Katydids of the Nakanai Mountains, East New Britain Province, Papua New Guinea (Insecta: Orthoptera: Tettigoniidae)

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Chapter 2

Katydids of the Nakanai Mountains, East New Britain Province, Papua New Guinea (Insecta: Orthoptera: Tettigoniidae)

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SUMMARY

Thirty five species of katydids were collected during a rapid biodiversity assessment of the Nakanai Mountains on New Britain island, which represents an increase of more than 130% in the known katydid fauna of the island. An additional nine species of katydids were recorded at the Mt. Gahavisuka Regional Park (Eastern Highlands Province). At least 12 species recorded during the survey are new to science, and one represents a genus new to science. Based on the limited sampling of the current survey it appears that the katydid fauna of New Britain is potentially rich, yet still virtually unknown. Although no specific conservation issues are known to affect the katydid fauna, habitat loss on New Britain is the primary threat to the biota of the island.

INTRODUCTION

Katydids (Orthoptera: Tettigonioidea) are useful organisms for assessing the success of conservation practices because they 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 long been recognized in Australia (Rentz 1993b) and Europe, leading to the development of captive breeding programs (Pearce-Kelly et al. 1998), listings on country (Glowacinski and Nowacki 2006) and global (IUCN) Red Lists, 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 critically important that more surveys of katydid faunas are conducted across the tropics to provide baseline data 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.

The katydid fauna of New Britain, and of the Bismarck Archipelago in general, is one of the least explored in Melanesia. To date no synthetic overview of its composition has been attempted and the entomological literature contains records of only 18 species of the Tettigoniidae collected on New Britain, and only one (*Segestidea insulana* Willemse) from the Nakanai Mountains (Willemse 1961). By comparison, nearly 300 species of the Tettigoniidae have been recorded from mainland New Guinea (Indonesian New Guinea and Papua New

Guinea combined) (e.g., Bolivar 1902, Brunner von Wattenwyl 1895, 1898; Ingrisch 2008, 2009; Jin 1992, Karny 1924, Willemse 1959, 1966; others). The large size of New Britain, its proximity to New Guinea, its varied topography and biotic composition, combined with the still relatively well preserved habitats over most of its area, virtually guarantee that the katydid fauna of New Britain is rich, most likely within the range of 200-250 species. Here I report the results of a survey that documented katydid species richness and endemism at three elevations in the Nakanai Mountains of East New Britain.

METHODS AND STUDY SITES

Field methods

During the survey four collecting methods were employed for collecting katydids: (1) collecting at ultraviolet (UV) and fluorescent lights at night, (2) visual searches at night, (3) acoustic tracking using a heterodyne ultrasound detector and a directional microphone, and (4) net sweeping of the understory vegetation during the day and at night.

Lights: UV light collecting was done nightly between approximately 8 pm and 11 pm, with the exception of Site 1 where insects were collected only from fluorescent lamps around the campsite. Collecting at lights was surprisingly ineffective, and only a handful of species was attracted to them.

Visual searches: By far the most effective method of collecting, both in terms of the number of species collected and number of collected specimens, was visual searches at night. Most collecting was conducted between 8 pm and 1 am when the activity of virtually all katydid species was highest.

Acoustic tracking: Stridulation of acoustic species was recorded using a Marantz PMD-661 digital recorder and a Sennheiser shotgun microphone ME-66. These recordings are essential to establish the identity of potential cryptic species, in which morphological characters alone are insufficient for species identification; they were analyzed using the bioacoustics package Raven Pro 1.3 (Cornell Lab of Ornithology). An ultrasound detector (Pettersson D 200) was used to locate species that produce calls in the ultrasonic range that are undetectable to the human ear.

Net sweeping: This was employed in the vegetation along the trails within the forest, the forest understory, and natural openings within the forest, such as edges of streams. This method was highly effective for collecting 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.

In addition to the above techniques day collecting along the forest trails and roads near villages yielded several interesting, mostly grass-feeding species.

Vouchers of all species were collected and preserved in 95% alcohol or dried and pinned. They 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 be the repository for holotypes of new species). Representatives of all collected morphospecies were photographed and these photographs will be added to the online Orthoptera database (Eades and Otte 2010).

Site descriptions

East New Britain, Pomio District

Site 1: Lamas (5°36.853'S, 151°24.483'E), 3-9 April 2009
This lowland site, situated at 200 m elevation, was covered by relatively undisturbed forest with the understory dominated by small palms and ferns. There were no obvious signs of logging, and trees with DBH over 50 cm were common. The presence of small trails, and a larger trail leading to a nearby village, indicated that the area was occasionally visited, most likely by hunters. Collecting was performed primarily by night searches and sweeping of low vegetation in forest clearings; no UV light was used because the fluorescent camp lights provided sufficient illumination to attract flying insects (but did not attract a single katydid).

Site 2: Vouvou (5°26.740'S, 151°27.842'E), 10-18 April 2009
The second site, which included forested and edge habitats at 860-910 m, was situated adjacent to a wide, unpaved road that connected the town of Pomio with an abandoned logging site. The forest was heavily disturbed alongside the road but was distinctly less disturbed further away from it, and no signs of logging or other disturbance were visible 300-400 m from the road. There were fewer large, emergent trees of DBH >50 cm, and large tree ferns (*Cyathea* sp.) were common in the understory. Collecting was done both along the road, which at places had large stands of giant grass (inhabited by several species of grass-feeding katydids), and deeper in the forest. UV light was used every night, between approximately 8 pm and 10 pm.

Site 3: Tompoi (5°20.623'S, 151°18.875'E), 19-25 April 2009
A pre-montane site at 1,500-1,700 m (the campsite at 1,600 m), which was once a dense southern beech *(Nothophagus*) forest. Following the drought of 1998/1999 many large trees have died, and now the dominant vegetation at the site is a dense bamboo thicket, with relatively widely scattered emergent beeches and other large trees. Humidity at the site was extremely high, and dense fog was present at the site throughout most of each day. UV light was used every night between 8 pm and 11 pm.

Site 4: Palmalmal (5°37'47.7"S, 151°29'33.3"E), 25-25 April 2009
This small coastal community retained little natural vegetation but nonetheless a few interesting katydid species were

collected along the main road that ran parallel to the coast from the Women's Guest House. All specimens were collected from tall grasses beside the road, both at night and during the day.

Eastern Highlands Province

Site 5: Mt. Gahavisuka Provincial Park, Eastern Highlands Province nr. IBR shelter (6°0'51.8"S, 145°24'46.9"E), 29 April-1 May 2009

A montane site, located at an elevation of 2,310 m, within a small (77.4 ha) protected area on a northwestern spur of Mt. Otto. Katydids were collected at night from trees and low vegetation along trails within the park, and from bushes surrounding a car park near the entrance to the park. Some insects were also collected at a lower elevation (ca. 2,200 m; 6°1'S, 145°24'35.4"E) from large *Pandanus* trees growing along a small stream as well as from grasses growing alongside the road leading to the entrance.

RESULTS

A total of 44 species of katydids were collected (Table 2.1). Of these, 35 were collected in the Nakanai Mts. (New Britain), and nine in the Mt. Gahavisuka Provincial Park (Eastern Highlands.) Although these numbers are relatively low compared to equivalent tropical sites elsewhere, they nonetheless constitute a significant increase (by over 130%) in the number of katydids known from New Britain. Species richness and abundance of the subfamily Phaneropterinae (5 spp.) was surprisingly low in the Nakanai Mountains. This group dominates most low- and mid-elevation tropical forests worldwide, often accounting for at least 50% of the katydid fauna. Their low abundance during this survey may have been related to seasonal effects (there are virtually no adult Phaneropterinae active in northern Queensland between May and October [D. Rentz, pers. comm.]) or reflect the fact that many tropical Phaneropterinae are canopy specialists that are rarely, if ever found at lower strata of the forest.

At least 12 species (27%) collected during this survey have been confirmed to be new to science, and are now being officially described; among these, one species will be placed in a new genus.

Most species documented in the Nakanai Mountains represent lineages associated with forest habitats, although a few (*Conocephalus* spp. and *Pseudorhynchus* spp.) are associated with open grassy habitats such as roads or disturbed forest edges. The presence of *Pseudorhynchus* spp. at Sites 1 and 2 may reflect early stages of encroachment of vegetation associated with anthropogenic changes. In addition to species collected as physical vouchers, the presence of at least 5-10 additional species was confirmed on the basis of their unique stridulations uttered from the forest canopy. However because these species were not collected their identity remains unknown.

Lamas

Seventeen species of katydids represented by 107 specimens were collected at this lowland site, Of particular interest was the specimen of *Biroa curvicauda*, an apparent New Britain endemic and a species previously known only from the female holotype. One species of *Anthracites* and one species of *Salomona* collected at Lamas are new to science and are now being described (Naskrecki and Rentz, 2010). Two species of *Nicsara* are also new to science, and they will be described by Dr. Sigfrid Ingrisch, who is in the process of revising the genus. Only one species of the Phaneropterinae was found at Site 1 (*Caedicia* sp. 1, represented by 2 specimens).

Vouvou

This site was both the richest in species (20), and had the highest abundance of katydids (210 specimens collected.). In addition to the possible "mid-domain effect" (Colwell and Lees 2000), which resulted in the presence of both typically low elevation (e.g., *Hexacentrus*) and high (e.g., *Segestidea*) elevation species, the presence of a road running through the site undoubtedly contributed to the higher number of species ("the edge effect"). The road and its accompanying grassy vegetation also accounted for the presence of widely distributed species that are often associated with disturbed or anthropogenic habitats (e.g., *Conocephalus redtenbacheri.*) At least five species collected at this site are new to science, including one that represents a new genus of the subfamily Agraeciinae (Naskrecki and Rentz 2010). *Paraphisis noonandae*, a species known only from the type specimens and apparently endemic to New Britain, was also collected at this site.

Tompoi

This pre-montane site had an interesting if small katydid fauna, represented by only eight species (95 specimens). At least two species are new to science, including the new genus collected at Site 2 (Naskrecki and Rentz 2010). Collections of *P. noonandae* and *Neophisis brachyptera* are the first since their original descriptions.

Palmalmal

Eleven species of katydids were recorded in the highly disturbed anthropogenic habitat around Palmalmal Village. Almost all are known to be widely distributed in Australasia (two species still await their final identification). Of particular interest was the presence of *Pseudorhynchus crassipes*, an Indo-Malayan species not previously recorded from New Guinea.

Mt Gahavisuka

Ten species were recorded at Mt. Gahavisuka, five of which represent species new to science (Naskrecki and Rentz 2010);

Table 2.1. Katydids collected during the 2009 Nakanai Mountains RAP survey (Orthoptera: Tettigoniidae).

Species	Lamas	Vouvou	Tompoi	Palmalmal	Gahavisuka
Conocephalinae					
Anelytra sp. (n.?)					X
Anthracites **sp. n. 2**					X
Anthracites **sp. n. 1**	X	X			
Gen. n. 1 & sp. n.		X	X		
Microsalomona **sp. n.**		X			
Nicsara **sp. n. 1**	X				
Nicsara **sp. n. 2**	X	X			
Philmontis **sp. n.**					X
Salomona bispinosa	X	X			
Salomona godeffroyi	X			X	
Salomona **sp. n. 1**	X	X			
Spinisternum **sp. n. 4**			X		
Spinisternum **sp. n. 5**		X			
Spinisternum **sp. n. 6**					X
Trichophallus **sp. n. 1**		X	X		
Trichophallus sp.		X			
Conocephalus semivittatus				X	X
Conocephalus redtenbacheri		X			
Conocephalus upoluensis				X	
Pseudorhynchus crassiceps				X	
Pseudorhynchus inermis	X			X	
Pseudorhynchus mimeticus		X			
Listroscelidinae					
Neophisis brachyptera	X		X		
Paraphisis noonadanae		X	X		
Mecopodinae					
Eumecopoda cyrtoscelis	X	X		X	
Huona variegata	X	X			
Phrictaetypus viridis	X	X	X	X	
Segestes stibicki					X
Segestidea defoliaria		X	X		
Biroa curvicauda	X				
Gressittiella castaneopicta					X
Phaneropterinae					
Phaneroptera celebica				X	
Caedicia sp. 1	X	X			
Caedicia sp. 2		X			
Caedicia sp. 3		X			
Caedicia sp. 4			X		
Hexacentrinae					
Hexacentrus mundus	X	X		X	

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Table 2.1. *continued*

Species	Lamas	Vouvou	Tompoi	Palmalmal	Gahavisuka
Pseudophyllinae					
Phyllomimus sp. 1					X
Tympanoptera sp. 1	X	X			
Tympanoptera sp. 2				X	
Phyllophorinae					
Phyllophorella sp. 1	X			X	
Sasima sp. 1	X				
Sasima sp. 2		X			
Sasima sp. 3					X
Total	**17**	**20**	**8**	**11**	**9**

two species still await final identification. Of particular interest was the collection of a series of specimens and recordings of the courtship call of *Gressitiella castaneopicta,* a moss-mimicking katydid previously known only from the type series collected at Mt. Otto. Also collected were 2 specimens of *Segestes stibicki*, a species previously known only from the type series collected in Madang Province.

DISCUSSION AND CONSERVATION RECOMMENDATIONS

The results of this survey constitute a dramatic increase in the number of species known from New Britain island, but at the same time highlight the need for its further exploration. Combined with the previously known 18 species, the fauna of New Britain now includes 45 species (Appendix 2.1), a number that in all likelihood represents but a fraction of the total species richness. At least 27% of the collected species are new to science and this number is likely to increase as the identification of specimens is completed. These results suggest that further basic, faunistic survey work in New Britain will increase the known katydid fauna substantially.

Katydids are a group of organisms known to be sensitive to anthropogenic disturbance and habitat fragmentation (Kindvall and Ahlen 1992), and are one of the relatively few groups of insects where extinction due to the habitat loss has been demonstrated (Rentz 1977). As such, katydid species may be useful indicators of the impact of human activities on natural habitats (although their usefulness as proxies for the diversity of other organisms still needs to be demonstrated). While most katydid species on New Britain are difficult to identify by non-taxonomists (and many still remain undescribed) there are also easy to recognize species that may be used for this purpose (e.g., *Huona variegata,* a large species apparently associated with very humid lowland rainforests). Additionally, thanks to their ability to produce acoustic signals (albeit not always audible to the human ear), katydids can and have been used to remotely monitor changes in the overall richness and abundance of faunas in tropical habitats (Brandes et al. 2006, Diwakar et al. 2007). As with most groups of insects, the principal threat to the survival of katydids on New Britain comes from habitat loss, especially from logging and the development of oil palm plantations. While species-level conservation recommendations are currently impossible to make, protecting the existing habitats, or at least major, connected fragments of them, are the most effective way of ensuring the survival of the biota of New Britain. Declaration of the Nakanai Mountains, including forest habitats extending from the lowlands to the highest elevations available, as a World Heritage Area, will be a crucial step in this process.

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Appendix 2.1. A check-list of katydid species recorded from New Britain (Orthoptera: Tettigoniidae) (Species in **bold** indicate new records for New Britain).

CONOCEPHALINAE

1. ***Anthracites* sp. n. 1**
2. *Conocephalus (Anisoptera) semivittatus vittatus* (Redtenbacher, 1891)
3. *Conocephalus (C.) infumatus* (Redtenbacher, 1891)
4. *Conocephalus (C.) redtenbacheri* (Bolivar, 1905)
5. *Conocephalus (Chloroxiphidion) upoluensis* (Karny, 1907)
6. **Gen. n. 1 & sp. n.**
7. ***Microsalomona* sp. n.**
8. ***Nicsara* sp. n. 1**
9. ***Nicsara* sp. n. 2**
10. *Palaeoagraecia chyzeri* (Bolivar, 1905)
11. *Pseudorhynchus cornutus* (Redtenbacher, 1891)
12. ***Pseudorhynchus crassiceps* De Haan, 1842**
13. ***Pseudorhynchus inermis* (Karny, 1907)**
14. ***Pseudorhynchus mimeticus* (Redtenbacher, 1891)**
15. ***Salomona bispinosa* Willemse, 1959**
16. *Salomona godeffroyi* (Pictet, 1888)
17. ***Salomona* sp. n. 1**
18. ***Spinisternum* sp. n. 4**
19. ***Spinisternum* sp. n. 5**
20. *Subria uniformis* Willemse, 1966
21. ***Trichophallus* sp.**
22. ***Trichophallus* sp. n. 1**

LISTROSCELIDINAE

23. *Neophisis (N.) brachyptera* Jin, 1992
24. *Paraphisis (P.) noonadanae* Kevan, 1992

MECOPODINAE

25. *Biroa curvicauda* Willemse, 1961
26. ***Eumecopoda cyrtoscelis* (Karsch, 1888)**
27. *Huona variegata* Kuthy, 1910
28. *Mossula intermedia* Willemse, 1940
29. *Phrictaetypus viridis* Brunner v. Wattenwyl, 1898
30. *Segestidea defoliaria defoliaria* Uvarov, 1924
31. *Segestidea defoliaria gracilis* (Willemse, 1957)
32. *Segestidea insulana* (Willemse, 1957)
33. *Segestidea uniformis* (Willemse, 1940)

PHANEROPTERINAE

34. ***Phaneroptera celebica* (De Haan, 1842)**
35. ***Caedicia* sp. 1**
36. ***Caedicia* sp. 2**
37. ***Caedicia* sp. 3**
38. ***Caedicia* sp. 4**

HEXACENTRINAE

39. ***Hexacentrus mundus* (Walker, 1869)**

PSEUDOPHYLLINAE

40. ***Tympanoptera* sp. 1**
41. ***Tympanoptera* sp. 2**

PHYLLOPHORINAE

42. *Phyllophora speciosa* Thunberg, 1815
43. ***Phyllophorella* sp. 1**
44. ***Sasima* sp. 1**
45. ***Sasima* sp. 2**