

THE *SPINOSA* SPECIES-GROUP, GENUS *BOOPIA* PIAGET (PHTHIRAPTERA: BOOPIIDAE)*

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Abstract

Four new species belonging to the *Boopia spinosa* species-group parasitic on Australian Dasyuridae are described: *B. greeni*, type-host *Antechinus minimus* (Geoffroy); *B. murrayi*, type-host *Antechinus swainsonii* (Waterhouse); *B. aquilonia*, type-host *Antechinus bellus* (Thomas); and *B. lukoschusi*, type-host *Sminthopsis murina* (Waterhouse). The characters within the group are considered and some remarks included on the possible relationships of the species and their hosts. The correct interpretation of Harrison and Johnston's original description of *B. brevispinosa* is discussed.

Introduction

Kéler (1971), in his revision of the Boopiidae, recognized, with some reservations, the genus *Phacogalia* Mjöberg for the two species *spinosa* and *brevispinosa*, both described by Harrison and Johnston (1916). Clay (1972) considered that the genus should not be recognized as there were other species now in *Boopia* Piaget which could be included, together with species intermediate between *Phacogalia* and the rest of *Boopia*.

Kéler (1971) separated the two species mainly on the absence (*spinosa*) or presence (*brevispinosa*) of a pair of stout spiniform setae on the ventral surface of the head. Recently, through the kindness of Mr R. H. Green and Dr F. S. Lukoschus, it has been possible to examine a good series of the *spinosa* species-group from *Antechinus minimus* (Geoffroy) and *Sminthopsis murina* (Waterhouse), and the opportunity has been taken to re-examine the specimens from the various hosts on which Kéler based his remarks and measurements of the two species. It is now apparent that there are six species, four of which are new, readily separable in both sexes by the chaetotaxy.

Key to species of the *Boopia spinosa* species-group

- | | | |
|----|--|---------------------|
| 1. | Head ventrally without a pair of stout spiniform setae.. .. . | spinosa |
| | Head ventrally with a pair of stout spiniform setae | 2 |
| 2. | Postspiracular complex on III-VII with two stout spiniform setae (Fig. 3) | 3 |
| | Postspiracular complex on III-VII without such setae | 4 |
| 3. | Anterior end ("handle") of ♂ anterior median plate bilobed; setae of ♀ sternite II 16-19 | greeni |
| | Anterior end of "handle" pointed; setae of ♀ sternite II 12-13 | murrayi |
| 4. | One of the two setae associated with postspiracular seta on V-VII stout and spiniform | brevispinosa |
| | Both these setae short and small | 5 |
| 5. | Tergal setae on IV-VIII 3 + 4 + 3 | lukoschusi |
| | Tergal setae on IV-VIII 2 + 4 + 2 | aquilonia |

Boopia brevispinosa (Harrison and Johnston) (Fig. 4)

Heterodoxus brevispinosus Harrison and Johnston, 1916, *Parasitology* 8: 355.

There has been some confusion about the host of this species. Calaby (in Kéler 1971: 80) argued convincingly that the true host was most probably *Antechinus stuartii* Macleay, 1841, and a specimen from this host was designated as lectotype (Kéler 1971). However, the original figure of the female (Harrison and Johnston 1916, fig. 12) shows the tergal chaetotaxy as 2 + 4 + 2, whereas on most segments the specimens from *A. stuartii* have 3 + 4 + 3. The lateral setae could be interpreted as those of specimens from the latter host, and the size fits. In the description, the abdomen is said to "exhibit the characteristic form and chaetotaxy of *Boopia*". Some specimens from *A. stuartii* have on tergum III 2 + 4 + 2, and it seems possible that the rest of the terga were

*Communicated by M. D. Murray.

copied from a specimen with this arrangement of setae on III, especially as the details of the chaetotaxy were not considered to be of diagnostic value. Even specimens from authenticated *A. flavipes* (Waterhouse) will not entirely solve this problem. For the present, however, *A. stuartii* will be assumed to be the host of *brevispinosa*. Specimens from a host alleged to be *A. flavipes*, but see Kéler (1971: 80), agree with specimens from *A. stuartii*.

Boopia greeni sp.n. (Figs. 3, 5)

Type-host: *Antechinus minimus* (Geoffroy, 1803).

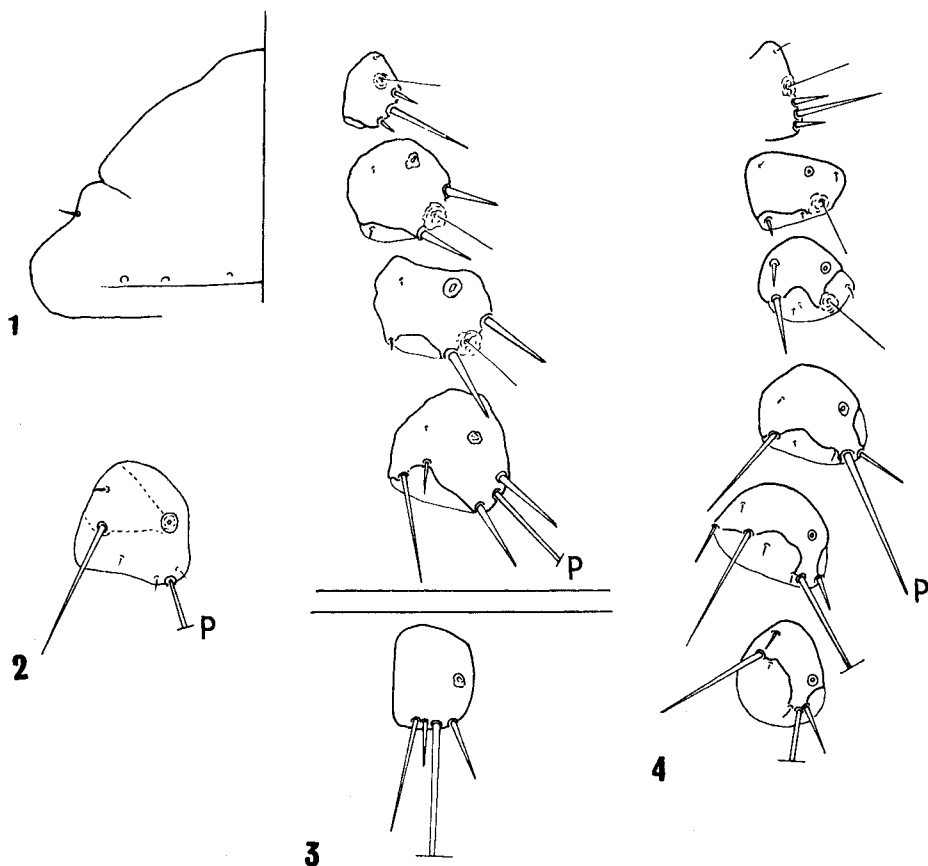
Types.—*Holotype* ♂ in Queen Victoria Museum and Art Gallery, Launceston, from *Antechinus minimus*, TASMANIA: Hunter Island (13.xi.1973, R. H. Green). *Paratypes*: 9 ♂, 8 ♀ from same host individual as holotype; 1 ♀ from same host, TASMANIA: Waratah (vi.1963, R. H. Green).

Other specimens examined.—7 ♂, 5 ♀ from *Antechinus swainsonii* (Waterhouse, 1840), TASMANIA: Royal George (5.ix.1969, R. H. Green) (4 ♂, 3 ♀); Cradle Mountain (4.x.1969, R. H. Green) (3 ♂, 2 ♀).

This species is distinguished from all others in the group except *murrayi* sp.n. by the number of setae on sternite II, the setae of the lateral plates and the details of the male genitalia. The characters distinguishing it from *murrayi* are given below under that species.

Diagnosis

Head and thorax as in *brevispinosa*, see Kéler (1971, figs. 107 A, B). Some of the minute setae of the head have been omitted in Kéler's figure, but these are not of diagnostic value; on the prothorax, the first anterior



FIGS. 1-4.—*Boopia* spp.: (1) *B. aquilona*, ♂, outline of half head; (2-4) lateral plates: (2) *B. aquilona*, plate VI; (3) *B. greeni* (VI and VII omitted, being the same as V); (4) *B. brevispinosa* from *Antechinus stuartii* (VIII omitted, being the same as VIII of *greeni*). (Seta p is the post-spiracular.)

marginal spiniform seta and the minute seta 5 between the stout marginal setae 4 and 6 are not shown; and the outer of the central pronotal setae (dps) is stouter than shown in the figure. The setae on the metanotum (Werneck and Thompson 1940, fig. 42) show some intraspecific variation in number, size and position in the species of the group, and are not diagnostic. Terminal segments of male and female abdomens with general characters as for *Boopia*; sensilla on tergite IX of female vary from 2-4 each side, range of total 4-7, \bar{X} 6 (6); inner margin of gonapophysis with sensilla as illustrated for *brevispinosa*, see Clay (1972, fig. 14). Male genitalia similar to those of *brevispinosa*, see Kéler (1971, figs. 108-109), but differing in details (Fig. 5), most marked being bilobed anterior end of "handle" of dorsal (anterior) median plate, *sensu* Kéler (1971). It has not been possible to make a useful comparison of the genital papilla in the species, largely owing to the difficulty of resolving the anterior end even with high-power phase-contrast, so that insufficient numbers can be seen to judge variability in shape. It appears that the papilla in *brevispinosa* and *greeni* is conical, the latter having the broader base; in *spinosa*, the only one seen clearly appears to be bottle-shaped, with a long neck.

Description

Chaetotaxy of the abdomen.—Terga with single row of setae: II 6, III-VIII 8 arranged 2 + 4 + 2 (occasionally 3 on one side), male IX 3 + 3 with minute seta at each end. Male: sternite II 14 — 19, \bar{X} 15.4 (10) arranged in two or three irregular rows; the following counts are based on a single specimen: III 21, IV 23, V-VII 20 each, VIII 13 (anterior setae of III-IV arranged in one or two irregular rows, those of V-VIII in one irregular row), IX 4 and 2 + 2 marginal setae. Female: sternite II 16-19, \bar{X} 17.6 (8) arranged in three irregular rows; the following counts are based on a single specimen: III 26, IV 22, V 21, VI 19, VII 23, VIII 18 (anterior setae of sternites III-VII arranged in irregular row). Vulval setae 7-9, \bar{X} 7.7 (7) with stout seta at each end somewhat removed from rest. Lateral setae and postspiracular complex as in Fig. 3.

Dimensions (in mm).—Temple width, ♂, 0.40-0.41, \bar{X} 0.406 (9); ♀, 0.405-0.412, \bar{X} 0.410 (8). Head length, ♂, 0.21-0.23, \bar{X} 0.22 (5); ♀, 0.22-0.25, \bar{X} 0.23 (7). Head index, ♂, 1.74-1.84, \bar{X} 1.80 (5); ♀, 1.66-1.96, \bar{X} 1.77 (5). Pronotum width, ♂, 0.37-0.39, \bar{X} 0.38 (9); ♀, 0.37-0.39, \bar{X} 0.38 (8). Metanotum width, ♂, 0.36; ♀, 0.35. Total length, ♂, 1.55; ♀, 1.59.

Comments

Owing to the frequent distortion of the head in mounted specimens of the *spinosa* species-group, as described by Kéler (1971: 40), it is not possible to calculate the head index of many specimens; for the same reason, the head length is an unreliable measurement and comparison between the measurements given by different authors unsatisfactory, as it is not certain from which points these have been made and how much the head is distorted. The above measurements for head length are taken to the posterior margin of the head, i.e. posterior to the sinus occipitalis, and given only for those specimens which show no distortion.

Specimens from *Antechinus swainsonii* from Tasmania, some of which were included by Kéler in *brevispinosa*, are conspecific with those from *A. minimus*. Temple width of males 0.405-0.416, \bar{X} 0.409 (7).

Boopia murrayi sp.n. (Fig. 7)

Type-host: *Antechinus swainsonii* (Waterhouse, 1840).

Types.—*Holotype* ♂ in Australian National Insect Collection, CSIRO, Canberra, from *Antechinus swainsonii*, VICTORIA: Marysville (12.viii.1962, R. M. Warneke). *Paratypes*: 5 ♂, 2 ♀ from same host individual as holotype.

This species is similar to *greeni*, but the males are sufficiently distinct to warrant its taxonomic separation (see key above).

Diagnosis

As for *greeni*. Sternite II with fewer setae: ♂, 9-13, \bar{X} 11.8 (6); ♀, 12, 13 (2). Male genitalia differ markedly from those of *greeni* in having anterior end of "handle" of dorsal (anterior) median plate pointed, and not bilobed (Fig. 7). Breadth of temple averages larger: ♂, 0.412-0.435, \bar{X} 0.425 (6); ♀, 0.420, 0.427 (2).

Comments

This species is named after Mr M. D. Murray, who has done much for the study of Australasian Boopiidae through his extensive work on the manuscript of the late Dr Kéler (Kéler 1971).

TABLE I
CHARACTERS OF THE *SPINOSA* SPECIES-GROUP, GENUS *BOOPIA*

| Species | Character states | | | | | | | |
|---------------------|------------------|---|----|---|---|---|---|----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| <i>spinosa</i> * | + | + | + | + | + | + | + | + |
| <i>brevispinosa</i> | 0 | 0 | + | + | + | 0 | + | 8a |
| <i>aquilonia</i> | 0 | 0 | 0† | + | + | + | + | + |
| <i>lukoschusi</i> | 0 | 0 | 0 | + | + | 0 | + | + |
| <i>greeni</i> | 0 | 0 | 0 | 0 | 0 | + | 0 | 8b |
| <i>murrayi</i> | 0 | 0 | 0 | + | 0 | + | 0 | 8b |

Characters: +, present in the state described; 0, absent or in a different state.

1. Head without spiniform setae: +; head with spiniform setae: 0. 2. Central marginal seta of prosternal plate longer and thinner than the other two: +; setae all similar: 0. 3. Tergites of most segments with a lateral suture on each side, forming 3 plates: +; 0† shows some indication of division. 4. "Handle" of anterior median plate of ♂ genitalia pointed: +; "handle" bilobed: 0. 5. Setae of sternite II under 8: +; setae of II over 8: 0. 6. Setae of IV-VIII: 2 + 4 + 2: +; 3 + 4 + 3: 0. 7. Seta each side of postspiracular setae III-IV small (Fig. 4): +; both these setae stout and spiniform (Fig. 3): 0. 8. Seta each side of postspiracular setae V-VII short and small (Fig. 2): +; on one side short and small, on other side stout and spiniform: 8a (Fig. 4); on both sides stout and spiniform: 8b (Fig. 3).

*Type-host: *Phascogale tapoatafa* (Meyer, 1793).

Boopia aquilonia sp.n. (Figs. 1, 2, 6)

Type-host: *Antechinus bellus* (Thomas, 1904).

Types.—*Holotype* ♂ (Slide No. 1505/8) in ANIC, from *Antechinus bellus* (Thomas), NORTHERN TERRITORY: Nourlangie Camp, South Alligator River, 12°46', 132°40' (18.viii.1962, J. H. Calaby). *Paratypes*: 1 ♂ (1515/9), 2 ♀ (1505/8, 9) from same host individual as holotype.

Although this species has the spiniform ventral head setae as in *brevispinosa*, in other characters, especially in the chaetotaxy of the lateral plates, it resembles *spinosa* (see Table I).

Diagnosis

Outline of head somewhat intermediate between *spinosa* and *brevispinosa*, with ends of temples square as in former and smaller postocular notch, but still more pronounced than in *brevispinosa* (Fig. 1). Prothorax also with square lateral margins as in *spinosa*; chaetotaxy as in fig. 111 of Kéler (1971), but the central marginal setae of the prothorax have been omitted in this figure, and the central seta of the prosternal plate, unlike that of *aquilonia*, should be shown finer and longer than the other two. Male genitalia similar to those of rest of group, with details shown in Fig. 6.

Description

Chaetotaxy of the abdomen.—Male and female, terga with single row of setae: II 6, III-VIII 2 + 4 + 2, male IX 3-4 + 3-4. Sternum II 4-6, III-VIII with two rows of setae, the anterior row irregular, of shorter and finer setae: III (total of anterior and posterior setae) 15-19, IV 17-20, V 18-23, VI 19-20, VII 21-23, VIII 10-15, male IX 5-6 and 2 + 2 marginal setae. Vulval setae 9, 10. Lateral setae: II as in *brevispinosa* (Fig. 4); postspiracular complex of III-IV as in *brevispinosa* III; V-VII with only minute setae on each side of postspiracular seta as in *spinosa* (Fig. 2); IV-VII with one stout, medium to long lateral seta (in *spinosa* III-VII).

Dimensions (in mm).—Temple width, ♂, 0.40, 0.39; ♀, 0.40. Head length, ♂, 0.22, 0.21; ♀, 0.22. Head index, ♂, 1.83, 1.86; ♀, 1.80, 1.77. Pronotum width, ♂, 0.38, 0.37; ♀, 0.38, 0.37. Total length, ♂, 1.30, 1.42; ♀, 1.37, 1.48.

Boopia lukoschusi sp.n. (Fig. 8)

Type-host: *Sminthopsis murina* (Waterhouse, 1838).

Types.—*Holotype* ♂ in Senckenberg Museum, Frankfurt, collected from a skin (11462) of *Sminthopsis murina*, AUSTRALIA: Mbanjambana (1910, M. von Leonhardi). *Paratypes*: 9 ♂, 10 ♀ from same host individual as holotype. The host, the locality of which is unidentifiable, was identified by Dr H. Felten and confirmed by Dr M. Archer (Queensland Museum); its subspecific status has not yet been clarified.

This species, although resembling *aquilonia* rather closely, can always be distinguished by the tergal chaetotaxy and details of the male genitalia, and from other members of the *spinosa* species-group by the association of two or more characters (see key above).

Diagnosis

Similar in general characters to *aquilonia*. Pronotum varies from having anterior lateral margins square to rounded, perhaps dependent on method of mounting; this is possibly not a reliable character in *aquilonia* either. Male genitalia similar to those of *aquilonia*, but differing in some details (Fig. 8); it has not been possible to see exact outline of lateral vesical plates.

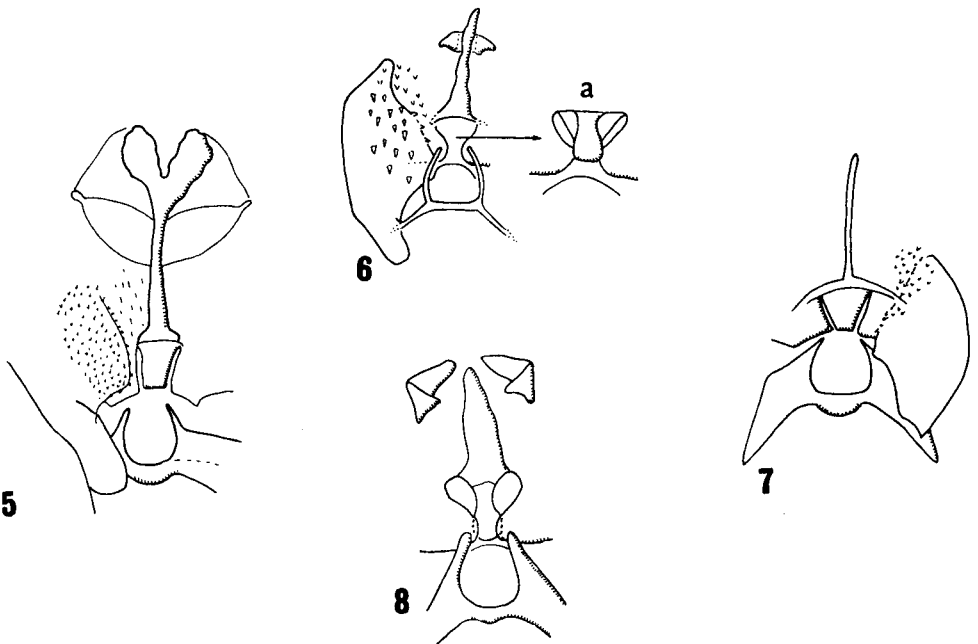
Description

Chaetotaxy of the abdomen.—Male and female, terga with single row of setae: II 6, III 2 + 4 + 2 or 3 + 4 + 3, IV-VIII 3 + 4 + 3, IX ♂ 4 + 4 and 5 central and 6 internal, ♀ 4 + 4 and 8 central. Sternum II ♂ 5-6 (nine specimens with 6, one with 5), ♀ 6-7 (nine with 6, one with 7), III (total of anterior and posterior setae) 15-17, IV 17-22, V 18-22, VI 19-20, VII 18-21, VIII 12-15, male IX 6 and 2 + 2 marginal setae. Vulval setae 6-10, \bar{X} 8.6 (10). Setae of postspiracular complex as in *aquilonia*; the two lateral setae on each segment show considerable variation from minute to stout and spiniform.

Dimensions (in mm).—Similar to those of *aquilonia*. Temple width: ♂, 0.39-0.42, \bar{X} 0.40(9); ♀, 0.39-0.41, \bar{X} 0.40 (10). Head length: ♂, 0.21-0.23, \bar{X} 0.22 (8); ♀, 0.21-0.25, \bar{X} 0.22 (10). Head index: ♂, 1.69-1.89, \bar{X} 1.78 (9); ♀, 1.67-1.96, \bar{X} 1.82 (10).

Comments

The specimens had all been mounted in Hoyer's medium, which makes it difficult to compare certain characters with those of specimens mounted in Canada balsam. Hoyer's medium seems to make the setae swell, so that the chaetotaxy of these specimens has the appearance of being comprised of stouter setae than those of related species mounted in Canada balsam.



FIGS. 5-8.—*Boopia* spp., vesicular sclerites of male genitalia: (5) *B. greeni*; (6) *B. aquilonia*, with inset a of central sclerite enlarged; (7) *B. murrayi*; (8) *B. lukoschusi*.

Discussion

Characters of the spinosa species-group

The characters shared by the *spinosa* species-group were shown in Table 1 in Clay (1972). In Table 1 the distribution of eight characters of specific value is given. In addition, the following features can be mentioned. In *greeni*, on segment II, there is a group of three setae posterior to the trichobothrium, a central long between two spiniforms (Fig. 4); in some specimens of *brevispinosa* and in all specimens of *spinosa* examined, one of the spiniforms is missing. The length and thickness of the lateral setae are not always diagnostic, as these may vary from minute to long and stout within the same species. The number of sensilla on tergite IX in the female tends to be larger in *spinosa* and *brevispinosa*: range 10-12, \bar{X} 10.8 (5) in *spinosa*; 6-10, \bar{X} 8.5 (6) in *brevispinosa*; 5-7, \bar{X} 6 (6) in *greeni*.

Relationships

It is not easy to say which of the characters used in the definitions of the species show relationships. Although the species parasitize members of three genera (see above and Table 1), they are all similar; however, it seems that *spinosa*, *brevispinosa*, *aquilonia* and *lukoschusi*, the hosts of which belong to these genera, have more characters in common than they have with the other two species (*greeni* and *murrayi*). Material from more of the species belonging to the Dasyuridae must be seen before it is possible to say whether the species of *Boopina* are likely to throw any light on host-parasite relationships within the group. The distribution of *greeni* is puzzling, with *A. swainsonii* in Tasmania being parasitized by *greeni* (type-host *A. minimus*), and in Victoria by a closely similar species, *murrayi*. Material from other hosts and other localities of known hosts might help to solve this problem.

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[Manuscript received February 7, 1975]