

Further Studies on the Water bugs of the genus *Anisops* (Hemiptera: Notonectidae) in Ceylon

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Introduction

The previous work on the Ceylonese *Anisops* has been reviewed by Leong and Fernando (1962). They also gave short descriptions of the species recorded and keys to the genera of Notonectidae and species of *Anisops*. We are fortunate in having at our disposal now an extensive collection of *Anisops* from Ceylon—on which the present study is based. The material was collected during a freshwater fisheries survey early in 1962, sponsored by the Fisheries Department, Ceylon, and supported by the Food and Agriculture Organization Office in Colombo. In addition some material was collected by one of the authors (C. H. F.) and by Dr. A. C. J. Weerekoon earlier. The Director, National Museums, Ceylon, placed at our disposal the unidentified *Anisops* in the Museum collections.

From a study of the present material we have added *Anisops occipitalis* Breddin to the Ceylonese list. The male of *Anisops ali* Distant is described for the first time. The large number of specimens of *Anisops batillifrons* Lundb. available has made possible a critical evaluation of the specific status of *Anisops cavifrons* Brooks which we consider a synonym.

Leong (1962a) has described the life history of *Anisops breddini* Kirk., a species common in Ceylon. Leong and Fernando (1962) have given short notes on the biology of *Anisops*. A popular account of the biology of *Anisops* is given by Leong (1962b). The distribution of *Anisops* in Ceylon is at present very inadequately known. The material available to us enables a few tentative remarks to be made in general and includes specimens collected practically throughout the Island.

In the present paper a short account is given of the biology of *Anisops* in Ceylon, their distribution and descriptions of *Anisops ali* and *A. occipitalis*. All the other Ceylonese species are described by Leong and Fernando (1962). Brooks (1951) has given detailed descriptions of all the Ceylonese species except *Anisops ali*. A revised key to the Ceylonese *Anisops* is given and includes for the first time *A. ali* whose male has so far not been described and therefore omitted from the keys of Brooks (1951) and Leong and Fernando (1962).

Biology

Anisops is essentially an inhabitant of standing water. It frequents clear calm water and is seldom found in streams except in protected backwaters. In the irrigation reservoirs it occurs in small bays or at the edges when these are overgrown with vegetation. They are absent from regions with even a slight wave action. It appears that they prefer shallow water although they are sometimes found in deep wells. It was found that whilst *Anisops* occurs in numbers in small ditches near irrigation reservoirs they are usually rare in the reservoir itself. At Wirawila and Hambegamuwa, small ditches a few yards from the waters edge had many *Anisops* whilst there were none in the reservoir itself. In collections made from 21 irrigation reservoirs *Anisops* occurred only in 8 of them and only in a single reservoir (Moragaswewa) were they abundant. On the other hand they were abundant in ponds especially in the Hambantota area. Here the ponds had contracted greatly in area due to drought and

were very rich in small animal life like Copepoda, Cladocera, Ostracoda, small Hydrophilidae, Dytiscidae and Corixidae in addition to rotifers and insect larvae of various kinds. The predatory *Anisops* had reached enormous numbers in these ponds. Hundreds of specimens were caught in a single sweep of a pond net and in two ponds in Hambantota and Palatupana, Yala, six species were found in each of a total recorded fauna in Ceylon of nine. Mosquito larvae were absent from these ponds. This lends support to the view that they are important natural enemies of mosquito larvae (Laird 1956). The absence of mosquito larvae from ponds with *Anisops* has been noted in Malaya by Fernando (in press). In Singapore *Anisops breddini* has been shown to feed on mosquito larvae under field conditions by Zaman, Fernando and Chelappah (1962).

Anisops is also found in paddy fields. Fernando (1959) has recorded two species in Ceylon namely *Anisops batillifrons* and *A. exigera* Horv. (the latter identified as *A. crinita* Brooks). They are however not so abundant as in slightly deeper ponds with small animal life.

Species of *Anisops* are believed to destroy fish eggs and fry. In experimental ponds at the Fisheries Research Station, Polonnaruwa, enormous numbers of *Anisops batillifrons* were found in some of the ponds. According to Fisheries Inspector Mr. W. B. Ellepola they cause destruction of fish fry. Oil spread on the surface killed the *Anisops* but the ponds were quickly recolonized by immigrants flying into them. This makes eradication difficult.

Notonectids (*Notonecta* spp.) are known to sting man (Hungerford 1933). I have not come across any *Anisops* stinging humans so far. *Anisops* spp. are generally smaller than *Notonecta* spp. Of the Ceylonese species only *Anisops barbata* Brooks similar in size to *Notonecta*. It is also possible that the rostrum of *Anisops* is too weak to penetrate human flesh.

Some species of *Anisops* have been recorded at light. Brooks (1951) found specimens of two species recorded at light. Fernando (1961a) recorded two species at light in Malaya. Fernando (1961b) found two species flying in the early hours of the morning in Ceylon and suggested that *Anisops* usually flies early in the morning. An observation supporting this view was made by Hale (1924) in Australia. They are commonly found in isolated habitats. Laird (1956) found them common in small habitats. Fernando (in press) found 5 species colonizing an isolated forest pond in Malaya. Together with the Corixidae they form the commonest Hemiptera in small ponds. It is likely that they migrate seasonally into small habitats like many of the Hemiptera (Fernando 1960).

The extent to which *Anisops* is eaten by fish is not known. Perhaps their absence from larger habitats can be accounted partly to predation. In one of the small irrigation reservoirs at Moragaswewa *Anisops breddini* was plentiful. This is the only reservoir where the fish fauna was poor, out of 21 we studied. *Anisops* which normally lives in open water would be a very easy prey for fish.

Some of the *Anisops* spp. collected had larval water mites on them. Usually only one or two mites were found and these were attached in the area of the rostrum. The occurrence of parasitic water mites on aquatic insects is widespread and has been recorded in Ceylon by Fernando (1958).

Eggs are inserted into water plants and the nymphs feed on microscopic plants and animals, later taking larger animals. They are also known to be cannibalistic. The life history of *Anisops breddini* has been described by Leong (1962a).

Distribution

The distribution of *Anisops* from records available are given in Figs. 4 and 5. These records are based on collections made from all areas except the Sabaragamuwa province. The relatively few records from the Eastern Province and the Mannar area are due to lack of intensive collecting and *Anisops* can hardly be rare in these areas.

Of the nine species so far recorded from Ceylon *Anisops batillifrons* and *A. breddini* are the most widely distributed. Together with *Anisops nivea*, *A. exigera* and *A. bouvieri* they occur in both

the dry and the wet zones. *Anisops ali* occurs only in the hilly areas. The distribution of the closely related species *Anisops bouvieri* Kirk, and *A. extendofrons* Brooks is interesting. The former occurs in the North and has been recorded in Colombo whilst the latter is found only in the South.

The great mobility of *Anisops* makes their local distribution depend largely on the suitability of habitats—since factors of isolation are probably relatively ineffective.

Taxonomy

A major contribution to the taxonomy of *Anisops* is that of Brooks (1951). Leong and Fernando (1962) have given a short review of the work on the taxonomy of *Anisops* and a key to the genera of Notonectidae and *Anisops* species recorded from Ceylon. From the present study it appears that the details of the chaetotaxy of the male foreleg have to be used with caution in the widely distributed species *Anisops batillifrons*. The number of teeth in the stridulatory comb also varies considerably within a species. Further work based on more abundant material than was available to Brooks (1951) would be very valuable in elucidating the specific status of what are at present known to be closely related species.

CEYLONESE SPECIES

Nine species of *Anisops* have been recorded from Ceylon. Seven of these have been described briefly by Leong and Fernando (1962). The additional species are *Anisops occipitalis* and *A. ali*. The former is a new record and is briefly described in the present paper. The latter has been known only from the female and is described in detail for the first time.

The nine species recognised as occurring in Ceylon are *Anisops ali*, *A. occipitalis*, *A. exigera*, *A. batillifrons*, *A. bouvieri*, *A. extendofrons*, *A. breddini*, *A. nivea*, (Fieb.) and *A. barbata*.

The present study lends further support to the view of Leong and Fernando (1962) that *Anisops nasuta* does not occur in Ceylon. Further, *Nychia* which was considered a doubtful record by the same authors has not been found.

Anisops ali Dist.

MATERIAL EXAMINED : Shannon Estate, Hatton 10.4.62 ; 1 male, 1 female, Hakgala. Aug. 1929 ; 3 males, 15 females.

DESCRIPTION : General facies stramineous. Slightly fusiform in shape with the greatest body width at mid-thorax. Eyes brown. Abdominal venter dark brown except for the keel and segmental margins of the connexivia which are stramineous. Legs stramineous.

MALE : 6.47-7.05 mm. long and 1.80-2.18 mm. in maximum breadth. The outline of the head from above is rounded. The greatest width of head is slightly more than the pronotal humeral width of vertex. Synthipsis and vertex of about equal width. Interocular space has almost parallel margins. Along the median longitudinal axis the head is slightly more than half the pronotal length. Pronotum with humeral width one and one seventh times the median length.

Its lateral margins are diverging and concave in outline, being slightly more than one third the median length. The posterior margin of the pronotum is convex, medially it is almost straight. A distinct, wavy carinate line occurs on the anterior region of the pronotum. Facial tubercle slightly raised. Labrum triangular with basal width three times the median length ; apex rounded. Rostral prong (Fig. 1c) longer than third rostral segment, apex rounded. Stridulatory comb of nineteen teeth of unequal length (Fig. 1b). Chaetotaxy of male foreleg as shown in Fig. 1a. Tibia with four large setae and a single small one. Tarsus with four setae.

The relative lengths of the parts of the legs are as follows :—

			Femur	Tibia	First tarsal	Second tarsal
Fore	..	..	100	135	.. 82	.. —
Middle	..	..	100	78	.. 44	.. 25
Hind	..	..	100	91	.. 34	.. 30

FEMALE : Viewed from above, the outline of the head is rounded. Greatest width of head slightly more than pronotal humeral width and about seven and three quarter times the anterior width of vertex. Synthlipsis and vertex almost equal in width as in the male. Along the median longitudinal axis the head is about seven tenths the pronotal length. The pronotal humeral width is about one and one third the median length. Lateral margins of pronotum as in male and measure one third the median length ; posterior margin as in male. Relative lengths of the parts of the legs as follows :—

			<i>Femur</i>		<i>Tibia</i>		<i>First Tarsal</i>		<i>Second Tarsal</i>
Fore	..	..	100	..	131	..	61	..	40
Mid	..	..	100	..	80	..	43	..	27
Hind	..	..	100	..	92	..	36	..	35

DISCUSSION : This species is distinguished by the almost parallel interocular space and the shape of the pronotum with the carinate wavy line (Distant 1911) both in the male and female. It resembles *Anisops allaudi* Poisson but can be separated from the latter by the chaetotaxy of the male foreleg and the structure of the stridulatory comb. Leong and Fernando (1962) suggested that *Anisops ali* and *A. allaudi* were synonymous but examination of the male has shown this view to be erroneous.

Anisops breddini Kirk

MATERIAL EXAMINED : Padaviya tank, 26.4.62 : 2 males, 3 females, 7 nymphs. Padaviya-Pulmoddai Rd. 14th Ml., roadside ditch 27.4.62 ; 1 female. Ridiyagama, ditch near tank 24.3.62 ; 19 males, 19 females. Lahugala tank, 14.4.58 ; 2 males, 3 females. Ehetuwewa tank, 27.2.62 ; 1 female. Manakumaya tank near Ehetuwewa, 27.2.62 ; 1 female. Topawewa, Polonnaruwa, 28.2.62 ; 1 nymph. Tabbowa tank, 19.3.62 ; 2 nymphs. Kandalama, ditch near tank 11.3.62 ; 2 females. Minneriya tank, 6.3.62 ; 13 males, 20 females 57 nymphs. Hambegamuwa, ditch near tank, 28.3.62 ; 1 male, 1 female. Ambalantota-Ratnapura Rd. 14Ml., roadside pond 24.3.62 ; 4 males, 1 female. Iranamadu tank, 30.4.62 ; 2 nymphs. Moragaswewa, near Habarana 7.3.62 ; over 500 nymphs.

Anisops breddini is easily recognised by its slender build and holoptic eyes. Superficially it resembles *Nychia* but can be separated from the latter by the presence of the hair-lined pit at the anterior end of the hemelytral commissure. It is possible that the records of *Nychia* from Ceylon refer to this species. Together with *Anisops batillifrons* it is the most common and widespread species in Ceylon.

Anisops barbata Brooks

MATERIAL EXAMINED : Hambantota, roadside pond, 27.3.62 ; 2 females. Palatupana, Yala forest pond, 26.3.62 ; 4 males, 1 female. Maradanmaduwa, Wilpattu, 24.6.52 ; 1 male, 4 females. Ratmale, near Maho, roadside pond 14.7.57 ; 1 male. Specimens were also collected from a forest pond in Kirinda on 26.3.62.

This species is the largest of the Ceylonese *Anisops*. It is robust, a character which it shares with only one other local species namely *Anisops occipitalis*. However the latter is much smaller.

This species has been described in detail by Brooks (1951) and its diagnostic features given by Leong and Fernando (1962). It appears to occur in jungle areas in small forest ponds.

Anisops occipitalis Breddin

MATERIAL EXAMINED : Hambantota, roadside pond, 27. 3.62 : 4 males, 2 females. Palatupana Yala, forest pond, 26.3.62 ; 6 males, 1 female, 1 nymph. Maradanmaduwa, Wilpattu, 24.6.52 ; 1 male, 1 female. Specimens were also collected from Kirinde on 26.3.62.

DESCRIPTION : The male measures 7.88–7.93 mm. in length and 2.42–2.63 mm. in maximum breadth. The female is 7.79–7.87mm. long and has a maximum breadth of 2.64–2.67 mm. The chaetotaxy of the male foreleg is shown in fig. 3a and the stridulatory comb and rostral prong in figs. 3b and 3c respectively.

This species is rather robust in appearance like *Anisops barbata* but somewhat smaller. It is easily recognised by the procumbent hairs on the labrum, structure of the rostral prong and the chaetotaxy of the male foreleg. It is recorded here for the first time in Ceylon. Its known distribution includes Australia, Java, New Caledonia, New Guinea and Malaya. In Malaya it has been recorded in a forest pond in Johore by Fernando (in press).

Anisops occipitalis is an inhabitant of forest ponds like *A. barbata* from the records so far available for Ceylon.

Anisops nivea (F.)

MATERIAL EXAMINED: Dunagaha Uraniya, Wilpattu, 23.6.52; 5 males, 5 females. Narahenpitiya, Colombo, 21.3.62; 1 female, 1 nymph. Hambantota, roadside pond, 27.3.62; 8 males, 10 females. Palatupana, Yala, forest pond 26.3.62; 5 males, 3 females. Horana, 9.6.57, 2 males, 1 female. Gangodawila, Nugegoda, January 1962; 1 female, at light. Colombo 16.1.34; 2 females in the National Museum Collection.

This species can be recognised by the wide synthlipsis, long labral hairs. It is slightly stouter than the "small" species like *Anisops batillifrons*. It has been described in detail by Brooks (1951) and Leong and Fernando (1962) have given the diagnostic features and illustrated the chaetotaxy of the male foreleg. It is not a common species and usually occurs in small numbers in ponds.

Anisops batillifrons Lundb.

A very large number of this widely distributed species was available for study.

MATERIAL EXAMINED: Polonnaruwa, Fisheries Research Station fishponds 1.3.62; 78 males, 126 females. Parakrama Samudra, Polonnaruwa, 29.2.62; 2 nymphs. Amupitiya, near Belihuloya, small pond in paddy field, 29.3.62; 3 males, 4 females. Mahailuppulama, Government Farm, small pools, 30.11.57; 4 males, 1 female. Horana, 9.6.57; 2 males, 1 female. Ridiyagama, ditch near tank 24.3.62; 8 males, 17 females. Ehetuwewa tank, 27.2.62; 2 males. Kiniyama, ditch near forest, 3.5.58; 2 males, 3 females. Wirawila, ditch near tank, 27.3.62; 27 males, 13 females, 11 nymphs. Kandalama, ditch near tank, 11.3.62; 2 males. Colombo, Fisheries Research Station ponds, March 1962; 1 male, 8 females. Gangodawila, Nugegoda, paddy field, 17.11.57; 7 males, 10 females. Padaviya-Pulmoddai Rd. 14MI., roadside ditch, 27.4.62; Kadahapola, Kurunegala District, temporary ponds, 29.7.57; 8 males, 1 female. Ambalantota, ditch near sea, 22.5.57; 2 males, 5 females. Batalagoda, ditch near tank, 23.5.58; 6 males, 4 females. Hambantota, roadside pond 27.3.62; 15 males 96 females. Palatupana, Yala, forest pond, 26.3.62; 2 males, 4 females, 4 nymphs. Ambalantota-Ratnapura Rd., 14 M., roadside pond. 24.3.62; 1 male, 2 females. Hambegamawa, ditch near tank, 28.3.62; 26 males, 29 females. Numerous specimens were also collected from a forest pond in Kirinda on 26.3.62. In the collection of the Ceylon National Museum the following material was found: Talgasmankada, (S. P.) 11.14-11.36; 2 males, 4 females. Colombo, 21.12.39; 4 males, 16 females.

Brooks (1957) separated *Anisops batillifrons* from a species he named *A. cavifrons* on the presence of a procumbent spine in the proximal portion of the tibia of the latter. The chaetotaxy of the male foreleg apart from this difference was identical. The cephalic projection and the rostral prong of the two species are also similar. In the material examined there were one, two or three procumbent spines on the tibia. In addition the procumbent spine is sometimes rudimentary (Figs. 2a-2d). In view of these observations it is advisable, we think, to retain only *Anisops batillifrons* as valid. The material examined by us agrees closely with the original description of Lundblad (1933). The variation in the procumbent spines makes this feature unreliable for specific diagnosis and details of chaetotaxy of this sort should be used with caution in separating *Anisops* species. *Anisops batillifrons* is perhaps the most widely distributed species of the genus. It has been recorded in China, Formosa, Hainan, Okinawa, Burma, India, Philippines and Ceylon. Variation is to be expected in a species of such wide distribution.

Anisops bouvieri Kirk.

MATERIAL EXAMINED: Jaffna peninsula, 6.12.57; 2 males, 3 females. Mandativu, 5.12.57; 1 male, 2 females, 2 nymphs. Also Colombo 16.1.34; 1 male, 1 female in the Ceylon National Museum.

It is clear that this species differs from *Anisops extendofrons* which it resembles closely in the shape of the cephalic projection. The cephalic projection of *Anisops extendofrons* appears to be slightly more blunt at the apex. *Anisops bouvieri* is characterised by the chaetotaxy of the male foreleg. The tibia has a distinct subapical angle with a prominent spine. This feature separates it from the closely related *Anisops extendofrons*. This species is rare and has so far been collected only on the Jaffna peninsula and in Colombo—a rather unusual distribution.

Anisops extendofrons Brooks

MATERIAL EXAMINED: Ambalantota, roadside ditch, 22.5.62; 7 males, 17 females. Palatupana, Yala, forest pond, 26.3.62; 2 males, 4 females. Hambantota, roadside pond, 27.3.62; 12 males, 47 females. Wirawila, ditch near tank, 27.3.62; 2 males, 12 females. Hambegamuwa, ditch near tank, 28.3.62; 2 males, 3 females.

This species has so far been collected only in the Southern extremity of Ceylon. It resembles *Anisops bouvieri* but can be separated by the chaetotaxy of the male foreleg.

Anisops exigera Horv.

MATERIAL EXAMINED: Dunagaha, Uraniya, Wilpattu, 26.7.52; 13 males, 9 females, 17 nymphs. Ridiyagama, ditch near tank, 24.3.62; 1 male, 1 female. Hambantota, roadside pond, 27.3.62; 15 males, 22 females. Palatupana; Yala, forest pond 26.3.62; 17 males, 9 females. In the Ceylon National Museum collections; 1 male, Colombo, 16.1.34. Many specimens were also collected from a forest pond in Kirinda on 26.3.62.

This is the smallest species found in Ceylon and can usually be recognised on size alone. It has been described in detail by Brooks (1951) and the diagnostic features given by Leong and Fernando (1962). It is closely related to *Anisops crinita* Brooks. Fernando (1959) misidentified *Anisops exigera* as *A. crinita*.

KEY TO THE CEYLONESE *Anisops*

(Based on the males)

1. Eyes holoptic *A. breddini*
Eyes not holoptic..... 2
2. Interocular space with sub-parallel margins..... *A. ali*
Interocular space without sub-parallel margins..... 3
3. Cephalic projection absent..... 4
Cephalic projection present..... 7
4. Large, more than 8.0 mm. long..... *A. barbata*
Less than 8.0 mm. long..... 5
5. Synthlipsis narrow, less than one third the anterior width of vertex..... *A. exigera*
Synthlipsis wide, one third or more the anterior width of vertex..... 6
6. Robust form; short procumbent hairs on labrum..... *A. occipitalis*
Slender form; long labral hairs present *A. nivea*
7. Cephalic projection short with rounded apex..... *A. batillifrons*
Cephalic projection long with acuminate apex..... 8
8. The anterior margin of the fore tibia with a subapical angle..... *A. bouvieri*
The anterior margin of the fore tibia without a subapical angle..... *A. extendofrons*

Summary

Study of an extensive collection of *Anisops* from Ceylon shows the presence of nine species one of which namely *Anisops occipitalis* is a new record. The male of *Anisops ali* is described for the first time. It is suggested that *Anisops cavifrons* is a synonym of *A. batillifrons*.

Some preliminary observations have been made on the biology and comments made on *Anisops* in relation to food for fishes and as an enemy of young fish and eggs especially in experimental ponds.

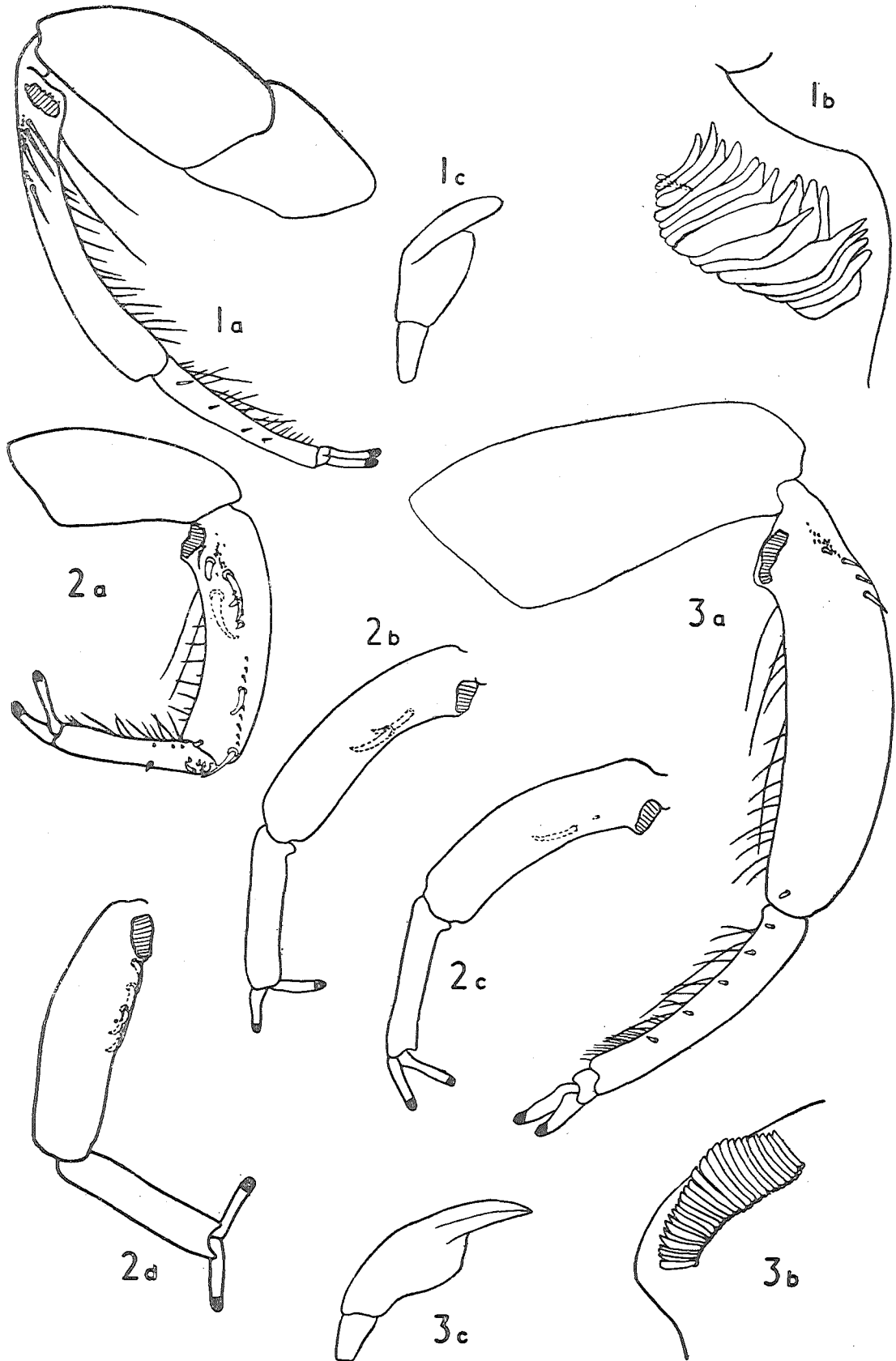
A list of material examined is given together with short notes on the species together with a key to the Ceylonese species.

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Figs. 1-3: *Anisops ali*: 1a Chaetotaxy of male foreleg; 1b. Enlarged stridulatory comb; 1c. Rostral prong.
Anisops batillifrons: 2a. Male foreleg with one procumbent spine; 2b. Male foreleg with two procumbent spines; 2c. Male foreleg with two procumbent spines; one of which is rudimentary; 2d. Male foreleg with three procumbent spines.
Anisops occipitalis: 3a. Chaetotaxy of male foreleg; 3b. Enlarged stridulatory comb; 3c. Rostral prong.

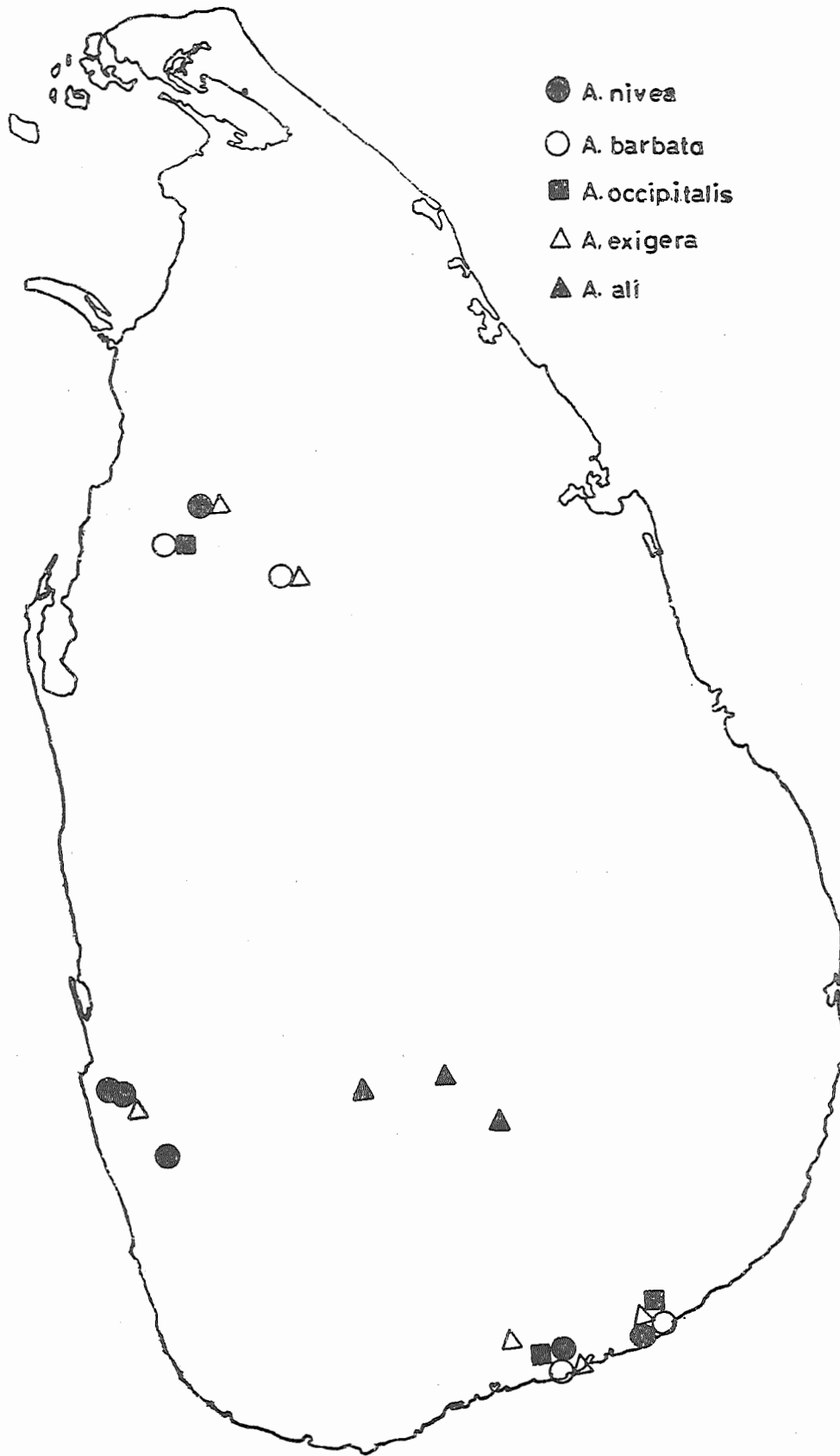


Fig. 4. Distribution of *Anisops* in Ceylon.

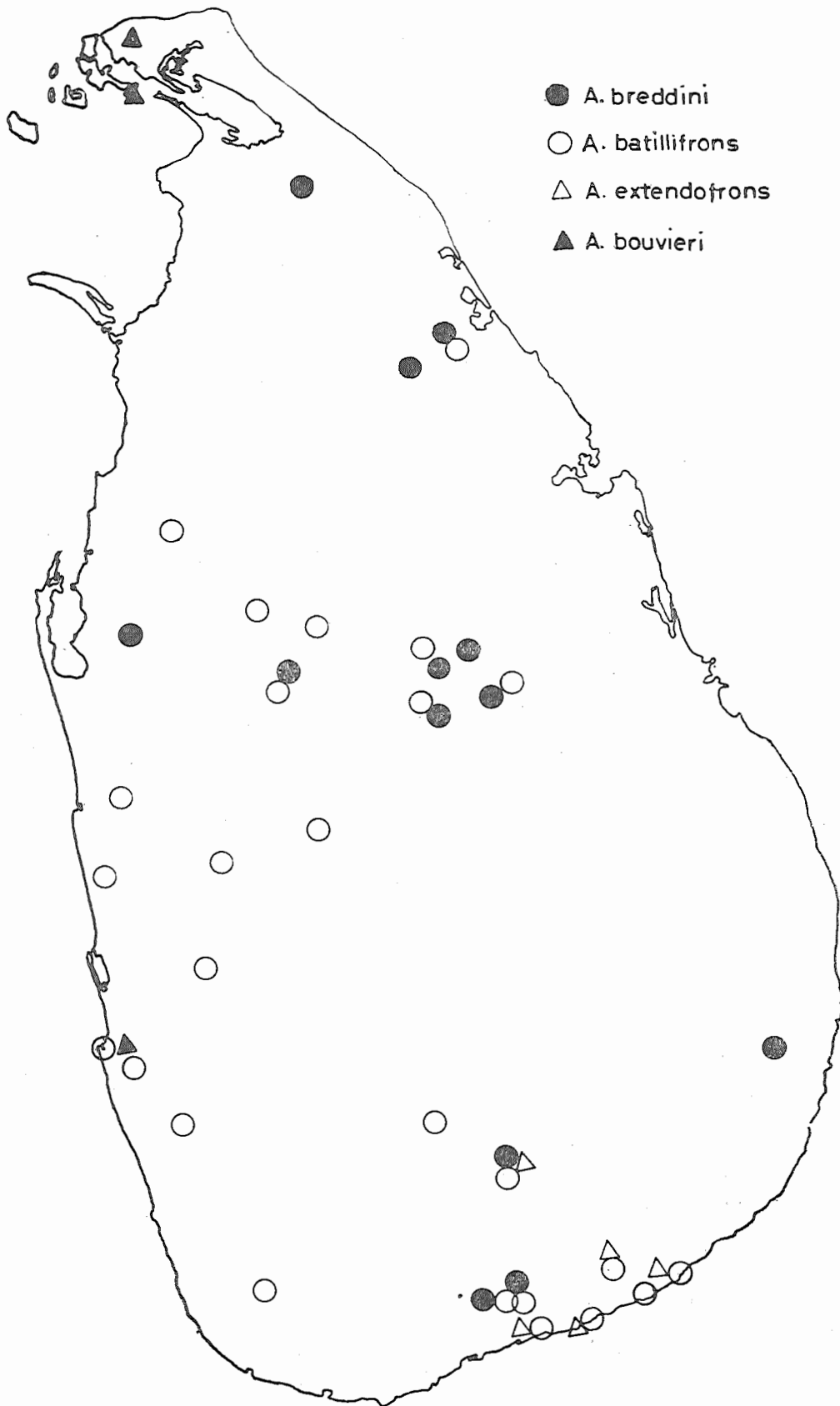


Fig. 5. Distribution of *Anisops* in Ceylon.