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Two New Species of *Bathypogon*: *gerhardi* and *monartoensis* (Insecta: Diptera: Asilidae: Bathypogoninae) from Monarto Zoological Park, South Australia, with Notes on Their Behaviour and Seasonal Distribution

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ABSTRACT

Two new species of robber flies of the genus *Bathypogon*, studied in the Monarto Zoological Park, South Australia, are described based on an examination of specimens of both sexes. *Bathypogon gerhardi* is a late autumn species and *B. monartoensis* is an early summer species; both occur in Mallee scrub and other dry environments. Copulation of both species takes place in the 'tail-to-tail' position with the male and female facing in opposite directions.

Key words: Biology, seasonal distribution, new species, South Australia, taxonomy, behavior.

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INTRODUCTION

The genus *Bathypogon*, described in 1851 by Loew as a subgenus, and recently placed in the subfamily Bathypogoninae (Dikov, 2009), is confined to continental Australia. A large number of species apparently have evolved on the continent, but few have been described (Hull, 1962). The expansion of our knowledge of the genus was due largely to the work of Hull (1956a, b; 1958a, b, c, 1959), who was the first to recognize the importance of the structural modifications of the hypandrial plate for separating species. Since 1959, the only new species of *Bathypogon* to be described were *B. danielsi* Lavigne in 2006 and *B. glatzi* Lavigne in 2013

MATERIALS AND METHODS

Methods and procedures have been covered in detail in several other papers (Lavigne and McAllister, 2012a; 2012b; 2015) and the author feels that there is no need to repeat them here other than to state that the seasonal data is based on a transect in Area 1 which consisted of the investigator following a circular convoluted path through the Mallee scrub over a two hour period on multiple dates in Monarto Zoological Park (GPS: 35º06'45"S, 139º08'51"E). *Bathypogon danielsi* also has been collected on site as well as a yet undescribed species collected only in ant traps. Most of the *Bathypogon* type material from South Australia resides in the Entomology collection of the South Australian Museum (Lavigne, 2004) so that comparisons of Monarto specimens to identified material was simplified.

RESULTS AND DISCUSSION

Biology

Habitat

In Monarto Zoological Park there occurs a mixture of original and revegetated Mallee scrub (WSW of Visitors Centre) (Fig. 1). The primary vegetation on Area 1 through which *B. gerhardi*, had to manoeuvre is as follows: *Enchylaena tomentosa* - Ruby Saltbush; *Heliotropium europaeum* - Common Heliotrope; *Lomandra effusa* - Scented Mat-rush; *Maireana brevifolia* - Bluebush; *Salsola kali* - Prickly Saltwort; *Sclerolaena* sp. -Bindyi. The vegetation at the Monarto Conservation Park nearby is the same. In December, species of wild flowers bloom profusely in the Park, but not in the study area where only weeds bloom.

Seasonal Abundance

Adults of *B. gerhardi* (recorded as *Bathypogon* species 1) were present on the Monarto Zoological Park site from late December 2003 to the beginning of January 2004 and from mid November 2004 to the end of January 2005 (Lavigne, 2005). Those of *B. monartoensis* recorded as *Bathypogon* sp. 2) were present from the beginning of January to the beginning of May, 2004 and from the beginning of February to beginning of May, 2005 (Fig. 2).

Fig. 1. Site in Monarto Zoological Park, S.A. where *Bathypogon gerhardi and B. monartoensis* were studied. Photo: R. Lavigne.

***Bathypogon gerhardi* Lavigne, sp. nov.**

Diagnosis: *Bathypogon gerhardi* is a medium sized asilid characterized by having the third antennal segment short and broad, a cream coloured mystax, hind femora black and the posterior margin of sternite 7 expanded with a single row of backward directed elongate setae. The genitalia are compact, the hypandrium being smooth, and lacking any distinguishing protrusions.

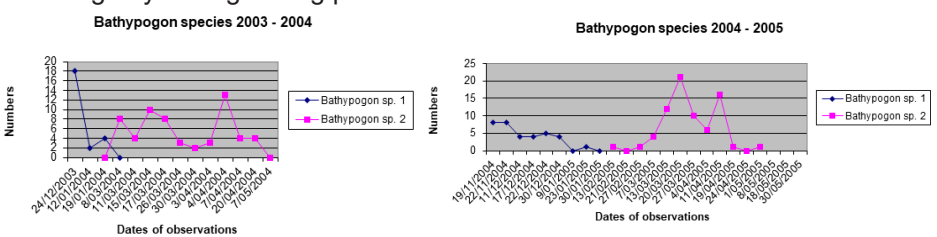

Fig. 2. Seasonal distribution of *Bathypogon gerhardi* (*Bathypogon* sp. 1) and *Bathypogon monartoensis* (*Bathypogon* sp. 2) over two seasons in Monarto Zoological Park, S. A.

Description: *Bathypogon gerhardi Lavigne* (Figs. 3-4) (Monarto/ Zoological Park/ 35°06'21"S 139º08'51"E). Length of Holotype Male - 12.1 mm.

Figs. 3, 4. Male *Bathypogon gerhardi*, sp. nov. (SAMA 29-001213) Photo: G. Weber and R. Lavigne 3. Lateral view. 4. Dorsal view

Range for additional ♂ s: 12.4 - 14 mm. Average = 13.4mm (n= 5)

Head: Antennae bi-colored, 4 segmented with apical spine: scape shining orange with apical narrow darkened ring, pedicel orange with one white setae above and 2-3 below, scape, elongate (0.24 mm), pedicel darker orange (0.14 mm) , 3rd segment

black, broad, short (0.28 mm), 4th segment short (0.10 mm), narrow, black, elongate with very short apical spine. Face strongly white pruinose. Facial gibbosity yellowish, almost reaching base of antennae; mystax contains 14-16 stout cream coloured setae. Frons and vertex dull whitish pruinose; single row of white setae laterally on frons; 4 ocellar bristles elongate, proclinate, brown. Occiput: narrow white pollinose stripe bordering eye with row of white setae, otherwise black; dorsal black, 5-6 postocular setae behind each eye. Palpi shining black covered with elongate setae; one segmented. Proboscis shiny black with pale short white setae at apex and longer white setae below for 2/3rd length from base, downwardly directed.

Thorax: Mesonotum brownish, but bordered dorsolaterally by yellowish grey pruinosity from humerus to base of scutellum. Mesonotum largely bare dorsally except for brownish medium pollinose stripe upon which are two parallel rows of tiny black setae. Antepronotum with row of stout brownish white bristles centrally. Postpronotum with multiple very thin setae. Humerus brownish grey pruinose with short reddish brown very thin setae. The elongate dorsal thoracic bristles are disposed on each side as follows: Three pairs of elongate black, dorsocentral bristles not extending anterior to transverse suture. Mesonotal bristles stout, elongate, black and curved at tips: 1 posthumeral bristle, 2 presutural bristles, 1 supra-alar bristle, 2 post-alar bristles. Katatergite with 20+ thin brownish white setae crinkled at apex. Apex of mesonotum squared off. Pleura mostly grey pollinose, bicoloured, darkened on anterior side of anepisternum and katepisternum; patch of thin white setae on posterior corner of katepisternum. Scutellar disk with dense yellowish grey tomentum; 4 long, apically curved black marginal setae the interior pair crossing at tips.

Wings: Hyaline, discal x-vein at 3/4th length of discal cell, wing tips usually not extending beyond apex of 4th abdominal segment; Haltere brown, knob brown.

Legs: Legs covered with dense short, white pile. Fore and mid coxae with dense patch of stout dirty white bristles intermixed with elongate thin, white setae on anterior surface; hind coxae with 2 stout white bristles. Fore and mid femora black anteriorly, brown posteriorly, hind femora black; fore femur with 1 stout, dirty reddish brown bristle laterally at 5/8 distance from base and 2 subapically; middle femur with 2 stout, reddish brown, subapical bristles anteriorly; hind femur with 4 stout white bristles in a row laterally on outer surface and 2 subapically. Fore and mid tibia black anteriorly, brown posteriorly, hind tibiae black; tibiae with 3 rows of 3-4 stout bristles plus 2 white subapical setae; bristles are mixed white and reddish brown. Tarsi: basal tarsal segment elongate, subequal to segments 2-4 combined; tarsal segment 5 elongate; stout, both short and long setae ventrally on tarsal segments 1-5. Claws bicolored, mostly black, brown only at base; pulvilli, cream coloured, and empodia, brown, as long as claws.

Abdomen: Tergites brown dorsally, grey tomentum laterally on segments 1-4. Tergite 1 with patch of 3-4 stout, dirty white bristles amidst elongate, thin hairs dorsolaterally and multiple dorsomedial straight dirty white backwardly directed setae/hairs. Brownish white short setae widely distributed on tergites 1-7. Posterior margin of sternite 7 expanded with a single row of backward directed elongate setae. Hairs on sternites 2-4 elongate, white.

Genitalia: (Figs. 5-6) Epandria black, elongate, pear-shaped, dorsally with multiple backwardly directed curved elongate light brown setae that are almost as long as the epandrium, double row of stout setae at point where epandria expands. Cerci not protruding but held between epandria, Gonocoxite broadly triangular, pointed apically, gonostylus narrow, knife-like at apex, inwardly directed but protruding beyond tip of gonocoxite. Hypandrium simple with no enhancements. Aedeagus single tubed, short.

Fig. 5. Lateral view of male terminalia of *Bathypogon gerhardi*, illustrating the flattened circular epandrium (SAMA 29-001213). Photo: A. McArthur and R. Lavigne.

Females: Body length: Range 13.5-15 mm. Average = 14.23 mm (n = 4). Similar to the male except that 3rd segment of antennae more elongate; visible 7th tergite 2 ½ times length of visible 8th tergite, grey pollinose, bearing 5 visible pairs of long apically rounded brown acanthophorite spurs; pads beneath acanthophorite spurs with dense sensory hairs (Fig. 7).

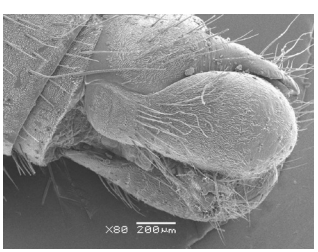

Fig. 6. SEM photo of genitalia of *Bathypogon gerhardi* illustrating shape of epandrium and the double row of setae near the base. Photo: Dr. Z. Suludere, Gazi University, Ankara, Turkey

Fig. 7. Lateral view of female *Bathypogon gerhardi* sp. nov. (SAMA 29-001847) Photo: G. Weber and R. Lavigne.

Material examined: Type data: Holotype male. Body length: 12.4 mm (Fig. 3). South Australia. Monarto/ Zoological Park/ 35º06'45"S, 139º08'51"E/ 22/12/04/ Mallee scrub R. J. Lavigne, Coll., SAMA Database No. 29-001214.

Paratypes: 1M S. Aust. Monarto/ Zoological Park/ 35º06'45"S, 139º08'51"E/ 17/12/04/ Mallee scrub R. J. Lavigne, Coll., SAMA Database No. 29-001213. 1F: same data as 1st paratype,, SAMA Database No. 29-001216; 1M: same data as 1st paratype, except 22/11/04, SAMA Database No. 29-001215; 1F:

same data as 1st paratype, except 19/11/04, SAMA Database No. 29-001218; 1M: same data as 1st paratype, except 05/11/05, SAMA Database No. 29-001846; 1F: same data as 1st paratype, except 22/11/05, SAMA Database No. 29-001847.

Etymology: The species is named after Mr. Gerhard Weber, an ardent observer of Asilid behavior, amateur photographer, and occasional co-author who has generously given of his time to produce large numbers of photographs of asilids belonging to the South Australian Museum over the past several years.

Depository: The holotype and 7 paratypes of *B. gerhardi* are deposited in the South Australian Museum (SAMA) Entomology Collection in Adelaide.

***Bathypogon gerhardi* Lavigne, sp.nov**

Distribution: This new species has only been studied in Area 1 (GPS: 35º06'45"S, 139º08'51"E) in Monarto Zoological Park, but has been found also at a farm in Loxton SA, at Point Davenport SA on Yorke Peninsula and at Vivonne Bay on Kangaroo Island. Additionally it has been recorded one km E of One Tree Hill, Elizabeth SA [as sp. A] by G. Daniels based on material collected by the author in 1979.

Resting Behavior: Based on 118 observations, specimens of *B. gerhardi* were noted resting on sand 19% of the time, on small rocks 36% of the time, on dead twigs 23% of the time, on low growing vegetation 14% of the time and on litter 8% of the time. Specimens rested on these substrates at heights ranging from 2.5-15 cm, where temperatures varied from 33 to 41º C.

Perch sites, from which *B. gerhardi* launched attacks on potential prey, varied: from sand 19%; from small rocks (3x3x3 cm to 8x10x2.5cm) 36%, from litter 8%; from dead twigs 23%; and from vegetation 14% (Fig. 8).

Grooming: Cleaning of body parts occurred intermittently and was accomplished primarily with the fore tarsi. However, cleaning usually followed feeding.

Flight patterns: Flight heights varied presumably depending on the pending activity and ranged from 4-30 cm (mean - 11.5 cm)

Orientation Flights: Orientation flights were flights of 15-60 cm involving flitting from rock to rock and usually occurred when the asilid was disturbed, primarily by ants.

Foraging Flights: While resting on foraging sites, the flies were largely quiescent, except when potential prey flew within their field of vision. The asilid would then turn its whole body to face the organism. One can assume that such postural changes increase range of vision and place the asilid in a suitable position to make a direct forage flight (Dennis and Lavigne, 1975). All forage flights were directed at insects that were air borne. Distances covered in forage flights ranged from 7.6 to 71 cm (mean 25.6 cm). Flights which resulted in prey capture ranged in length from 7.6 to 45.7 cm.

Prey Selection: Collected prey of *Bathypogon gerhardi*

Prey were usually collected by the author at the cessation of feeding. All of the collected prey were less than half the size of their predator. Because of the small size of many of the prey selected, many could not be collected before the wind blew

them away. Prey were varied. Four orders and 6 families of insects were represented in this very small sample suggesting that *B. gerhardi* is an opportunistic predator.

Prey selected: Diptera: Muscidae: bush fly [*Musca vetustissima* Walker] ♀, ♀, ♂ (Fig. 9), Coleoptera: Curculionidae: *Sitona discoideus* Gyll., Coleoptera: Scarabaeidae: *Liparetrus rothei* Blackburn, Coleoptera: Scarabaeidae: *Liparetrus laeticulus* Blackburn (2),Hemiptera: Lygaeidae: *Nysius vinitor* Bergroth (2), Hymenoptera: Tiny wasp -unidentified, Additional prey: Tiny prey (7) (unknown - blew away)


Figs. 8-9. *Bathypogon gerhardi* S. A. Photos: R. Lavigne 8. Male resting on debris in Monarto Zoological Park. 9. Female with bush fly**,** *Musca vetustissima* Walker, as prey in Monarto Zoological Park.

Manipulation: During feeding, *B. gerhardi* may manipulate prey. In this process, the robber fly raises its head and thorax and adjusts the prey with its front and hind tarsi using the mid legs as stabilizers similar to the manner of *Lasiopogon cinereus* (Cole) [Lavigne and Holland 1969] and *B. monartoensis*. Manipulation of prey was observed five times during the study.

Mating Behavior: The position taken by mated pairs was 'tail to tail'; initiation of mating was not observed, but is presumed to be similar to that carried out by *B. monartoensis* Lavigne noted later in this paper. Mated pairs of *B. gerhardi* were observed three times in 2004 and twice in 2005 (22/11/04; 11/12/04; 30/12/04; 22/11/05; 07/12/05) (Fig. 10) when temperatures on the substrate were 32-35º C. In two instances the female was feeding on prey.


Figs. 10-11. *Bathypogon gerhardi* in Monarto Zoological Park, S. A. Photo: R. Lavigne 10. Mated pair resting on small rock 11. Female ovipositing in soil.

Oviposition Behavior: The female tests potential oviposition sites by tapping the tip of her abdomen on the surface of the soil prior to inserting her abdomen into the soil. Eggs are deposited singly but glued together. Once the eggs are deposited in a clutch she removes her abdomen and sweeps dirt into the hole. Three of the observations of female ovipositions (Fig. 11) were made in a single day [dates of occurrence: 19/11/04; 07/12/05 (3)] when temperatures on the substrate were 32-35º

C. In one instance eggs were recovered; eggs were cemented together in a packet of seven (Fig. 12); soil temperature was 46º C.

Fig. 12. Egg packet deposited by female *Bathypogon gerhardi* in Monarto Zoological Park, S. A. Photo: R. Lavigne.

Bathypogon monartoensis Lavigne

Diagnosis: *Bathypogon monartoensis* is a medium sized asilid characterized by having the third antennal segment broad, a mystax with black bristles centrally, hind femora bi-coloured and the genitalia with multiple backwardly directed curved elongate light brown setae, that are almost as long as the epandrium. The hypandrium is yellowish brown, with paired ventromedial spurs.

Description: *Bathypogon monartoensis* Lavigne (Figs. 13-14) Monarto/ Zoological Park/ 35°06'21"S 139º08'51"E. Length of Holotype Male - 13.9 mm.

Figs. 13-14. Male *Bathypogon monartoensis* sp. nov. (SAMA 29-001226) Photo: *G. Weber and* R. Lavigne. 13. Lateral view. 14. Dorsal view.

Range for additional ♂ s: 13 - 15 mm. Average = 14.02 mm (n= 6).

Head: Antennae bi-colored, 4 segmented with apical spine: scape orange with multiple short white setae below, pedicel brown with two white setae above and a three or four white setae below, scape, elongate (0.26 mm), pedicel darker orange (0.14 mm) , 3rd segment black, elongate (0.50 mm), 4th segment short (0.06 mm), narrow, black, elongate with very short apical spine. Face strongly white pruinose. Facial gibbosity orange basally reaching ¾ distance to base of antennae; mystax contains 7-8 central dark brown slightly curved bristles surrounded by 20+ slender curved whitish setae. Frons and vertex greyish pruinose; single row of black setae laterally on frons; 2 ocellar bristles elongate, erect, black. Occiput: yellowish grey pollinose; 10 dorsal black, postocular setae behind each eye. Palpi shining black with multiple whitish setae at apex; one segmented. Proboscis shiny black with pale short white setae at apex and longer white setae below on basal half, downwardly directed. Beard white haired.

Thorax: Mesonotum brownish, but bordered dorsolaterally by whitish pruinosity from humerus to base of scutellum. Mesonotum with pair of central narrow dark brownish stripes; central portion of mesonotum covered with tiny black setae. Antepronotum with row of stout dark brown bristles centrally. Postpronotum bare, black with fairly dense dirty white hair. Humerus greyish whitish pruinose with very short mixed black and whitish setae. Proepisternum with 2 stout white bristles amidst white hair. The elongate dorsal thoracic bristles are disposed on each side as follows: Four pair of elongate black, dorsocentral bristles, not extending anterior to transverse suture. Mesonotal bristles stout, elongate, black and curved at tips: 1 posthumeral bristle, 2 presutural bristles, 1 supra-alar bristle, 2 strongly curved post-alar bristles. Pleura mixed grey and brown pollinose, anepimeron with patch of thin white setae on posterior half. Scutellar disk with whitish tomentum on corners, darkened in middle with multiple long white hairs; 4 long, apically curved black marginal setae, the interior pair crossing midway.

Wings: Hyaline except microtrichiae occur along veins giving wings a brown aspect, discal x-vein at approximately 3/4th length of discal cell; wing tips extending to apex of 5th abdominal segment. Haltere stem light brown, knob light brown.

Legs: Legs covered with dense short, white pile. Fore and mid coxae with dense patch of stout dirty white bristles intermixed with elongate thin, white setae on anterior surface; hind coxae with 2 stout white bristles. Femora black anteriorly, brown posteriorly; fore femur with 1 stout, dirty reddish brown bristle laterally at 5/8 distance from base and 1 subapically; middle femur with 3 stout, reddish brown, subapical bristles; hind femur with 4 stout brown bristles in a row laterally on outer surface and 2 subapically. Fore and middle tibia light brown with 10-12 mixed light and dark brown setae plus subapical setae. Hind tibia dark brown with 3 rows of 3 stout reddish brown bristles plus 2 white and 1 brown subapical setae. Tarsi: basal tarsal segment elongate, subequal to segments 2-4 combined; tarsal segment 5 elongate; short white setae with multiple elongate mixed reddish brown and white bristles ventrally on tarsal segments 1-5. Claws bicolored, mostly black, brown only at base; pulvilli, cream coloured, and empodia, brown, nearly as long as claws.

Abdomen: Thin pollinose line dorsolaterally on segments 1-6. Tergite 1 with 3-4 stout, dirty white setae dorsolaterally and a row of straight dirty white backwardly directed setae/hairs dorsomedially. Short cream coloured setae widely distributed on tergites 1-7. Hairs on sternites 2-4 elongate, white. Patch of white setae laterally on sternite 7.

Genitalia (Fig. 15-16): Epandria blackish, reddish brown at base, broadly rounded, dorsally with multiple backwardly directed curved elongate light brown setae, that are almost as long as the epandrium; black setae at apex exceptionally long. Cerci elongate protruding between epandria and heavily setose apically. Gonocoxite broadly triangular, apically becoming a short finger-like structure, gonostylus narrow, knife-like at apex, inwardly directed but protruding beyond tip of gonocoxite. Hypandrium yellowish brown, with paired ventromedial spurs. Aedeagus single tubed, short.

Similar to the male except that: a/ 8th tergite prominent, grey pollinose, slightly longer than 7th, bearing 4 visible pairs of long apically rounded brown acanthophorite spurs; pads beneath acanthophorite spurs with dense marginal hairs.

Fig. 15. Lateral view of male terminalia of *Bathypogon monartoensis*, illustrating the elongate curved setae arising from the epandrium (SAMA 29-001226). Photo: A. McArthur and R. Lavigne.

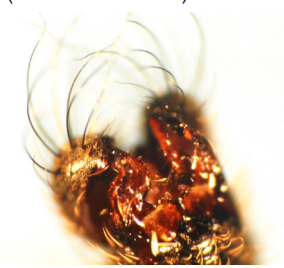

Fig. 16. Ventral view of male terminalia of *Bathypogon monartoensis* illustrating one type of physical enhancement on the hypandrium. Photo: A. McArthur and R. Lavigne.

Females: Body length: Range 13.8-16.2 mm. Average = 14.9 mm (n = 5). (Fig. 17)

Fig. 17. Lateral view of female *Bathypogon monartoensis* sp. nov. . (SAMA 29-001225) Photo: G. Weber and R. Lavigne.

Material Examined

Type data: *Holotype* male. Body length: 13.9 mm (Fig. 13). S. AUST. Monarto/ Zoological Park/ 35º06'45"S 139º08'51"E / 04/04/04 /R. J. Lavigne, Coll, 2nd label: SAMA Database No 29-001226.

Paratypes: 1M S. AUST. Monarto/ Zoological Park/ 35º06'45"S 139º08'51"E/ 08/03/04/ Mallee scrub R. J. Lavigne, Coll., SAMA Database No 29-001219; 1M: same data as 1st paratype, except 26/03/04 SAMA Database No 29-001220; 1M: same data as 1st paratype, except 20/04/04, SAMA Database No 29-001221; 1F: same data as 1st paratype, except 11/03/04, SAMA Database No 29-00122; 1F: same data as 1st paratype, except 30/03/04, SAMA Database No 29-001223; 2F: same data as 1st paratype, except 04/04/04, SAMA Database No 29-001224, No 29-001225; 1M: same data as 1st paratype, except 04/04/04, SAMA Database No 29-001226; 1F: same data as 1st paratype, except 03/04/05, SAMA Database No 29-001227; 2M: same data as 1st paratype, except 04/04/05, SAMA Database No 29-001228, No 29-001229; 1M: same data as 1st paratype, except 13/02/05, SAMA Database No 29-001230; 1M: same data as 1st paratype, except 11/04/05, SAMA Database No 29-001231; 1M: same data as 1st paratype, except 30/03/04, SAMA Database No 29-001232 (genitalia in glycerine).

Etymology: The species is named after Monarto Zoological Park where the new species was studied.

Depository: The holotype and 12 paratypes of *B. monartoensis* are deposited in the South Australian Museum (SAMA) Entomology Collection in Adelaide.

Distribution: This new species has been studied only in Area 1 (GPS: 35º06'45"S, 139º08'51"E) in Monarto Zoological Park; in the same area as *B. gerhardi*, but occurs in the early months of the year.

Habitat: Same as for *Bathypogon gerhardi*.

Resting Behavior: Based on 184 observations, specimens of *B. monartoensis* were noted resting on sand 53% of the time, on small rocks 21% of the time, on dead twigs 23% of the time, on low growing succulents 7% of the time, on litter 14% of the time and on dead branches 3% (Fig. 18). Specimens rested on substrates at heights ranging from 2.5-15 cm.

½ hour observation of female *Bathypogon monartoensis* 08/03/04: "- 1:34 pm - ♀ *Bathypogon* (sp. 2) id OK landed on dead branch 2" above soil - broadside to sun; 1:35 reacted to tiny ant scurrying (5" away) and turned to face it; 30 sec later it turned back (terminal segments reddish brown - same color as red sand); 1:41 - reacted to flying insect 3' away - turned to face and then back, but up on extended legs; 1:44 turned 180° - still with legs extended (slight breeze); 1:49 - turned to face fast flying insect 1' above and then took original position broadside to sun - ignores moving shade provided by leaves in tree being blown by wind; 1:52 - crouched facing away from the sun; 1:53 - up and down (in position); 1:56 - now completely in shade provided by tree leaves overhead, turned and aligned self in direction of length of branch; 2:02 mostly in shade - turned broadside to sun; 2:05 (collected female) - temp at height in shade -92 ºF, 33 ºC."

Flight patterns: Orientation flights varied in length from 1-3m.

Foraging Flights performed by this species were on a diagonal tract ranging in length from 10 cm to 1.5m. When movement is observed, the whole body is turned to face potential prey.

They tended to make rapid semi-circular flights of 1m when disturbed.

Prey Selection: Prey were usually collected by the author at the cessation of feeding. Most of the collected prey were less than half the size of their predator. Because of the small size of many of the prey selected, many could not be collected before the wind blew them away. Prey were varied. Five orders of insects were represented in this small sample suggesting that *B. monartoensis* is an opportunistic predator.

Collected prey of *B. monartoensis*: Coleoptera: Carabidae: *Adelotopus* sp., Diptera: Asilidae: ♂ *Stichopogon davfergusi* Lavigne and McAlister, Muscidae: *Musca vetustissima* Walker; Tabanidae: unidentified, Hymenoptera: Formicidae: *Iridomyrmex* sp. (winged reproductives -3): tiny flying ant, tiny flying ant or wasp, tiny black wasp, tiny wasp, about size of asilid's thorax (4), Hemiptera: Lygaeidae: *Nysius vinitor* Bergroth (2); Pentatomidae: *Kapunda troughtoni* (Distant), Lepidoptera: microlepidoptera (5) (Fig. 19), Tiny unidentified prey (5).


Figs. 18-19. *Bathypogon monartoensis* in Monarto Zoological Park, S. A. Photo: R. Lavigne. 18. resting on sand 19. Female with microlepidoptera as prey.

On two occasions, a *B. monartoensis* flew towards a honey bee, but turned away before making contact. While feeding, the asilids were constantly disturbed by foraging ants and moved to new locations.

Manipulation: During feeding, *B. monartoensis* may manipulate the prey. In this process, the robber fly raises its head and thorax and adjusts the prey with its front and hind tarsi using the mid legs as stabilizers in a manner similar to that exhibited by *Lasiopogon cinereus* (Cole) [Lavigne and Holland 1969] and *B. gerhardi*. Manipulation of prey was observed 12 times during the study.

Mating Behavior: Matings of *B. monartoensis* are initiated in air when a male encounters a female and the pair land on the substrate. Matings are short. Four complete matings were observed [11:53-12:06, 1:21-1:29, 1:35-1:43, 1:50-1:57] (Fig. 20) when temperatures on the substrate were 31-38º C. Additional partial mating times were 6 min., 9 min. and 8 minutes. The earliest mating observed was at 9:48 am and the latest at 2:58 pm. Upon completion of mating the male releases his claspers and flies off. In two instances a mated female was observed to have prey. In one instance a second male attacked a mated pair. Male to male encounters were observed twice suggesting that males are unable to recognize females until contact is made.

Fig. 20. *Bathypogon monartoensis* mated pair resting on small rocks in Monarto Zoological Park, Monarto, S. A. Photo: R. Lavigne

Oviposition Behavior: Pre-oviposition by *B. monartoensis* was only observed twice, once on 15/03/2004 and again on 20/03/2005. Pre-oviposition behavior was the same as that for *B. gerhardi*. Based on pre-oviposition behavior, eggs are deposited in the soil although no eggs of this species were recovered. In preparation for oviposition a female would test the soil with her ovipositor, moving from one spot to another over an area approximating 900 square cm. Upon finding a 'suitable' site, the female would

sink her ovipositor into the soil to a depth of 5-6 abdominal segments. If not disturbed, her ovipositor would remain embedded in the soil for approximately 7-8 min. Once she completed oviposition, she would remove her ovipositor and sweep soil into the hole with the tip of her ovipositor.

Cleaning Behavior: Cleaning behavior occurred following feeding; sometimes a feeding asilid would go through a cleaning sequence. However asilids would often exhibit cleaning behavior while resting on a substrate or while in copula. The sequence varied, but usually began with the cleaning of the eyes with the fore tarsi or the rubbing together of the fore tarsi. A typical sequence occurred as follows: 20/04/04 "12:01pm: sp.2 after feeding cleaned fore tarsi, then hind tarsi; fore tarsi, fore tarsi, eyes, fore tarsi; eyes, fore tarsi; facing sun while sitting on sand straddling former prey; cleaned fore tarsi again; 12:02 - cleaned fore tarsi again while still crouched over prey; cleaned fore tarsi again."

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