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Author: Agnarsson, Ingi

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Chapter 4

Spiders of the Nakanai Mountains, East New Britain Province, Papua New Guinea

Ingi Agnarsson

SUMMARY

I documented spider diversity at three sites (Lamas: 200 m, Vouvou: 900 m and Tompoi:1,600 m) in the Nakanai Mountains of East New Britain Province, Papua New Guinea. Sampling techniques included beating vegetation to dislodge spiders and nocturnal visual searches, and together they produced over 100 species. Lamas was the richest site with over 80 species, and Vouvou had over 50 species. Tompoi had the lowest diversity but was sampled less intensively than the other two sites so data from there are not comparable. Species overlap between sites was less than 20%. Given the current knowledge of New Britain's spider fauna and known levels of endemism, over 50% of the spider species are likely to be new to science, i.e. 50+ species. This high diversity and the large number of new species, some of which are likely to be endemic to the Nakanai Mountains, confirm the significance of World Heritage nomination for this area as an important step in the conservation of New Britain's rich but poorly-known fauna.

INTRODUCTION

Spiders represent a mega-diverse yet understudied taxon with over 41,000 species described (Platnick 2010) and an estimated diversity of over 100,000 species, making them by far the largest group of exclusively predatory animals. High diversity of predator species in any given environment implies a high diversity of prey. Thus as important invertebrate predators, spiders are commonly used as indicators of response to environmental change (e.g. Cardoso et al. 2010), and are exemplar organisms in many prominent biodiversity assessment projects (reviewed in Coddington et al. 2009). Spiders occur on all major landmasses except Antarctica and on virtually all oceanic islands. Many spiders are excellent dispersers, being able to 'balloon' for long distances on silk threads. The spiders present on the Bismarck Archipelago are likely descendents of such good dispersers because the islands were never connected to a major landmass.

Knowledge of New Britain's spider fauna is very limited. For example, probably no more than 5-10 species of the family Theridiidae were known from New Britain prior to the 2009 Nakanai Mountains RAP survey, including cosmopolitan species (Platnick 2010). Similarly only about 10-15 native species of the most diverse spider family in the world, the jumping spiders (Salticidae, with over 5000 described species) have previously been recorded from New Britain. Given the general expectation of relatively high endemicity due to the biogeographical history of the Bismarck islands, New Britain promises to be a sanctuary for tens or hundreds of spider species new to science.

This survey represents the first attempt to assess spider diversity in the Nakanai Mountains, a region currently on the World Heritage Tentative List. The results provide a first glimpse of species richness and endemicity in several groups of New Britain spiders but the generally poor knowledge of spiders in Australasia hinders accurate identification of many species. Although estimates of endemism are therefore necessarily crude and a more complete understanding of diversity and historical biogeographic patterns in New Britain spiders will require many new data from the entire region, the current survey represents a starting point for comparison with other sites in New Guinea and beyond.

METHODS

Spider sampling employed two main methods, beating and 'aerial' search. During the day spiders were sampled by beating vegetation with a heavy stick to dislodge animals sheltering in the foliage. Dislodged animals fell onto a 1 m^2 white sheet that was stretched between tent poles and held horizontally under the foliage being beaten. Spiders were sampled using this technique in all habitat types encountered close to camps for approximately 6 hrs daily. At night spiders were detected with the aid of a headlamp and by employing a corn-starch puffer that coated the near-invisible webs of cryptically colored species with a fine powder revealing their structure and complexity. Night samples were conducted for approximately 3-5 hrs nightly.

Identifications, mostly to the level of morphospecies, were based predominantly on published literature. In addition Salticids were identified by W. P. Maddison and Junxia Zhang, Tetragnathidae by R. Gillespie, and Theridiidae by I. Agnarsson, who also more coarsely sorted the remaining spider groups.

For some spider groups it has not been possible to confirm new species because published descriptions of spiders from the region occur in literature that is widely scattered, both in venue and time. As a result the overall number of new species is estimated roughly based on the previously known number of species in New Britain, and estimated levels of endemism.

STUDY SITES

Camp 1 (Lamas). April 4-8, 2009.
Spiders were surveyed in lowland rain forest at about 200 m elevation. Vegetation was diverse and composed of typical Melanesian lowland flora with *Pometia pinnata* (Sapindaceae) as one of the common lowland tree species.

Camp 2 (Vouvou), April 9-17, 2009.
Spiders were surveyed in mid-elevation rainforest at about 900 m. The forest was cooler and wetter than the lowland site with, patches of understory bamboo, and *Castanopsis acuminatissima* (Fagaceae) as the dominant tree.

Camp 3 (Tompoi) April 18-24, 2009.
Some spiders were sampled by D. Gassmann in lower- montane forests at an elevation of around 1,550-1,700 m. The

Table 4.1. List of spiders collected during the 2009 RAP survey of the Nakanai Mountains in East New Britain, Papua New Guinea.

Species	Lamas Camp (200 m)	Vouvou Camp (800-900 m)	Tompoi Camp (1,550-1,700 m)
Araneidae			
cf. *Arachnura* sp. 1	X		
Argiope sp. 1	X	X	
cf. *Araneus* sp. 1	X		
cf. *Araneus* sp. 2		X	
Cyclosa sp. 1	X		
Gasteracantha sp. 1	X		
Gasteracantha sp. 2		X	
cf. *Neoscona* sp. 1	X		
cf. *Neoscona* sp. 2		X	
cf. *Verrucosa* sp. 1	X		
Other indet Araneidae	X	X	X
Clubionidae			
Indet Clubionidae	X	X	X
Deinopidae			
Deinopis sp. 1	X		
Gnaphosidae			
Indet Gnaphosidae	X		
Hahnidae			
Indet Hahnidae	X	X	
Linyphiidae			
Indet Linyphiidae	X	X	
Lycosidae			
Indet Lycosidae	X	X	
Mysmenidae			
Indet Mysmenidae	X	X	
Mimetidae			
cf. *Mimetus* sp. 1	X		
cf. *Mimetus* sp. 2		X	
Oonopidae			
Indet Oonopidae	X	X	X
Oxyopidae			
Indet Oxyopidae	X	X	
Pholcidae			
Indet Pholcidae	X	X	
Psechridae			
Fenecia sp. 1	X	X	
Psechrus sp. 1	X		
Salticidae			
Athamas cf *whitmeei*	X		
Athamas sp. 1	X		
Athamas sp. 2	X		
Athamas sp. 3	X		

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Table 4.1. *continued*

Species	Lamas Camp (200 m)	Vouvou Camp (800-900 m)	Tompoi Camp (1,550-1,700 m)
cf *Bristowia* sp. 2	X		
Coccorchestes sp. 8		X	
Diolenius sp. 2		X	
Euryattus sp. 9	X		
Euophryine sp. 24	X		
Euophryine sp. 25	X		
Euophryine sp. 26	X		
Euophryine sp. 27		X	
Euophryine sp. 28			X
Euophryine sp. 29			X
cf *Gambaquezonia* sp. 1	X		
cf. *Myrmarachne*	X		
Palpelius sp1	X	X	X
Palpelius sp. 2		X	
Palpelius sp. 3		X	
Palpelius sp. 4	X		
cf. *Paraharmochirus*	X		
cf *Pristobaeus* cf sp. 2	X		
cf *Pristobaeus* sp. 1	X		
cf *Pristobaeus* sp. 2	X		
Simaetha	X		
cf *Xenocytaea* sp. 1			X
Zenodorus sp. 22	X		
Zenodorus sp. 25	X		
Zenodorus sp. 26			X
Other unidentified Salticidae	X	X	X
Tetragnathidae			
Leucauge cf. *papuana*		X	
Leucauge sp. 1	X		
Leucauge sp. 2	X	X	X
Leucauge sp. 3		X	
Mesida sp. 1		X	
Mesida wilsoni			X
Tetragnatha micrura	X		
Tetragnatha sp. 1	X	X	
Tetragnatha sp. 2		X	
Tylorida sp.	X		X
Tylorida striata		X	
Tylorida ventralis	X	X	X
Theridiidae			
Argyrodes sp.	X		
Ariamnes sp. 1	X		
Ariamnes sp. 2		X	

Species	Lamas Camp (200 m)	Vouvou Camp (800-900 m)	Tompoi Camp (1,550-1,700 m)
Faiditus sp. 1	X		
Faiditus sp. 2	X		
Faiditus sp. 3	X		
Rhomphaea sp. 1	X		
Rhomphaea sp. 2		X	
Dipoena sp. 1	X		
Dipoena sp. 2	X		
Dipoena sp. 3		X	
Dipoenura sp. 1	X		
Euryopis sp. 1	X		
Phoroncidia sp. 1	X		
Phoroncidia sp. 2		X	
Episinus sp. 1	X		
Achaearanea valoka	X	X	
Achaearanea sp. 1	X	X	
Achaearanea sp. 2	X		
Achaearanea sp. 3	X		
Achaearanea sp. 4	X		
Achaearanea sp. 5		X	
Wamba sp. 1	X		
Wamba sp. 2		X	
Chrysso sp. 1	X		
Chrysso sp. 2		X	
Theridion sp. 1	X		
Theridion sp. 2	X		
Theridion sp. 3	X		
Theridion sp. 4		X	
Theridion sp. 5		X	
Other indet Theridiidae	X	X	X
Theridiosomatidae			
Ogulnius sp. 1	X		
cf. *Theridiosoma* sp. 1	X		
Other indet Theridiosomatidae	X	X	
Thomisidae			
Indet Thomisidae	X	X	X
Uloboridae			
cf. *Lubinella* sp. 1	X		
other indet Uloboridae	X	X	
Other indet Araneae	X	X	X

highest site was the coolest and most humid, with bamboo dominating the understory. *Castanopsis acuminatissima* and *Nothofagus* sp. (Nothofagaceae) were the dominant trees.

RESULTS

More than 100 species of spiders belonging to at least 20 families were documented during this survey (Table 4.1). Lamas was the richest site with over 80 species, and Vouvou had more than 50 species. Tompoi was sampled much less intensively than the other two sites so data from there are not comparable. However general observations indicated that the spider fauna was both less diverse and less abundant at the highest elevation site.

Species turnover was high with an estimated less than 20% of species overlap between sites 1 and 2, and less than 5% overlap between sites 1 and 3, and 2 and 3. Although patterns of spider diversity are relatively poorly studied in the tropics these results support the general themes of high diversity in lowland rainforests and rapid turnover of species with change in elevation that are common to many other animal and plant groups.

At least 50% of the spider species collected are new to science. While such estimates are necessarily crude at this point, they are based on current knowledge of the local fauna, and expected levels of spider endemism on this large but relatively isolated island. For example over 30 species of the family Theridiidae were documented, but less than 10 species were previously known from the island (including several cosmopolitan species not recorded during the Nakanai survey). Very few theridiid species occur on more than one oceanic island, so up to 20 species of this family found in the Nakanai Mountains are likely to be new to science. Notably the survey documented several subfamilies and genera of theridiids that have not previously been documented from the New Guinea region. Similarly most Salticidae (jumping spiders) could only be identified to morphospecies (rather than to previously described species), and several salticid genera found in the Nakanai Mountains have not previously been recorded in New Guinea – in such cases the likelihood that they represent new species is extremely high. Suspected new species will have to be compared with type material and with descriptions in the scattered literature. However in groups where the author knows the world fauna and literature, new species have already been confirmed. One example is a new *Anelosimus* species from Pomio village.

SPECIES OF INTEREST

Of the three endemic New Britain theridiids currently known, two were re-collected during this survey. One is the elegant *Achaearanea veloka*, a species that was previously only known from a few female specimens. I documented the male of *A. veloka*, a dwarf compared to the female, and for the first time documented the female web. The web is unique among theridiids in its highly stereotypic form, and in details of its architecture.

Achaearanea

Achaearanea was the most diverse genus encountered during the survey with 6+ species, and I discovered an amazing architectural variety among webs produced by species within the genus. Some web architectures documented, such as 'sheet web' and 'star-shaped' webs are known from other *Achaearanea* species elsewhere, others are novel. Work will now focus on describing these species and their webs, and elucidating relationships among them to test two competing hypotheses: (1) that web architectural diversification occurred along with species diversification within New Britain, which will be supported if they are all closely related, or (2) that multiple lineages of *Achaearanea* have independently colonized New Britain, which will be supported if these species are not close relatives of one another.

Theridiidae

We documented several spider families in New Britain for the first time and many subfamilies and genera of salticids and theridiids that have not been recorded previously from the New Guinea region. These include the theridiids *Anelosimus*, *Chrysso*, *Faiditus*, *Phoroncidia*) (Table 4.1).

Salticidae

A number of exceptionally colorful and variable jumping spider species were collected, many of which are likely to be new to science (M. Maddison pers. comm.). Some of the jumping spiders take on bizarre forms, such as *Myrmarachne* that mimic ants and the unusual *Coccorchestes* that mimic beetles.

DISCUSSION

The spiders encountered at three elevations in the Nakanai Mountains indicate a fauna that is quite diverse and one that changes considerably in species composition with increasing altitude.

Overall over 50 species, and as many as 90, may be new to science. The composition of the spider fauna, based on two of the best studied families (Theridiidae and Tetragnathidae), is fairly typical of oceanic islands, which are colonized mostly by relatively small and easily dispersed taxa. Practically all New Britain species of these two families can be characterized as good dispersers, and such bias towards small easily dispersed groups has been referred to as 'taxonomic disharmony' (Gillespie et al. 2008). In some cases, species encountered are excellent dispersers and are found on a variety of islands (e.g. *Tylora*, *Tetragnatha*), in other cases the New Britain fauna represents descendents of good dispersers that have radiated within the island.

These results represent a starting point in efforts to compare spider diversity and range distributions between mainland New Guinea and New Britain, and to other parts of the world. However, prior work has shown that the effort necessary to gain accurate diversity estimates for spiders is around 10-100x that employed here (Coddington et al. 2009). In comparison to prior studies, getting about 100 species in a sample of approximately 1000 is certainly less diverse than typical diversity in tropical forests on continents, as one would expect. However, diversity is higher e.g. than found in a similar study on the island of Tobago in the Caribbean (Coddington et al. 2009), and is comparable to that found in the 2009 Muller Range RAP on New Guinea (pers. obs). Hence the combination of relatively high diversity and endemism demonstrate the importance and uniqueness of the remaining forest areas in New Britain, and emphasize the need for further and more intense sampling in the area to gain an accurate estimate of the true diversity and levels of endemism of spiders in the Nakanai Mountains.

CONSERVATION RECOMMENDATIONS

New Britain's age and isolation from mainland New Guinea and other landmasses has resulted in high endemism of many lineages. The Nakanai Mountains of East New Britain conserve some rare intact forest ecosystems that preserve some of these endemic forms. Yet many threats face these forests. The high diversity and expected endemism of spiders in the Nakanai Mountains, and the rapid turnover in species composition, support the conservation importance of these forests at various altitudes. Hence, these results argue that adequate conservation measures should be taken to protect the unique spiders and other animals and plants that occur within them. The nomination of the Nakanai mountains for World Heritage Area status is an important step in that direction and the current results support the value of confirming such listing.

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