The Katydids of the Atewa Range Forest Reserve, Ghana

Author: Naskrecki, Piotr

Source: A Rapid Biological Assessment of the Atewa Range Forest Reserve, Eastern Ghana: 63

Published By: Conservation International

URL: https://doi.org/10.1896/054.047.0112

Chapter 7

The at dids of he ewa ange ores Reser e, hana

Piotr Naskrecki

SUMMARY

Sixty-one species of Tettigoniidae were collected, the highest number of katydids known from a single location anywhere in Africa. Of these, at least 8 are new to science, and 36 are new to Ghana. Site 2 (Asiakwa South) showed the highest species richness (50 spp.), likely due to a high edge effect created by a dense network of roads. While we recommend this area be protected in its entirety, any future development that is allowed within the area should be restricted to the southern part of the range in order to reduce further fragmentation of the remaining forest. Furthermore, roads and clearings that are no longer in use should be reforested to reduce habitat fragmentation and to discourage illegal logging and hunting.

INTRODUCTION

Katydids (Orthoptera: Tettigonioidea) have long been recognized as organisms with a significant potential for their use in conservation practice. Many katydid species exhibit strong microhabitat fidelity, low dispersal abilities (Rentz 1993a), and high sensitivity to habitat fragmentation (Kindvall and Ahlen 1992) thus making them good indicators of habitat disturbance. These insects also play a major role in many terrestrial ecosystems as herbivores and predators (Rentz 1996). They are themselves a principal prey item for several groups of invertebrates and vertebrates, including birds, bats (Belwood 1990), and primates (Nickle and Heymann 1996). At the same time many species of katydids are threatened, and some appear to have already gone extinct (Rentz 1977).

The conservation value of katydids has been recognized in Australia (Rentz 1993b) and Europe, leading to the development of captive breeding programs (Pearce-Kelly et al. 1998), listings on individual country (Glowacinski and Nowacki 2006) and global Red Lists (IUCN 2006), and introduction of regulations aimed at their conservation. But their use as conservation tools or targets of conservation actions in tropical regions, where their importance and the level of endangerment are the highest, is hampered by the lack of baseline data on katydid distribution as well as the shortage of katydid expertise and identification tools, a phenomenon known as the taxonomic impediment. It is therefore critically important that more effort be directed towards basic faunal surveys of katydids across the tropics, thus creating the basis on which a successful conservation strategy for these animals can be built. Such surveys, if conducted in pristine or relatively undisturbed areas, also provide reference data, which can later be used in habitat monitoring or restoration efforts that should follow any industrial or agricultural activity. West African ecosystems are in particular need of extensive biotic surveys, as these are some of the least studied tropical habitats while also being subject to widespread, poorly regulated, and often illegal logging and mining activities, combined with persisting slash-and-burn agricultural practices. This results in a rapid decline of available, natural habitats, and thus an inevitable loss of biodiversity.

The following report presents the results of a survey of katydids conducted between June 6 – 24, 2006 at selected sites within the Atewa Range Forest Reserve (Atewa) in the Eastern

Region of Ghana. This is the first systematic survey of katydids in this country, and its results indicate the presence of a rich and unique fauna of this group of insects. To date, the only records of katydids in Ghana are those in the works of Beier (1965), Bolivar (1886, 1890, 1906), Karsch (1888, 1890), Ragge (1962, 1980), and Redtenbacher (1891) who collectively recorded only 13 species of katydids from this country.

From both floristic and faunistic points of view, the Atewa Range is a particularly interesting area. Located in the Akyem Abuakwa Traditional Area, the reserve comprises two blocks of the Upland Evergreen Forest, one of only two such forest ecosystems in Ghana. The reserve contains about 60% of the forest coverage within the entire Eastern Region, and thus most of the available habitats for its forest fauna. The area included within the confines of the reserve spans two floristic zones, with the larger, northern portion of the reserve covered with a moist deciduous forest. Most of the reserve is situated on two plateaus, ranging in elevation from 350 to 800 m above sea level. This topography contributes to climatic conditions that favor plant formations that require constant, high humidity, and somewhat lower temperatures than floras in the surrounding, lowland areas. Consequently, the insect faunas of the Atewa Range can be expected to differ from lower areas of Akyem Abukawa.

METHODS

During the survey three methods were employed for collecting katydids: (1) collecting at incandescent and ultraviolet (UV) lights at night, (2) visual search at night, and (3) net sweeping of the understory vegetation during the day and at night. Unfortunately, the UV light method was not available at all study sites, thus potentially reducing the chance to collect flying, nocturnal species, such as many members of the Phaneropteridae. However, the availability of other light sources (incandescent lights around the camp) allowed us to collect many of the nocturnal, flying species of katydids, including several inhabitants of the upper layers of the forest canopy.

Net sweeping was employed in the vegetation along the roads within the forest, the forest understory, and natural openings within the forest, such as edges of streams or forest ponds. This method was highly effective in locating seed-feeding katydids in tall grasses as well as a number of arboreal katydids that cling upside-down to the lower surface of leaves. Sweeping was standardized by performing five consecutive sweeps in a series before the contents of the net were inspected. By far the most effective method of collecting, both in terms of the number of species collected and number of collected specimens, was the visual search at night. Most of the collecting was conducted after dark, between the hours of 8 pm and 2 am when the activity of virtually all katydid species is the highest. Yet day collecting along the forest roads also yielded several interesting species, including one (*Ruspolia* sp. 1), the presence of which may indicate an encroachment of savanna elements into the reserve.

In addition to physical collection of specimens, stridulation of acoustic species was recorded using the Sony MZ-NHF 800 digital recorder and a Sennheiser shotgun microphone. These recordings are essential to establish the identity of potentially cryptic species, for which morphological characters alone are not sufficient for species identification. An ultrasound detector Pettersson D 200 was also used to locate species that produce calls in the ultrasonic range, undetectable to the human ear.

Representatives of all encountered species were collected and voucher specimens were preserved in 95% alcohol and as pinned, dry specimens. These specimens will be deposited in the collections of the Museum of Comparative Zoology, Harvard University and the Academy of Natural Sciences of Philadelphia (the latter will also become the official repository of the holotypes of several new species encountered during the present survey upon their formal description).

Katydids were surveyed at three sites within the reserve, Site 1 in the southern, and Sites 2 and 3 in the northern part of the range. Site 1 (Atiwiredu) was located at 6°12’24.7”N, 0°34’37.2”W, elevation 795 m, and sampling was conducted there from 6 – 10 June, 2006. This site had an extensive network of roads, and was subject to prospecting activity by ALCOA. Despite this activity, the forest condition was rated 2 by the botanical team, indicating a relatively low level of disturbance.

Site 2 (Asiakwa South) was situated at 6°15’44.3”N, 0°33’18.8”W, at the elevation of 690 m, and sampling was conducted there from 11 – 16 June, 2006. This site, while not currently subject to prospecting activity, still contained an extensive network of roads, some overgrown with tall grasses. These roads appear to act as passages allowing the penetration of invasive elements, such as grasses or species of insects normally associated with open habitats, deep into the forest. The condition of the forest at this site was rated as 3.

Site 3 (Asiakwa North) was located at 6°16’16.4”N, 0°33’52.8”W, elevation 769 m, and was sampled from 16 – 24 June, 2006. Most of the site was covered with tall, closed-canopy forest, with little underbrush, and no open roads. Its condition was rated as 2. There were few gaps in the forest, which accounts for the low number of species associated with such habitats. The only gaps present were overgrown with tall, broad-leaved plants of the family Marantaceae.

RESULTS

The survey resulted in the collection of 61 species of katydids, the highest number of katydids known from a single location anywhere in Africa. Most collected species represent new records for Ghana, and at least eight species are new to science (but it is quite likely that more species will be determined to be new once the process of their identification is completed.) Identities of several species require confirmation by comparing them to type specimens of species described from West Africa as in some cases the original descriptions are not detailed enough to make positive identification.

Many species listed here appear to have a wide, West African distribution, having been recorded from sites in Cameroon and Guinea. Their presence in eastern Ghana supports this notion, and fills a gap in our knowledge of West African biogeography. A full list of recorded taxa is given in Table 7.1, and below I comment only on new or particularly interesting species.

Family Phaneropteridae

This group of katydids includes most species restricted to thecanopy level of the forest. Many are excellent fliers, and can be collected at night using UV or incandescent lights. Some are diurnal and can be heard calling during the day from tall trees. All members of this family are exclusively herbivorous. Twenty-seven species of this family were found during this survey.

Ducetia fuscopunctata Chopard, 1954 – this species was originally described from Mt. Nimba, Guinea, and this is its first record from Ghana. It is associated with edge habitats, such as tall vegetation along the roads, but in can also be found in natural gaps within the forest. This species was particularly abundant at Site 2, but was conspicuously absent from Site 3.

Arantia spp. – Six species of this genus were recorded, at least two of which are possibly new to science. They were all associated with tall understory vegetation within the forest as well as tall, broad-leaved plants along the roads. *A. rectifolia* Br.-Watt, *A. retinervis* Chopard, and *A. angustipennis* Chopard are new to Ghana, having been previously recorded only from Fernando Po, Cameroon, and Guinea, respectively.

Preussia lobatipes Karsch, 1890 – This spectacular leaf mimic has been known so far only from a handful of specimens collected in Cameroon and Guinea, and its presence in Ghana is not surprising. A single female was collected at lights at Site 2.

Weissenbornia praestantissima Karsch, 1888 – Like the previous species, *W. praestantissima* has previously been known only from Cameroon and Guinea. Two individuals were collected at lights at Site 2.

Plangiopsis foraminata Karsch – Two individuals of this arboreal, lichen-mimicking katydids were collected at lights at night at Site 2. Previously this species has only been known from Cameroon (Karsch 1891).

Family Conocephalidae

The Conocephalidae, or the conehead katydids, include a wide range of species found in both open, grassy habitats, and high in the forest canopy. Many species are obligate graminivores (grass feeders), while others are strictly predaceaous. A number of species are diurnal, or exhibit both diurnal and nocturnal patterns of activity. Only three species of this family were recorded.

Conocephalus carbonarius Redtenbacher, 1891 – This species is one of the few true forest species of the genus. Individuals of *C. carbonarius* were common in the understory of forests at all visited sites, but were particularly abundant along roads and in herbaceous vegetation along the edges of bodies of water. Unlike most species of the genus *Conocephalus*, males of *C. carbonarius* are active both day and night, singing from vegetation very low to the ground. This species appears to be predominantly predaceous. It was originally described from Ghana (Redtenbacher 1891), and was subsequently found in Guinea (Chopard 1954).

Ruspolia sp. 1 – A single individual of this predominantly savanna genus was found at Site 2 in grasses along one of the roads. *Ruspolia* species are obligate graminivores, and can only survive in habitats rich in grasses, and where humidity is not very high. The presence of a *Ruspolia* species deep within the forest is a sign of potentially negative changes within this environment, and points to the important role roads play in allowing foreign elements to penetrate forested areas.

Thyridorhoptrum sp. 1 – A new species of this genus was found at Site 2. It appears to be related to *T. baileyi* Pitkin from forests of Uganda, but differs in a number of characters, including the call pattern of the males.

Family Meconematidae

This poorly studied family includes some of the smallest species of katydids, and many appear to be exclusively predaceous. Nearly all species of Meconematidae are arboreal, nocturnal, and extremely agile, making it very difficult to collect them (many are flightless, and thus rarely come to lights at night.) Ten species were recorded, including at least two representing a new genus and new species.

Amyttosa mutillata (Karsch, 1890) – A species known previously only from Cameroon (Karsch 1890). It was also erroneously recorded from Equatorial Guinea (Beier 1965), a mistake based on the false assumption that the original type specimens of *A. mutillata* possessed damaged female reproductive organs (hence the name), and that similar but "undamaged" individuals from other parts of Africa were conspecific. Yet numerous individuals collected at Sites 2 and 3 during the current survey prove conclusively that this species is unique in having a highly reduced, rudimentary ovipositor, a condition extremely rare within this group of katydids, and usually associated with egg laying on exposed surfaces, such as leaves or bark. Such a behavior is found in katydids living in highly humid environments.

Gen. nov. spp. – Two species of a new genus of flightless Meconematidae were found at Sites 2 and 3. They appear to be closely related to a yet undescribed genus of katydids from the Upper Guinean forest of Guinea, and may turn out to be congeneric. Because these new species appear to have poor dispersal abilities, typical of most flightless katydids, it is possible that they may be endemic to the Atewa Range.

Family Mecopodidae

Three species of this exclusively tropical group of katydids were found during this survey. Most of its species are associated with humid forests, and all species appear to be herbivorous. No members of this family have ever been recorded from Ghana, although their presence there is not surprising as they are known from most of the neighboring countries.

Afromecopoda spp. – Two species of this genus were

Table 7.1. A check list of species of katydids recorded from the Atewa Range Forest Reserve, Eastern Ghana.

	Species	Site 1 (Atiwiredu)	Site 2 (Asiakwa S)	Site 3 (Asiakwa N)	New to Ghana	New to science
	Conocephalidae (3 spp.)					
1	*Conocephalus carbonarius* Redtenbacher	x	x	x		
2	*Thyridorhoptrum* sp. nov. 1		x		x	x
3	*Ruspolia* sp. 1		x			
	Meconematidae (10 spp.)					
4	*Amytta* sp. 1		x			
5	*Amytta* sp. 2		x			
6	*Amyttosa mutillata* (Karsch)		x	x	x	
7	*Anepitacta lomana* Ragge		x	x	x	
8	*Anepitacta* sp. 2		x			
9	*Anepitacta* sp. 3	x				
10	*Anepitacta* sp. 4		x			
11	Gen. Nov. sp. 1		x	x	x	x
12	Gen. Nov. sp. 2		x	x	x	x
13	*Proamytta* sp. 1			x		
	Mecopodidae (3 spp.)					
14	*Afromecopoda frontalis* (Walker)	x	x	x	x	
15	*Afromecopoda* sp. nov.	x			x	x
16	*Corycoides abrubtus* (Krauss)		x	x	x	
	Phaneropteridae (27 spp.)					
17	*Ducetia fuscopunctata* Chopard	x	x		x	
18	*Tapiena minor* Bolivar	x	x			
19	*Arantia rectifolia* Br.-Watt.		x		x	
20	*Arantia retinervis* Karsch		x	x	x	
21	*Phaneroptera nana* Stal		x			
22	*Arantia* sp. 2	x	x	x		
23	*Arantia* sp. 3	x	x	x		
24	*Arantia angustipennis* Chopard	x	x	x	x	
25	*Arantia* sp. 4	x		x		
26	*Catoptropteryx capreola* Karsch	x	x	x		
27	*Catoptropteryx* sp. 2		x			
28	*Catoptropteryx* sp. 3		x			
29	*Catoptropteryx* sp. 4		x			
30	*Eurycorypha ornatipes* Karsch			x	x	
31	*Eurycorypha* sp. 2	x	x			
32	*Eurycorypha* sp. 3		x			
33	*Eurycorypha mutica* Karsch		x	x	x	
34	*Plangiopsis foraminata* Karsch		x		x	
35	Gen. Nov. 2 Phan sp. 1		x		x	x
36	Gen. Nov. 3 Phan sp. 1			x	x	
37	*Goetia galbana* Karsch	x			x	
38	*Preussia lobatipes* Karsch		x		x	
39	*Poreumena lamottei* Chopard		x	x	x	
40	*Tetraconcha* sp. 1	x	x			
41	*Tetraconcha* sp. 2		x			
42	*Weissenbornia praestantissima* Karsch		x		x	
43	*Zeuneria melanopeza* Karsch		x		x	
	Pseudophyllidae (18 spp.)					
44	*Stenampyx annulicornis* Karsch		x	x	x	
45	*Tomias hardus* (Karsch)	x	x		x	
46	*Adapantus bardus* Karsch	x	x	x	x	
47	*Adapantus nitens* Chopard	x	x	x	x	
48	*Adapantus* sp. nov. 3	x	x	x	x	x
49	*Adenes obesus* Karsch	x		x	x	
50	*Adenes* sp. 2	x	x			
51	*Adenes* sp. 3		x	x		
52	*Batodromeus richardi* Griffini			x	x	
53	*Habrocomes personatus* Sjöstedt	x			x	
54	*Lichenochrus congicus* Rehn	x	x	x	x	
55	*Polyglochin peculiaris* Karsch		x		x	
56	*Mormotus* sp. n. 1	x	x	x	x	x
57	*Mormotus* sp. n. 2	x			x	x
58	*Mormotus obtusatus* Br.-Watt.		x	x	x	
59	*Mormotus bardus* Karsch	x	x	x	x	
60	*Tympanocompus erectistylus* (Karsch)		x			
61	*Mustius superbus* Sjöstedt	x	x			
	Totals	**26**	**50**	**29**	**36**	**8**

collected, and one appears to represent a species new to science. *A. frontalis* (Walker) was found to be common at all three sites. Members of this genus are some of the few West African katydids associated with leaf litter and the bottom of evergreen and deciduous forests.

Corycoides abruptus (Krauss, 1890) – This interesting species is known only from the holotype from an unknown locality and a handful of specimens collected in Guinea (Chopard 1954). This is the first record from Ghana.

Family Pseudophyllidae

Virtually all members of tropical Pseudophyllidae can be found only in forested, undisturbed habitats, and thus have a potential as indicators of habitat changes. These katydids are mostly herbivorous, although opportunistic carnivory was observed in some species. Many are confined to the upper layers of the forest canopy, and never come to lights, making it difficult to collect them. Fortunately, many of such species have very loud, distinctive calls, and it is possible to document their presence based on their calls alone, a technique known well to ornithologists. At least 18 species of this family were collected during the present survey.

Adapantus nitens (Chopard, 1954) – Originally described from N'Zo (Mt. Nimba), this is only the third record of this species, and the first outside of Guinea. These katydids were common at all three sites.

Adenes spp. – Three species of this flightless genus were found during this survey, at least one of which appears to be new to science (a comparison with the type specimens of the already described species is required before the final decision of its new status can be made).

Lichenochrus and *Polyglochin* – Two species of these interesting, lichen-mimicking genera were found: *L. congicus* Rehn and *P. peculiaris* Karsch. Both are new to Ghana. Like most lichen-mimicking katydids, these insects may be restricted to small patches of humid, higher elevation forests that can support a wide variety of the lichens these katydids feed upon.

DISCUSSION

Despite a relatively very short period of time spent surveying katydids within the ARFR, this study increased the number of species known from Ghana by over 500%. This does not necessarily indicate the uniqueness or particular richness of the area's insect fauna, but clearly demonstrates the lack of baseline data on the distribution of katydids (and most likely other invertebrates) in this country. Such data are critically important as a reference for future habitat restoration projects, and may also help pinpoint populations of particularly endangered or threatened species where an immediate conservation action is required.

Within the ARFR we found a remarkable species richness of katydids, and a very high number of new and potentially endemic species. Despite ongoing bauxite prospecting activity, the forest of the reserve still appears fairly intact, and harbors the highest number of katydids known from any single location in Africa. Thus, every effort should be made to minimize the impact any future development may inflict on the forest reserve. Of the three sites within the reserve, the highest number of species was found at Site 2 (Asiakwa South). In comparison to Sites 1 and 3, which appeared to have fewer roads and less open, easily accessible habitat, Site 2 shows the most pronounced edge effect. Because Sites 2 and 3 are both located within the northern part of the range (the northern plateau), and this part constitutes a larger, continuous swath of the forest than the southern plateau, conservation of the northern portion of the reserve should receive a higher priority. If any development is planned within the reserve, it is strongly recommended that such activity be limited to the southern part of the range, thus reducing the fragmentation of the already severely restricted forest, and the loss of species that require large, continuous areas of a forest habitat. Landscape- or habitat-altering development within this robust and intact ecosystem will not only damage, perhaps irreparably, the original forested habitats, but will also open them to other destructive activities, such as illegal logging or hunting, by creating access points and inroads. The negative effects of a dense network of prospecting roads within the Atewa Range are already evident through the loss of virtually all tall, emergent trees, and the rampant bushmeat hunting activity. In addition, wide roads entering the forest allow invasive elements, such as grasses or savanna insects to penetrate into this environment. They also contribute to fragmentation, higher light penetration, and ultimately a decrease in forest humidity, which may lead to the loss of species requiring shady and humid conditions. Thus, in addition to restricting any potential exploration activities to the southern part of the range, it is strongly recommended that any roads or exploratory clearings within the forest that are no longer in use be reforested with the same tree species that were present prior to prospecting activities.

REFERENCES

Beier, M. 1965. Die afrikanischen Arten der Gattungsgruppe "Amytta" Karsch. Beiträge zur Entomologie 15: 203-242.

Belwood, J.J. 1990. Anti-predator defences and ecology of neotropical forest katydids, especially the Pseudophyllinae. Pp 8–26. *In:* Bailey, W.J. and D.C.F. Rentz (eds.). The Tettigoniidae: biology, systematics and evolution: ix + 395 pp. Bathurst (Crawford House Press) & Berlin et al. (Springer).

Bolívar, I. 1886. Enumeracion y estudio de las collecciones recogidas en su viaje por el Dr. Ossorio. In: Articulados del viaje de; Dr.Ossorio a Fernando Poo y el Golfo de Guinea. Anales de la Sociedad Española de Historia Natural 15: 341–348.

Bolívar, I. 1890. Ortópteros de Africa del Museo de Lisboa. Jornal de Sciencias da Academia de Lisboa 1(2): 211–232.

Bolívar, I. 1906. Fasgonuridos de la Guinea española. Memorias de la Real Sociedad Española de Historia Natural 1: 327–377, pl. 10.

Chopard, L. 1954. La reserve naturelle integrale du Mont Nimba III. Orthopteres Ensiferes. Mem.IFAN 40: 25-97.

Glowacinski, Z. and J. Nowacki. 2006. Polish Red Data Book of Animals: Invertebrates. URL: http://www.iop.krakow.pl/pckz/default.asp?nazwa=default&je=en (accessed 20 July 2006)

IUCN. 2006. IUCN Red List of Threatened Species. URL: http://www.iucnredlist.org/ (accessed 20 July 2006)

Karsch, F. 1888. Ortopterologische Beitrage. III.. Berlin. Entomol. Zeitschr. 32(2): 415-464.

Karsch, F. 1890. Verzeichniss der von Herrn Dr. Paul Preuss auf der Barombi-Station in Deutsch-Westafrika 1890 gesammelten Locustodeen aus den Familien der Phaneropteriden, Mekonemiden und Gryllakriden. Entomologische Nachrichten 16 (23).

Karsch, F. 1891. Uebersicht der von Herrn Dr. Paul Preuss auf der Barombi-Station in Kamerun gesammelten Locustodeen. Als Anhang: Ueber die Mecopodiden (pp. 341-346). – Berliner Entomologische Zeitschrift 36: 317–346.

Kindvall, O. and I. Ahlen. 1992. Geometrical factors and metapopulation dynamics of the bush cricket, *Metrioptera bicolor* Philippi (Orthoptera: Tettigoniidae). Conserv. Biol. 6: 520–529.

Nickle, D.A. and E.W. Heymann. 1996. Predation on Orthoptera and related orders of insects by tamarin monkeys, *Saguinus mystax* and *S. fuscicollis* (Primates: Callitrichidae), in northeastern Peru. J. Zool. Soc. 239: 799-819.

Pearce-Kelly, P., R. Jones, D. Clarke, C. Walker, P. Atkin and A.A. Cunningham. 1998. The captive rearing of threatened Orthoptera: a comparison of the conservation potential and practical considerations of two species' breeding programmes at the Zoological Society of London. Journal of Insect Conservation 2: 201-210.

Ragge, D.R. 1962. A revision of the genera Phlaurocentrum Karsch, Buettneria Karsch and Leiodontocercus Chopard (Orthoptera: Tettigoniidae). Bulletin of the British Museum (Natural History), Entomology Series 13 (1): 1–17.

Ragge, D.R. 1980. A review of the African Phaneropterinae with open tympana (Orthoptera: Tettigoniidae). Bulletin of the British Museum (Natural History), Entomology Series 40: 67–192.

Redtenbacher. 1891. Monographie der Conocephaliden. Verh. der Zoologisch-botanischen Gesellsch Wien 41(2): 315-562.

Rentz, D.C.F. 1977. A new and apparently extinct katydid from antioch sand dunes (Orthoptera: Tettigoniidae). Entomological News 88: 241–245.

Rentz, D.C.F. 1993a. Tettigoniidae of Australia, Vol. 2, The Austrosaginae, Zaprochilinae and Phasmodinae: i–x, 1–386; East Melbourne (CSIRO).

Rentz, D.C.F. 1993b. Orthopteroid insects in threatened habitats in Australia. Pp 125–138. *In:* Gaston, K.J., T.R. New and M.J. Samways (eds.). Perspectives on Insect Conservation: 125–138; Andover, Hampshire (Intercept Ltd).

Rentz, D.C.F. 1996. Grasshopper country. The abundant orthopteroid insects of Australia. Orthoptera; grasshoppers, katydids, crickets. Blattodea; cockroaches. Mantodea; mantids. Phasmatodea; stick insects: i–xii, 1–284; Sydney (University of New South Wales Press).