Printed ISSN 0966-0011
Online ISSN 1750-3329

PHASMID STUDIES

Volume 20.

January 2019.

Editors: Edward Baker & Judith Marshall

Bacillus atticus Brunner von Wattenwyl, 1882: A New Species for the Albanian Fauna (Phasmida: Bacillidae)

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Abstract
The present study represents the first report of the presence of *Bacillus atticus* Brunner von Wattenwyl, 1882 in Albania.

Key words
Distribution, *Pistacia lentiscus*, Vlorë, stick insects.

According to PSF (2018) the stick insects (order Phasmida) are represented worldwide with 3286 valid species and in Europe with 19 species. The most common phasmid genus in Europe is *Bacillus* Berthold, 1827, and it is represented with six species (*atticus*, *grandii*, *inermis*, *lynceorum*, *rossius* and *whitei*), reported from central and eastern parts of the Mediterranean Basin.

Bacillus species are characterized by the slightly narrowed head, smooth or granulated pronotum which is longer than wide, strongly elongated meso and metanotum, tapered subgenital plate and short, stout cerci (Harz & Kaltenbach, 1976: 15, 18; Brock, 1994: 103).

Herein, we record for the first time *B. atticus* Brunner von Wattenwyl, 1882 for Albania. The new record is based on a photo of a female specimen taken on 11 VIII 2014, by EH and uploaded on iNaturalist and Facebook page “Regjistri Elektronik i Specieve Shqiptare” (Fig. 1A-C). The specimen was observed on Jal beach, Vuno village, Vlorë region, Albania (40°06’51.7”N, 19°42’04.7”E). In addition,

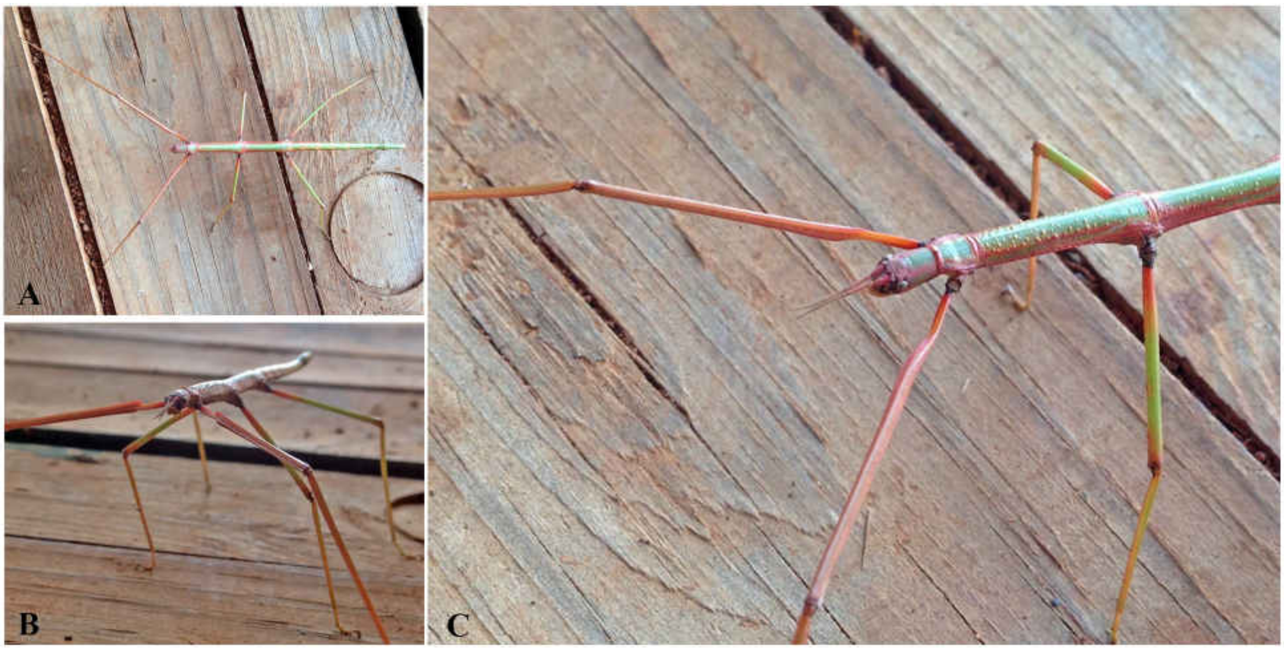

Figure 1. *Bacillus atticus* Brunner von Wattenwyl, 1882, female. A, B – Habitus; C - Granulated pro- and mesonotum.

the specimen was green coloured, which is an uncommon form in *B. atticus*, as brown is the dominant colour morph (green morph seen in Vouliagmeni, Greece and a few reports from elsewhere; Brock, pers. comm., 2018).

The biotope of the photographed specimen was *Pistacia lentiscus*, which is favoured as the main foodplant (Brock, 1994: 104), *Myrtus communis* and *Arbutus unedo* (Fig. 2).

Figure 2. Habitat where *Bacillus atticus* was found.

The species can be differentiated from *B. rossius* (Rossi, 1790), which can be found syntopically (Mantovani & Scali, 1991), by presence of granulated pro- and mesonotum (Figure 1C), but the degree of granulation varies considerably (Brock, 1994: 103).

The known distribution of *B. atticus* includes Italy and Croatia to the east, Greece, Turkey, Cyprus, Israel and Libya to the west (Brunner von Wattenwyl, 1882: 76; Harz & Kaltenbach, 1976: 21; Mantovani & Scali, 1993: 346; Brock, 1994: 104; Scali et al., 2003: 138; Brock, pers. comm., 2018) (Fig. 3). Therefore, finding the species in Albania is not unexpected; however, new studies are needed to confirm the distribution range in other parts of Adriatic region – Montenegro, Bosnia & Herzegovina and Slovenia in addition to clarifying the subspecies range.

Acknowledgements
We would like to thank Paul Brock for critically reviewing the manuscript, providing comments, his unpublished data and valuable suggestions concerning the manuscript.

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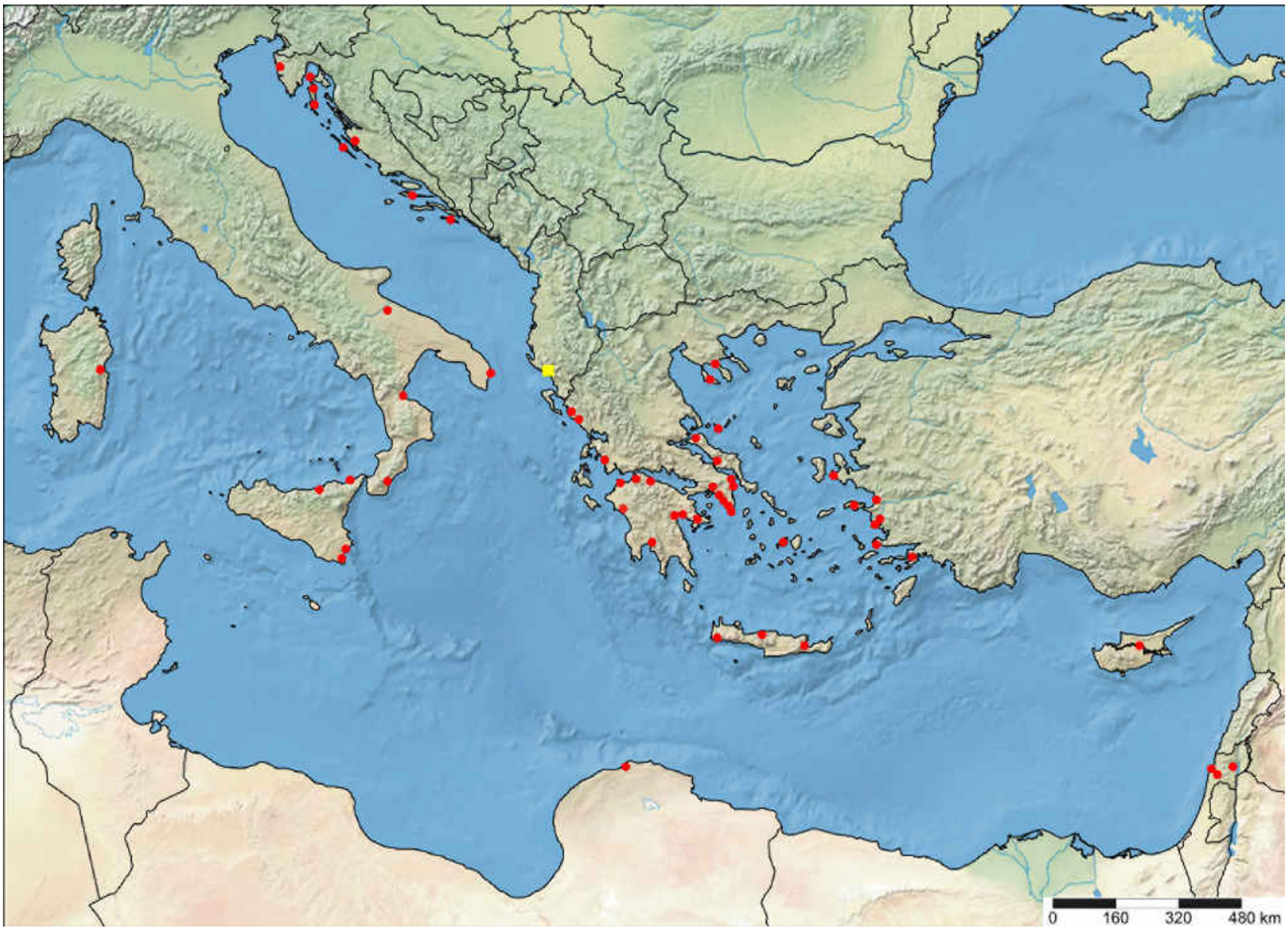

Figure 3. Distribution of *Bacillus atticus*: red circles – literature data; yellow square – new data. (map was created using SimpleMappr)

Could *Medauroidea extradentata* (Brunner von Wattenwyl 1907) survive in Provence (France)?

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Abstract
Several cases of accidental introduction of insects far away from their biotope have already been reported. Could *Medauroidea extradentata*, a stick insect originally from the district of Annam, Vietnam, survive in Provence (France)? To answer this question, two sets of experiments were performed. In the first one, specimens were put together with five plants growing only in the Mediterranean areas (bear's breeches (*Acanthus mollis*), almond tree (*Prunus dulcis*), fig blanche d'Argenteuil variety (*Ficus carica*), fig violette de Solliès variety (*Ficus carica*), olive (*Olea europaea*), Aleppo pine (*Pinus halepensis*)) to investigate their adaptability to these diets. In the second set, the egg survival rate when exposed to moderate cold was investigated. In view of the results, *M. extradentata* could survive in Provence, since it was possible to breed specimens on almond trees and on the two fig trees, while half of the eggs have survived the cold.

Key words
Stick insects, walkingsticks, Phasmid, *Medauroidea extradentata*, breeding, Provence, acclimatization

Introduction
The case of species which acclimatise to non-native regions after an accidental importation is unfortunately quite common. *Carausius morosus* (Sinéty 1901) (native of southern India (Westmark, 2007)), a very common breeding stick insect, is a perfect example of this, having notably acclimatised in the United States, the Azores and South Africa (Baker, 2015). It is also possible to mention the palmivorous butterfly *Paysandisia archon* (Burmeister 1880) in the Var (France) in 2001 coming originally from South America (André & Tixier Malicorne, 2013) or the spotted aphid *Therioaphis maculata* (Buckton 1899), endemic from Central Asia and Southern Europe, which colonized New Mexico (United Sates) in 1954 (Kindler, 1967 ; Bournoville, 1977 ; Haymaker, 1999). In 2013, Siaud discussed the possible acclimatization in Provence of *Macrothele calpeiana* (Walckenaer 1805), a tarantula native to Andalusia in southern Spain imported with Spanish olive trees at Cuges-les-Pins (Siaud & Raphaël, 2013).

France has, among its insects, only three morphologically similar species of stick insects, out of the 3196 described in the world (Brock et al., 2018): the French Stick Insect *Clonopsis gallica* (Charpentier 1825), the Mediterranean Stick Insect *Bacillus rossius* (Rossi 1790) and the Spanish Stick Insect *Pijnackeria masettii*[1] (Scali, Milani & Passamonti 2013) (Lelong, 1995b ; Baliteau, 2005 ; Lelong, 2014 ; Mûller, 2015). Of these three species, *B. rossius* and *P. masettii* live only in the Mediterranean area between the Italian border and the Spanish border on a broad band of about 50 km, while *C. gallica* is found in the Mediterranean arc and in the western half of a line going from Montpellier to Le Havre (Lelong, 1995b). Their eggs are perfectly capable of surviving the winter with only their chorion (Baliteau, 2005) for protection and will hatch the following spring or a year later (Lelong, 1995b ; Baliteau, 2005). The eggs of the French Stick Insect can even survive unprotected in temperatures of -5 °C (Lelong, 2014). On the other hand, none of the adults of the *C. gallica* and *P. masettii* species are able to survive the winter without dying, whereas those of *B. rossius* can survive (Lelong, 1995b). The diet of the French Stick Insect and of the Mediterranean Stick Insect is composed of Bramble (*Rubus fruticosus* (L. 1753)), Spiny Sloe (*Prunus spinosa* (L. 1753)), Wild Rose (*Rosa* sp. (L. 1753)) and almond (*Prunus dulcis* (Mill.) D.A. Webb 1967) (Baliteau, 2005) while *P. masettii* feeds exclusively on *Dorycnium pentaphyllum* (Scop. 1772) (Lelong, 1995b ; Lelong, 2014).

1 Until 2009, it was described under the binomial name *Leptynia hispanica* (Bolivar 1878).

Insects appeared on Earth 479 million years ago (Rausher, 2015). The discovery in the Jehol deposit in Inner Mongolia (China) of three fossils of *Cretophasmomima melanogramma* dating from the lower Cretaceous is a evidence of the presence of stick insects on Earth for more or less 126 million years (Wang et al., 2014). The genus *Medauroidea* belongs to the order Phasmatodea (or Phasmida), in the suborder Verophasmatodea, infraorder Anareolatae, super-family Phasmatidae, family Phasmatinae, subfamily Clitumninae and the Medaurini tribe. *Medauroidea extradentata* (Brunner von Wattenwyl 1907) is a stick insect native to the Annam district in southern Vietnam (Lelong, 1995a ; Boucher & Varady-Szabo, 2005), better known as Annam stick insect in English ("Vietnam stick insect" as common name in French). This stick insect has been renamed several times since its discovery, but is named *Cuniculina imbriga* by some authors especially on the Internet (Olive et al., 2016). Trade of this stick insect is completely legal in France (OPIE, 2015 ; Arthropodia, 2016). Females can be up to ten centimeters long and only seven for the males, which seldom occur, and live for 12 to 14 months (Westmark, 2007). *M. extradentata* is easy to breed and accepts a large number of plants for feed, in particular, bramble (*Rubus fruticosus* (L. 1753)), raspberry (*Rubus idaeus* (L. 1753)) or hazel (*Corylus maxima* (Mill. 1768)). It can adapt in case of shortage as already demonstrated (Olive et al., 2016). There are no different dietary preferences at the different instars of this stick insect.

The study focuses on the themes mentioned above, and the purpose of this note is to show the possible acclimatization of the *M. extradentata* species in Provence (France). Although there is no known case of adaptation of this species outside its natural environment, with the current global transit[2], an invasion could happen, like the other commonly reared stick insect, *C. morosus*. A number of experiments have been carried out, both in terms of adaptation to typically Mediterranean diets, and in terms of cold resistance. The bear's breeches (*Acanthus mollis* (L. 1753)), the almond tree (*Prunus dulcis* ((Mill.) D. A. Webb 1967)), the fig blanche d'Argenteuil variety (*Ficus carica* (L. 1753)), the fig violette de Solliès variety (*Ficus carica* (L. 1753)), the olive tree (*Olea europaea* (L. 1753)) and the Aleppo pine (*Pinus halepensis* (Mill. 1768)) were tested and compared to a control group fed exclusively with bramble. This latter, but also the wild rose and the blackthorn are common diets for the French Stick Insect, the Mediterranean Stick Insect, and the other species studied. The almond tree was chosen because it is also food for some french stick insects. The other plants have been tested because they grow exclusively in the Mediterranean. If *M. extradentata* can feed with one or more of these diets, this would increase its chances of survival in Provence. In addition, the cold resistance of eggs has also been tested. These first tests are described in this note and others will be conducted later on over a longer period and repeated, in order to assess the ability to perform a complete lifecycle. The goal is simply to be able to answer the question of the title, without considering its potential to impact the indigenous stick insects.

Materials and Methods

Experiments were conducted in Marseilles (France) [43°18'47"N 5°28'15"E] and in Gembloux (Belgium) [50°34'15"N 4°41'50"E] (Google Earth) in perforated polypropylene boxes of 1180 cm^3 (15 cm (l) x 10.5 cm (w) x 7.5 cm (h)), carefully washed with green Dreft® (brand Procter & Gamble) and thoroughly rinsed with warm water between each experiment. The stick insects were kept at room temperature (32 ± 2 °C for Marseilles and 22 ± 3 °C for Gembloux), the lighting corresponding to the natural light cycle and the relative humidity was approximately 65 % in both experimental areas. The number of specimens used in each experiment was randomly selected by the module Study on Random V 1.6 of the software Gabriel Data Analysis and the curves were analysed by the module Two variables statistic V 1.35 of the same software (Olive, 2016). Stick insects were measured from the tip of the abdomen to the base of antennae with a Stanley brand ruler. *M. extradentata* insects originated from the Hexapoda breeding facility located in Belgium (Insectarium "Jean Leclercq", Rue de Grand-Axhe 45, B-4300 Waremme).

Preliminary feeding tests with Mediterranean plant leaves

Preliminary feeding trials with bear's breeches, almond, clementine tree, fig blanche d'Argenteuil variety, fig violette de Solliès variety, medlar, olive tree were made by placing two specimens, whose size

[2] For example, the authors live in Belgium and spend their holidays in the south of France.

was chosen randomly, in the presence of a leaf surrounded by aluminum foil so that the insects did not have access to water. The tests were stopped as soon as it was certain that the leaf had been eaten or that the leaf was beginning to be inedible.

The same methodology was used with bear's breeches for a later test to check if this stick insect can eat leaves of this plant.

Survival on the leaves of Mediterranean plants (4th August to 1st December 2015)
This study is based on a previously described protocol (Olive et al., 2016). A random number of specimens, which the size was also chosen at random, was placed in 6 boxes with a leaf of different Mediterranean plants (bear's breeches, almond tree, fig blanche d'Argenteuil variety, fig violette de Solliès variety, olive tree or pine) whose petiole is held in moist paper towels surrounded by a sheet of aluminium foil, so the leaf is fed with water without the stick insects having access to it (Figure 2-B). The leaves were changed on the 5th, 8th and 12th days (Phase 1). This first phase was carried out in Marseilles (France) while the following phases were carried out at Gembloux (Belgium). At the end of the 15th day, the leaves of Mediterranean plants were replaced by leaves of *Rubus idaeus* which were changed on the 5th, 8th and 12th following days (Phase 2). This second phase also lasted 15 days. The specimens were also followed for 91 days more to achieve an experience of 120 days (Phase 3). Phase 4 consisted of observing the stick insects for another 150 days. The results were compared to a control group, which under the same conditions was only fed on bramble or raspberry.

Cold survival of eggs (12th September 2015 to 30th April 2016)
A total of 12 eggs of an adult female, selected from the main breeding tank, were recovered after three and a half days of laying. Six eggs were kept at room temperature (ERT), while the other six were put in a refrigerator at 9 ± 1 °C (EC). After 21 days, the latter were placed next those named ERT. Their development was followed for nine months. All specimens born were fed on bramble or raspberry. Since it was not always possible to see all developmental instars, a measurement at a fixed date has been preferred. These measurements were carried out in Gembloux.

Results and discussion
The first experiment was to observe the survival of specimens on typically Mediterranean plants, that is to say, fed for 15 days only with bear's breeches, almond tree, fig blanche d'Argenteuil variety, fig violette de Solliès variety, olive tree and Aleppo pine. Table 1 shows the evolution of the different specimens of *M. extradentata* over time for each plant and for the control group. The high number of deaths found in the first phase with *A. mollis* is not consistent with what was expected. In fact, leaves of this plant were eaten either during a preliminary test or during a subsequent verification carried out from the 2nd to the 6th January 2016 (Figure 1-A and 1-B). No explanation was found for this observation, but two assumptions can be made. The first is related to the quality of the leaves picked. The leaves harvested in August were less lush and more elastic. The second hypothesis is related to the size of the specimens participating in the experiments. For all experiments, the number and the size of each specimen present are totally random. However, in the case of the first and last experiments, there was at least one specimen whose size was greater than the largest of the August's experiment (4.40 cm (August 2015), 6.70 cm (early) and 8.90 cm (late)). From the fifth day of the first test the authors were challenged by the inexplicable disappearances of the smallest *A. mollis* and *F. carica* violette de Sollies variety phasmids, thought only to be accounted for by incomprehensible escapes. Figure 1-C provides a more plausible explanation for this observation ; the specimens of the species studied, *M. extradentata,* are liable to cannibalism during severe food and water shortage (Wikimini, 2015). The first deaths were recorded on the sixth and tenth days for the olive tree and the Aleppo pine respectively, although in the case of the olive tree a death was found the day after the beginning of the test, but after examination of the corpse, in poor condition, this one has been excluded from the results. For these two plants, olive tree and pine, none of the ten (twice five) starting specimens survived the first phase of this experiment. It is clear that neither the olive tree nor the Aleppo pine allow the survival of the *M. extradentata* species. On the other hand, this is not the case for the tests carried out in the presence of

	A. mollis	*P. dulcis*	*F. carica*[b]	*F. carica*[c]	*O. europaea*	*P. halepensis*	control group
Start phase 1 Day 1	1.30 ; 1.35 ; 1.50 ; 2.60 ; 2.80 ; 4.40 a: 2.33	1.25 ; 1.30 ; 1.40 ; 2.40 ; 2.40 a: 1.75	1.30 ; 1.35 ; 2.50 ; 3.40 a: 2.14	1.20 ; 1.25 ; 1.25 ; 1.40 ; 3.90 ; 5.30 a: 2.38	1.20 ; 1.25 ; 2.15 ; 2.40 a: 1.75	1.15 ; 1.25 ; 2.50 a: 1.63	1.15 ; 1.25 ; 1.25 ; 1.25 ; 1.35 a: 1.25
Start phase 2[a] Day 15	1	5	4	5	0	0	5
Start phase 3 Day 29	-	1.80 ; 1.95 ; 2.00 ; 2.90 ; 3.50 a: 2.43	1.70 ; 1.95 ; 3.60 ; 3.75 a: 2.75	1.45 ; 1.70 ; 1.70 ; 3.55 ; 6.20 a: 2.92			1.90 ; 2.00 ; 2.03 ; 2.13 ; 2.65 a: 2.14
End phase 3 Day 120		4.60 ; 5.30 ; 5.60 ; 6.30 ; 6.90 a: 5.74	3.70 ; 5.10 ; 5.40 ; 7.60 a: 5.45	3.50 ; 4.6 ; 6.1 ; 9.3[d] a: 5.88			5.80 ; 6.90 ; 7.70 ; 7.80 ; 8.00 a: 7.24

[a] number of survivors

[b] blanche d'Argenteuil variety

[c] violette de Solliès variety

[d] the smallest specimen, which never moulted, died on the 56th day

Table 1. Size in centimeters of the specimens during the different phases of feeding with Mediterranean plants. Days are counted from the beginning of the experiment. a represents the average of the cell.

P. dulcis, *F. carica* blanche d'Argenteuil variety and *F. carica* violette de Solliès variety. Figure 2 clearly shows the areas eaten for these three plants and Table 1 describes the evolution over four months of the different specimens involved. It is clear that these three diets can perfectly allow a normal development of the specimens of the studied species. The change in the number of specimens in the case of the violette de Solliès variety fig tree calls for a number of comments since there have been two losses. As already mentioned above, there was a case of cannibalism on the fifth day. In addition, the smallest surviving specimen in the first two phases died on day 56 without moulting. These two events were not observed either with the almond leaves or with the fig leaves of the blanche d'Argenteuil variety, where all the specimens survived. Although the experiment was stopped after 120 days, a follow-up of more than 150 additional days (Phase 4) showed that the 12 stick insects were always healthy and all became adults, all females giving viable eggs. It should be noted, however, that if the control group was initially the smallest average size in the series, after 120 days, this control group became the largest, from 1.25 to 7.24 cm (a factor of 5.80), largely exceeding the three groups tested as shown in Table 1. The same remark can be made when analyzing the averages of Mediterranean plants, the average of specimens fed with almond tree being multiplied by 3.28 (from 1.75 cm to 5.74 cm) whereas for both varieties of fig the multiplication factor is only 2.55 and 2.47 respectively for the blanche d'Argenteuil variety and the violette de Solliès variety. Survival on *Ficus carica* leaves is not so surprising, as it is well known that it is possible to breed *M. extradenta* on *Ficus benjamina* (L. 1767) (Calvin & Lange, 2010 ; da Silva et al., 2012) which are both of the same genus, the first having the vernacular name "common fig tree" and the second "weeping fig tree".

The second experiment was to test the resistance to moderate cold of the eggs. The methodology of Potvin was not used (Potvin, 1996), but instead, a female was isolated for almost four days and its eggs, twelve in all, were then harvested and divided into two equal groups. The first one was kept at room temperature (ERT), that is to say at about 22 °C, while the second one, named EC, was placed 21 days in a refrigerator at 9 °C and then at room temperature. This value of 9 °C was chosen because it is accessible in Provence to eggs, even in winter in protected places. All ERT specimens were born between days 63 and 67, while only half of the ECs hatched between the 100th and the 106th day, and after 200 days, the last three ECs were declared unsustainable. There is therefore a lag of about

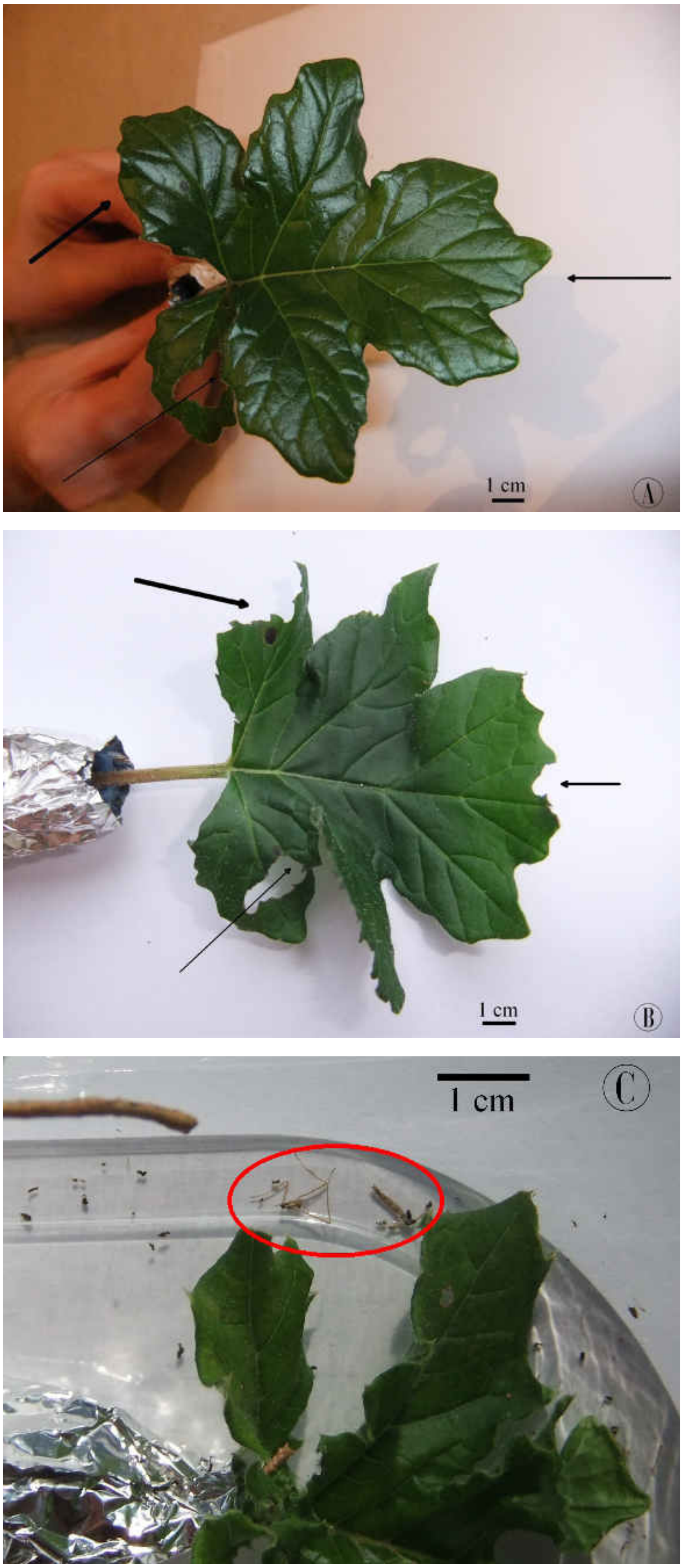

Figure 1. Tests with *A. mollis*. A: leaf at the beginning of the posterior experiment carried out from 2nd to 6th January 2016. The thickness of the line of the arrows shows the certainty that the place has been eaten. B: leaf at the end of the posterior experience. C: cannibalism (in the center of the oval) on the 9th day between specimens of *M. extradentat*a in case of shortage of diet and water. G. Olive.

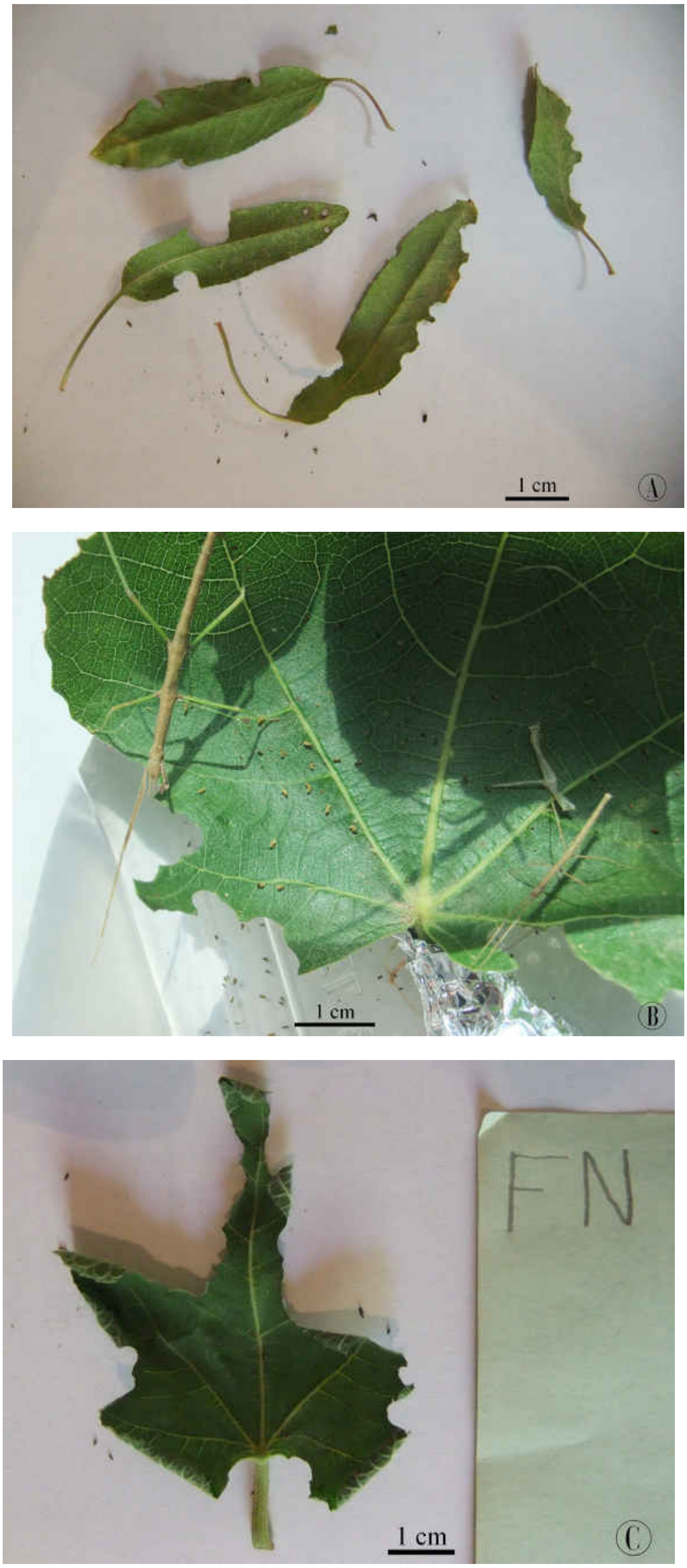

Figure 2. Leaves' surface eaten among the various Mediterranean plants allowing the survival of the species *M. extradentata*. A: *P. dulcis*. B: *F. carica* blanche d'Argenteuil variety. C: *F. carica* violette de Solliès variety. G. Olive.

	Eggs kept only at room temperature (ERT)	Eggs having been 21 days at 9 °C and then at room temperature (EC)
Number of days (and size (cm)) for birth	63 (1.20 ; 1.20 ; 1.25) 66 (1.15 ; 1.20) 67 (1.25) a: 64.7 (1.21)	100 (1.20) 106 (1.15 ; 1.20) a: 104.0 (1.18)
Number of days for first moult	101	133
Size (cm) at day 130	2.85 ; 2.90 ; 3.6 ; 3.65 ; 3.70 ; 3.90 a: 3.43	1.60 ; 1.70 ; 2.15 a: 1.82
Size (cm) at day 155	3.80 ; 4.60 ; 4.70 ; 4.90 ; 4.90 ; 5.10 a: 4.67	2.50 ; 2.65 ; 2.80 a: 2.65
Size (cm) at day 172	4.70 ; 4.80 ; 4.80 ; 6.10 ; 6.20 ; 6.25 a: 5.48	2.60 ; 2.80 ; 3.60 a: 3.00
Size (cm) at day 193	6.10 ; 6.10 ; 6.20 ; 7.70 ; 7.90 ; 8.05 a: 7.01	3.40 ; 3.40 ; 3.75 a: 3.52
Size (cm) at day 218 (sex)	6.80 (M) ; 6.80 (M) ; 7.00 (M) ; 9.20 (F) ; 9.30 (F) ; 9.50 (F) a: 8.10	5.60 (F) ; 6.25 (M) ; 6.40 (F) a: 6.08
Size (cm) at day 242 (sex)	a: 8.10	8.00 (F) ; 7.30 (M) ; 7.10 (F) a: 7.47
Size (cm) at day 270 (sex)	a: 8.10	10.10 (F) ; 7.30 (M) ; 10.80 (F) a: 9.40

Table 2. Summary of the cold resistance of the eggs. Days are counted from the day of egg collection. a represents the average of the cell.

40 days which is almost found during the first moult (Table 2). It also seemed important to see if the incubation temperature of the eggs had an influence on the development of young stick insects after their birth. Figure 3 shows that the temperature influences the growth of the young during the first 90 days of life, but then the difference disappears since the 110th day. In such cases, the analysis, based on linear adjustments[3], indicates that in the first part, with a slope of 0.04368 (Equation 1), the ERT specimens grow 1.6 times faster than the EC specimens with a slope of only 0.02673 (Equation 4). On the other hand, after that, the difference decreases with 0.04568 (Equation 2) and 0.03873 (Equation 5) respectively, and in terms of the average size, the ECs catch up with the ERTs (Figure 3) and even exceed them. A closer look shows that, in fact, the growth curve for ERT follows the Herschell-Bulkley law (Equation 3). Equations 1 to 5 give the evolution of the mean size of the specimens according to the number of days of life (Figure 3), whereas the equations 6 to 9 give this evolution according to the number of days of experimentation (Figure 4).

$$\text{Size ERT}_{90\text{ days}}\ (\text{cm}) = 0.94222 + 0.04368 \times \text{NumberDaysLife}\ ;\ r = 0.98717 \qquad \text{Eq. 1}$$
$$\text{Size ERT (cm)} = 0.83830 + 0.04568 \times \text{NumberDaysLife}\ ;\ r = 0.99008 \qquad \text{Eq. 2}$$
$$\text{Size ERT (cm)} = 1.19383 + 0.000905 \times \text{NumberDaysLife}^{1.32246}\ ;\ r = 0.99845 \qquad \text{Eq. 3}$$

[3] Without forgetting that in the case of insects, the experimental values are discrete values by the principle of the moults.

Size $EC_{90\ days}$ (cm) = 1.18306 + 0.02673 × NumberDaysLife ; r = 0.99772 Eq. 4
Size EC (cm) = 0.79549 + 0.03873 × NumberDaysLife ; r = 0.94262 Eq. 5

Size ERT (cm) = -2.11689 + 0.04568 × NumberDaysExp ; r = 0.99008 Eq. 6
Size ERT (cm) = 0.14976 + 0.000866 × $NumberDaysExp^{1.69776}$; r = 0.99816 Eq. 7

Size EC (cm) = -3.23213 + 0.03873 × NumberDaysExp ; r = 0.94262 Eq. 8
Size $EC_{90\ days}$ (cm) = -3.19647 + 0.16460 × $NumberDaysExp^{0.70517}$; r = 0.99810 Eq. 9

The 218th day line in Table 2 shows that the cold does not eliminate any gender, thus allowing optimal survival of this species. The experiment was stopped when all surviving specimens reached the adulthood.

Conclusion

Thanks to the two experiments carried out, it is possible to answer the question of the title. The species *M. extradentata* could effectively live in Provence. Indeed, this species already accepts a large number of not typically Mediterranean diets (also present in the south of France) such as bramble, raspberry or even hazel. In addition, and this has just been demonstrated in this note, these stick insects can survive on Provençal plants, such as almond and fig, whether white or black variety. With the strong adaptability that this stick insect has shown, this species could become invasive during an accidental introduction. Furthermore, and this has just been highlighted in this work, the eggs are able to survive to the winter at relatively mild temperatures, as is it the case today with global warming.

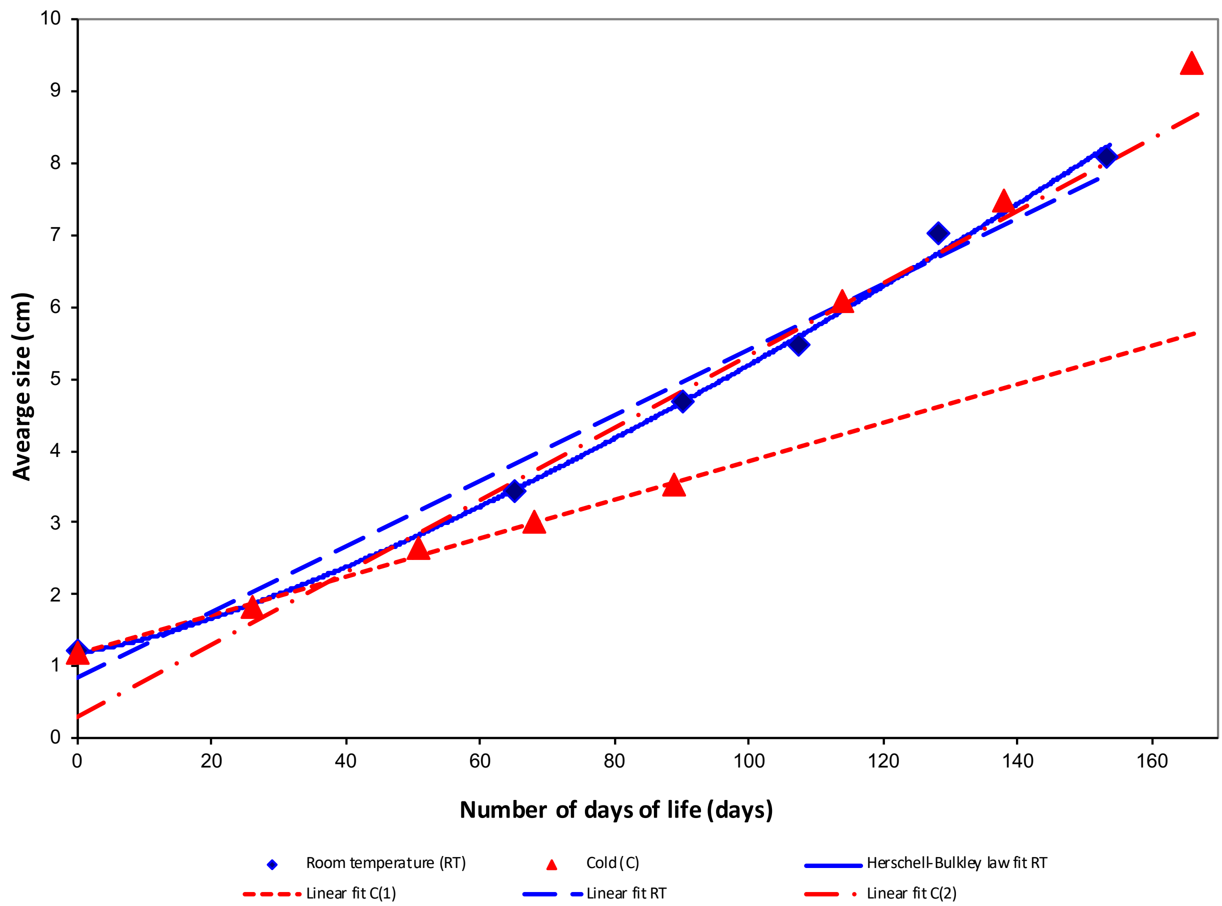

Figure 3 . Evolution of the average size of the specimens according to the number of days of life of the specimens for ERT and EC. Days are counted from the day of birth. C(1) corresponds only of the first 90 days of life of ECs. C(2) corresponds of all EC life days.

These tests will be repeated over longer periods to study, for example, whether specimens living on one of the plants mentioned, but also those which are derived from eggs having been placed in the cold, have the capacity to perform a complete cycle, if the eggs laid by adults are viable while comparing also their size compared to a control group. In addition, other plants, including *Dorycnium pentaphyllum*, and other colder temperatures will be tested. Indeed, despite all our efforts, it was impossible to find *D. pentaphyllum* in the study area.

Moreover, thanks to this communication, the number of diets accepted by this species has been increased, since it is able to feed on almond and fig leaves but also bear's breeches to a lesser extent.

Acknowledgements

The authors would like to thank Professor Frédéric FRANCIS (Gembloux Agro-Bio Tech, University of Liège, Functional and Evolutionary Entomology Unit) for the initial donation of specimens of the species of *M. extradentata*. Judith Marshall and Hillery Warner (both Natural History Museum, London) provided assistance in English proof-reading.

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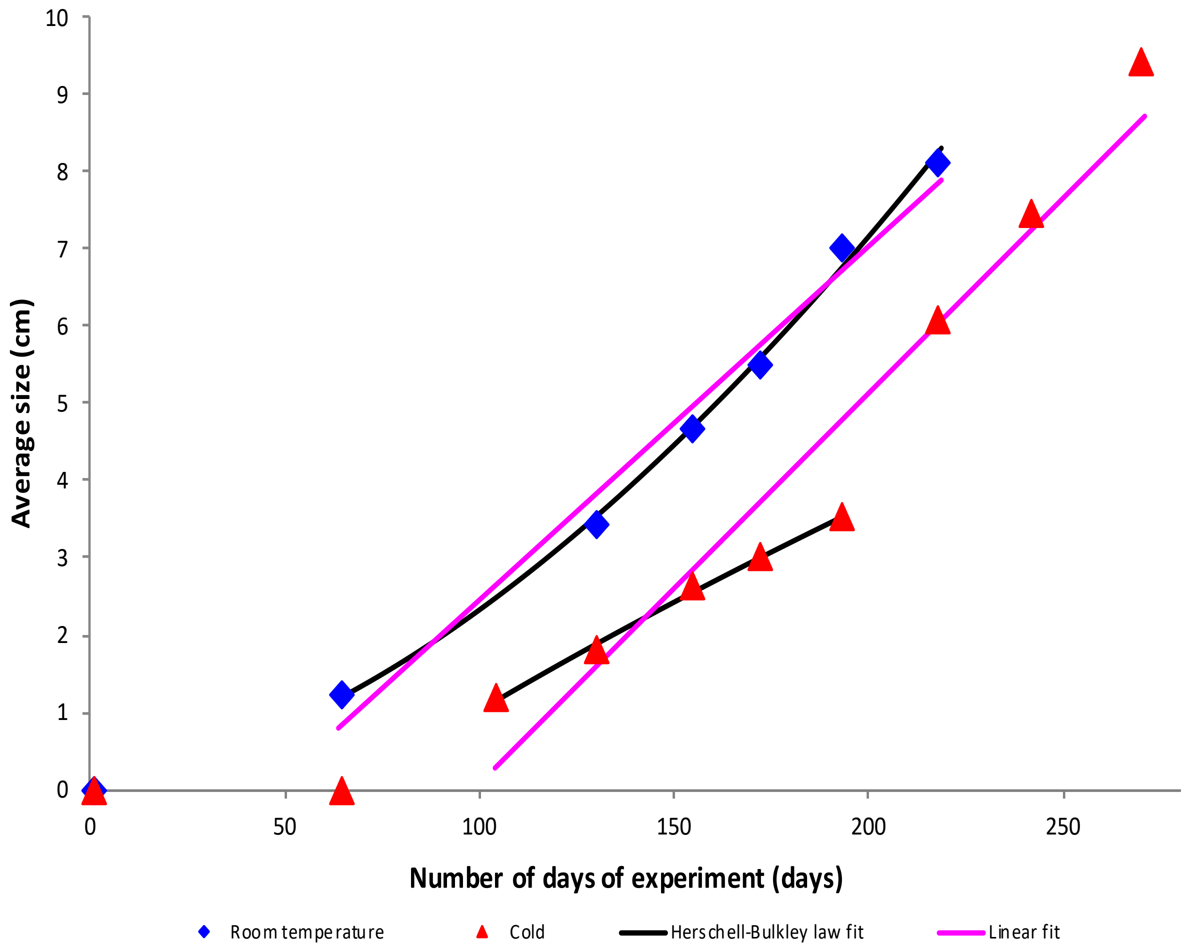

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A spectacular new Australian stick insect genus and species (Phasmida)

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Abstract
Gibbernecroscia n. gen. (Phasmida: Lonchodidae: Necrosciinae), which includes the sole species *P. kooymani* sp. n. from New South Wales and Queensland, is described and figured.

Key words
Phasmida, *Gibbernecroscia*, new genus, *kooymani*, new species, Australia

Introduction
The Australian phasmid fauna has recently been studied in more detail (Brock & Hasenpusch (2007, 2009)), but there remain several new taxa to describe, with DNA barcoding now featuring (Velonà et al, 2015). The authors' extensive research indicates that key places to search for phasmids new to science are New South Wales, Queensland and Western Australia. This paper discusses a remarkable find in northern New South Wales in 2007 by SP, whilst undertaking a rainforest vine survey on private land. The unusual winged phasmid found looks nothing like other Australian Necrosciinae and was later found in another site just across the border in Queensland.

Studies made
Extensive searches of the Australasian phasmid fauna have been made by PDB and JWH (including checks of all major and many minor collections), and Asian fauna where relevant, to either find material in collection(s), or find a link to species with related taxa. Brock et al (2018) was also referred to. Fieldwork included searching vegetation by torch at night, including in potential sites nearby, such as Springbrook NP where a new phasmid species was recently described (Brock & Monteith (2018)) and other species are being described (Brock, in preparation). Having delayed the formal description for so long, in the hope of obtaining material for molecular work, the decision was taken to finally publish. Unfortunately, eggs appear to have been mislaid, hence lack of full details on these.

Abbreviations for depositories
QM - Queensland Museum, Brisbane, Australia

Gibbernecroscia gen. n.

ZooBank: urn:lsid:zoobank.org:act:3655F910-97D5-4F36-BD15-4763E4A29336

Type species
Gibbernecroscia kooymani, sp. n., here designated.

Characteristics of the genus

Stocky (in female), medium-sized, short winged Necrosciinae (hindwings only present), female with strongly humped tuberculate mesonotum.

Head rounded posteriorly, about as wide as long in female. Antennae longer than forelegs. Sexually dimorphic, male slender, female robust. Eyes moderate size. Pronotum almost as long or same length as head. Mesonotum over three times length of pronotum, in female with numerous tubercles, particularly on large, raised central hump. In male of the only species known to date, mesonotum with few central tubercles. Metanotum short, combined length including median segment just over half length of mesonotum. Fore wings absent. Hind wings brachyterous, not reaching end of 2nd abdominal segment in female or 4th in male. Abdomen elongate, but robust in female. Cerci short. Female operculum with slightly rounded tip, reaching end of 9th abdominal segment; in male poculum short of end of 9th abdominal segment. Cerci short, stout.

Egg

Oval, glossy capsule with base incised. Micropylar plate oval, about central.

Notes

A large thoracic hump is rare in phasmids and only present in few Necrosciinae, such as in representatives of the colourful Asian genera *Calvisia* Stål, 1875 and *Trachythorax* Redtenbacher, 1908; even so this is more a swelling on the hind part of the mesonotum. The shape of the hump in *Gibbernecroscia* is superficially like *Cranidium gibbosum* (Burmeister, 1838), a large, spectacular South American member of the Phasmatidae, subfamily Cladomorphinae. Thus, the stocky *Gibbernecroscia* is easily distinguished from all other Australasian genera by the hump on the mesonotum, also the lack of forewings is unique in the Australian Necrosciinae (where wings are present in other Necrosciinae, the forewings may be small, but always leaf-like. In some genera tiny forewings are present, but not hindwings, the loss and recovery of wings in phasmids is discussed in Whiting et al, (2003)). There appear to be no close Asian relatives, despite a superficial resemblance to *Calvisia* Stål, 1875 and *Trachythorax* Redtenbacher, 1908, which have broad forewings. Some *Lopaphus* Westwood, 1859 species are broadly similar, again except for the forewings. The egg of this new genus is unlike any of these genera, as is often the case with Australasian species. Bradler & Buckley (2018) is a useful up to date overview of the biodiversity of phasmids and these authors refer to 'Lanceocercata' Bradler as a monophyletic group in the Australasian region (a synonym of Phasmatidae). However, this clade excludes Australian Necrosciinae.

Species included

G. kooymani, sp. n.

Etymology

Gibber, for 'humpbacked' and *Necroscia* to emphasise that it is in the subfamily Necrosciinae.

Gibbernecroscia kooymani **sp. n.**

[Kooyman's Stick-insect]

(Figs. 1–16)

ZooBank: urn:lsid:zoobank.org:act:D0DB5C7C-7B5E-4B50-96A8-FEAFA74BB8B2

Holotype ♂, AUSTRALIA, New South Wales, Hughes family property via Upper Main Arm, boundary of Mt Jerusalem NP, 28.502400°S, 153.370000°E, 27.i.2008, S. Petrović (QM, T244738). Paratypes: 2 ♀, same data; 1 ♂, Queensland, Binna Burra, Lamington NP, 28.194°S 153.187°E, 13.ii.2016, P.D Brock & N. Tweed, c.762 m, DNA project PB0145 (all QM T244739-T244741).

Description

Brown with some greenish, particularly in male. Medium sized Necrosciinae of unique appearance, lacking forewings (hindwings brachypterous) and female with conspicuous humped tuberculate mesonotum.

Male (Figs 1-6, 14).

Head. Slightly longer than wide. Brown, with black central longitudinal line and broader lines from eye to back of head. Eyes brown, with black line and blotches. Antennae long, with c.60 hairy segments, more elongate towards tip; basal segments black.

Thorax. Pronotum brown, slightly longer than head, with central impression. Black central line broad in part. Bold almost inverted, 'U' mark beneath central impression. Mesonotum about 3 x length of pronotum, with a few central darker tubercles. Black central blotch may feature at top of segment, short black lines posteriorly, either side of central line. Mesonotum brownish green, but ventrally green. Metanotum and median segment combined shorter than mesonotum; more brownish than green except ventrally.

Abdomen. Brown with sparse dark markings. Anal segment less than half length of 9th abdominal segment. End of anal segment slightly incised at tip. Poculum not reaching end of 9th abdominal segment; tip subtruncate. Cerci short, with rounded tip.

Wings. Forewings absent. Hindwings short, not reaching end of 4th abdominal segment. Pre-anal part uniform brown, wings transparent, slightly brownish.

Legs. Brownish green, hind legs green. elongate, slightly hairy. Fore femora slightly longer than hind femora. Apices of all femora and tibiae dark brown.

Figure 1. Male dorsal view (holotype). Paul D. Brock.

Figure 2. Male, lateral view. Paul D. Brock.

Figure 3. Male head and thorax, lateral view. Paul D. Brock.

Figure 4. Male abdominal apex, dorsal view. Paul D. Brock.

Figure 5. Male abdominal apex, lateral view. Paul D. Brock.

Figure 6. Male abdominal apex, ventral view. Paul D. Brock.

Female (Figs 7-13, 15)
Greenish [brown forms also, dead specimens change colour to brownish green], robust-looking with some mottling on legs.

Head. Rounded; almost as long as wide. Eyes moderate size. Antennae longer than forelegs, with numerous slightly hairy segments [often with broken tips, as in paratypes], more elongate towards tip.

Thorax. Pronotum slopes down from head and has a few tubercles. Mesonotum over 3 x length of pronotum, sloping upwards to a large hump with numerous tubercles. Whole of mesothorax swollen, with the dorsal and lateral surfaces (mesonotum + mesopleurae) convex. Metanotum and median segment combined just over half length of mesonotum.

Abdomen. End of anal segment subtruncate. Cerci short but stout, tapered to tip. Operculum with slightly rounded tip, reaching end of 9th abdominal segment.

Wings. Hindwings short, only reaching about half length of 2nd abdominal segment. Pre-anal part uniform brown, wings transparent, slightly brownish.

Legs. Elongate.

Egg (Fig. 16). Dark, but slightly glossy, oval capsule [mainly, one egg shown (bottom right) may be first laid and not be a normal shape]. Base a conspicuous shape. Capitulum short. Micropylar plate oval, about central.

Measurements (in mm) for 1 male and 2 females
Length of body: male 49, female 64-65. Head: male 2.6, female 4. Antennae: male 47, female 31-32 (tips broken, much longer in life). Pronotum: male 2.8, female 4. Mesonotum: male 9, female 13. Metanotum: male 2.5, female 3.5. Median segment: male 2.5, female 3.5. Forewing: N/A. Hindwing: male 17, female 9. Femora, fore, mid, hind: male 15, 10, 14, female 15-16, 10, 14. Tibiae, fore, mid,

Figure 7. Female dorsal view (paratype). Paul D. Brock.

Figure 8. Female lateral view. Paul D. Brock.

Figure 9. Female head and thorax, dorsal view. Paul D. Brock.

Figure 10. Female head and thorax, lateral view. Paul D. Brock.

Figure 11. Female abdominal apex, dorsal view. Paul D. Brock.

Figure 12. Female abdominal apex, lateral view. Paul D. Brock.

Figure 13. Female abdominal apex, ventral view. Paul D. Brock.

hind: male 15, 9.5, 16, female 14.5, 9, 15. Cerci: male 0.7, female 0.6. The male paratype is proportionately smaller, Length of body: 44.

Etymology
The species is named after Dr Robert Kooyman, an eminent ecologist in northern New South Wales, who is well known for conservation work. Dr Kooyman was also instrumental in organizing for SP to conduct the actual survey of vines that yielded the initial discovery of the species.
Distribution. The type series is from northern New South Wales and southeastern Queensland where it is known from two localities: Near Mt. Jerusalem NP (Fig. 17) and Binna Burra, Lamington NP (Fig. 18), a well-known site for entomologists. Ross Coupland (personal correspondence, 2016) found a large female nymph at Binna Burra on 4 November 2016; and eventually located adult females there on 4 December 2018 and 4 January 2019, after various unproductive searches.

Habitat
Montane rainforest, feeding on *Neolitsea dealbata* [Hairy-leaved Bolly Gum] (Lauraceae) and another unidentified plant near Mt Jerusalem and on *Backhousia myrtifolia* [Grey Myrtle] (Myrtaceae). Al-

Figure 14. Living male (paratype). Paul D. Brock.

Figure 15a. Living female (paratype). Stephen Petrović.

Figure 15b. Living female. Ross Coupland.

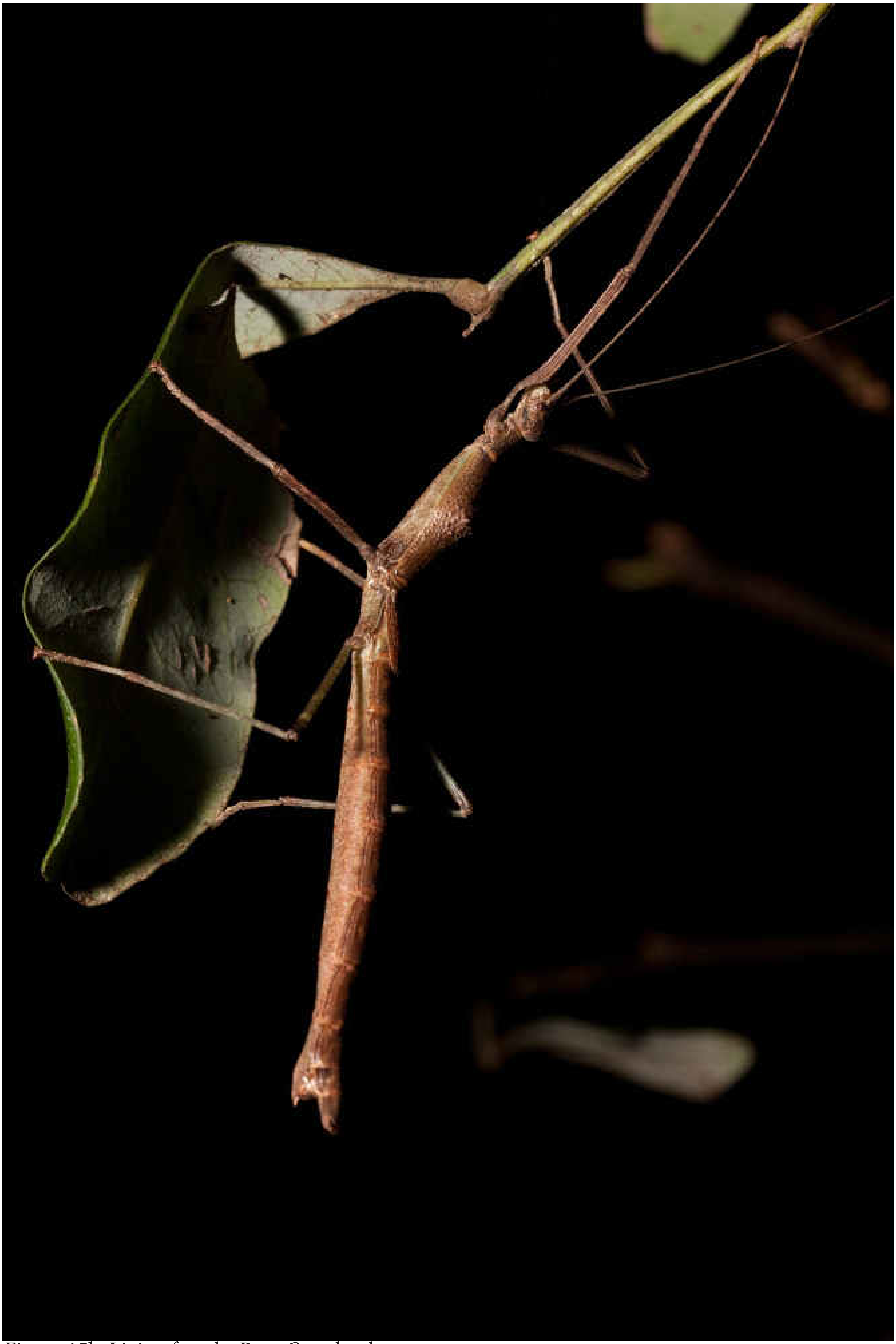

Figure 15b. Living female. Ross Coupland.

Figure 16. Eggs. Stephen Petrović.

Figure 17. Rainforest habitat nr. Mt. Jerusalem. Stephen Petrović.

though only noted as adults so far between December and February, these are likely from November to March. So far, all specimens have been found no higher than two metres from the ground, with stunning camouflage in nature (e.g. figure 14).

Discussion
Research is needed to ascertain which taxa this unique species is related to. Only one male has been submitted for DNA-barcoding and ideally further material is needed, including both sexes.
Although likely that this elusive species will be more widespread, searches have not so far revealed its presence and it is clearly a rare species in Binna Burra, where various naturalists have searched for it. It should be searched for in Mt Jerusalem NP and elsewhere. Braxton Jones (pers. com., 2019) found a male on Lilly Pilly *Syzygium* (Myrtaceae), 400 m. from the peak of Mt Wollumbin [= Mt Warning], New South Wales on 7 January 2019. Rudolf & Brock Red List assessed Australian phasmids in 2017 and 2018 and it is likely that this species warrants a conservation status. Richard Hughes (pers. comm., 2018) mentioned that the Main Arm Valley area experienced a slow-moving fire in August 2017, lasting 45 days. This burnt along the mountain top for some days and came close to the property and phasmid habitat, one of the hazards faced by wildlife. Another is invasive weeds, but a three year project to control these has just finished [funded by Biodiversity Conservation Trust].

Acknowledgements
We wish to thank the Hughes family who gave permission to collect insects on private land; Richard Hughes very enthusiastically assisted in the search for these insects. Helen Brock and Geoff Monteith accompanied PB in 2016 without finding the species, but Noelene Tweed spotted a well camouflaged male whilst with PB in 2017. Ross Coupland has also made searches for this species and supplied photographs. Also to Frank Hennemann and Oskar Conle for constructive comments on the manuscript.

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Figure 18. Rainforest habitat: Binna Burra. Paul D. Brock.

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Three new localities for proposed *Clonaria* sp. phasmids in Southern Uganda

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Abstract
Phasmids have previously only been reported from one locality in Uganda – Bukasa island in Lake Victoria. In this paper, the males and females of three distinct species, assumed to be *Clonaria*, are described from both rainforest and savannah ecosystems across an altitude range of 1250-1460m in the south of the country. Short descriptions and illustrations of both sexes are given, with a brief commentary on foodplants and ecology.

Key words
Uganda, *Clonaria*,

Introduction and methods
During an organised trekking holiday to Southern Uganda in February 2017, five short night walks and one day walk were undertaken in four localities in search of local Phasmids. The only Phasmid record on the Phasmida Species File for Uganda is one from 1910 of *Clonaria minuta* (Giglio-Tos, 1910) from Bukasa (Bukassa) Island in Lake Victoria, an area that was not on the itinerary for the trip (Figure 1). Phasmids were found at three out of the four localities, despite the advice of local guides that these were very rare or hadn't been seen for a number of years.

Based on discussions with UK experts and initial queries of the Phasmida Species File (Brock, Büscher & Baker, 2018), the author focused on locating either *Bactrododema* spp. or *Clonaria* spp., both of which have been described from neighbouring East African countries. Photographs of both genera were taken to Uganda and shown to local guides at all localities before any walks were undertaken. Vegetation types were checked during the day before the walks to locate disturbed natural vegetation containing *Acacia* spp., on the advice of Allan Harman (pers. comm.). All walks were accompanied by an armed guard on the advice of the local tour operators, as in all areas there were large mammals present which could present a danger to people if disturbed. No formal collecting was undertaken, with photographic records, accompanied where possible by measurement, being used to generate the descriptions and diagrams presented in this paper.

Figure 1. Localities and itinerary in Southern Uganda.

Location 1. Primate Lodge, Kibale Forest National Park.
Primate Lodge is located at 0.4618N

(Latitude), 30.3781E (Longitude), and an altitude of 1250m. Therefore the temperatures, although around 25°C in the day, fell quite quickly to around 15°C overnight, especially after rain. February is the end of the dry season, and many of the plants were showing signs of water stress. According to the local guides the wet season was slow in coming this year and the forest was therefore unusually dry.

The first night walk was taken down the main drive to the Lodge, which was allowed unguided as there were armed guards posted at various points along the drive. After only about 50m of looking a small *Acacia* bush was located, containing a cicada, mantid, cricket and caterpillar. Here a small (approx 4cm long) male *Clonaria* sp. insect was found feeding on the *Acacia* (Figures 2 a and b). Its appearance suggested that it may have still been sub-adult, although the genitalia were quite well developed and distinctively shaped.

The following evening a night walk was taken deeper into the neighbouring forest with an armed guard. Despite having very powerful spotlights (powerful enough to spot bush babies in the canopy)

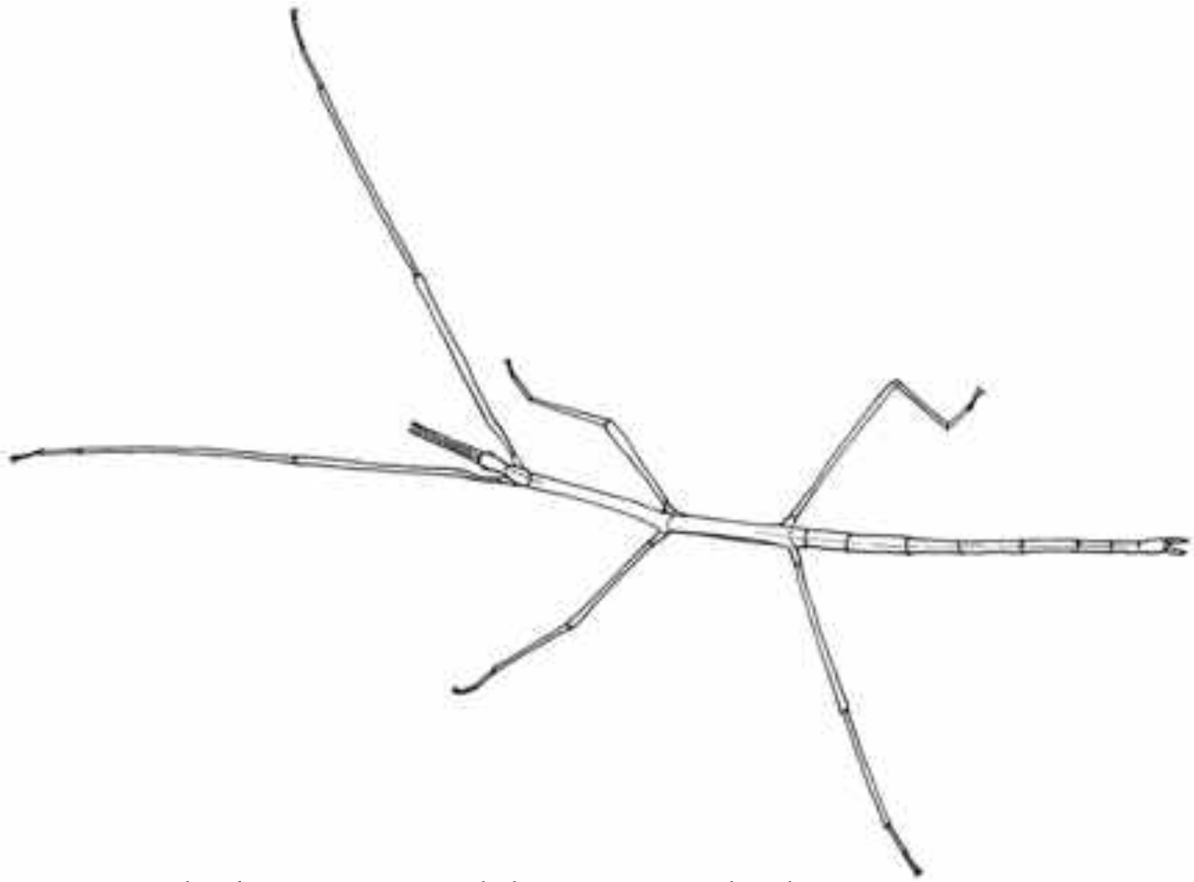

Figure 2a. Male *Clonaria* sp. From Kibale Forest National Park

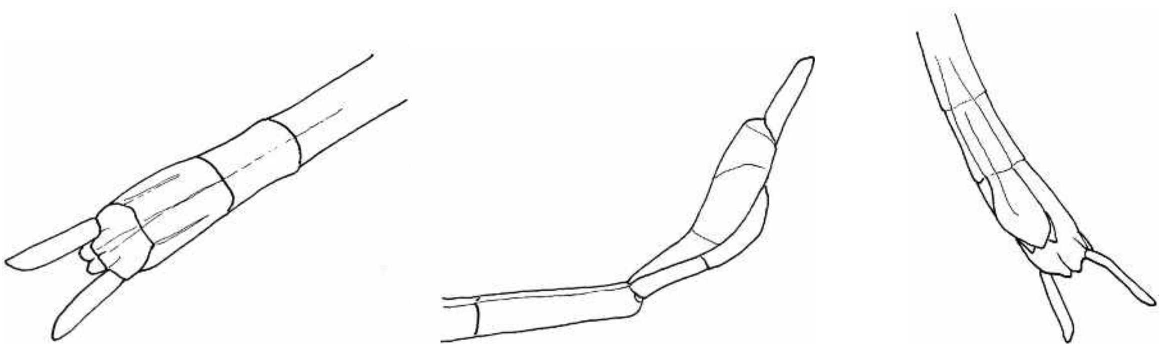

Figure 2b. Left to right, dorsal, lateral and ventral views of the abdomen of the male from Kibale.

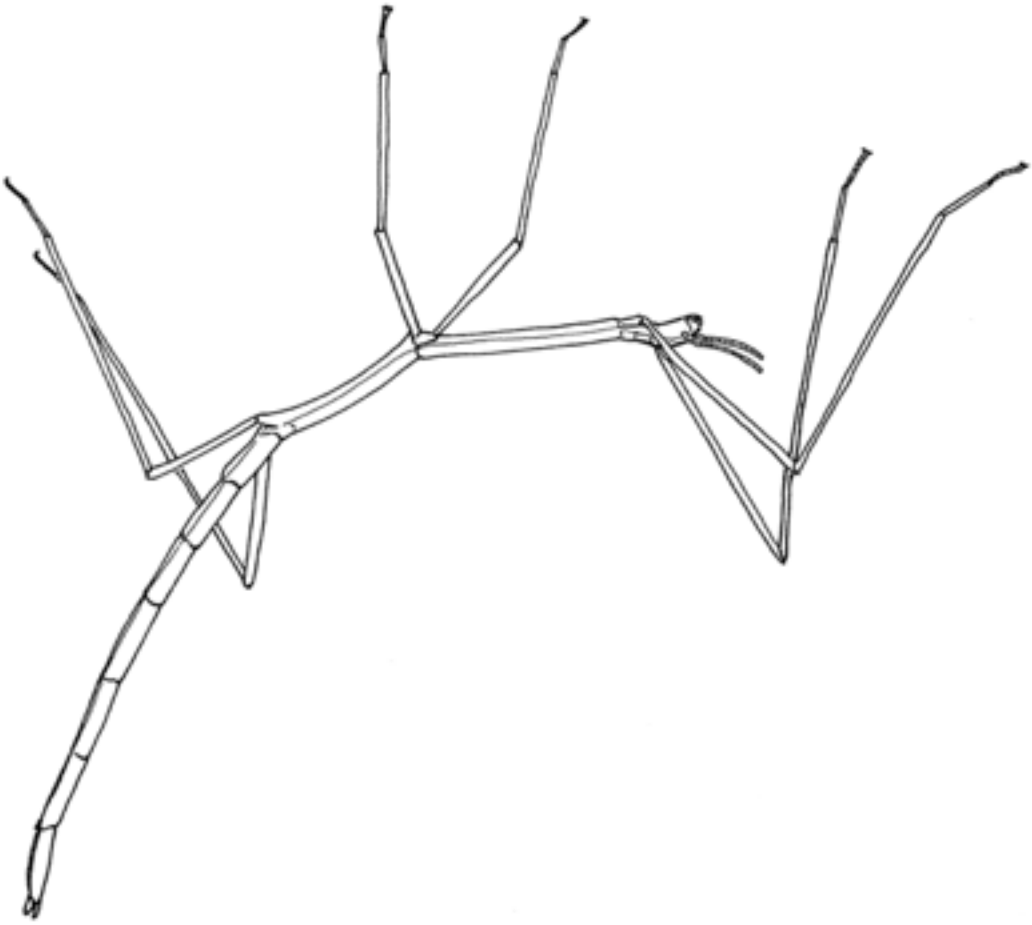

Figure 3a. Female *Clonaria* sp. From Kibale Forest National Park.

Figure 3b. From left to right dorsal and lateral views of the abdomen of the female from Kibale.

and searching for over two hours, we found very few insects on the trails, and only one stick insect. This was a female, very similar in appearance and therefore presumably of the same species as the male found on the drive (Figures 3 a-d). She was feeding actively on an unidentified small tree with tripartite leaves. This was clearly not an *Acacia* species, suggesting that this species is at least somewhat polyphagous. Again, the slender stature of the insect suggested it might not be adult, but again it was well developed enough to offer some hopefully diagnostic features for identification.

Male

Entire body smooth, being an even, light green colour. Antennae short (less than half the length of forelegs, and 2/3 the length of the mesothorax). Legs unarmed. Wingless. Head smooth, longer than wide and dorsally aligned with prothorax. Faint darker median line down much of the body, most prominent on the abdomen. End of the abdomen held at 45 degrees to abdomen, with the last three abdominal segments making a nearly straight line along the dorsal edge. Cerci large and obvious, straight, and held out straight in line with the tip of the abdomen.

Female

Body light green in colour as with the Male. A slender insect – mesothorax over 6 times longer than wide. Numerous black spots and markings on the sides of thorax and abdomen. Thorax irregularly granulose with the granules being a lighter green/yellow colour. Median line not visible on thorax and largely reduced to darker spots at the intersections of the abdominal segments. Darker banding present on all legs, most obviously on the middle pair. Antennae very short (only just longer than the head). Head longer than wide, very slightly rounded. Legs unarmed. Tip of abdomen slender terminating in two small, leaf like cerci held slightly out form the body line. A slender spine present on the ventral side of the 7th abdominal segment pointing to the rear and almost touching the operculum.

Location 2. Queen Elizabeth National Park

It was not possible to conduct night walks within the scrubby savannah vegetation in Queen Elizabeth National Park, due to the presence of a large population of elephants, lions and other large mammals. A small search of vegetation surrounding the lodge in which we were staying (Kingfisher Lodge, Kichwamba on an escarpment overlooking the park and Lake Edward) was conducted. Although a daytime search had located some semi-natural looking vegetation patches, with *Acacia* bushes present, no phasmids were found within the area surrounding the lodge.

Location 3: Bwindi Impenetrable Forest National Park

The village of Buhoma on the North-East of the Bwindi Impenetrable Forest National Park was chosen as a base from which to conduct gorilla trekking. It was not possible to enter the forest itself at night, but the disturbed rainforest vegetation at the boundaries was accessible. Prior correspondence with Bwindi Forest Farm had suggested the presence of phasmids in the area, and the Bwindi Research Institute had a picture of what looked like a *Clonaria* species on their website.

Mahogany Springs Lodge, although within five minutes' drive from the park, was almost devoid of local vegetation, with well-tended gardens surrounded by land given over to agriculture. However, the neighbouring Engagi Lodge (00.58'50.48S - 29.37'05.24E Alt 1,460m) did have a path leading down to a river that flowed out of the forest, and a night walk along that path was arranged on the advice that the vegetation was much more natural there. Again this was accompanied by an armed guard from the lodge (the gorillas are known to come into the grounds of the lodge as they move around their territory), and by Paul Ahimbisibwe, who acted as guide.

Within twenty metres of the lodge the first phasmid was located, a female *Clonaria* sp., clearly different from the Kibale species (Figure 4 a and b). She was found on (but not feeding on) ferns within 50 cm of the ground.

Shortly after that an adult male (presumably of the same species, although we did not find any mating pairs) was spotted, very well camouflaged on some dry twigs at a similar height (figures 5 a and b) and within a few feet of the female. Insects here were much more abundant than at Kibale, and various orthoptera and moths were spotted. After a further 50m, a number of female specimens were found feeding on a *Triumfetta macrophylla* bush, which was about 2m in height. This is relative of the mallow with small yellow flowers and thick, greyish green, slightly hairy leaves, offering the insect very little camouflage. In all, a further four insects were found on this bush, including one half-grown juvenile. On return to the lodge, one further female was spotted on another *T. macrophylla* bush and collected with the foodplant into a collapsible cage in an attempt to collect an egg to assist taxonomy. The cage was hung from the mosquito net in the lodge for two days, the foodplant being changed daily (it was eaten each night), and some fresh and dried grass added to mimic the natural habitat (which was not eaten). However, no eggs were laid and the female was released when it was time to leave the lodge.

Male

Body length approximately 4cm, smooth and dark brown dorsally with a red/orange stripe running

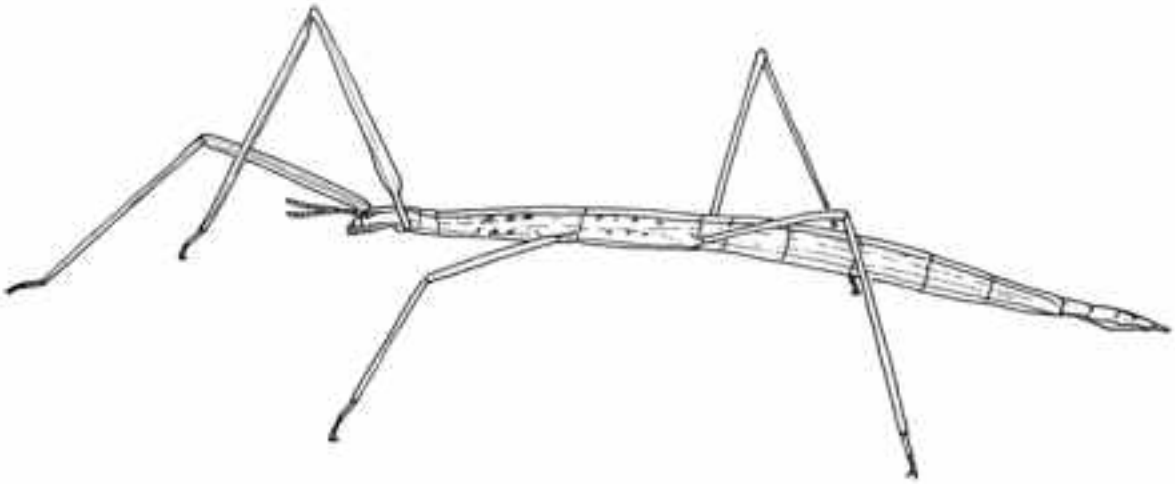

Figure 4a. Female *Clonaria* sp. found in Bwindi Impenetrable Forest National Park.

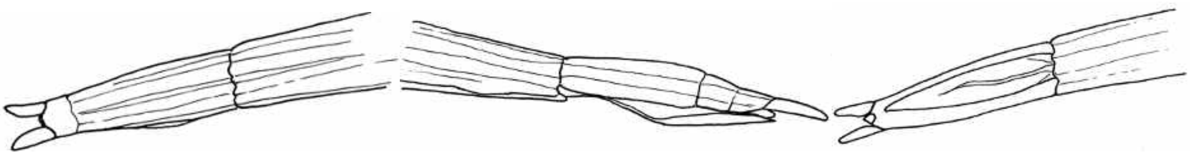

Figure 4b. from left to right dorsal, lateral and ventral views of the abdomen of the female from Bwindi, showing the characteristic ribbed appearance.

down the upper sides of the meso and metathorax. Head small, smooth, longer than wide and dorsally in line with the prothorax. Antennae nearly half the length of the profemur and almost as long as the mesothorax. Legs all unarmed. Tip of the abdomen slightly swollen dorsally and laterally. Very prominent cerci present, sharply incurving, and with the appearance of being slightly saddle shaped held pointing downwards at about thirty degrees from the line of the abdomen.

Female

Body length approximately 5cm. Colour variable shades of light and dark brown or orange-brown. Some black spotting on the sides of the thorax and abdomen in some specimens, colour not always uniform. Body quite stocky (mesothorax only 4 times as long as wide), with a noticeably swollen abdomen when gravid. Whole body granulose and having a slightly ribbed appearance down its length, as do the legs. Antennae as long as the head and prothorax combined; the head being flattened in line with the body. Tip of the abdomen slender with a noticeable dip in the operculum. Cerci small and leaf-like held nearly in line with the body. No spine on the 7th abdominal segment.

Notes on Ecology

The camouflage of the insects strongly suggested grass mimicry, but clearly they were feeding on a plant against which they were very poorly camouflaged. It was hypothesised therefore that they would be hiding in the grassy vegetation growing below the *T. macrophylla* bushes during the day, only coming up to feed at night. On a three-hour walk undertaken along the same river the next afternoon, this was discussed with Paul, who was acting as guide again. Passing the same bushes where the most insects had been found the most insects the previous night, Paul managed to locate one of the females hiding, as hypothesised, within the dried grasses at the base of the bush, perfectly camouflaged against the dried leaves.

Further down towards the river, some younger bushes of *T.macrophylla* were located which showed signs of insect damage. On one of these the author located a small (first or second instar) phasmid nymph. This was thread-like and bright green in colour, and hiding on the lower surface of the leaf. It is of course not possible to say whether this was the same species as described above, but it is interesting to speculate whether this species shows a change of both camouflage and ecology during its development, starting life living on and camouflaged against its food plant and then as it gets larger, changing strategy and descending to the grasses and twigs below to rest in the day before climbing up to the higher leaves of the foodplant to feed at night.

The females all exhibited a similar defensive behaviour of curling their abdomens up over their backs when agitated making an almost perfect semicircle with the tip of the abdomen pointing forwards. It is not known how this behaviour may help the insects avoid predators.

Location 4: Lake Mburo National Park

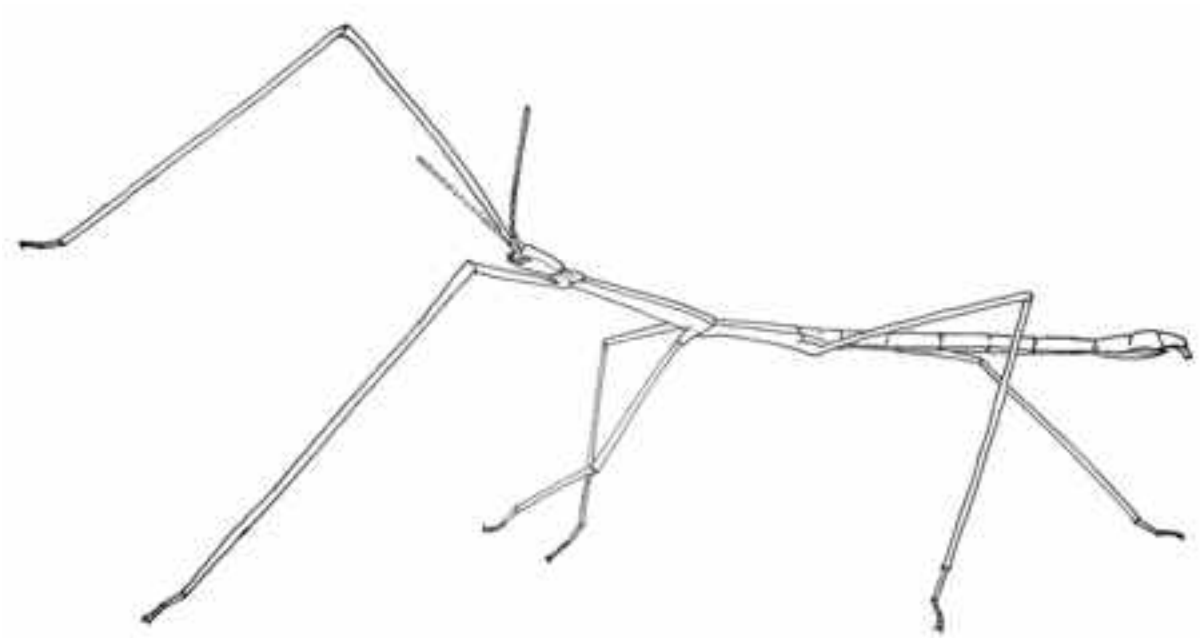

Figure 5a. Male *Clonaria* sp. from Bwindi Impenetrable Forest National Park

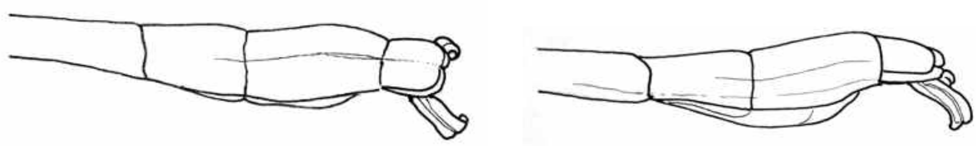

Figure 5b. from left to right dorsal and lateral views of the abdomen of the male from Bwindi.

The final destination of the tour was the savannah-dominated Lake Mburo National Park, in the far south of Uganda (00.37'01.16"S and 30.58'48.04"E Alt 1310m). Even at the end of the dry season there was still a lot of green vegetation available to insects and other animals, although the grasses were generally quite withered. A day time walk from the lodge located some suitable looking acacia bushes and trees within 100 m of the lodge where insects might be located, although only a large locust was discovered during preliminary searches during the day.

That evening, accompanied by three of the guides from the lodge (the lodge was not gated and there were leopards, water buffalo and a lion in the area) a short walk was taken up to the acacias. The guides had suggested that phasmids had been observed near here, but that they were very rare, with the last sighting over three years ago.
However, on the first bush searched, tentatively identified as *Acacia hockii*, a number of adults of a

third species of Clonaria were spotted, who appeared to be feeding on the finely divided leaves (characteristic feeding damage was noted near the insects). There were different ages of insect on the bush, both males (figure 6 a and b) and females (figure 7 a and b). Further up the path an adult female was spotted within the grass several metres away from any acacia bushes). At the summit (about 100m from the camp) another female was found at around 2m from the ground in an *Acacia* tree, possibly gerrardii or abyssinica. Returning to the first bush after just a few minutes, it was interesting to note that all of the insects previously spotted had moved, but a mating pair was found this time, which quickly dropped, still coupled, into the grass when disturbed.

Male
A very slender insect, a little over 5 cm long, body smooth and dark brown. Antennae the same length as the metathorax. Legs unarmed. Head small and in line with body, with eyes protruding obviously when viewed dorsally. Clear darker median line, especially on abdomen. Last three abdominal segments swollen laterally and dorsoventrally, forming a swollen “s” shape towards the tip, enhanced by long cerci, which both bend inwards and downwards from the tip of the abdomen.

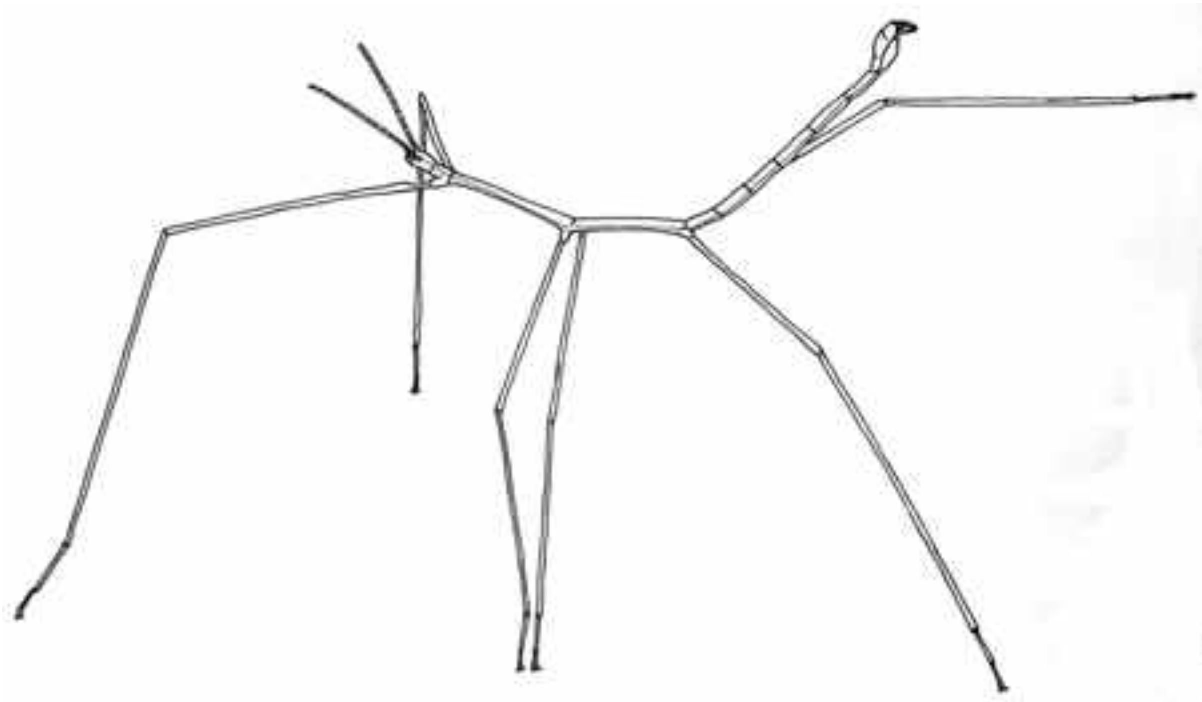

Figure 6a. *Clonaria* sp. male from Lake Mburo National Park

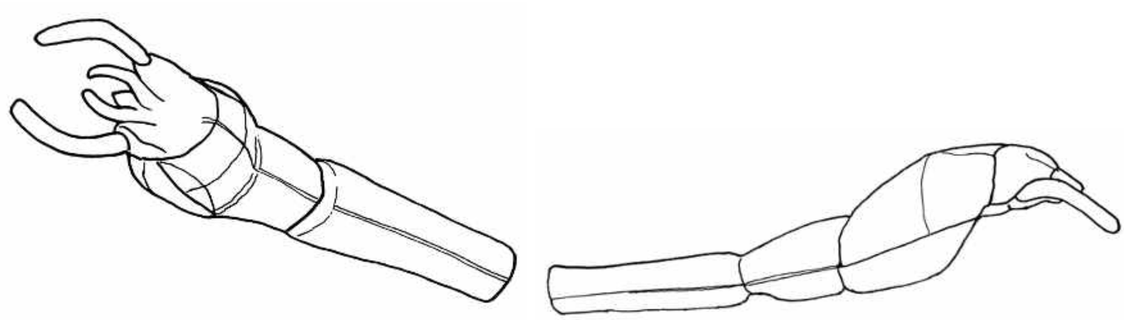

Figure 6b. From left to right dorsal and lateral views of the abdomen of the male from Lake Mburo.

Female

A graceful insect, of smooth appearance, and observed in a number of colour forms, all pale, from a straw colour, to a pastel green and pink on a tan base, camouflaging extremely well with the grasses surrounding the acacia bushes. Body length around 7.5cm, sparsely granulose on the dorsal surface of the thorax. Slender, with the metathorax being 6 times longer than its width. Antennae short and tapered in appearance, being only the length of the head and prothorax combined. Head small and in line with thorax. Abdomen very slightly expanded when gravid, terminating in a slender tip with small leaf-like cerci. A small triangular spine was present on the ventral surface of the 7th abdominal segment of one specimen, although this was not visible in the female of the mating pair.

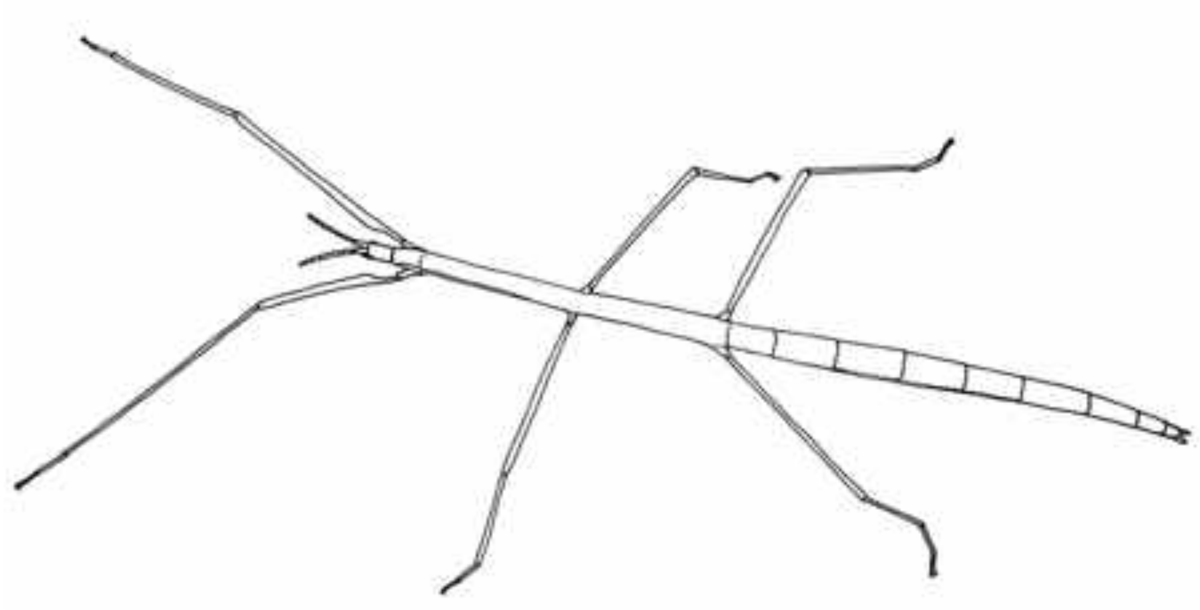

Figure 7a. Female *Clonaria* sp. from Lake Mburo National Park

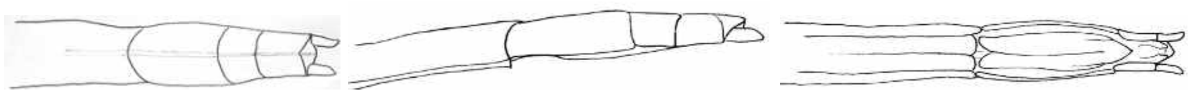

Figure 7b. Dorsal, lateral and ventral views of the abdomen of the female from Lake Mburo.

Ecology

Again this appears to be a species where the female is camouflaged extremely well against the grass below its foodplant, but very visibly apparent when active at night when it climbs as much as 2m up into the bushes and small trees that grow up from the grass in this area. Discovered eating two species of acacia, it would be interesting to see how polyphagous it is. Despite having observed animals in the grass, no evidence was found of the insects eating this, especially in this locality where the grasses were almost completely withered due to it being the end of the dry season. It appears to be quite a mobile species, moving several metres to find food, and quite prepared to drop from the foodplant to escape predation if disturbed. Several nymphal stages were found on the same bush suggesting a protracted hatching period in this locality.

Conclusions

Although clearly not as diverse as many other areas of the globe, locating phasmids so easily in three new localities in Uganda suggests that there are potentially many more species to be discovered and described in this area of East Africa. It would be interesting to see if, perhaps at other localities or at different times of year, the other genus *Bactrododema*, which is known from neighbouring Tanzania, might also be located in Uganda. Clearly the logistics of observation and collection are challenging in this region, with many large and potentially dangerous animals active at night, but the assistance of local guides and experts that the author worked with while in Uganda was exemplary and it is hoped therefore that further study in regions such as this will be easier in future.

Taxonomy within *Clonaria* is recognised to be extremely challenging, and a quick scan of the type materials of many of the African species on the Phasmida Species File shows how many are in a very poor state, with many of the taxonomically useful features missing. There is a large gap in the literature between the 1920s and the 21st Century. Added to this, with so many species being very effective grass mimics, even if they are not eating it, convergent evolution is highly likely, making identification yet more difficult. Therefore, although a quick scan of the literature has been performed, no further attempt has been made at this time to identify the insects to species level and therefore no claims are made that these are new species – merely new localities.

Acknowledgements
To Noel Bayo and his team at Great Lakes Safaris, who were so accommodating to the author's constant requests to disappear off into the forest at night. To Paul Ahimbisibwe, an excellent guide in Buhoma, whose keen eyesight enabled daytime phasmid spotting. And to Judith Marshall and Allan Harman for their invaluable advice on where to look for phasmids in Uganda and how to collect taxonomically useful information.

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