomé (0°16'N – 6°37' E, altitude 848 m.). Viette described them as a new species *Mantispa thomensis* (Viette, 1958), now known as *Pseudoclimaciella thomensis* (Viette), which is endemic to São Tomé.

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In June and July 2001, the *California Academy of Sciences Gulf of Guinea Expedition, 2001* spent two months, visiting the two main islands. The Expedition's main objective was to study the potential of Neuroptera for biological control of agricultural pests, and focused almost entirely on coffee and cocoa fields and other more intensively cultivated areas. The team collected 368 specimens belonging to 13 species of Chrysopidae and Hemerobiidae (Penny, 2005). The team also observed larval pits of Myrmeleontidae in urban areas, which they could not identify in the absence of adult specimens at the time of the survey.

Altogether 15 species of Neuroptera were known on the archipelago: Hemerobiidae (3), Chrysopidae (10), Myrmeleontidae (1), and

Mantispidae (1). Seven species were found on São Tomé Island only, and 2 species on Príncipe alone. Six species were found on both islands. Table 1 summarizes the list of recorded species to date, including the second *Mantispa* species identified during the present survey.

Present survey

In 2019, The *Centro de Investigação Agronómica e Tecnológica de São Tomé e Príncipe* conducted two entomological surveys, assisted by Microland, an environmental NGO, as part of the project *São Tomé e Príncipe Archipelago of Biodiversity*. The first survey, in February, concentrated on the island of São Tomé. The second one in November also covered Príncipe and Rolas.

Both surveys concentrated on conservation areas, undisturbed environments, secondary forests, altitude spots above the limit of cultivated areas, and river banks. Light traps at night complemented daytime captures.

Four species of Neuroptera, each represented by a single specimen, were collected in 2019:

Micromus timidus Hagen, 1853 [Hemerobiidae] 1♂ and *Apertochrysa luaboensis* (Tjeder, 1966) [Chrysopidae] 1♀ both on the Island of São Tomé, Monte Café 0°30 N - 6°64 E, alt. 632 m., 23.10.2019, at night on bushes and low vegetation.

Pseudoclimaciella apicipennis (Kolbe, 1897) [Mantispidae] 1♂ Lagoa Amelia 0°17 N - 6°36 E, 1475 m., in the centre of the island of São Tomé, 7.2.2019, night trap.

Pseudoclimaciella thomensis (Viette, 1958) 1♀ Island of Príncipe, Azeitona broca, 1°66 N - 7°39 E, 29.10.2019, night trap.

Of particular interest is the first recorded finding of *P. thomensis* on the island of Príncipe, and the discovery of the presence of a well-known African Mantispidae, *P. apicipennis* (Kolbe, 1897), not recorded previously from the archipelago.

The total number of species of Neuroptera is thus raised to 16 species (Table 1).



Figure 1 Geographical location and map of the archipelago of São Tomé (courtesy of the French Ministry of Foreign Affairs, Geographical department).

Table 1

List of Neuroptera species collected in the Republic of São Tomé e Príncipe (adjusted to current nomenclature).

	Island of São Tomé	Island of Príncipe
Chrysopidae		
<i>Ankylopteryx tristicta</i> Navás, 1910	-	X
<i>Ankylopteryx</i> sp. (pallidula group)	X	-
<i>Apertochrysa luaboensis</i> (Tjeder, 1966) (as <i>Pseudomallada luaboensis</i> (Tjeder, 1966)	X	-
<i>Apertochrysa nubilata</i> (Navás, 1910) (as <i>Pseudomallada sjoestedti</i> Van der Weele, 1910)	-	X
<i>Apochrysa leptalea</i> (Rambur, 1842) (partim as <i>Anopochrysa africana</i> Kimmins, 1952)	X	-
<i>Borniochrysa squamosa</i> (Tjeder, 1966)	X	-
<i>Ceratochrysa antica</i> (Walker, 1853)	X	X
<i>Chrysoperla congrua</i> (Walker, 1853)	X	X
<i>Glenochrysa conradina</i> (Navás, 1910)	X	-
<i>Mallada desjardinsi</i> (Navás, 1911) (as <i>Pseudomallada boninensis</i> Okamoto, 1914)	X	X
Hemerobiidae		
<i>Hemerobius reconditus</i> Navás, 1914	X	-
<i>Micromus timidus</i> Hagen, 1853	X	X
<i>Notiobiella</i> sp.	X	X
Mantispidae		
<i>Pseudoclimaciella apicipennis</i> (Kolbe, 1897)	X	-
<i>Pseudoclimaciella thomensis</i> (Viette, 1958)	X	X
Myrmeleontidae		
<i>Myrmeleon</i> sp (according to Penny, 2005)	X	X

Discussion

The results of the three expeditions that are summarized in this paper are not directly comparable. The California Academy (2001) expedition concentrated on plantations and anthropized environments, the 2019 expedition on conservation areas and undisturbed environments. In addition, The Paris Museum (1956) and the California Academy (2001) expeditions took place in June and July which receive low rainfall (on average 29 mm in June and 16 mm in July). The 2019 expedition took place during more rainy and humid months, with 121 mm rainfall in February and 219 mm in November on average. To arrive at a definitive composition of the Neuroptera communities on these islands would probably require year-round observation. For example, species that might have escaped attention because they reach the adult stage outside the period of the survey include at least one pit-building species of Myrmeleontidae. The sampling nevertheless probably broadly covered the seasonality and differences in climatic conditions in a country which is altogether subjected to an equatorial humid climate.

A striking feature is the absence of the family Coniopterygidae both in 2001 and in our expedition in 2019, despite an intensive search for them by the California expedition (Penny, 2005), and our search on a different terrain. This is all the stranger because six species inhabit the island of Bioko (Republic of Equatorial Guinea) (Monserrat, 1990) which is located north of Príncipe and close to the continental coast line (40 km). The distance from the continent, 250 km for Príncipe, 300 km for São Tomé, has probably been a natural barrier to the dispersal of these small-sized insects.

The validity of *Pseudoclimaciella thomensis* Viette (Mantispidae) was questioned. Only two females were known before the present survey, very similar to *P. apicipennis*. The presence of a median tubercle at the basis of the metazone of the pronotum was considered by Viette as a discriminating character that justified the description of a new species. Whether it is a discriminating character of specific importance, or the result of individual variation is still discussed. During this recent survey, two variant specimens were collected, one with a tubercle and one without tubercle on the pronotal metazone. These specimens otherwise look similar to *P. apicipennis*. This finding leaves even more so open the question of the validity of *P. thomensis*.

Another striking feature is the infrequency of endemism of species of Neuroptera. In other insect groups, such as Lepidoptera and Coleoptera, up to 30 per cent of species in São Tomé are endemic. In another study conducted during the 2019 mission, of Reduviidae, 50 per cent of the recorded species were unique to São Tomé (Prost and Cauquil, 2020). *Pseudoclimaciella thomensis* (Viette), if valid, seems to be the only endemic species of Neuroptera. Not only Chrysopidae and Hemerobiidae species collected in São Tomé are all present on the African continent, but some of them have their most widespread distribution in tropical areas. *Micromus timidus* Hagen, 1853 and *Chrysoperla congrua* (Walker, 1853) for example are present in the Oriental region, the Pacific islands and South Asia.

A third feature of all the expeditions is the absence of Hemerobiidae and Chrysopidae in conservation zones and in the natural environment of the islands, with the exception of *Apochrysa leptalea* (Rambur, 1842) which was collected exclusively in humid forest above 1300 m. Other species inhabit anthropized and modified environments. They were collected in coffee and cocoa fields, on the margin of agricultural plots, on grassy fields typical of abandoned plantations, and in peri-urban subsistence crop gardens. To the contrary, Mantispidae were found only in natural undisturbed environments. This distribution explains the difference between the results of the California expedition which focused on agricultural zones of economic interest, and yielded a substantial number of specimens of Chrysopidae and Hemerobiidae, and

other surveys such as the 2019 one which concentrated on undisturbed areas and collected few specimens.

These findings support the hypothesis that Hemerobiidae and Chrysopidae were introduced with cash crop cultivation of sugar cane, cocoa, and coffee, some of them as late as the 19th century. They are not part of the original – or native – biodiversity, to the extent it exists. *Micromus timidus* Hagen, *Ankylopteryx tristicta* (Navás) and *Ceratochrysa antica* (Walker) are common in cocoa plantations all over Africa, *Borniochrysa squamosa* (Tjeder) and *Mallada desjardinsi* (Navás) are locally abundant in African agricultural fields. *Apertochrysa luaboensis* (Tjeder) is a peri-urban species in São Tomé. Their isolation in island environments is probably too recent to have allowed speciation mechanisms to generate endemic species in São Tomé. Whereas São Tomé e Príncipe is considered a hot spot for biodiversity, and rightly so for most insect families, it is not true in the case of Neuroptera

On the other hand, the presence of an endemic Mantispid which is associated with undisturbed environments indicates that the group is ancient, and was present before human settlement.

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Conflicts of interest

The author declares no conflicts of interest.

Research permit

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