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THE ENDEMIC SEA - SKATER *HALOBATES ALLUAUDI* BERGROTH, 1893 (HEMIPTERA: GERRIDAE) IN THE SEYCHELLES

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ABSTRACT. - The sea-skater *Halobates alluaudi* Bergroth, 1893, endemic to the Seychelles, was collected from the islands of Mahé, Praslin, La Digue, and Curieuse, but not from Cousin, Ste. Anne or Cerf. Large flotillas, consisting of both nymphs and adults, were found only associated with mangroves or under overhanging coastal vegetation. Adult females were rare in all the samples and were completely absent from samples from Praslin.

INTRODUCTION

The Republic of the Seychelles is one of the smallest countries in the World, situated in the Indian Ocean between 4° and 10°S, and between 45° and 57°E. The archipelago consists of two groups of islands, the granitic Seychelles, consisting of some 40 islets formed largely of continental rocks, and the Aldabra group of islets formed of coral limestone. The granitic Seychelles, which form the main island group, lie about 1600 km from the African continent, about 1000 km from Madagascar, and about 2800 km from India, while the Aldabra group is situated to its south-west, much closer to Madagascar. These islands are of great biological interest as they support a unique fauna and flora, with many endemic species (Stoddart, 1984). Although much is known about the terrestrial insects of the islands, almost nothing is known of their marine insect fauna (Cogan, 1984). During a three-week expedition carried out from August 16 to September 7, 1985, an intensive survey concentrating on marine insects was carried out around three of the main islands of the granitic Seychelles: Mahé, Praslin, and La Digue. Some collections were also made from the smaller islands of Cousin, Curieuse, Ste. Anne and Cerf, all under conservation protection.

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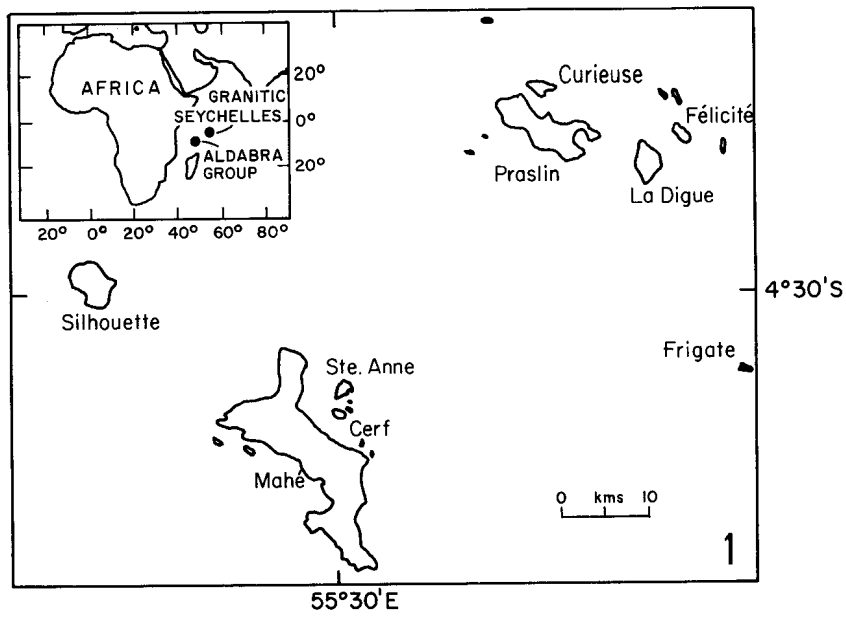

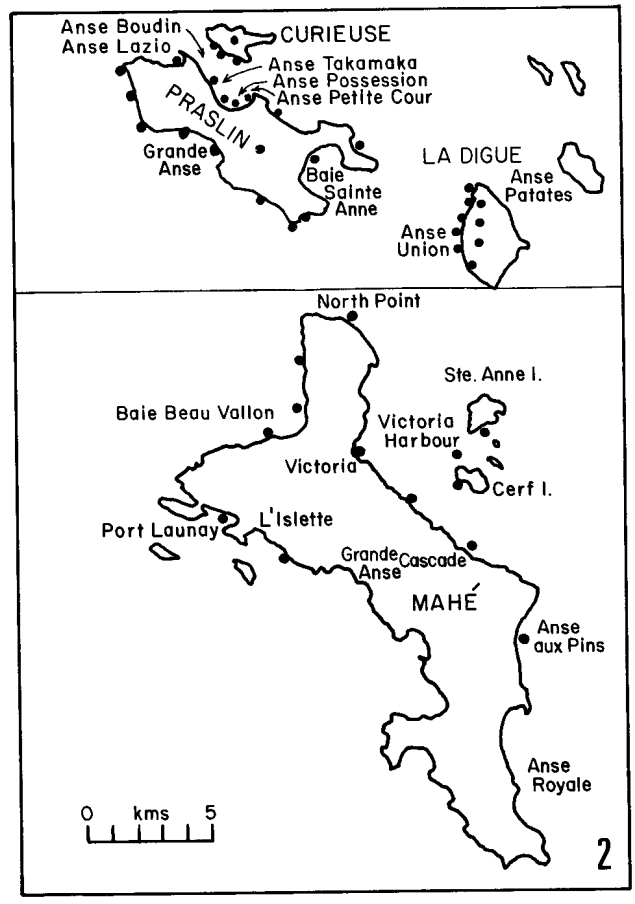

Fig. 1. Location of the Seychelles archipelago and main islands of the granitic Seychelles. Fig. 2. Locations of sampling sites on granitic Seychelles.

MATERIALS AND METHODS

A total of 45 coastal locations were visited and about 100 collections of insects were made from beach sand, wrack (cast seaweed), mangrove swamps (mainly *Bruguiera gymnorhiza* and *Rhizophora mucronata*), coastal salt-ponds, lagoons, bays, and nearshore open water. Insects of the orders Heteroptera, Diptera, Coleoptera and Hymenoptera were found, represented by at least 18 families. A summary of the general marine insect collection will be published elsewhere (Cheng, in press). In this paper only observations on sea skaters (*Halobates*, Gerridae) will be presented.

All of the sea-surface insects were collected by using a plastic scoop of 20cm in diameter with a 1mm mesh. They were preserved in 70% alcohol, and brought back to the Scripps Institution of Oceanography laboratory for further studies.

RESULTS AND OBSERVATIONS

The locations around each of the islands where marine insect samples were collected are given in Fig. 1. Specimens of *Halobates* were found at only 18 of the 45 sampling locations, given below:

Mahé: Beau Vallon Bay; Mangrove at Victoria; Mangrove at Cascade; Mangrove at Port Launay; Mangrove at Anse aux Pins.

Praslin: Beach, La Reserve Hotel; Anse Takamaka; Anse Possession, night light; Grand Anse; Mangrove at Anse Boudin; Bai Ste. Anne jetty, night light.

La Digue: Main dock,under tree overhang; main dock, night light, jetty, night light; Anse Union.

Curieuse: Mangrove bay; enclosed mangrove lagoon.

None were found around the coasts of Cousin, Ste. Anne or Cerf.

The number of specimens collected at each location on each island, with the composition of the catches, is given in Table 1. They were all identified as *H. alluaudi* Bergroth, 1893 a species endemic to the Seychelles. A total of 627 specimens were collected. Some 83% were nymphs. Of the 107 adults found, only 14 (13%) were females, whereas among the 148 fifth-instar specimens collected 68 (46%) were females. Although it could be speculated that females inhabit slightly different niches from males, and many might have been missed by our sampling, this possibility seems unlikely. It is also possible that there is some reproductive seasonality and that prior to our arrival many females had died after oviposition. However, we have no data to support this hypothesis, except that nymphs of the first two instars were rarer (7.3% and 5.4% respectively) than those of the last three instars (3rd: 22.7%, 4th: 36.2%, 5th: 28.5%). Seasonal data are needed to resolve this problem.

Although the numbers of positive sites were about the same on each of the three main islands, large populations (144 and 242 specimens respectively) were found only at two locations: at the mangrove bay in Cascade, Victoria, Mahé, and under the shade of a Takamaka (*Calophyllum*) tree near the main dock on La Digue island.

Table 1. Number and composition of *Halobates alluaudi* collected at each location in the granitic Seychelles.

Location of Insects	Total No	No.s at each developmental stage I	II	III	IV	V	Adults	1985
Mahé Island								
Anse Aux Pins, night light	3	2	-	-	-	-	1m	18 Aug
Cascade Mangrove	144	12	8	40	56	8m 14f	3m 3f	19 Aug
Victoria Mangrove	6	-	-	-	-	-	4m 2f	19 Aug
Beau Vallon Bay	9	-	-	-	-	-	9m	20 Aug
Port Launay Mangrove	45	1	5	36	3	-	-	6 Sep
Praslin Island								
Anse Takamaka	13	-	-	-	1	-	1 m	25 Aug
Anse Possession, night light	16	-	-	-	-	-	16m	26 Aug
Grand Anse Bay	1	-	-	-	-	-	1m	26 Aug
Anse Boudin Mangrove	41	7	9	15	5	-	5m	28 Aug
Hotel La Reserve Beach	11	-	-	1	1	-	9m	3 Sep
Bai Ste. Anne Jetty	1	-	-	-	1	-	-	4 Sep
La Digue Island								
Near dock under tree	36	16	5	-	11	2m 2 f	-	29 Aug
Main dock, under shade	36	-	1	10	17	6 m 2 f	-	29 Aug
Jetty, night light	9	-	-	-	-	-	6m 3f	29 Aug
Jetty, night light	1	-	-	-	-	-	1m	30 Aug
Anse Union, under tree	242	-	-	16	93	64m 50f	19m	2 Sep
Curieuse Island								
Enclosed mangrove lagoon	9	-	-	-	-	-	4m 5f	23 Aug
Mangrove lagoon	4	-	-	-	-	-	3m 1f	23 Aug

(I-V = nymphal stages 1-5; m = males, f = females)

Of the 10 coastal locations visited on Mahe island *Halobates* was found at only five. Only one sample was collected in an open bay; the others were all associated with mangroves. The large sample from the Cascade mangrove site was collected at sunset (about 6 pm), and the specimens were brought back to a make-shift laboratory and kept alive in a plastic bucket for 4 hr. At 10 pm I noted that many specimens had moulted. Thirty-four cast skins were found in the sample and five of the nymphs were observed in the process of moulting. They were preserved with the moult still attached. Moulting has also been found to occur predominantly at night or during early morning hours in other *Halobates* species (Cheng, 1981; Foster & Treherne, 1986). About 67% of the nymphs in this sample were in the 3rd or 4th instar; there were relatively few in the 1st (8.3%), 2nd (5.6%) or 5th (15.3%) instar, and only 6 adults.

A few eggs were found deposited singly on the dorsal surfaces of two of the 5th-instar females, and another two on cast skins. Out of thousands of specimens previously examined over the last twenty years, I have only once found eggs laid on the body of one nymph of an open-ocean species. Coastal *Halobates* spp. are known to lay eggs on submerged vegetation or rocks (Foster & Treherne, 1986), unlike their open-ocean cousins which lay eggs on flotsam (Cheng,

1974; Polhemus & Andersen, 1976). Laying eggs on flotsam has been postulated to be a prerequisite for an ancestral coastal *Halobates* species to adapt to an open-ocean existence (Newman & Cheng, 1983), although it has not been observed among other coastal *Halobates* species to date. Whether the practice is common among females of this species in the field is not known; if so, *Halobates alluaudi* might be related to an ancestor of open-ocean species. It is also interesting to note that in the open-bay habitats of Mahé there was a complete absence of nymphs and a predominance of adult males. Females were very rare, unlike in several other coastal species, where one usually finds similar numbers of males and females (Cheng, unpublished data).

Among the 16 coastal locations sampled on Praslin Island, *Halobates* was found at only six; all but one sample were collected in lagoons or open bays. The only sample associated with mangroves was the largest, consisting of nymphs of the first four instars, and five adult males. The remaining samples, all from open bays, consisted largely of adult males (90%). Not a single adult female was collected from Praslin.

There are no mangroves around the island of La Digue. Although nine locations were sampled, *Halobates* was found only near the main dock and jetty. Huge flotillas, consisting of thousands of specimens, were observed under the shade of Takamaka trees by the dock, but where there were no overhanging tree branches to provide shade we did not see any such sea-skater aggregations. The largest sample collected on this island, with 242 specimens, representing about 10% of the individuals of one such flotilla, comprised very few adults, all males. However, a few females were collected in one night-light sample at the jetty. The majority of the nymphs (n = 223) in this sample were in the 4th (41.7%) and 5th (51.1%) instars; there were 16 specimens in the 3rd (7.2%) instar, but none in the first two instars.

The small island of Curieuse has a rather large stretch of coastal mangrove and a mangrove-enclosed lagoon, but not many *Halobates* specimens were found there. The two collections from this island consisted only of adults (7 males, 6 females). It is surprising that no nymphs were collected among the mangroves, since the very young nymphs of several other coastal species have been found predominantly in protected areas amongst mangroves, and rarely venture out to more open waters (Birch *et al.*, 1979; Cheng, 1985; Foster & Treherne, 1986). Adults, however, may be found either in open waters far from shore, or in flotillas very close to shore (Foster & Treherne, 1982).

DISCUSSION

Halobates alluaudi was the only species found in this study around the islands of the granitic Seychelles, where it is endemic (Cheng, 1989b). Although over 35 coastal sea-skater species are known from around the World, only nine occur in the Indian Ocean. Of these only two are known from the seas adjacent to the Seychelles: *H. poseidon* Herring, 1961 from the coast of Kenya, and *H. tethys* Herring, 1961 from the Mauritius, are both endemic (Herring, 1961; Cheng, 1985, 1989b). A third species, *H. hayanus* White, 1883, originally described from the Gulf of Aden, is also found in Singapore (Cheng & Fernando, 1969; Murphy, 1990), Malaysia, Indonesia, Thailand, Australia and several other Pacific island groups (Cheng, 1989b). Two open-ocean sea-skater species have also been reported in the vicinity of the Seychelles: *H. micans* Eschscholtz, 1883 and *H. germanus* White, 1883 (Cheng, 1989a). We did not collect any individuals of either species in this study, although specimens of *H. micans* have been found in the guts of the bridled tern (*Sterna anaethetus*) breeding in the Seychelles (Cheng, 1985;

Diamond, 1976). A third open-ocean species, *H. eschscholtzi* Herring[1], known only from the type locality off the coast of Zanzibar, has never been collected since it was described (Herring, 1961; Cheng, 1985).

The adults of *Halobates alluaudi* measure about 5-6 mm in body length, the males being slightly larger than the females. It can be easily distinguished from other *Halobates* species by the structure of the male genitalia. In morphology the nymphs are like those of other *Halobates* species. Unlike the adults, which are almost totally black dorsally, the nymphs are brown with dark brown markings. The sexes are not distinguishable until the 5th instar. Nymphs of different stages, once they have been determined to belong to the same species, can be distinguished by measuring the lengths of various appendages. Since the mid-femur, which is the longest segment of the appendages and has the greatest growth increment, was found to be less variable than body lengths (Cheng & Maxfield, 1980), the five nymphal stages can be easily separated by measuring just the mid-femoral lengths (see Fig. 3).

In the granitic Seychelles *H. alluaudi* appears to be associated with mangroves wherever such habitats are available. If mangroves are absent, as around the island of La Digue, the sea-skaters are found only in large aggregates under the shade of overhanging coastal vegetation. During our visit to La Digue, flotillas of *Halobates alluaudi* were almost always found beneath the overhang of a Takamaka tree. Some of the more obvious reasons for the associations of sea-skater flotillas with coastal vegetation are food and shade. Land insects that fall onto the water surface from overhanging trees may provide a source of food for the sea-skaters below. Since

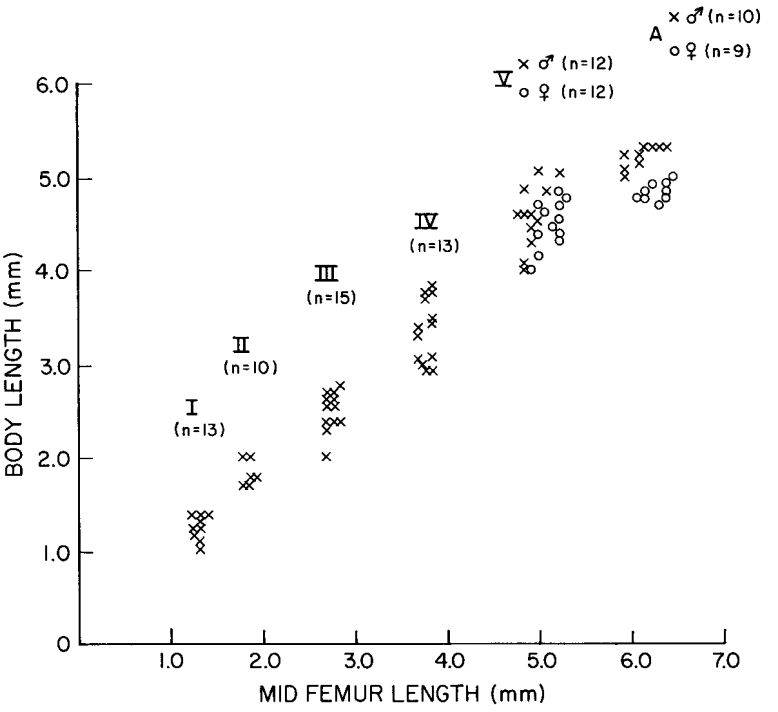

Fig. 3. Relationship between body and mid-femora lengths of nymphs (stages I-V) and adults (A) of *Halobates alluaudi*.

[1] Editor's note : See however, paper of J. T. Polhemus & D. A. Polhemus, 1991, Three new species of marine water striders from the Australasian region with notes on other species (Gerridae : Halobatinae, Trepobatinae), *Raffles Bull. Zool.*, **39**(1): 1-13.

ultra-violet (UV) rays in sunlight are known to be harmful to most living organisms, many insects have either evolved adaptations to protect themselves from damage by UV-irradiation (Cheng *et al.*, 1978), or avoid direct sunlight by seeking shade from such overhanging trees.

Very few marine insect species were found in association with *Halobates* in the Seychelles. The commonest was a veliid, *Halovelia pauliani* Poisson (Hemiptera: Veliidae), previously known only from the Mozambique Channel (Andersen, 1989). We also collected a species of the coral bug *Hermatobates* (Hemiptera: Hermatobatidae), probably *H. djiboutensis* Coutière and Martin, in several of our night-light samples. These bugs were seldom seen during the day, and were most easily collected at the sea surface at night by light at suitable coastal locations (Cheng, 1977), or at low tide when they came out to feed (Foster, 1989). As with the sea-skater *Halobates*, we know very little about their biology and ecology.

The Seychelles is of great importance biogeographically as they are the only isolated oceanic islands in the World that are built of continental rocks and not of coral limestone (Stoddart, 1984). The islands may have been separated from the continental land masses since early Tertiary, making possible a high degree of endemism in the fauna and the flora. A large collection of the terrestrial insect fauna was made during the Percy Sladen Trust Expedition, and the results were summarised by Scott (1933). Of the over 2,000 insect species recorded, some 51% were found to be endemic. Although a number of other scientific expeditions with insect collections have been carried out over the last century, much still remains to be studied on the marine insect fauna of the Seychelles, which are of special interest because of their distance from other land masses and their long history of isolation.

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