

**Chapter 1.4. Herpetofauna of the Wau Creek proposed Wildlife Management Area, Gulf Province, Papua New Guinea**

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*A juvenile Pig-nosed Turtle (Carettochelys insculpta)*

## Summary

We report the results of a survey of frogs and reptiles in the Wau Creek proposed Wildlife Management Area in Gulf Province, Papua New Guinea (PNG). Fifty-one species were encountered including 23 frogs and 28 reptiles. Five species of frogs are undescribed; and four of these are known only from a small area in south-central PNG. One species of treefrog, *Litoria richardsi*, is classified as Data Deficient by the IUCN owing to its poorly-known distribution and habitat requirements, and two species of large freshwater turtles, The Pig-nosed Turtle (*Carettochelys insculpta*), and the New Guinea Giant Softshell Turtle (*Pelochelys bibroni*) are classified as Vulnerable by the IUCN owing to unsustainable harvesting over at least some of their range.

The forests at Wau Creek support a high diversity of frog and reptile species, and the freshwater streams there provide significant habitat for nesting Pig-nosed Turtles. Ongoing protection of these important nesting sites will help to ensure the long-term future of this iconic species in the Kikori basin.

## Introduction

The herpetofauna of New Guinea is exceptionally diverse, with the total number of frog and reptile species known from the region currently exceeding 600 (Papuan Herpetofauna 2013). This number is expected to increase substantially as recent taxonomic revisions of the fauna and exploration of remote regions have revealed numerous new species, particularly in the frog families Hylidae (now Pelodyadidae) and Microhylidae (e.g. Kraus and Allison 2009; Richards et al. 2009; Günther et al. 2012; Günther and Richards 2011, 2016), the gecko genus *Cyrtodactylus* (e.g. Rösler et al. 2007; Oliver et al. 2008; Oliver et al. 2012, 2016) and the snake genus *Stegonotus* (Ruane et al. 2017).

Existing knowledge about the frogs and reptiles of the Kikori basin is derived largely from a series of surveys sponsored by the World Wildlife Fund (WWF) between 1995 and 2003. These covered habitats including mangroves, lowland, hill, and montane forest, and resulted in a number of unpublished flora and fauna inventories (e.g. Hartshorn 1995; Richards 2000, 2002b,c; Richards and Allison 2003) and a guide to the frogs of the Kikori basin (Richards 2002a). One of the surveyed sites, Dark End Lumber (DEL), is located immediately adjacent to the Wau Creek survey area (Richards 2000). Descriptions of numerous newly-discovered frog and several reptile species also resulted from these surveys (e.g. Richards 2007; Richards et al. 2007; Rösler et al. 2007; Richards and Oliver 2006, 2010). In addition, an assessment of the diversity and conservation status of freshwater turtles in the Kikori River basin was produced by Georges et al. (2008a).

Despite these efforts, survey coverage within the basin remains patchy and herpetofaunal communities are incompletely documented. Here we report the results of a series of herpetofauna surveys conducted at Wau Creek in Gulf Province, Papua New Guinea between 2015 and 2017.

## Methods

### Field methods

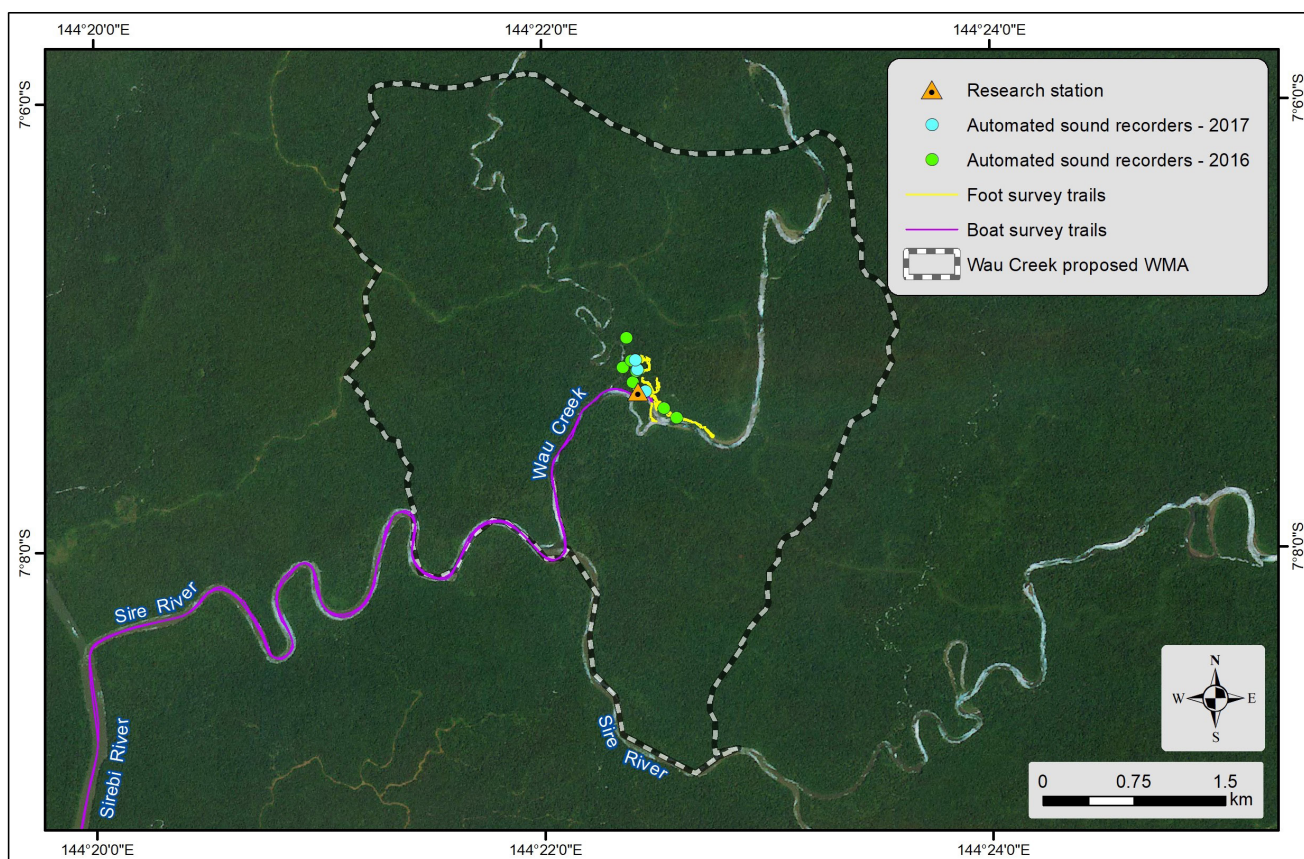
Sampling was undertaken during three survey periods; by SC, DB and AG from 15–26 November 2015 and 13–25 November 2016, and by SR from 22–26 April 2017, always with support and guidance from 2–3 local assistants. Field methodology closely followed the protocols proposed by Catenazzi et al. (2016) for rapid herpetofauna assessments in tropical environments. We conducted intensive searches for frogs and reptiles along a network of existing trails. During the day we searched for heliothermic (basking) reptiles along trails through forest, in 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 freestanding water, we also conducted extensive visual and aural searches along trails in forest away from water. Frog calls are an important diagnostic character that assists greatly

with species identification so whenever possible we recorded the advertisement calls of frogs with a Marantz PMD-661 Solid-state Recorder with a Sennheiser ME66 microphone [SR] or Marantz PMD660 Professional Solid State Recorder with a RØDE NTG-2 directional condenser microphone at a distance of approximately 30 cm [SC].

Representatives of most species were photographed alive and a small number of voucher specimens were retained for more detailed examination and identification. Voucher 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 and stored in 95% ethanol. Voucher specimens will be deposited in the Papua New Guinea National Museum and Art Gallery, Port Moresby, South Australian Museum, Australia and Australian Museum, Australia; tissue samples will be lodged with the Wildlife Tissue Collection at the University of Canberra and at the University of Newcastle.

The conservation status of each species was taken from the IUCN Red List (IUCN 2017): LC = Least Concern; DD = Data Deficient; NE = Not Evaluated. Species are referred to as 'undescribed' if they are unnamed but were previously known from other sites.

The general vegetation structure of the area is described in Chapter 1.1, and only those habitat features relevant to herpetofauna are mentioned further here. A map illustrating the trails used during this survey is presented in Figure 1.



**Figure 1. Herpetofauna survey coverage at Wau Creek**

### **Automated sound recorders**

In November 2016, SC, DB and AG deployed seven SongMeter SM2 audio recorders in forest and along watercourses within 500 m of the Wau Creek research station (Figure 1). Each unit recorded all audible sounds, including frog calls continuously for 6–7 days. In April 2017 SR deployed three automated sound recorders (SongMeter SM3) in forest environments within 300 m of the research station (Figure 1). These recorded continuously for four days of the 5-day

survey period. All SongMeter recordings were screened for the calls of notable species, including frogs not detected during active survey periods, using Adobe Audition software. Images of all reptiles captured by the camera trap arrays established during both the 2016 reconnaissance and the 2017 survey (see Chapter 1.5) were also examined and species identified from these images are incorporated into the lists presented here.

## Results and discussion

Fifty-one species were encountered during the three surveys including 23 frogs and 28 reptiles (Appendices 1 & 2). Five species of frogs appear to be undescribed and four of these are known only from a small area in south-central PNG. One species of treefrog, *Litoria richardsi*, is classified as Data Deficient by the IUCN owing to its poorly-known distribution and habitat requirements, and two species of large freshwater turtles, the Pig-nosed Turtle (*Carettochelys insculpta*), and the New Guinea Giant Softshell Turtle (*Pelochelys bibroni*) are classified as Vulnerable by the IUCN owing to unsustainable harvesting over at least some of their range. Examples of frog and reptile species encountered and their habitats are illustrated in Plates 1 and 2.

The forests at Wau Creek support a high diversity of frog and reptile species, and the freshwater streams there provide significant habitat for nesting Pig-nosed Turtles. Ongoing protection of these important nesting sites will help to ensure the long-term future of this iconic species in the Kikori basin.

## Undescribed and other significant species

### Undescribed species

Five species collected during this survey are undescribed. These include three microhylid frogs in the genera *Copiula*, *Oreophryne* and *Xenorhina*, and two treefrogs in the genus *Litoria*. Brief accounts for each of these species are presented here. The status of one other species, the ranid frog here referred to *Papurana arfaki*, is uncertain. Some populations of this species in southern PNG are genetically distinct but we conservatively retain *arfaki* for the Wau Creek population pending further studies.

### ***Copiula* sp. 1. (Plate 1C)**

A moderately small (males 26–31 mm), short-legged microhylid frog with a plump body and an angular snout. At Wau Creek this species called from within litter on the forest floor. The call is a series of 2–4 harsh, rapidly produced ‘yapping’ notes lasting about 0.2–0.3 s. This species was previously known from several other sites in Gulf Province, including Kopi, and is listed as *Copiula* sp. nov. 2 in Richards (2002a).

### ***Oreophryne* sp. 1.**

A small (males <25 mm) microhylid frog with large finger discs that calls with a series of brief chirping notes from high in the canopy, and sometimes from lower foliage, in lowland forests. It is known from several localities in the south-central lowlands of Papua New Guinea but has yet to be formally described.

### ***Xenorhina* sp. 1. (see Plate 1C in Chapter 2.4)**

A moderately large (~45 mm), semi-fossorial (burrowing) frog with extremely short legs, a narrow snout and small eyes. This species lives under moist leaf litter on the forest floor where males call from small depressions in the soil under dense litter, or from within burrows in the humus layer itself. Occasionally a male will call from a semi-exposed position in the upper surfaces of the litter layer. The call consists of a long series of soft, hooting notes that increases in both pitch and intensity during the call sequence. *Xenorhina* sp. 1 is undescribed but it is known from several localities in the southern lowlands and foothills of Papua New Guinea spanning both the Kikori and Purari River catchments in Gulf Province. It is listed as *Xenorhina* sp. by Richards (2002a).

### ***Litoria* sp. 1. cf. *genimaculata* (Plate 1D)**

A medium sized (males to ~ 40 mm) slender treefrog with large eyes, limited webbing between the fingers and a small spine on each heel. This species is closely associated with slow-flowing but clear streams where males call from low riparian vegetation with a series of quiet ticking notes occasionally followed by a short trill. It belongs to a taxonomically difficult group of frogs related to *Litoria genimaculata* and is listed as *Litoria* sp. nov. 5 in Richards (2002a).

### ***Litoria* sp. 2. cf. *graminea* (Plate 1E)**

A large (to ~80 mm) green treefrog with extensive finger webbing that lives high in the forest canopy where males call with a guttural grunting sound. This species was previously confused with *Litoria graminea*, a species now known to occur only in the north-east of Papua New Guinea, and *Litoria sauroni*, which is known to occur nearby at Dark End Lumber (Richards and Oliver 2006). It is currently being described by Kraus (in press).

### **Species listed by IUCN or protected under PNG legislation**

The conservation status of most frog and reptile species known from PNG has been evaluated by the IUCN for inclusion in the IUCN Red List. No species listed by the IUCN as Critically Endangered or Endangered were encountered during this project but two species listed as Vulnerable and one that is listed as Data Deficient, were documented.

### ***Litoria richardsi* (Data Deficient; Plate 1F)**

A moderately small (30 mm), strikingly coloured treefrog with extensive thick, black webbing between the fingers and bold black and yellow markings ventrally. This species was previously known from a small number of sites between Tabubil in Western Province and the Gulf Province lowlands, with a single specimen also known from the Mamberamo basin of Papua Province, Indonesian New Guinea. In the original description of the species Dennis and Cunningham (2006) noted that they expected it to occur more widely in suitable habitat in intervening areas between the Star Mountains and the Mamberamo basin. The discovery of this species at Wau Creek confirms that *L. richardsi* has a broad distribution in central New Guinea. It is possible that this species breeds in tree-holes (Dennis and Cunningham 2006) and remains high in the canopy for most of its life.

One other frog species that was assessed as Data Deficient by the IUCN almost certainly occurs at Wau Creek. *Litoria sauroni* is a large, green treefrog related to *L. graminea* that has a striking colour pattern on the eye and extensive pigmentation on the nictitating membrane (third eyelid). This species was recorded adjacent to Wau Creek at the WWF Dark End Lumber survey site in 1999 (Richards and Oliver 2006) and was assessed as Data Deficient 'since it has only recently been described, and there is still very little known about its extent of occurrence, area of occupancy, status and ecological requirements' (Richards 2008).

Two freshwater turtles, the Pig-nosed Turtle and the New Guinea Giant Softshell Turtle are listed by the IUCN as Vulnerable. These species are discussed below.

*Carettochelys insculpta* (Pig-nosed Turtle; Vulnerable, see chapter cover) is a large (to > 55 cm carapace length and 22 kg) freshwater turtle known only from the southern lowlands of New Guinea and several drainages in the Northern Territory of Australia (Georges and Rose 1993). In New Guinea it occupies most of the major drainages south of the central cordillera (Georges and Rose 1993; Rhodin and Genorupta 2000; Georges et al. 2008a,b). The Pig-nosed Turtle inhabits a wide variety of water bodies including rivers, swamps and lagoons. Adults are omnivorous, and in the Gulf Province lowlands feed primarily on unripe fruits, leaves, and stems of mangroves and *Sonneratia* spp. (Georges et al. 2008b), on other fruits and on various molluscs and crustaceans.

The Pig-nosed Turtle nests in sandy banks along major river channels, and it is also known to nest adjacent to water in the mouths of major rivers, on islands in river deltas, and even on coastal beaches (summary in Georges et al. 1980b). In New Guinea nesting occurs at night between September and February.

Adults and eggs of this species are widely consumed in the Kikori basin (Pernetta and Burgin 1980; Eisemberg et al. 2011, 2015). Other sources of mortality include predation by varanid lizards and inundation of nests during river flooding. The harvesting of *Carettochelys* for local consumption in at least some of its range in PNG is unsustainable, and a significant threat to the survival of these populations (Eisemberg et al. 2011, 2015). The species is listed as Vulnerable by the IUCN in part because it is 'heavily exploited and locally consumed in PNG'. A proposal to elevate its status to Endangered is currently under consideration by the IUCN.

*Pelochelys bibroni* (New Guinea Giant Softshell Turtle; Vulnerable, Plate 2A) is a very large (carapace to > 100 cm) freshwater turtle endemic to the southern river drainages of New Guinea (Rhodin et al. 1993; Rhodin and Genorupa 2000). It occurs primarily in rivers and streams, although some coastal records do exist. Information about this species' distribution and natural history were presented by Rhodin et al. (1993). Few data have become available since, and Georges et al. (2008b) reported that this species is rarely encountered in the Kikori basin. Unlike the Pig-nosed Turtle *P. bibroni* feeds primarily on crustaceans, molluscs and fish and some aquatic plants may also be eaten. Nesting occurs between June and August or September along 'mudflats of the major rivers' when between 20 and 45 eggs are normally laid per clutch (Rhodin et al. 1993). Owing to its large size humans and crocodiles are the only predators of adults.

Rhodin et al. (1993) concluded that this species appears to be naturally rare and is heavily exploited when encountered, and Georges et al. (2008b) reported that in the Kikori basin the species is rare and probably critically endangered locally. It is listed as Vulnerable by the IUCN because of 'expected continuing decline in the future' (Asian turtle trade working group 2000, updated 2016). None of the species documented during this survey are protected by PNG law.

## General comments

The total of 23 species of frogs documented at Wau Creek between 2015 and 2017 is similar to the diversity reported from the adjacent Dark End Lumber (DEL) site in 1999 (20 species; adjusted from 21 species in the original report based on new taxonomic knowledge) and there is a near-complete overlap of component species (Richards 2000). However the number of reptile species encountered at Wau Creek (28) is substantially higher than the 16 species found at DEL, and this probably reflects the generally slower rate of detection of reptiles (because frog calls are more easily detected) and the brief survey period at DEL (9 days vs a total of 30 days at Wau Creek).

The only other site with a comparable search effort for herpetofauna in the lowland forests of PNG is the Lakekamu basin (Allison et al. 1998). A six-week survey at Lakekamu in 1996 recorded 74 species including 30 frogs and 44 reptiles. The major differences between that site and Wau Creek are a much higher number of treefrog species (10 vs 5) and skinks (21 vs 9) at Lakekamu. Of particular note was a much higher diversity of skinks in the genera *Emoia* (7 vs 3 species) and *Sphenomorphus* (8 vs 3 species) at Lakekamu.

There are two possible explanations for this discrepancy. Firstly, the Lakekamu site was topographically more varied so more habitat types were encountered there than at Wau Creek. Habitats at Lakekamu that were not found at Wau Creek included large, permanent natural forest pools isolated from flowing streams containing fish; and torrential streams in the upper basin that supported a suite of specialist torrent-dwelling frogs. It is likely that, given the greater range of habitats available at Lakekamu, the herpetofauna diversity there really is somewhat greater than at Wau Creek.

However secondly, the survey effort at Wau Creek was focused heavily towards detecting frogs. Many skinks in the genus *Sphenomorphus* in particular are crepuscular, occur at low density, and can be difficult to detect. These reptiles

require intensive search effort focused on cryptic litter-dwelling lizards. The survey effort at Lakekamu was substantially more focused on this component of the fauna than the survey at Wau Creek and it is likely that the number of lizard species occurring at Wau Creek is substantially higher than we documented.

### **Biodiversity and conservation values**

The forests at Wau Creek support a high diversity of frog and reptile species, and the freshwater streams there provide significant habitat for nesting Pig-nosed Turtles. The invasive Cane Toad (*Rhinella marina*), which is abundant at Kopi, was not detected at Wau Creek. Despite previous logging activity within and around the Wau Creek proposed WMA the area continues to support both a rich herpetofauna and a number of iconic species, including the Pig-nosed Turtle and Giant New Guinea Softshell Turtle, both listed by the IUCN as Vulnerable owing to unsustainable harvesting. Also detected on camera traps at Wau Creek was a Crocodile Monitor (*Varanus savadorii*; Plate 2B), a poorly known species that is one of the longest lizards in the world.

One species of canopy-dwelling frog found at Wau Creek, *Litoria richardsi*, is listed as Data Deficient and another, *L. sauroni*, almost certainly occurs there. Both have small known distributions focused on south-central PNG so the forest at Wau Creek, and particularly the patches of primary forest around the research station, represents significant habitat for these species. The small, shaded clear-flowing watercourses and their adjacent riparian vegetation at Wau Creek also provide important habitat for an undescribed treefrog related to *Litoria genimaculata*, and the moist litter on the forest floor shelters two species of undescribed microhylid frogs (*Copiula* sp. 1 and *Xenorhina* sp. 1) that have small known distributions in the lowlands of southern PNG. Like other terrestrial Australopapuan microhylid frogs (Anstis et al. 2011) these species are predicted to lay direct-developing eggs in or under moist litter on the forest floor. Because reduction of the forest canopy through damage to or removal of trees in the primary forest increases insolation to, and reduces humidity and moisture content of, the litter layer potentially increasing embryonic mortality of these species the patches of primary forest at Wau Creek are important for their long-term survival.

### **Recommendations**

Maintaining the diversity of herpetofauna at Wau Creek, and ensuring the long-term survival of freshwater turtles and of canopy and litter-dwelling frogs in particular, will require that forest within the proposed WMA be protected from future logging. In addition the following activities are recommended:

- Ongoing protection of Pig-nosed Turtle nesting sites, and further research into the species' ecology and conservation status, will help to ensure the long-term future of this iconic turtle in the Kikori basin.
- Formal recognition of the Wau Creek area as a WMA should be finalised, working with the local landowners, local and regional government authorities and the CEPA.
- Landowners at Wau Creek should be encouraged to broaden their focus from the Pig-nosed Turtle to the accompanying benefits of the proposed WMA for the ecological community more generally, and the other vulnerable or threatened species that reside there.
- Activities that damage or degrade the remaining patches of primary forest in the proposed WMA should be prevented or minimised, including cutting of timber for construction activities or fuel.
- The invasive Cane Toad (*Rhinella marina*), which is abundant at Kopi, was not detected at Wau Creek. This species is commonly transported between sites in human cargo, and in PNG and Solomon Islands is sometimes deliberately moved to new sites in the belief that it control snakes. Care should be taken to avoid accidentally transporting this toad to Wau Creek among cargo in canoes.

- Local landowners intend to conserve the Wau Creek environment, and their support for research activities in the area should be encouraged more broadly, as a mechanism to generate income from their commitment to conservation and attendant loss of opportunity from logging and harvesting.

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Plate 1



A. The main channel of Wau Creek



B. Small stream in forest interior



C. *Copiula* sp. 1



D. *Litoria* sp. 1



E. *Litoria* sp. 2



F. *Litoria richardsi* (IUCN Data Deficient)

Plate 2



A. *Pelochelys bibroni*



B. *Varanus salvadorii*



C. *Litoria auae*



D. *Lechriodus melanopyga*



E. *Sphenophryne cornuta*



F. *Callulops doriae*

## Appendix 1. List of frog species encountered at Wau Creek and their IUCN status

Species	IUCN Status
<b>Limnodynastidae</b>	
<i>Lechriodus melanopyga</i>	LC
<b>Microhylidae</b>	
<i>Austrochaperina palmipes</i>	LC
<i>Callulops doriae</i>	LC
<i>Callulops omnistriatus</i>	NE
<i>Choerophryne crucifer</i>	NE
<i>Copiula derongo</i>	LC
<i>Copiula guttata</i>	LC
<i>Copiula</i> sp. 1 (fast call)	NE
<i>Hylophorbus rufescens</i>	LC
<i>Mantophryne lateralis</i>	LC
<i>Metamagnusia slateri</i>	LC
<i>Oreophryne oviprotector</i>	NE
<i>Oreophryne pseudunicolor</i>	NE
<i>Oreophryne</i> sp. 1 (small chirper)	NE
<i>Sphenophryne cornuta</i>	LC
<i>Xenorhina</i> sp. 1	NE
<b>Pelodyadide</b>	
<i>Litoria auae</i>	LC
<i>Litoria infrafronata</i>	LC
<i>Litoria richardsi</i>	DD
<i>Litoria</i> sp. 1 cf. <i>genimaculata</i>	NE
<i>Litoria</i> sp. 2 cf. <i>graminea</i>	NE
<b>Ranidae</b>	
<i>Papurana arfaki</i>	LC
<i>Papurana daemeli</i>	LC
<b>Total number of species = 23</b>	

## Appendix 2. List of reptiles encountered at Wau Creek and their IUCN status

Species	IUCN Status
<b>Agamidae</b>	
<i>Hypsilurus dilophus</i>	LC
<i>Hypsilurus magnus</i>	LC
<i>Hypsilurus modestus</i>	LC
<b>Gekkonidae</b>	
<i>Cyrtodactylus novaeguineae</i>	LC
<i>Cyrtodactylus serratus</i>	LC
<i>Gehyra</i> sp.	NE
<b>Scincidae</b>	
<i>Carlia aenigma</i>	LC
<i>Emoia caruleocauda</i>	LC
<i>Emoia longicauda</i>	NE
<i>Emoia physicina</i>	LC
<i>Lygisaurus</i> sp.	NE
<i>Sphenomorphus muelleri</i>	NE
<i>Sphenomorphus meyeri</i>	LC
<i>Sphenomorphus simus</i>	LC
<i>Tiliqua gigas</i>	NE
<b>Varanidae</b>	
<i>Varanus indicus</i> -group	LC
<i>Varanus salvadori</i>	LC
<b>Colubridae</b>	
<i>Boiga irregularis</i>	NE
<i>Dendrelaphis calligaster</i>	LC
<i>Stegonotus cucullatus</i>	NE
<i>Stegonotus parvus</i>	NE
<b>Pythonidae</b>	
<i>Morelia amethestina</i>	LC
<i>Morelia viridis</i>	LC
<b>Carettochelyidae</b>	
<i>Carettochelys insculpta</i>	VU
<b>Chelidae</b>	
<i>Elseya rhodini</i>	NE
<b>Trionychidae</b>	
<i>Pelochelys bibroni</i>	VU
<b>Crocodylidae</b>	
<i>Crocodylus novaeguineae</i>	LC
<i>Crocodylus porosus</i>	LC
<b>Total number of species = 28</b>	