

**The California Academy of Sciences  
Gulf of Guinea Expedition (2001)**

**IV. The Neuroptera of São Tomé and Príncipe Islands**

**Norman D. Penny**

*Department of Entomology, California Academy of Sciences, 875 Howard Street,  
San Francisco, CA 94103; Email: npenny@calacademy.org*

**Fifteen species in four families of Neuroptera are known from São Tomé and Príncipe Islands. The diversity of species appears more closely correlated with island size and elevation than with distance from the mainland. The family Coniopterygidae was not found on either Príncipe or São Tomé Islands although six species are known from Bioko. Strong habitat preferences were exhibited. *Ankylopteryx tristicta* Navás, *Ceratochrysa antica* (Walker), *Micromus timidus* Hagen, and *Notiobiella* sp. were most frequently associated with cacao and show the greatest potential for biological control on this crop. *Borniochrysa squamosa* (Tjeder) and *Pseudomallada boninensis* (Okamoto) show good potential as biological control agents on vegetable crops.**

The Gulf of Guinea islands lie off the west coast of Africa in the Bight of Benin and are an excellent biological laboratory for the study of insect dispersal, rates of immigration, and extinction. However, there have been few reports of neuropterans from these islands. The first record of Neuroptera was the description of *Chrysopa* (now *Glenochrysa*) *conradina* by Navás in 1910. Navás (1922) noted two species, *Ceratochrysa antica* (Walker) and *Ankylopteryx tristicta* Navás, from Bioko based on two specimens. Navás (1929) again recorded *Ceratochrysa antica* (as *Musola impar*) from Bioko. Kimmins (1952) designated a paratype of *Anapochrysa africana* (now *Apochrysa leptalea* Rambur) from São Tomé Island. Viette (1958) described a new species of Mantispidae from São Tomé Island based on two specimens. The only major study of the Neuroptera fauna of Bioko was conducted by Monserrat and Diaz-Aranda in August 1986 and August 1987. Their study resulted in a collection of 110 specimens representing 18 species of Coniopterygidae, Chrysopidae, and Hemerobiidae (Monserrat 1990; Hölzel and Monserrat 1992). On a subsequent California Academy of Sciences (CASC) multidisciplinary expedition to Bioko in 1998, an additional two specimens of Chrysopidae and Mantispidae were collected by Jens Vindum, Darrell Ubick, and Keith Dabney. Finally, the only specimen of Neuroptera known from Annobon, *Micromus timidus*, was reported by Monserrat (1990).

To better understand the selective filter mechanism to dispersal of west African Neuroptera, a concerted attempt was made to collect specimens on São Tomé and Príncipe Islands between 8 April and 28 May, 2001. Because neuropterans have good potential as biological control agents (see Tauber et al. 2000), special efforts were made to collect on important local crops, such as cacao and coffee.

## MATERIALS AND METHODS

Because neuropterans are generally nocturnal, arboreal predators that rest on the underside of leaves during the daytime, the most effective method of capture was to beat the understory vegetation or grasses with a hand net. Other individuals were collected with Malaise traps and light traps. Some larval antlions form distinctive pits in sand or loose soil in sheltered areas. These were hand collected by scooping under the pit with a stiff piece of paper and extracting the larva from the loose sand or soil. The larvae were then reared on small crickets. Male genitalia were studied by first macerating the abdomen in cold KOH for from four to 24 hours, then staining them in chlorazol black E for 30 minutes. The resulting stained abdomens were stored in glycerin-filled glass microvials under the pinned specimens. All specimens are deposited in the Entomology Collection of CASC.

## RESULTS

A total of 368 specimens representing 14 species were collected during the eight week period of field work in 2001. They belong to three families: Chrysopidae, Hemerobiidae, and Myrmeleontidae. Together with the mantispid species described earlier by Viette, 15 species of Neuroptera are now known from São Tomé and Príncipe Islands, including those discussed below.

## Family Chrysopidae Schneider, 1851

*Apochrysa leptalea* (Rambur, 1842)

Fig. 1.

**MATERIAL EXAMINED.**— SÃO TOMÉ ISLAND: Macambrara, 00°17'N, 06°36'E, 1170 m, 9 May 2001, 1 ♂, 1 ♀, N.D. Penny; same locality, 23 May 2001, 1 ♀, Rato Cabinda; Obó National Park, 00°17'18.5"N, 06°36'11.3"E, 1300 m, 18 April 2001, 2 ♀ ♀, N.D. Penny; same locality, 25 April 2001, 1 ♀, N.D. Penny; same locality, 6 May 2001, 1 ♂, N.D. Penny.

When Kimmins described *Anapochrysa africana* in 1952, he selected as holotype a specimen that had come from the eastern Usambara Mountains of Tanzania. Other specimens at his disposal had come from Kenya and South Africa. Also, he listed two specimens from São Tomé Island, collected in November, 1932 but without specific locality. The generic name *Anapochrysa* was synonymized with *Apochrysa* by Winterton and Brooks in 2002 and the species name *africanus* was not included in the list of included species (ostensibly, but not explicitly synonymizing the name with *A. leptalea*). The specimens reported on from East and South Africa had been collected in moist upland forest. The recent São Tomé collections included seven specimens that were also collected in moist upland forest at about 1300 m within Obó National Park and on an adjacent ridge.



FIGURE 1. *Apochrysa leptalea* (Rambur)

***Ankylopteryx tristicta* Navás, 1910**

**MATERIAL EXAMINED.**— PRINCIPÉ ISLAND: São José Pincaté, 01°37'30"N, 0723'30"E, 150-300 m, 18 May 2001, 1 ♀, N.D. Penny and Quintino Quade, on *Theobroma cacao*.

This species is known from Congo, Cameroon, and Equatorial Guinea. Hölzel and Monserrat (1992) reported its presence on Bioko Island. As with the female from Principé reported on here, Hölzel and Monserrat (ibid.) also noted that three of their specimens were collected on cacao.

***Ankylopteryx* sp.**

**MATERIAL EXAMINED.**— SÃO TOMÉ ISLAND: 2 km W São Tomé City, 00°18'N, 06°44'E, 100 m, 26 May 2001, 3 ♂♂, 3 ♀♀, N.D. Penny and Quintino Quade, on *Theobroma cacao*; Bom Sucesso, 00°17'N, 06°36'E, 1000–1170 m, 10 May 2001, 1 ♂, Delfim; Macambrara, 00°17'N, 06°36'E, 1300 m, 23 May 2001, 2 ♀♀, Rato Cabinda.

This species was collected on cacao near São Tomé City. It was also found in disturbed agricultural land near the Bom Sucesso field station and the nearby radio tower at Macambrara. Thus, there appears to be a considerable elevational tolerance on São Tomé, from near sea level to nearly 1300 m. This species is part of the “*pellucida*” group with a dark spot at the wing base of the mesonotum, but it differs from all South African species because it lacks the large dark spot at the distal cubital cell of the forewing.

***Borniochrysa squamosa* (Tjeder, 1966)**

Fig. 2.

**MATERIAL EXAMINED.**— SÃO TOMÉ ISLAND: São Tomé Island, São Tomé City, 00°20'N, 06°44'E, 10 m, 11 May 2001, 1 ♀ Fábio R. Penny, at light; Bom Sucesso, 00°17'N, 06°36'E, 1000-1170 m, 26 April 2001, 2 ♂♂, N.D. Penny, 1 May 2001, 1 ♂, 2 ♀♀, N.D. Penny; 6 May 2001, 1 ♂, 5 ♀♀, N.D. Penny and F.R. Penny; 7 May 2001, 1 ♂, F.R. Penny; 9 May 2001, 4 ♂♂, 1 ♀, N.D. Penny; 10 May 2001, 1 ♂, 3 ♀♀, 1?, Delfim; 5 ♂♂, 3 ♀♀, N.D. Penny; Obó National Park, 00°17'N, 06°36'E, 1300 m, 25 April 2001, 1 ♀, N.D. Penny; Bombaim, 00°15'00"N, 06°38'30"E, 28 May 2001, 9 ♂♂, 19 ♀♀, Rato Cabinda, on coffee: Rio Ió Grande, 00°07'N, 06°38'E, 10 m, 28 May 2001, 1 ♀, N.D. Penny and Quintino Quade; Macambrara, 00°17'N, 06°36'E, 1300 m, 23 May 2001, 5 ♂♂, 4 ♀♀, Rato Cabinda.

This species is known from South Africa, Zimbabwe, Mozambique, and the Democratic Republic of the Congo. It was not encountered on Principé, and on São Tomé it was found mostly in the disturbed agricultural lands near the Bom Sucesso field station and urban environments. In the agricultural area, this species and *Pseudomallada boninensis* were locally abundant.

***Ceratochrysa antica* (Walker, 1853)**

**MATERIAL EXAMINED.**— PRINCIPÉ ISLAND: São José Pincaté, 01°37'20"N, 07°23'52"E, 100 m, 14 May 2001, 4 ♂♂, 3 ♀♀, 2??, N.D. Penny; 15 May 2001, 2 ♀♀, N.D. Penny; 18 May 2001, 1 ♂, 3 ♀♀, N.D. Penny; 20 May 2001, 6 ♂♂, 7 ♀♀, N.D. Penny, on *Theobroma cacao*; road to Praia Salgada, 01°38'N, 07°27'30"E, 100 m, 16 May 2001, 1 ♀, N.D. Penny; SÃO TOMÉ ISLAND: south of Shipwreck Cove, 00°23'N, 06°36'E, 10



FIGURE 2. *Borniochrysa squamosa* Tjeder

m, 3 May 2001, 1♂, N.D. Penny, on arboreal Leguminaceae; Lagoa Azul, 00°24'N, 06°37'E, 10 m, 27 April 2001, 1♀, N.D. Penny; 29 April 2001, 2♂♂, N.D. Penny and Quintino Quade, 1 May 2001, 1♀, N.D. Penny; 22 May 2001, 1♂, N.D. Penny; 27 May 2001, 2♀♀, N.D. Penny and Quintino Quade, on *Tamarindus indica*; São Tomé City, 00°20'N, 06°44'E, 10 m, 8 April 2001, 2♀♀, Jens Vindum; 2 km west of São Tomé City, 00°18'N, 06°44'E, 100 m, 26 May 2001, 3♂♂, 2♀♀, N.D. Penny and Quintino Quade.

This species is reportedly widespread within the Afrotropical region from Mali to Guinea to Madagascar and the Mascarenes (Hölzel 1990). It was reported by Hölzel and Monserrat (1992) from Bioko Island. During this project, *C. antica* was found abundantly on cacao in the lowlands of Príncipe and on the tamarind trees, *Tamarindus indica*, of coastal São Tomé. It was not found above 200 m elevation.

### *Chrysoperla congrua* (Walker, 1853)

**MATERIAL EXAMINED.**— PRINCÍPE ISLAND: Sundi Plantation, 01°39'30"N, 07°23'15"E, 13 May 2001, 1♀, N.D. Penny; SÃO TOMÉ ISLAND: Lagoa Azul, 00°24'N, 06°37'E, 5 m, 22 May 2001, 6♂♂, 1♀, N.D. Penny; 27 May 2001, 9♂♂, 7♀♀, N.D. Penny and Quintino Quade, on grasses; Rio Ió Grande, 00°07'N, 06°38'E, 10 m, 28 May 2001, 1♀, N.D. Penny and Quintino Quade, on grass; Bombaim, 00°15'00"N, 06°38'30"E, 28 May 2001, 1♂, Rato Cabinda.

This is probably the most widespread of all species of Chrysopidae. It is found from the Pacific Islands of Easter Island, Rapa Island, Samoa, and Fiji to Australia and Papua New Guinea, through the Oriental and Afrotropical regions. Hölzel and Monserrat (1992) record it from Bioko. This species was collected only once on Príncipe on some roadside shrubs near cultivated fields along the road to the Sundi Plantation. The only places where it was collected on São Tomé were on tall grasses in extensive grasslands near Lagoa Azul at the north end of the island and on grasses at a scenic overlook near Rio Ió Grande near the south end of the island. The grassland at Lagoa Azul was searched extensively for this species on April 27 without success, but individuals became progressively more abundant at this site until May 27. When alive, individuals of this species appear almost white in the brightness of the open fields.

### *Glenochrysa conradina* (Navás, 1910)

Fig. 3.

**MATERIAL EXAMINED.**— SÃO TOMÉ ISLAND: Lagoa Azul, 00°24'N, 06°37'E, 5 m, 27 April 2001, 2♀♀, N.D. Penny; 29 April 2001, 3♂♂, 7♀, N.D. Penny, 1 May 2001, 1♂, N.D. Penny; 6 May 2001, 22 May 2001, 9♂♂, 5♀♀, N.D. Penny; 27 May 2001, 15♂♂, 9♀♀, N.D. Penny and Quintino Quade, on *Tamarindus indicus*.

This lovely small species is poorly known. Originally described from Bioko, it has since been recorded from Nigeria and Senegal (Hölzel and Monserrat 1992). It was not found on Príncipe and was seen on São Tomé only in the open savannahs near Lagoa Azul. There, however, it was locally abundant on the tamarind trees from 27 April until 27 May.



FIGURE 3. *Glenochrysa conradina* Navás

***Pseudomallada boninensis* (Okamoto, 1914)**

**MATERIAL EXAMINED.**— PRINCIPÉ ISLAND: Santo Antonio, 01°38'N, 06°19'E, 10 m, 19 May 2001, 1 ♀, Quintino Quade, at light; SÃO TOMÉ ISLAND: Bom Sucesso, 00°17'N, 06°36'E, 1000–1170 m, 5 May 2001, 1 ♂, N.D. Penny; 9 May 2001, 3 ♂♂, 1 ♀, N.D. Penny and Delfim; 10 May 2001, 9 ♂♂, 8 ♀♀, Delfim; 1 ♂, 1 ♀, N.D. Penny; Macambrara, 00°17'N, 06°36'E, 1300 m, 23 May 2001, 1 ♂, 3 ♀♀, Rato Cabinda; Bombaim, 00°15'00"N, 06°38'30"E, 28 May 2001, 1 ♂, 3 ♀♀, Rato Cabinda; Roca de São João, 00°09'N, 06°36'E, 2 May 2001, 1 ♀, N.D. Penny, on *Citrus*.

This species ranges from Japan and Taiwan and throughout the Afrotropical region to the Cape Verde Islands. It has not been collected on Bioko. However, on Principé, and along with *Borniochrysa squamosa*, this species was locally abundant among the shrubs at the edge of cultivated fields near the Bom Sucesso field station. One additional specimen was collected on a citrus tree at the Roça de São João near Angularisch in southern São Tomé.

***Pseudomallada luaboensis* (Tjeder, 1966)**

**MATERIAL EXAMINED.**— SÃO TOMÉ ISLAND: Bombaim, 00°15'00"N, 06°38'30"E, 28 May 2001, 1 ♀, Rato Cabinda; Bom Sucesso, 00°17'N, 06°36'E, 1000–1170 m, 9 May 2001, 1 ♀, N.D. Penny; Macambrara, 00°17'N, 06°36'E, 1300 m, 23 May 2001, 1 ♂, 2 ♀♀, Rato Cabinda; Praia Francesca, 1 ♀, Jens Vindum; Praia Melao, 00°19'07.8"N, 06°44'18.3"E, 17 April 2001, 1 ♀, N.D. Penny; São Tomé City, 00°18'N, 06°44'E, 100 m, 10 May 2001, 1 ♀, Fábio R. Penny, at light; south of Shipwreck Cove, 00°23'N, 06°36'E, 10 m, 3 May 2001, 6 ♂♂, 6 ♀♀, N.D. Penny, on tall grasses.

This species was described from Mozambique and also recorded from Bioko (Hölzel and Monserrat, 1992). It was not collected on Principé, but it was collected hovering about lights at our lodging in downtown São Tomé City and also at Praia Melão on the south side of the city. The individual at Praia Melão was found resting on a large bunch of tall grass. A large number of specimens of this species was collected at night just south of Shipwreck Cove (0°23'14.6"N, 006°35'41.7"E); they were found hovering around the panicles of tall grasses in a small sheltered culvert near the coast.

***Pseudomallada sjostedti* (van der Weele, 1910)**

**MATERIAL EXAMINED.**— PRINCIPÉ ISLAND: 1.7 km WSW Santo Domingo, 01°38'N, 07°24'E, 120 m, 20 April 2001, 1 ♀, N.D. Penny; São José Pincaté, 01°37'20"N, 07°23'52"E, 100 m, 14 May 2001, 1 ♂, 1 ♀, N.D. Penny; 18 May 2001, 4 ♂♂, 2 ♀♀, N.D. Penny and Quintino Quade; 20 May 2001, 1 ♂, 3 ♀♀, N.D. Penny on *Theobroma cacao*; Sundi Plantation, Ponte de Ministro, 01°40'N, 07°24'E, 21 April 2001, 4 ♂♂, 1 ♀, N.D. Penny.

This species is known in East Africa from Ethiopia to Natal and in West Africa from Senegal, Gambia, Guinea Bissau, and Equatorial Africa. Hölzel and Monserrat (1992) recorded it from Bioko and Rio Muni. It was not collected on São Tomé, but it was found in cacao plantations on Principé.

**Family Hemerobiidae Latreille, 1803*****Hemerobius nairobicus* Navás, 1910**

**MATERIAL EXAMINED.**— SÃO TOMÉ ISLAND: Obó National Park, 00°17'18.5"N, 06°36'11.3"E, 1300 m, 18 April 2001, 2 ♂♂, N.D. Penny; 25 April 2001, 1 ♂, 1 ♀, N.D. Penny; 10 May 2001, 1 ♂, N.D. Penny.

This species was not seen on Principé and was found only in moist primary forest above 1300 m elevation in Obó National Park on São Tomé. Although not known from Bioko, it has been collected in Uganda and South Africa (Tjeder 1961).

***Micromus timidus* Hagen, 1853**

**MATERIAL EXAMINED.**— PRINCIPÉ ISLAND: road to Bella Vista, 01°37'20"N, 07°25'00"E, 50 m, 15 May 2001, 9♂♂, 3♀♀, N.D. Penny, on *Theobroma cacao*; São José Pincaté, 01°37'20"N, 07°23'52"E, 100 m, 14 May 2001, 1♂, N.D. Penny; 18 May 2001, 12♂♂, 1♀, N.D. Penny and Quintino Quade; 20 May 2001, 7♂♂, 6♀♀, N.D. Penny, on *Theobroma cacao*; trail to Praia Salgada, 01°38'00"N, 07°27'30"E, 100 m, 16 May 2001, 1♂, N.D. Penny; SÃO TOMÉ ISLAND: 2 km west of São Tomé City, 00°18'N, 06°44'E, 100 m, 26 May 2001, 13♂♂, 9♀♀, N.D. Penny and Quintino Quade.

This is the most widely distributed of all hemerobiids, ranging from the Pacific Islands to Australia and westward into the Oriental and Afrotropical regions. Monserrat (1990) reported this species from Bioko and Annobon. We found it abundantly on cacao at lower elevations of both Principé and São Tomé.

***Notiobiella* sp.**

**MATERIAL EXAMINED.**— PRINCIPÉ ISLAND: São José Pincaté, 01°37'20"N, 07°23'52"E, 100 m, 18 May 2001, 2♀♀, N.D. Penny and Quintino Quade; SÃO TOMÉ ISLAND: 2 km west of São Tomé City, 00°18'N, 06°44'E, 100 m, 26 May 2001, 4♂♂, 7♀♀, N.D. Penny and Quintino Quade.

Monserrat (1990) mentioned two species of *Notiobiella* from Rio Muni, the mainland province of Equatorial Guinea, but none from the island of Bioko. We found individuals of *Notiobiella* together with *Micromus timidus* in the cacao plantations of both Principé and São Tomé. The male genitalia of this species appears unlike the published illustrations of either of the species reported by Monserrat.

**Family Mantispidae Leach, 1815*****Pseudoclimaciella thomensis* (Viette, 1958)**

**MATERIAL EXAMINED.**— EQUATORIAL GUINEA: Bioko, Punta Beecroft, 03°43'N, 08°40'E, 18 October 1998, 1♀, Darrell Ubick and Keith Dabney.

The original description of this species mentions two specimens from Bombaim on São Tomé. Although originally described in "Mantispa," it was mentioned as being closely related to *M. tropica*, a species now placed in the genus *Pseudoclimaciella*. No specimens of this, or of any other species of mantispid, were collected during this trip. However, a previous trip to Bioko yielded one specimen of *Pseudoclimaciella*, which is likely this same species. However, the validity of this name is questionable.

**Family Myrmeleontidae Latreille, 1803*****Myrmeleon* sp.**

Fig. 4.

**MATERIAL EXAMINED.**— PRINCIPÉ ISLAND: southwest side of island, 01°36.09'N, 07°31.22'E, 50 m, 23 April 2001, 6 larvae, N.D. Penny; SÃO TOMÉ ISLAND: São Tomé City, 00°19'45.8"N, 06°43'45.0"E, 10 m, 29 April 2001, 6 larvae, N.D. Penny.

Larval pits of *Myrmeleon* were found at an abandoned plantation house at a cove along the southwest shore of Principé Island (01°36.09'N, 007°21.22'E) and in a partially completed home in downtown São Tomé City. Larval pits were also seen at the root bases of baobab trees at Lagoa Azul, but when we returned to collect the larvae after a heavy rainstorm the sand was moist and the pits closed. A young insect collector (Delfim) also described antlion pits from the town of

Trinidade, although no pits were actually seen by the author.

### DISCUSSION

(Table 1) Bioko, the island closest to the African mainland, lies only 40 km from the coast and was probably connected to Africa during the last ice age, approximately 10,000 years ago. This island is also the largest and highest of the group and, consequently, would be expected to have the richest neuropteran fauna. To date, 20 species in five families are known from this island: Chrysopidae (9), Coniopterygidae (6), Hemerobiidae (3), Mantispidae (1), and Osmyliidae (1).

Príncipe, the second island from the mainland, is also the oldest island. It has been dated at 31 million years; it lies 250 km west of the mainland. Eight species in three families were encountered there: Chrysopidae (5), Hemerobiidae (2), and Myrmeleontidae (1). The small size of the island may be the reason that so few species are found there; insufficient habitats and/or intense competition for limited resources.

The third island, São Tomé, is larger and higher than Príncipe and lies 300 km from the coast. Its age has been dated at 14 million years. Thirteen species have been found on this island: Chrysopidae (8), Hemerobiidae (3), Mantispidae (1), and Myrmeleontidae (1).

Finally, Annobon is a very small island lying 350 km from the mainland. It is only 4.8 million years old and would be expected to have the most depauperate fauna. Not surprisingly, the only species known from there is the hemerobiid *Micromus timidus*.

The most striking feature of the fauna is the apparent lack of coniopterygid species on any of the



FIGURE 4. *Myrmeleon* sp. larval pits in sand pile inside house under construction.

TABLE 1. Species of Neuroptera known from the Gulf of Guinea Islands.

	<i>Bioko</i>	<i>Príncipe</i>	<i>São Tomé</i>	<i>Annobon</i>
<i>Ankylopteryx splendidissima</i>	X			
<i>Ankylopteryx tristicta</i>	X	X		
<i>Ankylopteryx</i> sp.				X
<i>Apochrysa leptalea</i>				X
<i>Borniochrysa squamosa</i>				X
<i>Ceratochrysa antica</i>	X	X	X	
<i>Chrysoperla congrua</i>	X	X	X	
<i>Dysochrysa furcata</i>	X			
<i>Glenochrysa conradina</i>	X		X	
<i>Parankyloptera polysticta</i>	X			
<i>Parankyloptera tenuis</i>	X			
<i>Pseudomallada boninensis</i>		X	X	
<i>Pseudomallada luaboensis</i>	X		X	
<i>Pseudomallada sjostedti</i>	X	X		
<i>Coniocompsa silvestriana</i>				
<i>Coniopteryx</i> sp.				
<i>Cryptosceneia</i> sp.				
<i>Helicoconis (Capoconis) bazi</i>				
<i>Heteroconis africana</i>				
<i>Semidalis</i> sp.				
<i>Hemerobius reconditus</i>				X
<i>Micromus africanus</i>	X			
<i>Micromus timidus</i>	X	X	X	X
<i>Notiobiella</i> sp.		X	X	
<i>Psectra jeanneli</i>	X			
<i>Pseudoclimaciella thomensis</i>	X		X	
<i>Myrmeleon</i> sp.		X	X	
<i>Spilosmlus leucomatodes</i>	X			

islands not previously connected to the mainland. Although Bioko has a fairly rich coniopterygid fauna, no species were found on either São Tomé or Príncipe, despite intensive searches for them. It is possible that seasonality of the collecting (August versus April-May) may be a determinant.

Two species of Chrysopidae, *Ankylopteryx tristicta* and *Pseudomallad sjostedti*, are found on the two nearest islands, but not on São Tomé, at least not yet, which suggests that these species are unable to bridge the 50 km water gap between São Tomé and Príncipe.

*Micromus timidus* shows its great dispersal ability by its presence on all four islands, and other species, such as *Ceratochrysa antica* and *Chrysoperla congrua*, will likely be found on Annobon with more collecting.

This numerical sequence of species (20–8–13–1) correlates well with island size and height, but much less so with distance from the mainland. It also correlates well with ease of collecting logistics and infrastructure.

The number of specimens of Chrysopidae encountered, especially around cultivated areas, was a striking contrast to the situation encountered on other tropical, Old World islands. There were far more individuals encountered on São Tomé and Príncipe Islands than on the larger islands of Madagascar and New Guinea. This may be due to reduced competition from other arboreal predators, such as ants.

### CONCLUSIONS

There is some evidence to support the theory that water gaps among the islands of the Gulf of Guinea play a significant role in restricting the dispersal of species. Further collecting needs to be done to test this supposition.

Two species of Chrysopidae, *Ankylopteryx tristicta* and *Ceratochrysa antica*, were frequently found associated with cacao plantations, as was the hemerobiid *Micromus timidus*. Two other species of Chrysopidae, *Borniochrysa squamosa* and *Pseudomallada boninensis*, were frequently collected at the margins of agricultural plots. Finally, *Chrysoperla congrua* was always collected in open, grassy situations, such as abandoned sugarcane plantations. These species show good potential for crop protection through augmentation programs.

### ACKNOWLEDGMENTS

I wish to thank Quintino Quade for helping with the field work, as well as Delfim and Rato Cabinda for collecting specimens. Robert C. Drewes is to be thanked for his initial vision and organizing the multidisciplinary expedition, as well as providing many thoughtful discussions of the fauna and its origins. The expedition would not have been possible without the local help provided by Ned Seligman. His assistance cannot be overstated. Angus Gascoigne provided valuable background information about São Tomé Island, including the reference to Viette's (1958) publication. Tereza d'Espiney of Ecofac helped obtain necessary permits and provided maps and reference guides. Dong Lin patiently photographed several of the chrysopid species alive, even while stricken with bouts of malaria. Fabio R. Penny provided valuable help with logistics and collected several of the specimens. More importantly, he and I engaged in many valuable discussions about the Neuroptera fauna of these islands and their implications. David H. Kavanaugh encouraged the development of this publication and reviewed an early draft. Finally, and most importantly, we could not have carried out this expedition without the help and support of the government of São Tomé and Príncipe.



## LITERATURE CITED

- HÖLZEL, H. 1990. The Chrysopidae of the Afrotropical Region (Insecta: Neuroptera). Pages 17–26 in M.W. Mansell, H. Aspöck, eds., *Advances in Neuropterology. Proceedings of the Third International Symposium on Neuropterology*. Berg en Dal, Kruger National Park, R.S.A., 1988. Pretoria, South Africa.
- HÖLZEL, H., AND V.J. MONSERRAT. 1992. Chrysopidae from Equatorial Guinea (Neuroptera: Chrysopidae). *Entomofauna, Zeitschrift für Entomologie* 13(28):465–476.
- KIMMINS, D.E. 1952. A revision of the Genera of the Apochrysinæ (Fam. Chrysopidae). *Annals and Magazine of Natural History*, ser. 12, 5:929–944.
- MONSERRAT, V.J. 1990. Some brown lacewings from Equatorial Guinea (Neuropteroidea: Planipennia: Hemerobiidae). *Journal of African Zoology* 104:17–22.
- NAVÁS, L. 1910. Crisópidos (Ins. Neur.) nuevos. *Brotéria (Zoológica)* 9:38–59.
- NAVÁS, L. 1922. Insectos de Fernando Poo. *Musei Barcinonensis Scientiarum Naturalium Opera* 4:109–116.
- NAVÁS, L. 1929. Insectos exóticos Neuropteros afines del Museo Cívico de Génova. *Annali del Museo Civico di Storia Naturale Giacomo Doria* 53:354–389.
- TAUBER, M.J., C.A. TAUBER, K.M. DANNE, AND K.S. HAGEN. 2000. Commercialization of predators: recent lessons from green lacewings (Neuroptera: Chrysopidae: Chrysoperla). *American Entomologist* 46(1):26–38.
- TJEDER, B. 1961. Neuroptera — Planipennia. The Lace-wings of Southern Africa. 4. Family Hemerobiidae. *South African Animal Life* 8:296–408.
- VIETTE, P. 1958. Mission du Muséum dans les îles du Golfe de Guinée. *Bulletin de la Société entomologique de France* 63(9-10):216–218.
- WINTERTON, S.L., AND S.J. BROOKS. 2002. Phylogeny of the Apochrysin green lacewings (Neuroptera: Chrysopidae: Apochrysinæ). *Annals of the Entomological Society of America* 95:16–28.