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Chapter 15

Herpetofauna of the Strickland Basin and Muller Range, Papua New Guinea

Stephen Richards and Chris Dahl

SUMMARY

Surveys of herpetofauna diversity and endemism were conducted in the upper Strickland Basin and Muller Range in southern Papua New Guinea in 2008 and 2009. A total of 61 species of herpetofauna (49 frogs and 12 reptiles) were documented across a 2,300 m elevational gradient in the Muller Range of Western and Southern Highlands Provinces, Papua New Guinea in 2009. At least 25 species of frogs (51%) are undescribed and 14 of these were discovered for the first time during this survey. Herpetofaunal diversity decreased with increasing elevation, with 32 species at the lowland site (500 m), 23 species at the mid-elevation site (1,600-2,000 m), and only six species at the montane site (2,875 m). However the proportion of frog species new to science at each elevation was remarkably consistent, with approximately half of the species collected at each site being undescribed.

A short survey in the Wanakipa area of the Strickland River Headwaters in 2008 documented 21 species of herpetofauna including 17 species of frogs (three of which appear to be new to science) and four lizards. Species overlap between the surveys was low but the poorly-known treefrog *Litoria dorsivena* (DD; IUCN) was found during both surveys and these new records indicate that the species' IUCN Red-list status should be adjusted to Least Concern.

INTRODUCTION

Herpetofaunal exploration has a long history in the central mountain ranges of Papua New Guinea (e.g. Zweifel and Tyler 1982). Despite this attention many areas remain under-sampled, as evidenced by the suite of new frog species discovered in the Kaijende Highlands during the 2005 RAP survey in Enga Province (Richards 2007), and the high proportion of undescribed species documented during surveys of the Kikori River headwaters in Southern Highlands Province (Richards 2002). The Muller Range, located in the headwaters of the Strickland River, remains a major 'blank' on the map of herpetological documentation in New Guinea with no studies focusing on the area before a recent paper by Kraus and Allison (2009) described three new species of microhylid frogs from the Muller Range and reported an additional 13 species of widespread taxa from the same range.

The Muller Range has received more attention for its caves and karst than for its biodiversity. It is riddled with extensive cave systems including Atea Kananda, which has more than 30 km of cave passages, and this has drawn speleological expeditions to the area for many years. At least one of those expeditions made small collections of cave-dwelling and nearby fauna and Smith (1980) mentioned six species of frogs and reptiles seen during the 1978 speleological expedition to the Atea Kananda cave complex.

Despite the brief observations of Smith (1980) and the recent survey by a Bishop Museum/PNG National Museum (which covered only a limited area within a narrow altitudinal band; Kraus and Allison 2009), the biodiversity of the Muller Range remains extremely poorly documented. In this chapter we report on two herpetofauna surveys conducted in the Strickland

headwaters during 2008 and 2009. Our results demonstrate that the herpetofauna (particularly frogs) of the Muller Range and surrounding areas is much more diverse than has previously been documented. This exceptional biodiversity of the region provides strong support for the recognition of the Muller Range as a World Heritage Area.

METHODS

Sites (see Takeuchi, Chapter 9 this volume, for more detailed descriptions)

Wanakipa 2008

Tualapa Camp (05°17.003S, 142o29.849E; 1,115 m), 11-26 July 2008

Tualapa camp was situated in a garden clearing surrounded by medium crowned hill forest near Wanakipa Village. The forest appeared to be have been impacted by the 1997-1998 El Niño drought but riparian vegetation along the streams was otherwise relatively undisturbed. Several streams, ranging in size from ~1 m to ~ 10 m wide were accessed for sampling at elevations between ~850 and 1,200 m.

Umge Fly Camp (05°18.245S, 142°30.704E; 1,438 m), 18-19 July 2008

Umge Fly Camp was located on doline karst in lower montane forest. Only two days and two nights were spent at this site. Large, steep craters made traversing the forest at night potentially dangerous. Most sampling effort was restricted to the immediate vicinity of camp, and along a small (< 5 m wide) clear stream about 100 m from camp.

Muller Range 2009

Gugusu Camp (05°43.751S, 142°15.797E; 515 m), 4-10 Sept 2009

Like Tualapa, Gugusu Camp was located in medium crowned hill forest. Situated on a low ridge in the foothills of the range a trail network provided access to a long, relatively dry ridge, and to a series of streams with different flow regimes and substrates. These included slow-flowing, muddy 'seepages' and fast-flowing, clear rocky streams.

Sawetau Camp (05°39.397S, 142°18.277E; 1,587 m), 11-17 Sept 2009

Sawetau Camp was in lower montane forest with *Nothofagus* emergents. The site was extremely wet from the frequent rain and dense fog that shrouded the forest on most days but the only aquatic habitat found in the vicinity of the camp was a short, narrow stretch of stream that emerged from the hillside adjacent to camp and disappeared under ground again ~ 50 m downstream. An open, boggy area with stunted vegetation at 2,000 m was also visited once at night and twice during the day. Most survey activity was conducted between 1,500-2,000 m along an established forest trail.

Apalu Reke Camp (05°29.174S, 142°18.117E; 2,875 m), 18-25 Sept 2009

Apalu Reke camp was located in a vast patchwork of upper montane forest, and subalpine grassland and scrub. The forest is extremely wet and most trunk and branch surfaces were covered with thick, saturated moss. The open meadow areas are covered with a dense mat of small ferns (not grasses; see Takeuchi, chapter 9). Aquatic habitats included small, shallow ponds scattered throughout the 'subalpine grasslands', and a small, clear stream flowing through a patch of upper montane forest adjacent to the camp.

Field methods

All sampling was done with the aid of 1-2 local assistants. At each site we conducted intensive searches for frogs and reptiles along trails established for this purpose. During the day we searched for heliothermic (basking) reptiles along trails through forest, clearings, and on stream banks. Small lizards were collected by hand or were stunned with a large rubber band. Large lizards and snakes were collected by hand. Non-basking reptiles were sampled by searching in deeply shaded forest, during rain, or at dusk. We searched for nocturnal reptiles, including geckos, by walking along forest trails at night with a headlamp.

We searched for frogs at night by conducting visual-encounter and aural surveys along streams, and in and around small ponds. Because a large proportion of New Guinea's frogs have life cycles that are independent of free-standing water, we also conducted extensive visual and aural searches along trails in forest away from water.

Frog calls are an important diagnostic character that assist greatly with species identification. Whenever possible we recorded the advertisement calls of frogs with a Marantz PMD-661 Solid-state Recorder and Sennheiser ME66 microphone. Most species were photographed alive before preparation as voucher specimens. Specimens were euthanized by submersion in chlorotone (for amphibians and small reptiles), or with lethal injection of chlorotone for larger reptiles. Specimens were fixed in 10% formalin solution, and then stored in 70% ethanol. Samples of liver tissue for DNA analyses were extracted from representative specimens of each species and stored in 95% ethanol. Voucher specimens will be deposited in the University of Papua New Guinea's Natural Sciences Resource Centre, Port Moresby, and the South Australian Museum, Australia.

RESULTS AND DISCUSSION

Wanakipa 2008

Twenty one species of herpetofauna including 17 species of frogs (three of which appear to be new to science) and four lizards were documented (Table 15.2). This is a relatively high diversity given that herpetofauna were sampled at only one major camp (Tualapa) and briefly at a nearby fly camp (Umge), and that the weather was extremely dry for most

of the survey. This RAP survey also documented a number of significant species including the poorly-known *Litoria dorsivena* (DD; IUCN) and a large and spectacular species of treefrog in the genus *Nyctimystes* that is new to science. Clear, rocky streams around Tualapa Camp are a critical habitat for new and poorly-known treefrog species.

Muller Range 2009

A total of 61 species of herpetofauna (49 frogs and 12 reptiles) were documented at the three sites. At least 25 species of frogs (51%) are undescribed and 14 of these were discovered for the first time during this survey. The frog fauna was dominated by species in the families Microhylidae (33 species; 67%) and Hylidae (13 species; 26.5%). The overwhelming dominance of the family Microhylidae is not surprising given the scarcity of surface water in the Muller Range, a feature resulting from the limestone geology of the area. Microhylids exhibit direct embryonic development within the egg capsule, and reproduce independently of free-standing (or flowing) water bodies. This has allowed them to dominate the frog fauna in areas of New Guinea with perpetually wet forests and limited surface water.

Herpetofaunal diversity decreased with increasing altitude, with 32 species at the lowland site (500 m), 23 species at the mid-elevation site (1,600-2,000 m), and only six species at the montane site (2,875 m). However the proportion of new frog species at each altitude was remarkably consistent, with approximately half of the species collected at each site being undescribed.

Species overlap between the Wanakipa and Muller Range surveys was low. Only three species, *Litoria arfakiana*, *L. dorsivena* and *Austrochaperina derongo* were found on both surveys despite the relatively close proximity of the two surveys in the upper Strickland basin. Two of these species, *L. arfakiana* and *A. derongo*, are known to have broad distributions in the central mountains of New Guinea but *L. dorsivena* is a poorly-known species which, prior to these surveys, was known with certainty only from the Telefomin area. The taxonomic status of several microhylid frogs encountered during these surveys remains unclear, and further studies may reveal that one or two additional species are shared between the Tualapa and Muller Range faunas.

Significant species

Wanakipa

Frogs

Litoria dorsivena (DD; IUCN)

This small, brown treefrog was previously known only from the Telefomin area (previous records from the Vogelkop Peninsula of West Papua by Menzies and Zweifel (1976) were discounted by Richards and Parker (2004)). We found this species at Tualapa Camp where males called from high in trees adjacent to a large, clear rocky stream (~1,100 m) and a single animal was found next to the trail at Sawetau Camp (Muller Range), not far from the only short stretch of stream in the vicinity of the camp.

Discovery of two additional populations of *L. dorsivena* in the upper Strickland catchment, where large areas of suitable habitat occur, suggests that its red-list status may warrant downgrading to Least Concern.

Nyctimystes sp. nov.

A single male specimen of a very large green treefrog of the hylid genus *Nyctimystes* was collected from a tree along the large rocky stream adjacent to Tualapa Camp. It is morphologically similar to the sympatric *N. humeralis* which was common along this stream, but differs from that species in the structure of its eyelid palpebrum, the structure of its nuptial pads, and in lacking a humeral spine.

Reptiles

Cyrtodactylus sp. nov.

A single specimen of the speciose gekkonid genus *Cyrtodactylus* (bent-toed geckos) was found in dense rainforest adjacent to Tualapa Camp. It represents an undescribed species and its description is currently being prepared for publication.

Muller Range

Frogs

Hylidae (Treefrogs)

Litoria dorsivena (see above)

Litoria majikthise (DD; IUCN)

This species was described from the Ok Tedi headwaters near the West Papua border. It is listed as Data Deficient because of lack of information about its distribution and ecological requirements (Richards and Bickford 2004). This species was common at Gugusu Camp where it occurred at similar elevations, and in similar habitats, to the type locality (e.g. Johnston and Richards 1994). Discovery of the Gugusu population represents a substantial easterly extension of the known distribution of *L. majikthise*. Given the extensive areas of suitable habitat for this species between the type locality and Gugusu it is probably appropriate that its IUCN red-list status be downgraded to Least Concern.

Litoria spp nov.

Five species of the hylid genus *Litoria* are represented by undescribed taxa (Table 15.1). Two of these were previously known from other sites but three appear to represent completely new discoveries. Perhaps the most significant of these is:

Litoria sp. nov. 1

This attractive species is known only from a single stream at Apalu Reke (2,875 m) where frogs perched on low vegetation next to small waterfalls in a patch of dense mossy forest. No individuals were encountered in or around the small shallow pools that were a conspicuous feature of the extensive 'montane meadow' habitats at this site. This species is possibly a restricted-range, high-montane species that is

endemic to the Muller Range. It is similar to, but distinct from, another high-montane *Litoria* found at similar elevations in the Kaijende Highlands of Enga Province (as *L. becki*; Richards 2007).

Microhylidae

Many of the microhylid frogs documented during the Muller Range survey are undescribed (Table 15.1); the status of several others is unclear and further studies are required before they are confirmed as species new to science. These species belong to taxonomically difficult complexes that will require detailed genetic and acoustic studies to determine species boundaries and relationships with other species. Only 3-4 of the species confirmed to be new to science are currently known from other sites and several species are so distinct that their descriptions will proceed rapidly. These include:

Choerophryne sp. nov. 1
A tiny (~12 mm) long-snouted frog found only at Gugusu Camp. It has a call distinct from all other members of this genus and clearly represents a species new to science.

Cophixalus sp. nov. 2
Another tiny microhylid frog, with a sharply angular snout that called from perches in low bushes in dense, mossy forest at Sawetau Camp after heavy rain.

Hylophorbus sp. nov. 1
One of the smallest species in this genus, this *Hylophorbus* has a call that is distinct from all other members of the genus. It was found under litter and in holes at the base of tree buttresses at Gugusu Camp.

Oreophryne sp. nov. 2
This small, strikingly-spotted frog called from high in moss-laden trees at Sawetau Camp. This undescribed species was exceptionally difficult to collect because males generally called from perches more than 5 m high.

Choerophryne burtoni (DD; IUCN)
This recently-described frog was previously known only from the type locality near Moran in Southern Highlands Province (Richards et al. 2007) and was subsequently located at one additional site in Southern Highlands Province (Kraus 2010). The record from Sawetau confirms a third population of this species, which may warrant having its IUCN status downgraded to Least Concern.

Hylophorbus richardsi (DD; IUCN)
This is a small ground-dwelling frog that was described from Mt Sisa in Southern Highlands Province (Gunther 2001). Documentation of this species by Kraus (2010) and its subsequent collection at Sawetau suggests that this species may have a broad distribution in the mountains of central Papua New Guinea and its IUCN Red-list status may warrant downgrading to Least Concern.

CONSERVATION RECOMMENDATIONS

Although reptile diversity was relatively low (probably due to the cold, wet environments sampled in the Muller Range) the results of this survey continue the trend for poorly-documented mountainous regions of mainland New Guinea to reveal an exceptional diversity of new and poorly-known frog species. Perhaps significantly, there was little overlap between the Wanakipa and Muller Range faunas despite the relatively close proximity of both sites in the headwaters of the Strickland River basin (Tables 15.1, 15.2). Kraus and Allison (2009) suggested that the Muller Range may have an endemic frog fauna at high elevations and our results provide support for this. Although a number of the species documented during this survey are known from other sites in the perpetually wet forests of central Papua New Guinea many of the species that are new to science are currently not known from any other mountain range.

The most pressing conservation issue at Wanakipa is restricting forest degradation, by gardening and/or fires, particularly in the riparian zones around Tualapa Camp. Protection of the forests around Tualapa is important because intensive gardening has severely degraded the forests closer to Wanakipa Village. The streams around Tualapa support a high diversity of torrent-dwelling frogs, at least two of which are not known with certainty from any other location. The Hewa community are currently involved in the Forest Stewards Program (Chapter 8) and as a result they are already involved with ongoing forest conservation initiatives. Incorporating (or emphasizing) the importance of protecting freshwater environments both for habitat-specialist frogs in the area and for their own sustainable use, into the Forest Stewards Program, will benefit these poorly-known species and the local communities alike.

In contrast to the Wanakipa area, forest degradation in the Muller Range was not detected. With the exception of small trails linking distant villages, and reports of annual harvesting of *Pandanus* fruit at Apalu Reke, signs of human activity were absent. In the absence of known mineral deposits, and given the low human population density in this area of the Range, protection of the Muller Range's biodiversity is currently assured by nature of its isolation. However there is no room for complacency, and timber harvesting, particularly at lower elevations is a potential threat. The conservation of this vast, sparsely-inhabited wilderness area will be greatly enhanced by its recognition as a World Heritage Area. Our results support the contention that the Muller Range is an environment of universal value, and we believe that its listing as a World Heritage Area will greatly enhance the long-term survival of a diverse and spectacular herpetofaunal assemblage.

Table 15.1. List of herpetofauna species documented at three sites during the 2009 Muller Range RAP survey.

Species*	Gugusu (515 m)	Sawetau (1,600-2,000 m)	Apalu Reke (2,875 m)	IUCN Status**
Frogs				
Hylidae				
Litoria angiana		X		LC
Litoria arfakiana		X		LC
Litoria auae	X			LC
Litoria dorsivena		X		DD
Litoria eucnemis	X			LC
Litoria iris		X		LC
Litoria majikthise	X			DD
Litoria micromembrana		X		LC
Litoria sp. nov. 1 cf. *becki*			X	N/A
Litoria sp. nov. 2 cf. *genimaculata*	X			N/A
Litoria sp. nov. 3 cf. *graminea*	X			N/A
Litoria sp. nov. 4 cf. *longicrus*	X			N/A
Litoria sp. nov. 5 cf. *nigropunctata*	X			N/A
Limnodynastidae				
Lechriodus aganoposis		X		LC
Microhylidae				
Albericus sp. 1	X			N/A
Albericus sp. nov. 2 (Camp 2, large)		X		N/A
Albericus sp. nov. 3 (Camp 2, small)		X		N/A
Albericus sp. nov. 4			X	N/A
Asterophrys leucopus?		X		DD
Austrochaperina derongo	X			LC
Austrochaperina sp. nov. 1	X			N/A
Austrochaperina sp. nov. 2 (Large)		X		N/A
Austrochaperina sp. nov. 3 (Camp 2 Fast)		X		N/A
Callulops sp. 1	X			N/A
Callulops sp. 2		X		N/A
Callulops sp. 3			X	N/A
Choerophryne burtoni		X		DD
Choerophryne sp. nov. 1	X			N/A
Cophixalus sp. 1	X			N/A
Cophixalus sp. nov. 2 (tiny, green)		X		N/A
Cophixalus sp. 3 (2000m)		X		N/A
Copiula sp. 1 (large)	X			N/A
Copiula sp. nov. 2 (small)		X		N/A
Hylophorbus richardsi		X		DD
Hylophorbus sp. nov. 1 (tiny)	X			N/A
Hylophorbus sp. nov. 2 (slow)	X			N/A
Hylophorbus sp.3 (large, fast call)	X			N/A
Hylophorbus sp. 4? (Camp 2)		X		N/A

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Table 15.1. *continued*

Species*	Gugusu (515 m)	Sawetau (1,600-2,000 m)	Apalu Reke (2,875 m)	IUCN Status**
Oreophryne sp. nov. 1 egg-brooder	X			N/A
Oreophryne sp. nov. 2 (spotted)		X		N/A
Oreophryne sp. nov. 3 (lowland peeper)	X			N/A
Oreophryne sp. nov. 4 (1,600 m rattler)		X		N/A
Oreophryne sp. nov. 5 (montane)			X	N/A
Sphenophryne cornuta	X			LC
Xenorhina sp. nov. 1 (small)	X			N/A
Xenorhina sp. nov. 2 (slow)	X			N/A
Xenorhina sp. nov. 3	X			N/A
Ranidae				
Rana cf. *grisea*	X			N/A
Rana garritor	X			LC
Total = 49 Species	**25**	**20**	**4**	
Reptiles - Lizards				
Agamidae				
Hypsilurus dilophus	X			N/A
Hypsilurus modestus	X			N/A
Gekkonidae				
Cyrtodactylus serratus	X			N/A
Cyrtodactylus sp. 1 (*capreoloides*?)	X			N/A
Scincidae				
Emoia sp.				N/A
Lobulia elegans			X	N/A
Papuascincus sp.		X	X	N/A
Sphenomorphus simus	X			N/A
Sphenomorphus sp. 1	X			N/A
Sphenomorphus sp. 2	X			N/A
Sphenomorphus sp. 3		X		N/A
Reptiles - Snakes				
Tropidonophis sp.		X		N/A
Total = 12 Species	**7**	**3**	**2**	
Grand Total = 61 Species	**32**	**23**	**6**	

*sp. = final identification to be determined – may be undescribed; sp. nov. = species new to science; cf. = resembles the indicated taxon.

** From IUCN Redlist, accessed 16 December 2010. NA=Not Assessed, LC=Least Concern, DD=Data Deficient.

Table 15.2. Herpetofauna documented at Tualapa and Umge, Strickland headwaters, Papua New Guinea during 2008 Wanakipa RAP survey.

Species	Tualapa (1,115 m)	Umge Fly Camp (1,430 m)	IUCN Status*
Frogs			
Hylidae			
Litoria arfakiana	X		LC
Litoria cf *arfakiana*	X		N/A
Litoria infrafrenata	X		LC
Litoria dorsivena	X		DD
Litoria modica		X	LC
Litoria multiplica		X	LC
Litoria sp. cf *micromembrana*		X	N/A
Nyctimystes humeralis	X		LC
Nyctimystes pulcher	X	X	LC
Nyctimystes sp. nov.	X		N/A
Microhylidae			
Albericus sp.	X		N/A
Austrochaperina derongo		X	LC
Hylophorbus sp.	X	X	N/A
Oreophryne sp. nov.	X		N/A
Xenorhina sp.	X		N/A
Ranidae			
Rana arfaki	X		LC
Rana cf *grisea*	X		N/A
Total = 17 Species	**13**	**6**	
Reptiles - Lizards			
Gekkonidae			
Cyrtodactylus sp. nov.	X		N/A
Scincidae			
Emoia caeruleocauda	X		
Emoia sp. (*obscura*?)	X	X	N/A
Lygisaurus sp.	X	X	N/A
Total = 4 Species	**4**	**2**	
Grand Total = 21 Species	**17**	**8**	

*N/A = Not Assessed, LC = Least Concern, DD = Data Deficient

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