FINAL REPORT
BIODIVERSITY (FAUNA) SURVEY FOR VARIRATA NATIONAL PARK
MAY 2018

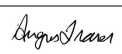
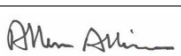
Conservation and Environment Protection Authority

Report Prepared by:
Allen Allison and Angus Fraser
Indo-Pacific Conservation Alliance
P.O. Box 17056, Honolulu, Hawaii, USA.
5th May 2018

Japan International Cooperation Agency

DOCUMENT STATUS & ISSUE HISTORY

Any document issued as an Alphabetic Revision (REV A), is an uncontrolled document issued to the client for review and comment in accordance to agreed document review procedures. Documents issued as 'REV 1 FINAL' must be dated and signed by relevant IPCA signatories as an assurance that the document has incorporated any proposed amendments to the mutual satisfaction of IPCA and the Client during the agreed document review procedure.

REV No.	Author	Reviewer	Signature	Approved for Issue	Signature	Date
REV L: DRAFT	A Allison					11 MAY 2018
REV 1: FINAL	A Allison	A Fraser		A Allison		26 SEP 2018
REV 2: FINAL	A Allison	A Fraser		A Allison		29 SEP 2018
REV 3: FINAL	A Allison	A Fraser		A Allison		09 OCT 2018

EXECUTIVE SUMMARY

The Japan International Cooperation Agency (JICA) in conjunction with Papua New Guinea's Conservation and Environment Protection Authority (CEPA) formally partnered in June 2015 to develop and implement a landmark biodiversity conservation initiative for Protected Areas in PNG's Central Province (JICA, 2018). This initiative is formally referred to by JICA & CEPA as: 'The Project for Biodiversity Conservation through Implementation of the PNG Policy on Protected Areas' (herein referred to as the 'Project').

The Project has been specifically developed to align with PNG's existing Policy on Protected Areas (PPA, 2014) and the UNESCO's Man and Biosphere Program, which adopts a strong focus on improving the livelihood of people while concurrently promoting sustainable resource conservation practices. The key objective of the Project is to establish an effective 'Conservation Management Framework' for Protected Areas through a combination of institutional strengthening, capacity building, landholder engagement, sound science and investment in infrastructure (JICA, 2018).

In February 2017, the Indo-pacific Conservation Alliance (IPCA) was commissioned by JICA on behalf of CEPA to undertake Biodiversity Surveys of fauna and flora within VNP to document the Park's key taxa and concurrently provide a thorough appraisal of the Park's current ecological condition and habitat quality.

Biodiversity surveys were conducted over a twelve-month period commencing in mid April 2017 and were concluded in early April 2018. This has enabled the unique opportunity to collect rigorous data sets for key taxa allowing for seasonal (monsoon and dry season) variability. The results of these surveys comprise a comprehensive assessment of biota in VNP.

Project Objectives

Seven key Project objectives established through contract and consultation between JICA and IPCA broadly framed the parameters of the Biodiversity Surveys. They comprise:

(i) Assess species richness of key taxa that occur within the park and buffer zone through conduct of a detailed literature review and intensive field survey program;

(ii) Prepare a habitat classification map of key vegetation types within the park using satellite imagery and results from field surveys;

(iii) Prepare species inventories for key taxa;

(iv) Produce Field Guide Brochures for key taxa commonly encountered within the park (birds, mammals, invertebrates, plants, amphibians and reptiles);

(v) Provide opportunity to capacity build with CEPA staff, which was extended to train local Koiari to assist in the conduct of biodiversity field surveys; and

(vi) Prepare an Invasive Species Management Plan for introduced taxa (primarily Rusa Deer and invasive plants) that occur within and adjacent to VNP.

(vii) Prepare a Monitoring Plan that identifies and prioritises monitoring programs which will provide Park Managers with information critical to improving the environmental management of VNP.

This standalone document presents key findings associated with the project objectives detailed in items (i) to (iii) for the zoological survey (fauna) component of scope. Reporting requirements for items (iv), (vi) and (vii) have been prepared as separate standalone documents (IPCA 2018a; 2018b; 2018d).

Visitor Amenity

Varirata National Park (VNP) is the most visited protected area in the country and represents a conservation success story. It is strongly supported by surrounding landowners and is patronised by a broad cross section of people. VNP provides a network of trails, popular swimming holes, camping and picnic areas, and scenic lookouts that provide sweeping views of Port Moresby and the escarpment.

The park currently receives a modest number of visitors comprising local Koiari, Port Moresby residents seeking recreational opportunities for picnics, bushwalking and camping, lotu lain (church parishioners), bushwalkers, eco-tourists (particularly local and international birdwatchers), and visiting scientists. It is also used regularly as a field site for tertiary education by local universities.

Its close proximity to Port Moresby provides enormous potential for a broad demographic to experience VNP's biodiversity and appreciate the broader environmental values provided by the Park.

Cultural Landscape

The buffer zone surrounding the park remains a traditional Koiari hunting ground with hunters targeting wallaby, deer, wild pig and cassowary. Koiari Burial grounds, rock engravings and cave paintings located on the lower slopes of the park buffer zone ensures the park and surrounding area remain part of an important cultural landscape that warrants protection.

Other Environmental Values

In addition to VNP's established biodiversity and cultural values, the Park's relatively high forest cover mitigates against runoff, sedimentation of waterways and erosion. Neighbouring communities downstream of the park are reliant on naturally occurring spring water as their primary source of drinking water. So to the wider Port Moresby populous, which benefits from the Park's catchment and its contribution to water quality and water supply for the Port Moresby power grid courtesy of the Rouna 1 and Sirinumu Dam hydropower schemes.

Vegetation Associations & Key Habitats

PNG has the third largest expanse of intact rain forest in the world and less than 5% of this is protected. Remarkably, VNP, which currently only covers 1,063 ha and with negligible range in elevation (630 to 833 m) contains an astounding diversity of biota, with nearly 10% (over 1,000 species) of the country's vascular plants and one third of the genera represented across five key habitats. The distribution of key taxa (invertebrates, fish, amphibians, reptiles, avifauna, and mammals) varies within the Park according to their ecological preference for the following vegetation associations:

(i) Eucalypt savannah;

(ii) Secondary forest dominated by Gymnostoma (*Gymnostoma papuana*);

(iii) Primary rainforest (medium-crowned lowland hill forest) including old re-growth forest;

(iv) Aquatic habitats (Streams and Lakes); and

(v) Forest edge (ecotones between vegetation communities, disturbed areas including landscaped gardens and roadside verges).

The dominant habitat is primary rainforest forest, which comprises approximately 80% of the Park.

Zoological Biodiversity

IPCA's Biodiversity Surveys for both botanical and zoological taxa have confirmed that Varirata National Park is an ecological asset of outstanding biodiversity value. At 1,063 ha, VNP is less than 0.01% of the country's total area

(462,840 km^2) yet is host to significant fauna diversity.

PNG's invertebrate taxa are extensive, diverse, incredibly species rich with high levels of endemism and are generally poorly known. Of the invertebrates, two groups of insects, the butterflies and the dragonflies and damselflies provide excellent ecological indicators of habitat quality. Appraisal of these taxa indicates a rich proportion of the country's butterfly taxa occur in the Park, with at least 10% of the country's dragonflies also occurring in VNP. Water quality is critical to their ecology and their occurrence and diversity within the Park indicates aquatic habitats are currently in good ecological condition.

The Park hosts 6% of the country's frog fauna, 12% of its described lizards, 15% of PNG's snake fauna, approximately 28% of PNG's total avifauna and 50% of its forest bird taxa. The mammals are similarly diverse with 13% of PNG's mammals currently recorded from the Park. There is a very strong case to suspect at least 29 additional mammal species will be added to the Park's checklist with further targeted field surveys.

In a broader perspective, vertebrate diversity within VNP's forests and savannah ecosystems is significant, with 338 species currently recorded, equating to approximately 16% of terrestrial vertebrates known from the country.

Many of the Park's fauna are endemic, further demonstrating international significance of the Park's biodiversity. The potential for describing new species from the park across all taxa is considered enormous.

Species with Scheduled Conservation Significance

Three species that occur within the Park are scheduled with 'Near Threatened' conservation status, namely: the Forest Bittern (*Zonerodius heliosylus*), Gurney's Eagle (*Aquila gurneyi*) and the New Guinea Quoll (*Dasyurus albopunctatus*). A fourth species, the Giant Bandicoot (*Peroryctes broadbenti*) is scheduled as 'Endangered'. All lowland species have been subjected to similar pressures of habitat loss, with the Giant Bandicoot and New Guinea Quoll also suffering from hunting pressure throughout their range.

Invasive Species

Six introduced invasive vertebrate species were documented to occur within the Park. Of these, the Rusa Deer (*Cervus timorensis*) and wild pig (*Sus scrofa*) potentially pose significant threats to Parks ecological integrity. Management of these species in addition to domesticated cats and dogs, which also occur in the Park, is discussed in detail in the Invasive Species Management Plan (IPCA, 2018d). Other threats including poaching of game and forest resources (timber and firewood) are also addressed in key recommendations of those reports.

Ecological Value of VNP

The expansion of secondary and primary forests combined with having largely avoided the negative ecological and social impacts associated with broad scale deforestation, and regular fire regimes typical in areas adjacent to large metropolitan centres across the country, has ensured that the Park's ecological integrity has been largely maintained since it's gazettal in 1973. This is remarkable given the Park's close proximity to Port Moresby and surrounding communities, which have concurrently undergone significant increases in population during the same period.

The Park's incredibly rich biodiversity, environmental values, cultural significance and educational and ecotourism potential dictates that Varirata National Park represents an outstanding natural asset of high ecological value in PNG's protected area portfolio.

Results of the Zoological Biodiversity Survey provide critical knowledge required to assist in the development of sound science based resource management strategies crucial to achieving the primary Project Objective of establishing a 'Conservation Management Framework' for Varirata National Park.

TABLE OF CONTENTS

LIST OF TABLES

TABLE OF FIGURES

LIST OF APPENDICIES

1. INTRODUCTION

The Japan International Cooperation Agency (JICA) in conjunction with Papua New Guinea's Conservation and Environment Protection Authority (CEPA) formally partnered in June 2015 to develop and implement a landmark biodiversity conservation initiative for Protected Areas in PNG's Central Province (JICA, 2018). This initiative is formally referred to by JICA & CEPA as: 'The Project for Biodiversity Conservation through Implementation of the PNG Policy on Protected Areas' (herein referred to as the 'Project').

The Project has been specifically developed to align with the objectives of PNG's existing Policy on Protected Areas (PPA, 2014) and also adopts key principles of the UNESCO's Man and Biosphere Program with a strong focus on improving the livelihood of people and concurrently promoting sustainable resource conservation practices.

The Project comprises multiple stages and is scheduled for roll out over a 5 year period with the primary objective to establish an effective 'Conservation Management Framework' for Protected Areas through a combination of institutional strengthening, capacity building, landholder engagement, sound science and investment in infrastructure (JICA, 2018).

Establishing an effective 'Conservation Management Framework' for PAs requires that the Project be structured to deliver the following four key outcomes (JICA, 2018):

1. Strengthen institutional frameworks including formulation of Policy on Protected Areas (PPA) Action Plan and establish a National Conservation Council;
2. Enhance the terrestrial Protected Area (PA) management model for Varirata National Park (VNP) and the surrounding Koiari area;
3. Develop a model of establishing a new Marine PA; and
4. Raise the awareness of the general public regarding the importance of biodiversity conservation.

1.1. Biodiversity Survey Objectives & Scope

In February 2017, the Indo-pacific Conservation Alliance (IPCA) was commissioned by JICA on behalf of CEPA to undertake Biodiversity Surveys of fauna and flora within VNP to document the Park's key taxa and concurrently provide a thorough appraisal of the Park's current ecological condition and habitat quality. The Biodiversity Surveys comprise a crucial component of the overall Project. Results from these surveys provide the foundations necessary to develop science based resource management strategies crucial to strengthening natural resource management functions within the Park. Seven key Project objectives established through contract and consultation between JICA and IPCA broadly framed the parameters of the Biodiversity Surveys. They comprise:

(i) Assess species richness of key taxa that occur within the park and buffer zone through conduct of a detailed literature review and intensive field survey program;

(ii) Prepare a habitat classification map of key vegetation types within the park using satellite imagery and results from field surveys;

(iii) Prepare species inventories for key taxa;

(iv) Produce Field Guide Brochures for key taxa commonly encountered within the park (birds, mammals, invertebrates, plants, amphibians and reptiles);

(v) Provide opportunity to capacity build with CEPA staff, which was extended to train local Koiari to assist in the conduct of biodiversity field surveys; and

(vi) Prepare an Invasive Species Management Plan for introduced taxa (primarily Rusa Deer and invasive

plants) that occur within and adjacent to VNP.

(vii) Prepare a Monitoring Plan that identifies and prioritises monitoring programs which will provide Park Managers with information critical to improving the environmental management of VNP.

This standalone document presents key findings associated with the project objectives detailed in items (i) to (iii) for the zoological survey (fauna) component of scope (APPENDIX 1). Reporting requirements for items (iv), (vi) and (vii) have been prepared as separate standalone documents.

1.2. Overview of Varirata National Park

Varirata National Park is Papua New Guinea's first National Park. It was declared on December 10, 1969 and was officially opened October 8, 1973, two years before Papua New Guinea (PNG) became an independent, sovereign nation. The Park is located approximately 23 km ENE from Port Moresby City (straight-line distance) at the edge of the Sogeri Plateau in the Astrolabe Range, and is accessible by vehicle from Sogeri Road (Figure 1). The Park borders on a prominent escarpment of the Astrolabe Range and occupies a total area of 1,063 ha over undulating terrain ranging in elevation from 630 to 833 metres (m) (Figure 2). The Park today contains a mixture of eucalypt savannah, secondary forest in various stages of regeneration, and old-growth primary rain forest. It features picnic and camping grounds together with more than 12 km of walking tracks.

Much of the Parkland was purchased by the Crown from the traditional landowners, the Koiari people, who inhabit the Sogeri Plateau. An additional parcel – formerly a pig and poultry farm and now the central picnic and information area of the Park – was later purchased from Burns Philip and added to the Park.

Varirata National Park (VNP), because it is so close to Port Moresby, is the most visited protected area in the country. It offers easy access to a rich array of rain forests and is often the first true rain forest visited by school children growing up in the urban areas of Port Moresby. It is especially important as a model for protection of natural areas in PNG. Historically, a number of important scientific studies have been conducted in the Park, and it comprises an important educational resource for local universities and maintains high recreational values for local tourism and international ecotourism.

1.2.1. Key Habitats

For the purposes of conducting the zoological surveys, five key habitats were identified to occur within the Park. These closely resemble the vegetation associations, which are characteristic of the Park described in IPCA's Biodiversity Survey Report for flora (IPCA, 2018b). The key habitats comprise: medium-crowned lowland hill forest (primary rainforest); secondary forest dominated by *Gymnostoma papuana*; eucalypt savannah, aquatic vegetation (found within and adjacent to streams and lakes) and the ecotones between these habitats, termed forest edge, which also includes disturbed areas and road verges.

Figure 1: Location of VNP, Papua New Guinea
Source: JICA, 2017

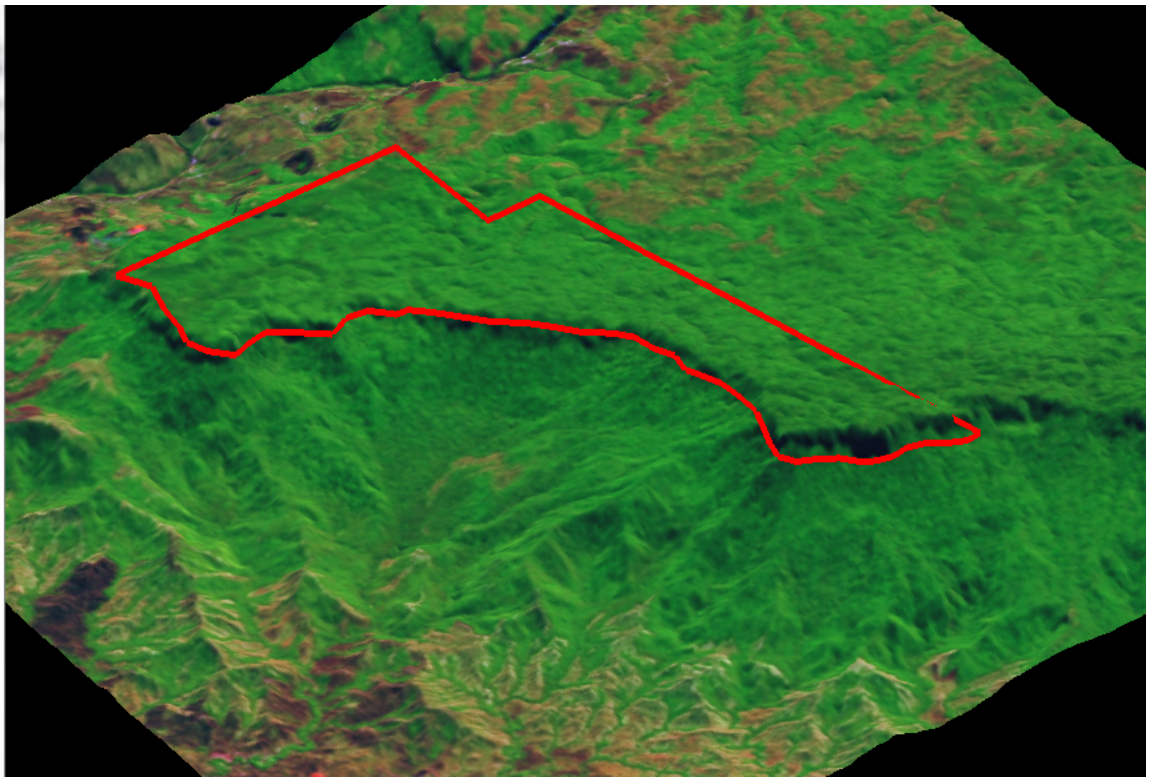


Figure 2: Satellite Image of VNP
Source: Phil Shearman, 2017

1.2.2. Visitor Facilities and Use

There is a network of trails, camping and picnic areas, and staff housing and visitor facilities within the Park (Figure 1). The western boundary of the Park borders on the main escarpment of the Astrolabe Range. There are several lookouts that provide sweeping views of Port Moresby along the Boundary Track and from the Main Lookout, which is accessible by road (Figure 3 to Figure 6). Prior to JICA and CEPA's commitment to re-establishing VNP under the proposed 'Conservation Management Framework', Park facilities were in disrepair with the Park receiving a modest number of visitors, particularly on the weekends. The Park remains a favoured site for avid bird watchers, with 231 species of birds recorded.

Figure 3: Port Moresby from the Main Lookout, VNP
The Lookout is located at the edge of the main escarpment of the Astrolabe Range. The vegetation on the hills below the Lookout is mainly eucalypt savannah (light green) with gallery forest (dark green) along creeks). Photo credit: Allen Allison

Figure 4: Lower Laloki Valley & Mt Lawes from the VNP Main Lookout
Photo credit: Allen Allison

Figure 5: Eucalypt savannah below the VNP Main Lookout
Photo credit: Allen Allison

Figure 6: Main Lookout, elevation 833 meters, VNP
Photo credit: Allen Allison

2. Methodology

IPCA were commissioned in February 2017 by JICA to conduct comprehensive biodiversity surveys of flora and fauna within VNP. This required detailed literature reviews and desktop studies in conjunction with an intensive field survey campaign. Biodiversity surveys were conducted over a twelve-month period commencing in mid April 2017 and were concluded in early April 2018. This has enabled the unique opportunity to collect rigorous data sets for key taxa allowing for seasonal (monsoon and dry season) variability. The results of these surveys comprise the first comprehensive assessment of biota in VNP.

CEPA approved IPCA's use of Mononumu Lodge, which is located in the northern part of the Park, for use as a field survey base. The facilities included a building, which was converted into a mess and a specimen preparation facility. Several satellite bungalows comprised accommodation for the survey team.

2.1. Biodiversity Field Survey Personnel

IPCA employed a field team comprising five land owners, one each from the four Koiari clans with land-owning interests in the Park and a technical officer from another Koiari clan who has been trained by IPCA in survey techniques during previous projects conducted on the Sogeri Plateau and elsewhere in PNG (Figure 7). This team was initially led by Mr John Sengo who provided training in various aspects of field biology and survey techniques to the following team members:

- Mr Dabio Moi – Technical Officer (Doe Village)
- Mr Bali Korohi (Omani Clan)
- Mr Gideon Warite (Nadeka Clan)
- Mr Monobe Kisea (Ianari Clan)
- Mr Noel Max (Narime Clan)

Figure 7: IPCA's Koiari Biodiversity Survey Team
Bali Korohi, Monobe Kisea, Gideon Warite, and Noel Max. Photo credit: Angus Fraser

2.2. Zoological Survey Collections

After successful implementation of the botanical survey program in May 2017, Mr. Bulisa Lova, who is highly experienced in conducting zoological collections and preparing voucher specimens from the PNG national Museum was mobilised to the field in June 2017. Mr Iova provided training and practical demonstration to the IPCA field survey team on appropriate protocols on key aspects associated with conduct of zoological surveys and collection of specimens.

In October 2017, Nittya Simard an experienced field biologist joined the team for approximately two months and provided further training in field biology techniques. These included: voucher specimen preparation, frog call surveys (recording call sonograms using specialised audio equipment), mist netting, deployment of Elliot traps to catch small mammals and general identification skills.

The field survey team generally spent Monday to Friday of each week collecting plants and animal specimens and documenting key observations, including conducting evening spotlight surveys searching for nocturnal fauna. By deploying the survey team on a nearly continuous basis over a twelve-month period, IPCA were able to collect animal specimens under a range of seasonal conditions. This is particularly important for reptiles and amphibians, which can be difficult to observe and capture under certain conditions. Prolonged dry spells prove

problematic when surveying for frogs, while monsoonal rains afford greater ground cover often making it difficult to locate cryptic reptiles.

IPCA's field survey encompassed the entire Park and the buffer zones, however collections were concentrated in the northern section where walking trails are located. A map of this area is shown in Figure 1.

There are no current, authoritative checklists of species found in within the Park. In compiling checklists of taxa within the Park, IPCA compiled the results of field surveys, JICA's camera trap program, literature reviews and shape file analysis (for vertebrates) to compile various species checklists presented as Appendices to this report.

2.3. Land Cover

JICA obtained Worldview satellite coverage of the Park and has used that to classify land cover into nine land use categories (Figure 8). IPCA confirmed this classification by ground truthing areas within the Park and believe that these categories are appropriate for defining the major habitat types present in the Park. IPCA has therefore adopted this land cover classification (vegetation map) as the base map for use in introducing Park visitors to the various ecological associations in the Park and for use in monitoring and management programs.

2.4. Literature Review

IPCA comprehensively searched the leading scientific literature databases, including Zoological Record, Web of Life and Google Scholar, for literature and references relating to the biota of VNP. Further, the bibliographies of all major field guides were reviewed regarding the biota of PNG. This effort returned 542 references. These are maintained in Endnote, the leading commercially available product for managing literature references and associated PDF files. Literature cited is referenced in the References Section of this report, however, key texts utilised throughout the field program included:

- Allen (1991) Guide to the Freshwater Fishes of New Guinea;
- Coates (1985) The Birds of Papua New Guinea Vol I;
- Coates (1990) The Birds of Papua New Guinea Vol II;
- Coates (2014) The Birds of Port Moresby;
- Flannery (1995) Mammals of New Guinea;
- Gregory (2017) Birds of New Guinea;
- Hopkins & Hisao (1994) Varirata National Park Field Guide;
- Menzies (2006) The Frogs of New Guinea and Solomon Islands;
- O'Shea (1996) A Guide to the Snakes of Papua New Guinea;
- Pratt & Beehler (2014) Birds of New Guinea (2nd ed.).

IPCA used GIS species distribution shape files and an extensive review of the literature to prepare checklists of species that likely occurred in the Park. Continuous revision of the checklists was undertaken throughout the program based on the results of the zoological field surveys.

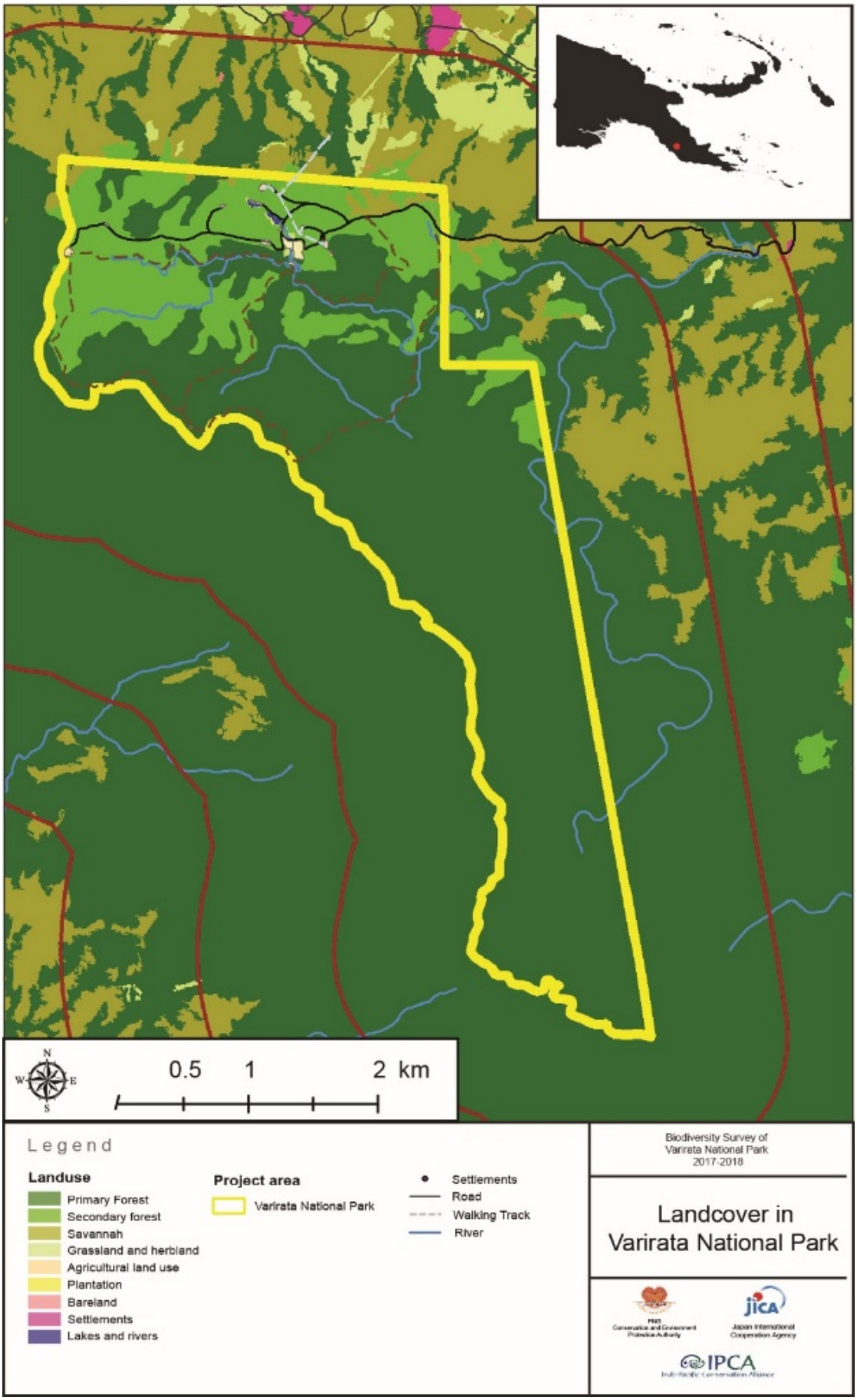


Figure 8: Land use in VNP and surrounding areas.

2.5. Community Outreach Program

Two former U.S. Peace Corps volunteers, Andrew McInnis and Christo Ferguson, joined the IPCA survey team for a three-week period between mid-October 2017 to early November 2017. They assisted in determining the feasibility of eradicating Clidemia from the Park through the establishment of trial plots in secondary and primary forest habitats as part of IPCA's botanical survey program.

Upon completion of this component of the botanical survey, McInnis and Ferguson assisted in developing and implementing an educational outreach program on behalf of IPCA to surrounding villages, community groups and schools (Figure 9). The program was designed to raise environmental awareness and highlight ecological importance of VNP among neighbouring communities. Live specimens including frogs, lizards and snakes were carefully handled and promoted amongst audiences to emphasis PNG's extraordinary biodiversity and assist in promoting the benefits of community conservation practices.

Figure 9: Delivering IPCA's Community Outreach Program

IPCA Field Team From left to right Noel Max, Andrew McInnis and Christo Ferguson, delivering conservation awareness workshops to schools on the Sogeri Plateau. Photo credit: IPCA, 2017

3. RESULTS

IPCA collected several hundred invertebrate specimens and over 200 frog and reptile specimens representing approximately 50 species.

Frog calls for all species encountered during field survey were recorded as sonograms and representative specimens photographed either in-situ or in a field studio setting. Bat species were also collected using mist nets with 21 voucher specimens collected representing seven species of bats.

DNA samples were collected from all collected specimens, which is key in determining the evolutionary origin and phylogenetic relationships of species and is fundamental to modern taxonomic studies.

IPCA's field survey team also recorded several hundred natural history observations (location of bird nests, megapode mounds, fruiting trees, flowering plants). Colour photographs of the plants, animals and landscapes throughout the Park were also captured during the course of the field surveys.

4. ZOOLOGICAL BIODIVERSITY IN VNP

VNP's monsoonal climate and its distinctive microclimate are key drivers (in addition to historical land use disturbances and current fire regimes) determining the distribution and composition of vegetation within the Park. Despite the lack of long-term rainfall or temperature data published for the Park Hopkins and Hiaso (1994) monitored rainfall from October 1990 to March 1993 suggesting that the Park receives approximately 1,500 mm of rain per year (Figure 10). This is only slightly greater than Port Moresby, which receives around 1,200 mm annually. The dry season extends from June to September and the wet season typically occurs from October to May. January is the wettest month with rainfall of nearly 300 mm. Temperatures during the day commonly reach 30º C and rarely drop below 16º C at night, with little annual variation.

It is likely that rainfall totals for the rain forest areas of the Park exceed 2,000 mm annually, with a less pronounced dry season than in the savannah areas.

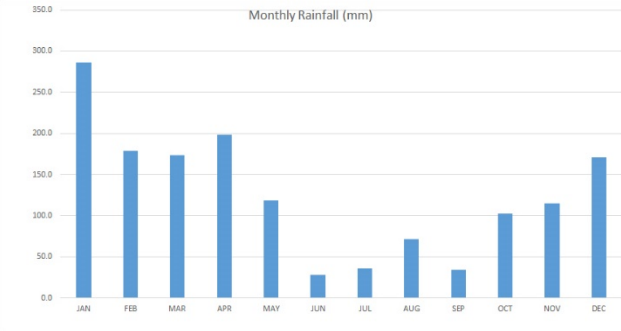


Figure 10: Monthly rainfall in VNP
Source: Hopkins and Hiaso, 1994

4.1. Key Habitats

The IPCA Botanical Biodiversity Surveys confirmed that five key vegetation associations occur within the Park (eucalypt savannah, secondary forest, primary forest, aquatic (streams and lakes) habitats and disturbed or open areas (landscaped gardens and road verges).

With the exception of 'Open Areas' (which was substituted for 'Forest Edge' ecotones) the key habitats identified for the fauna survey mirrored those selected for the botanical survey as would be expected. The key habitats for the fauna survey therefore comprised:

- Eucalypt savannah;
- Secondary forest dominated by Gymnostoma (*Gymnostoma papuana*);
- Medium-crowned lowland hill forest (primary rainforest);
- Aquatic habitat (streams and lakes); and
- Forest edge ecotones

Each of these habitat types are briefly discussed below, with further detail provided in IPCA's Biodiversity (Flora) Survey Report (IPCA, 2018b).

4.1.1. Eucalypt Savannah

The northern border of the park is covered in eucalypt savannah (Paijmans, 1973; 1975) dominated by four myrtaceous trees, Ghost Gum (*Corymbia papuana*), Grey Gum (*E. tereticornis*), White Gum (*E. alba*) and Weeping Paperbark (*Melaleuca leucadendroni)*, with an understory of grasses, particularly Kangaroo Grass (*Themeda australis*) and Cogon Grass (*Imperata cylindrica*), together with scattered shrubs, including Grassland She-oak (*Grevellia papuana*), Tropical Banksia (*Banksia dentata*), and a cycad (*Cycas campestris*) (Figure 11 to Figure 13). Other aspect dominants include species of *Pandanus*.

Figure 11: Eucalypt Savannah, VNP
White Gum (*Eucalyptus alba*), cycad (*Cycas campestris*) in the lower right) and a mixture of Kangaroo Grass (*Themeda triandra*) and Congon Grass (*Imperata cylindrica*). Photo credit: Angus Fraser

Figure 12: Eucalypt Savannah and Secondary Forest ecotone, VNP
Ecotone between savannah and secondary forest. The grass species in the foreground is mainly Congon Grass (*Imperata cylindrica*); the plants at the edge of the forest are cycads (*Cycas campestris*). Photo credit: Angus Fraser

Figure 13: Eucalypt Savannah with White Gum and Grey Gum, VNP
White Gum (*Eucalyptus alba*), Grey Gum (*E. tereticornis*). The dominant grass species is Kangaroo Grass (*Themeda triandra*). Photo credit: Angus Fraser

This vegetation covers < 2% of the overall Park area but is the dominant vegetation around Port Moresby and along the road from the city to Sogeri, reflecting the monsoonal climate of the area. Eucalypt savannah is highly susceptible to fire and large tracts burn each year during the dry season (Figure 14). Savannah plant assemblages have adapted to a fire ecology with grassland species generally recovering within a year or two if not burned repeatedly

Figure 14: Large tracts of Eucalypt Savannah burning during the dry season
Fires are deliberately lit to burn large areas during the dry season. This is looking north to the Sogeri Plateau from the VNP escarpment. Photo credit: Angus Fraser

The overall plant species richness in these Eucalypt Savannah is low and comprises less than 1% of the plant species known from the Park. However, at least one species of mammal and several species of lizards known from the Park occur primarily in the eucalypt savannah forests. Eucalypts are also particularly critical for a variety of marsupials and birds such as parrots, which rely on hollows produced by these trees for nesting sites (Figure 15).

Figure 15: Red Cheeked Parrot (*Geoffroyus geoffroyi*)
Photo credit: Angus Fraser

4.1.2. Secondary Forest

Immediately south of the eucalypt savannah lies a band of mainly secondary forest dominated by Gymnostoma (*Gymnostoma papuana*), a nitrogen fixing and pioneering

tree species in the family Casuarinaceae (Figure 16 to Figure 17). Other common species include Ghost Gum, Grey Gum, sumac *(Rhus taitensis Figure 18), Macaranga* spp., *Ficus* spp. and *Euodia* spp.

Figure 16: Gymnostoma (*Gymnostoma papuana*) foliage and seedpods, VNP
Photo credit: Angus Fraser

Gymnostoma forms nearly pure stands in parts over much of the area covered in secondary forest (Figure 17). The boundary between the secondary forest and eucalypt savannah is typically characterised with some mixing of species. In particular Ghost Gum and Grey Gum are common elements between the two vegetation types. The presence of the two species of eucalypts together with other typical savannah species, such as Weeping Paperbark, within the secondary forest likely represents remnants of the former savannah grassland that covered the area in 1973.

Figure 17: Secondary forest (*Gymnostoma papuana*) adjacent to Lake Lifilikatabu
Photo credit: Allen Allison

Figure 18: Sumac (*Rhus taitensis*) is prominent in mixed second growth forest, VNP
This tree was photographed on 04 April 2017 near the Lodge. It was in flower throughout the Park and in the upper Laloki Valley. Photo credit: Allen Allison

In the absence of fire in areas with sufficient rainfall, a shield fern (*Sticherus* sp.) will tend to invade forest clearings. This fern (Figure 19), which forms dense thickets and helps re-establish soil, is eventually followed by other successional species, particularly Gymnostoma. This process of ecological succession can result in nearly pure stands of Gymnostoma with a ground layer of shield fern (Figure 20). The shade produced by the Gymnostoma canopy provides allows for the establishment of other tree species within the secondary forest, including sumac *(Rhus taitensis)*, Albert Palm *(Caryota rumphiana)*, Red Cedar *(Toona sureni)* and species of *Macaranga*, *Pandanus*, *Syzygium*, *Ficus*, *Neolitsea*, *Schizomeria*, and *Euodia*.

The area of secondary forest within the Park is remarkable given that this has expanded significantly to reclaim approximately 94% (207.9 hectares) of the estimated 220.7 hectares of grassland present when the Park was officially opened in 1973. This has occurred through naturally through succession largely facilitated by an absence of fire. Over time, the floristic composition of secondary forest will assume a greater proportion of rainforest species resulting in re-establishment of primary rainforest.

Figure 19: Early successional native shield fern (*Sticherus* sp.), VNP
Sticherus is abundant in Varirata National Park and tends to invade clearings and open areas adjacent to forest and is eventually shaded out by pioneering tree species. Photo credit: Allen Allison

Figure 20: Shield Fern (*Sticherus* sp.) comprising a dominant ground cover, VNP
Photo credit: Allen Allison

In addition to Clidemia (*Miconia crenata*), another serious invasive shrub from South America, Spiked Pepper (*Piper aduncum*), also occurs throughout the secondary forest and in disturbed areas along roadsides and tracks (Figure 21 and

Figure *22*).

Figure 21: Clidemia (*Miconia crenata*) is a dominant ground cover in Secondary Forest, VNP
Photo credit: Allen Allison

Figure 22: Spiked Pepper (*Piper aduncum*), VNP
Native to Central and South America this invasive tree is widespread throughout PNG. Photo credit: Allen Allison

4.1.3. Primary Forest

Although there are subtle differences in the occurrence and distribution of tree species within the primary forest, depending primarily on slope, aspect and other factors, these differences are ecologically minor with respect to the overall distribution of plants within the Park. Approximately 80% of the land area of the Park is currently covered in primary forest, including old re-growth forest and is part of an association termed medium-crowned lowland hill forest (Paijmans, 1973; 1975) (Figure 23).

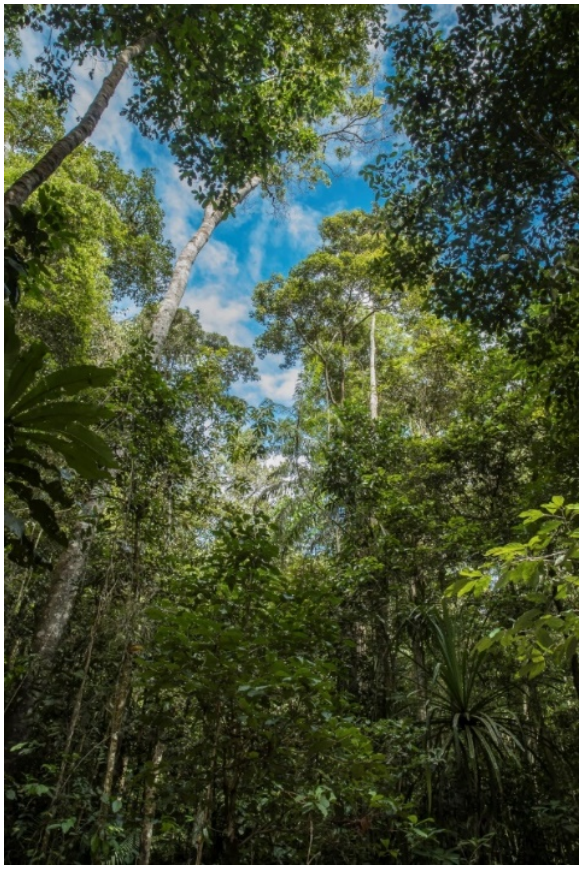


Figure 23: Primary Forest, VNP
Photo credit: Angus Fraser

The Park's primary forests include a rich diversity of tree species and a dense understory of shrubs, small trees and lianas and are dominated by ten plant families (IPCA, 2018b). In addition, a conifer, Tulip *(Gnetum gnemon)*, is common throughout the forest, which is also rich in epiphytes, particularly ferns and orchids.

Oak forest occurs at higher elevations in the Park, particularly around Gare's Lookout and is dominated by two species: PNG Oak (*Castanopsis acuminatissima*) and *Lithocarpus celibicus*. These forests typically occur along ridgelines and comprise a distinctive element within the medium-crowned lowland hill forest (Figure 24). The understory of these forests is generally less dense than other parts of the primary forest, with fewer lianas and epiphytes. The fruit, a spiny ovoid nut is harvested by people throughout PNG for food and is also an important food source for many species of parrots.

Figure 24: PNG Oak (*Castanopsis acuminatissima*) along the Scarp Track ridgeline
Photo credit: Angus Fraser

4.1.4. Aquatic Habitat

The lentic habitat in the Park comprises two small lakes (Figure 25 to Figure 27) referred to as the Lake Lifilikatabu complex situated west of the main picnic ground. Lotic habitat comprises Nairogo Creek, which is a small stream with several tributaries within the Park's catchment (Figure 28 and Figure 29). A number of frogs, including *Papurana daemeli, Litoria chloristona*, *L. nasuta*, *L. priora* and *Nyctimystes infrafrenatus* breed in the Lake Lifilikatabu complex and can be observed here of an evening or afternoon particularly after a rainfall event when their calls are voluminous. Their habitat is mapped in Figure 30. Other frogs such a *Nyctimystes semipalmata*, breed in streams and are found in close association with Nairogo Creek and its tributaries.

Figure 25: Lake Lifilikatabu complex, VNP
The surrounding secondary forest consists of almost pure stands of Gymnostoma (*Gymnostoma papuana*). These forests are estimated to be over 50 years old. Photo credit: JICA, 2017 (-9.433697°, 147.360793°)

Figure 26: Lake Lifilikatabu complex (upper) during the dry season
Photo credit: Allen Allison

Figure 27: *Pandannus* vegetation adjacent to the Lake Lifilikatabu complex
Photo credit: Angus Fraser

Figure 28: Nairogo Creek tributary in Primary Forest, VNP
Photo credit: Angus Fraser

Figure 29: Primary re-growth riparian vegetation along Nairogo Creek, VNP
The small tree along the stream on the right is a species Neonauclea (Rubiaceae). Photo credit: Angus Fraser

Similarly, the few species of waterbirds that are occasionally observed in the Park, including the spotted whistling duck, Australasian grebe, herons, egrets, and cormorants are all confined to the lakes. Other species, such as the azure kingfisher are generally found in both the forest edge around the lake complex and the tributaries of Nairogo Creek. The Forest Bittern, a rare bird is occasionally observed hunting in Nairogo Creek.

4.1.5. Forest Edge

A number of animal species, particularly some birds and many lizard species (such as species from the genus *Emoia*), typically occur at the edge of clearings – natural or unnatural. In the Park, forest edge habitat would include the perimeter of open areas such as the picnic grounds as well as forest along the roads (Figure 31) and to some extent along the trails within the Park that traverse through savannah and secondary forest ecotones and secondary forest and primary forest ecotones Figure 32). The areas within the Park where forest edge species are best observed are mapped in Figure 33.

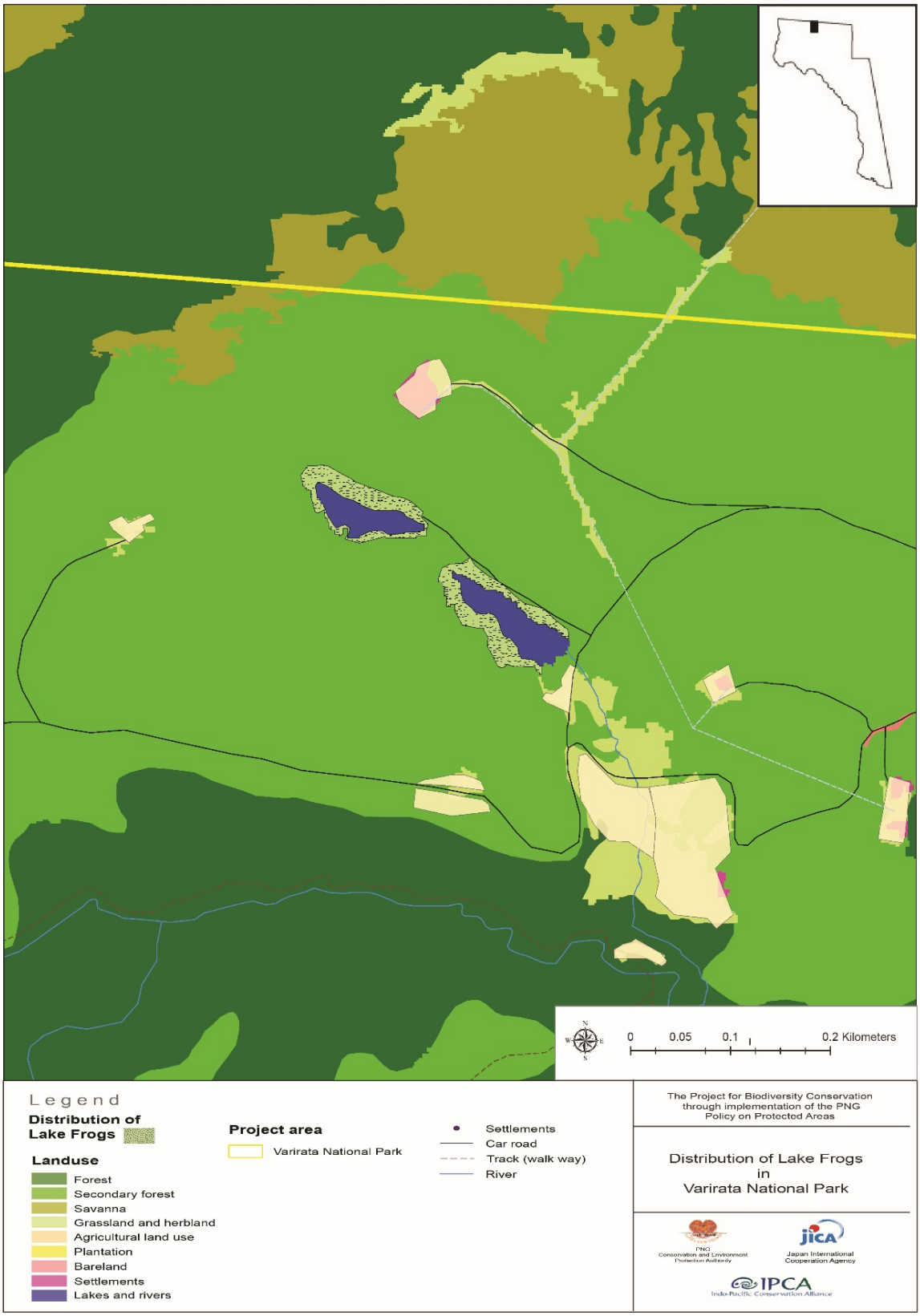


Figure 30: Map of frog habitat around the Lifilikatabu Lake complex in VNP.
A number of aquatic plants such as Eleocharis are found in the Park only around the lakes.

Figure 31: Entrance to VNP, 2017

Forest edge - mixed primary and secondary forest near the Park entrance. Much of the wildlife in the forest concentrates at the forest edge around clearings and along roads making observation of wildlife at these ecotones more probable. Photo credit: Angus Fraser.

Figure 32: Aerial photograph of primary and secondary forest ecotone

This image was taken near the Digicel Tower (9.430232°S, 147.351295°E) showing the sharp separation (ecotone) between the secondary forest dominated by Gymnostoma (*Gymnostoma papuana*) (left) and primary forest (right). Photo credit: JICA, 2017.

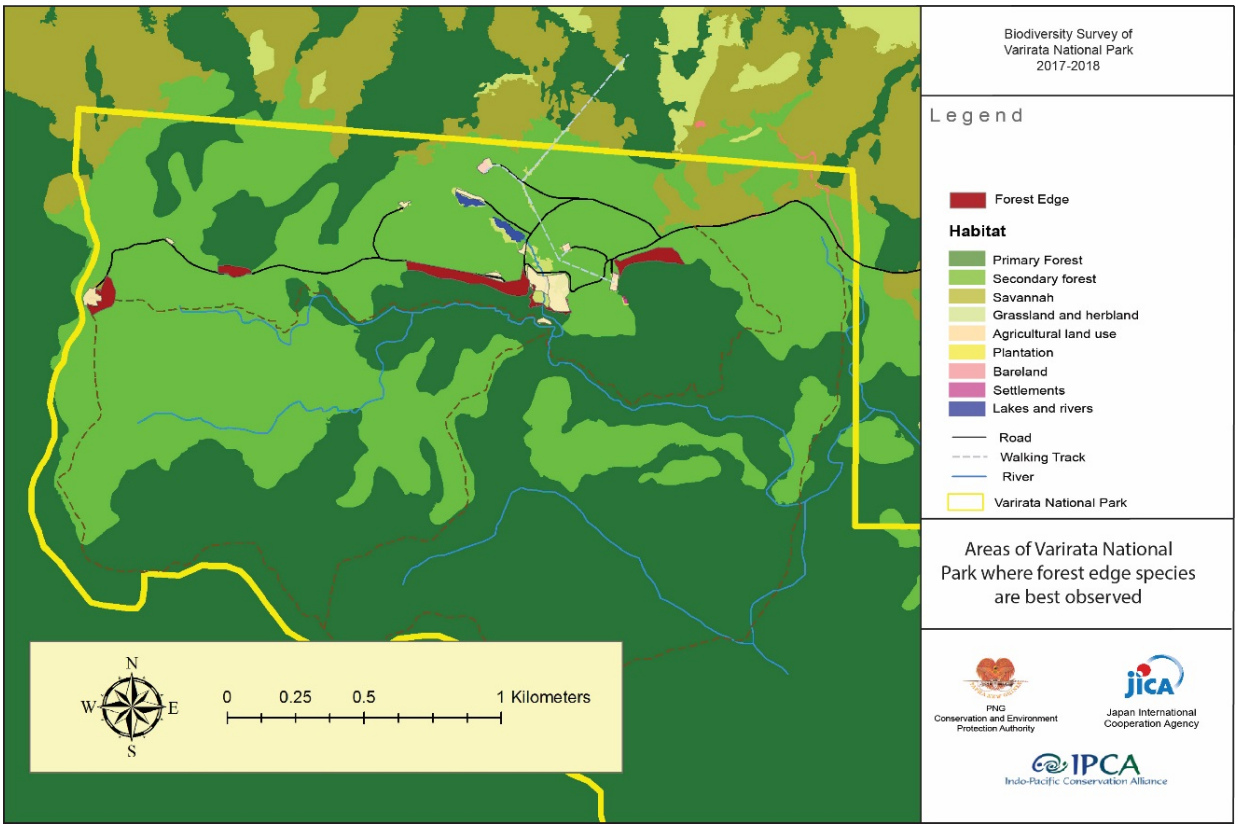


Figure 33: Map of forest edge communities where wildlife can be readily observed

4.2. Invertebrate Composition, Richness and Endemism

Invertebrates are the dominant group of animals globally comprising approximately 95% of all species on earth (CSIRO, 2018). The number of invertebrate species within the Park is estimated to range between 3,000 – 5,000 species with an inordinate number of these likely yet to be described given the taxonomy of PNG's invertebrates is generally very poorly known (Miller, 1994).

Of the invertebrates the Malacostraca (crabs) and Lepidoptera (butterflies) are reasonably well described. The taxonomy and ecology of several other key insect groups including Odonata (dragonflies and damselflies), and Coleoptera (beetles) has been studied, however significant gaps remain in the current body of knowledge (Miller, 1994, Orr & Kalkman, 2015; Kalkman & Orr 2013).

The ecological roles of invertebrates are extraordinarily diverse with many species key in maintaining healthy ecosystems through decomposition (breaking down) of organic matter and recycling nutrients, aerating soils, pollinating plants and dispersing seeds. Some are voracious predators (spiders and praying mantis) and scavengers (flies). Several taxa are potentially harmful to humans if bitten and these include certain species of spiders, scorpions and centipedes found within the Park.

Invertebrate taxa occurring within the Park that are discussed here include: land snails; leeches; millipedes and centipedes; spiders; freshwater crabs; and insects. These groups were surveyed opportunistically by IPCA and the checklist presented in this document presents a selection of common and intriguing species (APPENDIX 2).

4.2.1. Annelida, Class Hirudinea: Leeches

Leeches belong to the Class Hirudnea under phylum Annelida and are soft bodied 'segmented worms' and are entirely parasitic feeding on the blood of other animals. Very little published literature is available regarding the diversity of leeches in PNG and little is known of this group within the Park. However, several species of leech do occur and a species from the genus Chtonobdella (family Haemadipsidae) is commonly encountered particularly during the monsoon season (Figure 34).

Figure 34: Haemadipsid Leech, VNP
Photo credit: Angus Fraser

4.2.2. Arthropoda, Class Gastropoda: Land Snails

The land snails of PNG remain incompletely known with approximately 500 species currently named and at least 150 species yet to be named (https://www.florida-museum.ufl.edu/pngsnails/). *Euplecta minor* was commonly observed secondary and primary forests throughout the Park (Figure 35).

Figure 35: Land Snail (Euplecta minor), VNP
Photo credit: Angus Fraser

4.2.3. Arthropoda, Class Diplopoda & Chilopoda: Millipedes & Centipedes

Millipedes (Class Diplopoda) and centipedes (Class Chilopoda) are characterised by elongated segmented bodies. These groups are differentiated with centipedes having one pair of legs per segment and millipedes have two pairs of legs per segment. Millipedes are typically decomposers in forest ecosystems (Figure 36) while centipedes are venomous predators and can inflict a painful bite to humans (Figure 37). The millipede depicted in Figure 36 comprised a large species frequently observed in both primary and secondary forests. As with many invertebrate taxa, their status in PNG is poorly known.

Figure 36: Millipede, VNP
Photo credit: Angus Fraser

Figure 37: Centipede, VNP
Photo credit: Angus Fraser

4.2.4. Arthropoda, Class Arachnida: Spiders

New Guinea's spider fauna is diverse, rich but poorly studied with very little taxonomy on PNG's spider fauna having been undertaken in the last 50 years (Robinson, 1982).

Spiders are easily differentiated among the invertebrates given their possession of eight legs. Highly adaptive and diverse, spiders have successfully colonised a broad range of microhabitats throughout the Park, including the soil subsurface (excavated burrows), leaf litter, vegetation and arboreally in elaborately constructed silk webs either socially or as solitary individuals. Several species of semi-aquatic spiders also inhabit the lake Lifilikatabu complex and Nairogo Creek and its tributaries. It is likely that several hundred species of spider occur within the Park with the most common and easily observed species including:

- *Nephila sp*
- *Argiope sp.*
- *Gastracantha sp. and*
- *Nihoa verireti*

Nephila sp (Golden Orb spider) is occasionally observed in both secondary and primary forests within the Park. Widely recognised for their large size, large webs and golden coloured silk. Adult female Golden Orb spiders build elaborately constructed webs capable of capturing large insects, small birds and bats (Figure 38).

Nihoa verireti is a large burrowing tarantula currently known only from Varirata National Park, although it is likely to be widespread on the Sogeri Plateau. This species is variable in colour occurring in a broad range of habitats from savannah to primary forests. Primarily a nocturnal predator it builds a silken lined cylindrical burrow that can extend up to 1 meter underground (Figure 39).

Figure 38: Golden Orb spider (*Nephila sp.*), VNP
Photographed in primary forest along the Scarp Track. Photo credit: Angus Fraser

Figure 39: Tarantula (*Nihoa verireti*), VNP
This species was named in 1994 and is currently known only from Varirata National Park. Photo credit: Angus Fraser

4.2.5. Arthropoda, Class Malacostraca: Freshwater Crabs

There is one family, Sundathelphusidae, and three genera, viz. *Rouxana*, *Geelvinkia*, and *Holuthisana*, and 14 species of freshwater crabs known from New Guinea. There is a single cryptic species in the small streams of Varirata National Park: *Holuthisana papuana* (Figure 40).

Figure 40: Freshwater crab (*Holuthisana papuana*), VNP
Photo credit: Angus Fraser

4.2.6. Arthropoda, Class Insecta: Insects

Within the invertebrates, insects are the most prolific group and comprise approximately 75% of all animal species on earth (CSIRO, 2018) with estimates of PNG's insect diversity ranging between 300,000 to 400,000 species (Miller, 1994). However, in a broader context, PNG's insect fauna is not well known and this is also the case regionally. Of the estimated 300,000 species of Australian insects, approximately only 160,000 have been identified to date (Aust Museum, 2018).

Within the insects, PNG's Lepidoptera (butterflies) are the most comprehensively studied group to date (Miller, 1994; Parsons, 1998). Appraisal of PNG's butterfly richness during survey provides a useful indication of habitat quality. Other key indicators of habitat quality in the insect taxa are the Odonata (dragonflies and damselflies), which are highly dependent upon good water quality during the nymph phase of their life history. Their diversity at any given site reflects habitat quality.

As expected, insect taxa are abundant throughout the Park. Iconic species such as the Birdwing Butterfly (*Ornithoptera priamus*), Blue Emperor Butterfly (*Papilio ulysses*), and many species of dragonflies, and cicadas are frequently observed in the Main Picnic Area, adjacent to the Lake Lifilikatabu complex and along walking trails adjacent to Nairogo Creek. Nocturnal species such as the large Rhinoceros Beetle

(*Xylotrupes gideon*), various species of longhorn beetles (Family Cerambycidae) and katydids are often attracted to artificial light sources as are an inordinate number of moth species.

4.2.6.1. Order Blattodea: Termites

Termites are key species in tropical monsoonal forests where their role as detritivores and environmental engineers promotes nutrient cycling, soil structure, soil moisture content and plant diversity (Ali et.al, 2013). Under appropriate atmospheric conditions, flying termites swarm (Figure 41) to mate after which they will shed their wings and commence the establishment of a new colony (Figure 42). The colonies depicted in Figure 42 are prominent, and primarily occur in the eucalypt savannah habitat.

Figure 41: Termites (Order Blattodea), VNP
Photo credit: Angus Fraser

Figure 42: Termite (Order Blattodea) mound in Eucalypt Savannah, VNP
Photo credit: Angus Fraser

4.2.6.2. Order Orthoptera: Grasshoppers & Katydids

This order includes grasshoppers, katydids and their relatives and comprises approximately 20,000 species worldwide with highest diversity recorded from the tropics (ALA, 2018). The diversity of Orthopterans in PNG is poorly understood, as is their status in VNP.

Orthopterans are differentiated from other insects by several unique anatomical characteristics, the most obvious being their elongated hind legs enlarged and modified to enable jumping. They are also widely known for their ability to generate sound either by rubbing their front wings together (crickets and katydids) or rubbing their forewings and legs together (grasshoppers and locusts). Often these insects are easier to observe at night spotlighting when they are active. They vary markedly in appearances with some species outrageous in colour (Figure 43) while many are cryptically camouflaged (Figure 44).

Figure 43: Katydid (Family Tettigonidae) in primary forest, VNP
Photo credit: Angus Fraser

Figure 44: Katydid (Family Tettigonidae) in secondary forest, VNP
Photo credit: Angus Fraser

4.2.6.3. Order Odonata: Dragonflies & Damselflies

Globally, the Odonata comprise an estimated 6,000 species of which 8% occur regionally in New Guinea (including West Papua) and includes 490 species of which 179 species are dragonflies and 311 species are damselflies. The dragonflies of PNG currently comprise 39 genera and approximately 122 species of which at least 10 species occur within the Park.

Currently, expectations are that many new species are yet to be described given much of New Guinea requires further investigation into the diversity of this group. Endemism is high within the Odonata with the majority of species found in New Guinea unique to the island (Kalkman & Orr, 2013; Orr & Kalkman, 2015).

Odonata are reliant on aquatic habitat with adults laying eggs that hatch into predatory nymphs, which remain submerged until they are ready to metamorphosis into imago (winged adults). Damselflies in particular are often associated with pristine habitats and are considered useful indicators of ecological condition (Kalkman & Orr, 2013). Common species regularly observed within the Park include:

- *Ictinogomphus australis lieftincki* (dragonfly) (Figure 45 and Figure 46);
- *Neurothemis stigmatizans* (dragonfly);
- *Orthetrum villosovittatum* (dragonfly);
- *Rhyothemis sp* (dragonfly); and
- *Idiocnemis sp* (damselfly) (Figure 47)

Within the Park, dragonflies and damselflies are most readily observed around the lakes and the banks along Nairogo Creek and its tributaries.

Figure 45: Dragonfly (Ictinogomphus australis lieftincki)
Photo credit: Dan Polhemus

Figure 46: Nymph metamorphosis (*Ictinogomphus australis lieftincki*), VNP
This specimen was observed and photographed during its metamorphosis from nymph to adult in Lake Lifilikatabu at night. Note the wings remain folded and have not yet been vascularised enough to assume the normal resting position diagnostic of dragonflies. Photo credit: Angus Fraser

Figure 47: Damselfly (*Idiocnemis* sp.), VNP
Photo credit: Angus Fraser

4.2.6.4. Order Lepidoptera: Butterflies

There are five families, 170 genera and 820 species of butterflies found in PNG (Parsons, 1998). Well known for its birdwing butterflies from the genus *Ornithoptera* and *Troides*, PNG is ranked PNG 12th in the world for

endemism in large butterflies (Parsons, 1998; Miller 1994). Given the broad body of knowledge available for PNG's butterfly fauna, local assessment of butterfly diversity as a key indicator of biodiversity is often used as an appropriate tool in determining ecological condition of habitats. Although not substantiated quantitatively, observations made during the biodiversity surveys indicate a rich proportion of PNG's butterfly taxa occur within the Park.

Many butterfly species in the Park are small and inconspicuous, but can be viewed imbibing minerals along stretches of Nairogo Creek and its tributaries. The landscaped areas of the Park's picnic grounds also provide good opportunity for viewing many of the Park's butterfly species including the New Guinea Birdwing (*Ornithoptera priamus*) (Figure 48) and the large iridescent Blue Emperor (*Papilio ulysses*). The New Guinea Birdwing lays it eggs on a vine from the genus *Aristolochia*, when the eggs hatch the caterpillars feed exclusively on the host plant. Other species such as the Red Lacewing (*Cethosia cydippe*) are frequently observed around the Lake Lifilikatabu complex (Figure 49). In the evenings hundreds of moth species can be attracted to artificial light sources including species from the family Saturniidae (*Figure 50*).

Figure 48: Common Birdwing Butterfly (*Ornithoptera priamus*)
Photo credit: Dan Polhemus

Figure 49: Red Lacewing (Cethosia cydippe), VNP
Photographed adjacent to the Lake Lifilikatabu complex. Photo credit: Angus Fraser

Figure 50: Saturniid moth (*Family Saturniidae*), VNP
Photographed in flight using a camera trap and light source configured specifically for this purpose enabling non-destructive sampling to be undertaken for insect taxa. Photo credit: Angus Fraser.

4.2.6.5. Order Coleoptera: Beetles

Coleoptera are the largest and most diverse group of insects and are estimated to comprise approximately 30% of all animals on earth (CSIRO, 2018). The number of species in PNG estimated to range between 30,000 to 40,000 (ABC, 2015) and probably comprise 25% of the Park's invertebrates. The taxonomy and ecology of PNG's diverse beetle fauna has been the focus of many entomologists, however significant gaps remain in the current body of knowledge (Miller, 1994).

Most species are cryptic and inconspicuous, however diurnal species such as Eupholus weevils (Figure 51) are often quite easy to observe along the walking tracks. Nocturnal Rhinoceros Beetles (*Xylotrupes gideon*) are often attracted to light sources (Figure 52) as

are large species of longhorn beetles (Figure 53). Other species such as the water beetles (*Spinosodineutes* sp) that occur in large numbers on Lake Lifilikatabu demonstrate the incredible adaptability of this taxa.

Figure 51: Weevil (*Eupholus* sp.) VNP
Photo credit: Angus Fraser

Figure 52: Rhinoceros Beetle (*Xylotrupes gideon*), VNP
Photographed in flight using a camera trap and light source configured specifically for this purpose enabling non-destructive sampling to be undertaken for insect taxa. Photo credit: Angus Fraser

Figure 53: Longhorn Beetle (*Agrianome* sp.), VNP
Photo credit: Angus Fraser

4.2.6.6. Order Hymenoptera: Bees, Wasps & Ants

Globally estimates indicate that over 100,000 species belong to the Order Hymenoptera (AM, 2018), which includes bees, wasps, sawflies and ants. PNG's Hymenoptera fauna is incompletely known with little published information available on the diversity and endemism of this group in PNG despite being considered globally abundant.

The Hymenoptera have evolved to fulfil a variety of ecological roles. They comprise predators, pollinators, and scavengers while the ecology of some species also promotes seed dispersal (CSIRO, 2018). Many species of bees, wasps and ants live in complex social structures and can be harmful to humans if bitten with severe cases resulting in fatality. Bees (Figure 54) and ants (Figure 55) are common throughout the Park.

Figure 54: Bumble Bee (Order Hymenoptera) VNP
Photo credit: Angus Fraser

Figure 55: Rainbow Ant (Order Hymenoptera) VNP
This species was photographed in primary forest. Photo credit: Angus Fraser

4.2.6.7. Order Hemiptera: Cicadas, Stink Beetles & Bugs

Hemipterans are a diverse order of insects and include leaf hoppers, bugs, cicadas that have several anatomical features in common including a piercing rostrum, which extends ventrally from the head (CSIRO, 2018).

All species within the sub order Auchenorrhyncha (including cicadas) feed primarily on plant phloem (sap). Both diurnal (Figure 56) and nocturnal (Figure 57) species of cicadas occur within the Park. Communal species are particularly noticeable given that males of some species can emit sounds louder than 100 decibels.

Figure 56: Diurnal cicada sp (Order Hemiptera), VNP
Photo credit: Angus Fraser

Figure 57: Nocturnal cicada sp (Order Hemiptera), VNP
Photographed in flight using a camera trap and light source configured specifically for this purpose enabling non-destructive sampling to be undertaken for insect taxa. Photo credit: Angus Fraser

4.2.7. Phenology of Invertebrates

The invertebrates that occur in the Park are present throughout the year in various stages of their life histories. They also appear to breed throughout the year and therefore no obvious phenological patterns have been observed.

4.3. Vertebrates Composition, Richness, Endemism and Phenology

A total of 3,952 vertebrate species (marine and terrestrial) are currently described from PNG. This is approximately 8% of the world's total vertebrates, including marine vertebrates, and approximately 5% of worlds total terrestrial vertebrates (Allison, Pacific Biological Survey databases).

Vertebrate diversity within VNP's forests and savannah ecosystems is significant, with 332 native species in addition to six introduced species, equating to approximately 16% of terrestrial vertebrates known from PNG (Table 1). No species are endemic to the Park.

Table 1: Vertebrate Species Richness, VNP and PNG

VNP Native Vertebrate sp	332
VNP Introduced Vertebrate sp	6
Total Vertebrate sp VNP	338
Total terrestrial Vertebrate sp PNG	2,115
VNP % of PNG's Vertebrate sp	16%

4.3.1. Freshwater Fishes

The freshwater fish fauna of PNG is depauperate compared to other vertebrate groups, with only 324 currently described native species (*Table 2*). Four of these occur in Central Province, namely the Four Spined Perchlet (*Tetracentrum apogonoides*); Moresby Mogrunda (*Mogurnda pulchra*), Short Finned Tandan (*Neosilurus brevidorsalis*), and Goldie River Rainbow Fish (*Melanotaenia goldiei*). Literature indicates these species also occur in the Park (Figure 58 to Figure 61). The Short Finned Tandan is occasionally harvested in Nairogo Creek and its tributaries by local Koiari who hunt this species at night with a spotlight and the flat edge of a bush knife, which is used to stun the fish in shallow waters.

Table 2: Freshwater Fish Species Richness, VNP and PNG

Native Fish sp	4
Introduced Fish sp	2
Total Fish sp VNP	6
Total Fish sp PNG	324
VNP % of PNG's sp	<1%

* In addition to the Freshwater Fishes, PNG has 1,786 marine fishes and 24 brackish water fishes

Figure 58: Goldie River Rainbow fish (*Melanotaenia goldiei*)
Photo credit: Gerald Allen

Figure 59: Short Fin Tandan (*Neosilurus brevidorsalis*)
Photo credit: Gerald Allen

Figure 60: Four-spined Glass Perchlet (*Tetracentrum apogonoides*)
Photo credit: Gerald Allen

Figure 61: Moresby Mogurnda (*Mogurnda pulchra*)
Photo credit: Gerald Allen

Two introduced species, the Mozambique Tilapia (*Oreochromis mossambicus*) (Figure 62) and the Common Guppy (*Poecilia reticulata*) (Figure 63), are widespread in Central Province and also occur within the Park.

Tilapia are common in the Lake Lifilikatabu complex and do occur in Nairogo Creek, while the guppy was recorded from Nairogo Creek during IPCA's biodiversity surveys. It is suspected that Tilapia was deliberately released into the Lifilikatabu complex as a food resource. A checklist of fishes found in the Park is presented in APPENDIX 3.

Figure 62: Mozambique Tilapia (*Oreochromis mossambicus*)
Photo credit: Gerald Allen

Figure 63: Common Guppy (*Poecilia reticulata*)
Source: Fotosearch.com

4.3.1.1. Phenology of Fishes

Insofar as is known the fishes breed through the year.

4.3.2. Amphibians

There are five families, 29 genera and 370 species of native frogs, known from Papua New Guinea of which 288 (78%) are endemic to the country. There are at least 23 native species of frogs found in the Park in addition the widespread cane toad, *Rhinella marina*, which was introduced to PNG in 1937 (Table 3 and Figure 64). Further field surveys are expected to reveal the presence additional species likely to occur in the Park such as the arboreal green tree frog *Litoria graminea* among others. In addition a taxonomic review of the *Litoria* genus, which is well represented in the Park will also likely result in the description of new species.

Table 3: Amphibian Species Richness, VNP and PNG

Native Amphibian sp	23
Introduced Amphibian sp	1
Total Amphibian sp VNP	24
Total Amphibian sp PNG	371
VNP % of PNG's Amphibian sp	6%

Figure 64: Introduced Cane Toad (*Rhinella marina*)
Photo credit: Angus Fraser

The Park's frog fauna are diverse and abundant and can be relatively easily observed in the lakes and tributaries within the Park of an evening or after late afternoon rain when their calls can be voluminous. Five species are commonly found around the Lake Lifilikatabu complex, namely: *Papurana daemeli*, *Litoria chloristona*, *L. nasuta*, *L. priora* and *Nyctimystes infrafrenatus*. The beds of *Elaeocharis* sedges along the shore of the lakes are prime habitat for, *L. chloristona* (Figure 65 and Figure 66). The Park also contains species of frogs belonging to the genus *Paedophryne,* which at < 8 mm are the smallest frogs currently known. These frogs live in the leaf litter of primary forest and while easily heard, they are inordinately difficult to locate (Figure 67). The Cane Toad is found throughout the Park but is particularly abundant around the open areas such as the Main Picnic Area.

A checklist to the frog species of the Park is provided in APPENDIX 4. In addition, a standalone Field Guide Brochure has been prepared presenting all 24 species of frogs currently known to occur in the Park and briefly describes their habit to assist in their identification in the field.

Figure 65: *Litoria chloristona*, Lake Lifilikatabu complex
Photo credit: Angus Fraser

Figure 66: *Elaeocharis* sp sedges along the shoreline of Lake Lifilikatabu complex
Photo credit: Angus Fraser

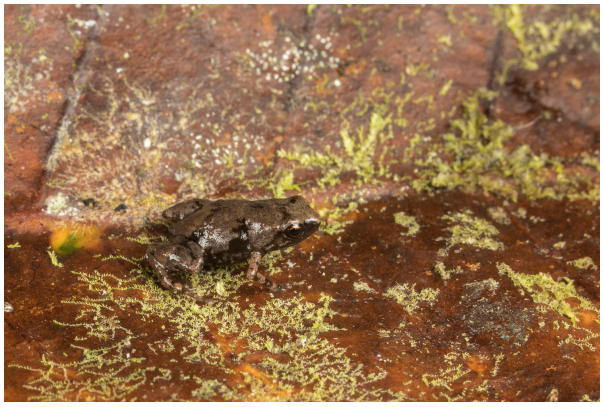


Figure 67: Frog from the genus Paedophryne, VNP
These frogs are < 8 mm in length. Photo credit: Angus Fraser

4.3.2.1. Phenology of Frogs

The frogs inhabiting the Park, as with most rain forest frogs throughout Papua New Guinea, breed throughout the year. All of the known species in Varirata National Park are nocturnal. They call throughout the year but generally call most intensely following late afternoon or early evening rain.

4.3.3. Reptiles

There are five families, 32 genera, and 346 species of reptiles known from PNG. This includes 18 marine and freshwater turtles, two species of crocodiles, 210 species of lizards and 116 species of snakes (both terrestrial and marine species). Forty-four reptile species have been recorded from the Park, comprising the first detailed appraisal of reptiles from VNP (Table 4).

Table 4: Reptile Species Richness, VNP and PNG

Reptiles	VNP	PNG
Native Lizard sp	26	210
Native Turtle sp	1	18
Native Snake sp	17	116
Native Crocodile sp	0	2
Introduced Reptile sp	0	0
Total Reptile sp VNP	44	346
VNP % of PNG's Reptile sp		13%

There is at least one species of turtle, *Emydura subglobosa*, known from the Park (*Figure 68*), together with 26 species of lizards and 25 species of snakes (APPENDIX 5). Approximately 66% of the lizards known from PNG are skinks (family Scincidae). The largest species of skink in PNG, the New Guinea Blue Tongue (*Tiliqua gigas*), which reaches > 30 cm in total length occurs within the Park Figure 69.

Figure 68: Red Bellied Short Necked Turtle (*Emydura subglobosa*), VNP
Photo credit: Angus Fraser

Figure 69: New Guinea Blue-tongue (*Tiliqua gigas*)
Photo credit: Allen Allison

Snake diversity within the Park is considered high and includes five highly venomous and dangerous species, including the widespread but relatively uncommon small-eyed snake (*Micropechis ikaheka*) (Figure 71) and the Papuan Taipan (*Oxyuranus scutellatus*), which has undergone significant range reduction throughout its southern New Guinea distribution (Figure 71). The Papuan Taipan is among the most venomous snakes in the world (O'Shea, 1996). Several species of python also occur in the Park, notably the impressive Olive Python (*Apodora papuana*), the largest snake in PNG, which can grow to over 4 m and is capable of killing large game. The White Lipped Python (*Leiopython albertisii*) also occurs in the Park and can grow upwards of 2.5 m (Figure 72).

Figure 70: Small-eyed Snake (*Micropechis ikaheka*) [venomous] VNP
Photo credit: Angus Fraser

Figure 71: Papuan Taipan (*Oxyuranus scutellatus*) [venomous], VNP
Papuan Taipans are the most venomous snake in PNG and the Taipan genus is considered to be among the most venomous snakes in the world. They are extremely wary but very aggressive if disturbed. They usually have a broad orange stripe running down the backbone like the specimen in this image. Photo credit: Angus Fraser

Figure 72: White Lipped Python (*Bothrochilus meridionalis*), VNP
Photo credit: Angus Fraser

4.3.3.1. Phenology of Reptiles

Rainforest reptiles in Papua New Guinea reproduce throughout the year without a distinct breeding season. Some species, such as the New Guinea bluetongue, *Tiliqua gigas*, produce live young; most species lay eggs.

4.3.4. Birds

The diversity and richness of PNG's avifauna unequivocally places it as one of the world's great tropical regions of avian biodiversity (Beehler & Pratt, 2015). There are 99 families, 335 genera and 813 species of birds known from Papua New Guinea. Varirata National Park includes a rich proportion of these, with 58 families, 150 genera and 231 species (Table 5). Excluding marine species and most groups of waterbirds (for which there is little suitable habitat within the Park), the Park's avifauna includes nearly half the species of forest birds found within Papua New Guinea. This is extraordinary diversity given the relatively small area (1,063 ha) of the Park.

Table 5: Bird Species Richness, VNP and PNG

Native Bird sp	231
Introduced Bird sp	0
Total Bird sp VNP	231
Total Bird sp PNG	813
VNP % of PNG's Bird sp	28%

*548 species are resident, and 265 are migratory comprising a total count of 813 species

Of conservation significance is the rare Forest Bittern (*Zonerodius heliosylus*), and Gurney's Eagle (*Aquila gurneyi*), which are both listed as 'Near Threatened' under the IUCN Red List (Figure 73 and Figure 74). Both are lowland species, which have been subject to large scale range reduction mainly due to habitat loss.

Figure 73: Forest Bittern (*Zonerodius heliosylus*), VNP
The Forest Bittern is listed as 'Near Threatened' Under the IUCN Red List. Photo credit: Angus Fraser

Figure 74: Gurney's Eagle (*Aquila gurneyi*) harassed by a Peregrine Falcon, VNP
Photo credit: Angus Fraser

Due to the richness of the Park's avifauna and ease of access from Port Moresby VNP is considered one of the prime birding spots within Papua New Guinea, with many tour leaders bringing their groups to the Park. Historically the Park was also frequented by members of the Papua New Guinea Bird Society, and as a result the avifauna is quite well known and well documented. APPENDIX 6 presents the checklist for species occurring within the Park with subsections categorised according to each of the five key habitats (Primary and Secondary Forest, Eucalypt Savannah, Forest Edge and Aquatic habitat).

4.3.4.1. Phenology of Birds

Most of the birds that occur in the Park are year-round residents and breed in the or near the Park. At least seven species, however, are seasonal migrants that generally migrate north from Australia during the austral winter, roughly May to September Table 6. Often termed Australian migrants, these species include such birds commonly seen in urban areas and gardens, open areas and forest edge such as the Rainbow Bee-eater, Sacred kingfisher and the Dollarbird. Other migratory species inhabit the forest interior. These include the buff-breasted paradise kingfisher, red-bellied pitta, black-faced monarch, and rufous fantail.

Table 6: Seasonal Patterns in the avifauna of VNP

	J	F	M	A	M	J	J	A	S	O	N	D
Australian Migrants			■	■	■	■	■	■	■			
Moulting									■	■		
Breeding	■	■	■	■	■	■	■	■				

4.3.4.2. Important Bird Species

Arguably the most interesting birds in the Park are the birds of paradise. They are iconic species in PNG, on account of their bright plumage, interesting mating habits and cultural significance. There are five species found in the Park including the Crinkle Collared Manucode (*Manucodia chalybatus*); Trumpet manucode (*Phonygammus keraudrenii*); Growling Rifle Bird (*Ptiloris intercedens*); Magnificent (*Diphyllodes magnificus*) and Raggiana Bird of Paradise (*Paradisaea raggiana*) (APPENDIX 6). The Raggiana Bird of Paradise is the national emblem of Papua New Guinea (Figure 75). It is common throughout the Park and displays in leks in the tree canopy. There are at least two known display trees in the Park and visitors are assured a good chance of observing this incredible spectacle between May to late September (Figure 76).

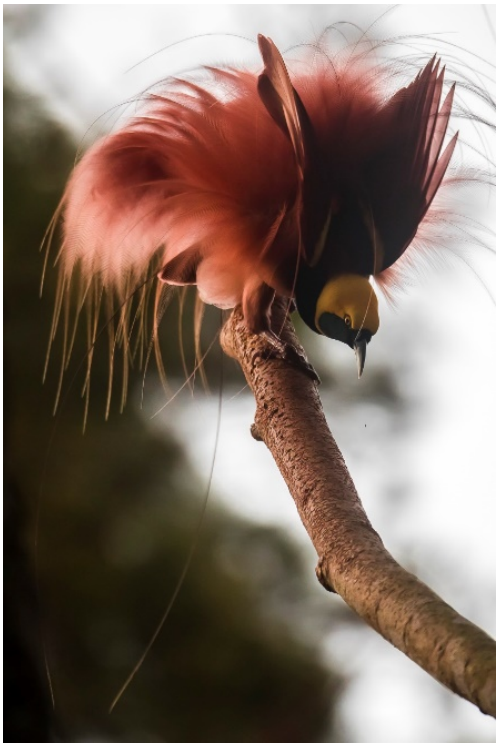


Figure 75: Raggiana Bird of Paradise (*Paradisea Raggiana*), VNP
Photo credit: Angus Fraser

VNP was the location where in 1998 it was discovered that the Hooded Pitohui (Pitohui dichrous) was one of the world's only poisonous species of birds (Dumbacher, 1999). John Dumbacher uncovered this mystery by accident when after handling Hooded Pitohui in mist nets and subsequently licking a scratch on his finger his mouth immediately began to tingle and burn. He subsequently had feather samples chemically analysed, which confirmed that the feathers of the Hooded Pitohui contain batrachotoxins. These chemicals are extremely potent cardio and neurotoxic steroidal alkaloids, the same chemicals found in poison dart frogs of central and south America.

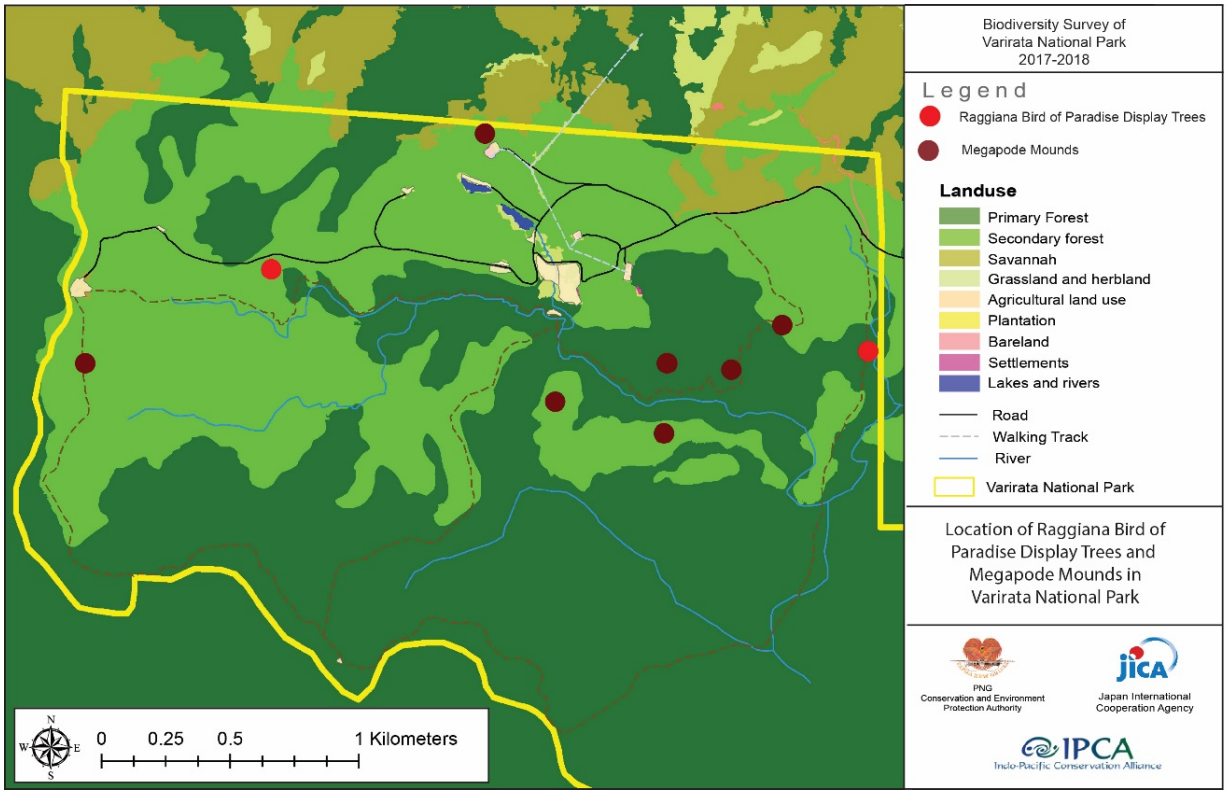


Figure 76: Map of Raggiana display leks and megapode mounds

It was subsequently revealed that the Hooded Pitohui obtained these toxins from its diet - Melyridae beetles. The Hooded Pitohui is commonly seen around the Main Picnic Area and secondary forest towards the Park entrance (Figure 77).

Figure 77: Hooded Pitohui (*Pitohui dichrous*), VNP
Photo credit: Angus Fraser

Another interesting group of birds occurring in the Park are the megapodes. There are two species of megapodes found in the Park, Yellow-legged Brush turkey (*Talegalla fuscirostris*) and Orange-footed Scrub fowl (*Megapodius reinwardt*) Figure 78. These chicken-sized birds are generally solitary but they collect soil and leaf litter from the forest to create large mounds in which they deposit their eggs (Figure 79). The heat from the decaying vegetation incubates the eggs and when the hatch, the young receive no parental care, which is unusual in avifauna.

Figure 78: Yellow Legged Brush turkey (*Megapodius reinwardt*), VNP
Photo credit: Dabio Moi

Figure 79: Megapode mound nest along self guide track, VNP
Photo credit: Angus Fraser

Megapode mounds are located along all the major walking trails within the Park, with one of the largest mounds located near the beginning of the Scarp Track Figure 76.

Many of the birds found within Varirata National Park, including all of the birds of paradise, pigeons, berrypeckers and others are dependent on fruit produced by various species of primary rain forest trees. There are at least 42 species of figs (genus *Ficus*) found within the Park. One of the species, which has bright orange fruit, is common at the forest edge. It was in fruit during November – December 2017 and was frequently visited by Raggiana Birds of Paradise, Brown Orioles (*Oriolus szalayi*), and several species of fruit doves and pigeons (Figure 80). There is a large tree near the Lodge, several in the Main Picnic Ground and another one at the beginning of the Scarp Track at the edge of the main Lookout.

Several other sought after species including two species of Paradise King Fisher, the Brown Headed (Tanysiptera danae) and Buff Breasted (Tanysiptera sylvia), the New Guinea Harpy Eagle (Harpyopsis novaeguineae), Cassowary (Casuarius casuarius) and a plethora of other widely recognized species such as Blythe's Hornbill (Rhyticeros plicatus) are also found within the Park.

Figure 80: Pink-spotted Fruit Dove (*Ptilinopus perlatus*) feeding on fig fruit

This tree located near the lodge was frequently visited by a number of frugivorous birds, including the Pink-spotted Fruit Dove, Raggiana Bird of Paradise, Brown Oriole and many others. Photo credit: Allen Allison

4.3.5. Mammals

There are 25 families, 117 genera and 263 species of mammals found in Papua New Guinea of which 82 species are endemic. The checklist of mammals for the Park contains 33 confirmed species in addition to three introduced species. A further 29 species are highly probable residents of the Park and as yet have not been recorded (Table 7 and APPENDIX 7).

The checklist for the mammals is presented in three sections. The first section contains 33 species, which includes species confirmed from historical accounts (Hopkins & Hisao, 1994) in addition to species that have been recently been confirmed to occur in the Park through JICA's Camera Trap Program and IPCA's biodiversity surveys. The confirmed number of species represents approximately 10% of PNG's mammalian taxa.

The second section of the checklist comprises a list of 29 probable species, which are strongly believed to occur in the Park based on their occurrence on the Sogeri Plateau, literature reviews and field experience. Confirmation of the 'probable' species from the Park will double the recorded mammal diversity to represent approximately 24% of the country's mammalian taxa. This is significant.

Table 7: Mammal Species Richness, VNP and PNG

Group	Native sp Confirmed	Native sp Probable	Introduced	VNP Total	PNG Total	*VNP % PNG
Mammals Comprising:						
Monotremes	1	0	0	1	2	50%
Marsupials	14	5	0	19	76	18%
Rodents	8	8	1	17	91	10%
Pigs and Deer	0	0	2	2	2	100%
Bats	7	16	0	23	92	8%
Total Terrestrial Mammals	30	29	3	62	263	13%

NB: Native sp confirmed represents species listed in Appendix 7.1 and Native sp Probable represents species listed in Appendix 7.2. * VNP % PNG is calculated assuming confirmed and introduced species only, rounded up. This is a conservative approach given that the records of mammals for the Park are likely to also include probable species. Note the total Mammals for PNG is 293 including marine species.

The third section of the checklist comprises a list of 25 possible species that were predicted to occur in the Park through shape file analysis, however it is believed unlikely that these species are present in the Park. Further mammal surveys are required to confirm their status in VNP.

The introduced species include: wild pigs (*Sus scrofa*), which occur throughout the Park (Figure 81 to Figure 84); Rusa Deer (*Cervus timorensis*), which transit through Primary

Forest but are found mostly in the Secondary Forest and Savannah (Figure 85), and the Black Rat (*Rattus rattus*), which is largely associated with human habitation and dwellings (Figure 86).

Figure 81: Wild Pig (*Sus scrofa*) in Secondary Forest, Scarp Track, VNP
Photo credit: JICA Camera Trap Program, 29-Feb-2016

Figure 82: Wild Pig (*Sus scrofa*) in Primary Forest along the Self Guide Track, VNP
Photo credit: JICA Camera Trap Program, 7-Apr-2016

Figure 83: A Wild Pig grass nest in Eucalypt Savannah, VNP
Photo credit: Angus Fraser

Figure 84: Wild Pig wallows are often encountered along watercourses, VNP
A lack of recent rain and coloured water indicates that this is a fresh wallow encountered along a watercourse in secondary forest. Wallows were often seen in both Primary and Secondary Forests during the IPCA Biodiversity Surveys. Photo credit: Angus Fraser

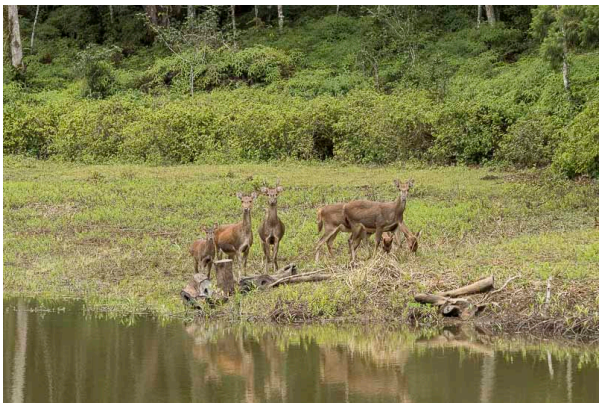


Figure 85: Rusa Deer (*Cervus timorensis*) watering at Lake Lifilikatabu during the dry season
Photo credit: Angus Fraser

Figure 86: Black Rat (*Rattus rattus*) near the IPCA, field camp
Photo credit: Angus Fraser

Dogs (*Canis familiaris*) have frequently been recorded by JICA's camera traps as vagrants (Figure 87), or as itinerants with their owners as they traverse through the Park from neighbouring communities (Figure 88). Less common are expatriates, likely from Port

Moresby walking the trails with their dog on a lead (Figure 89). Vagrant dogs have been captured on camera excavating bush turkey nests in search of eggs and have also been observed by IPCA's Field Survey Team hunting large game very close to the Park boundary.

Figure 87: Itinerant dog (*Canis familiaris*) on Gare's Track
Photo credit: JICA Camera Trap Program, 9-Sep-2016

Figure 88: Domestic dogs often accompany villagers in transit through the Park
Note the dog positioned in the bend in the track.
Photo credit: JICA Camera Trap Program, 2-Dec-2015

Figure 89: Port Moresby expatriates walking their dog on a lead, VNP
Photo credit: JICA Camera Trap Program, 27-May-2017

Figure 90: Itinerant dog excavating a bush turkey nest, VNP
Photo credit: JICA Camera Trap Program, 23-Sep-2015

Evidence of cats (*Felis catus*) in the Park has also been documented on JICAs camera traps, however their status as part of a feral breeding population is less clear with two cats occasionally captured by JICA's camera trap in close vicinity of the Head Ranger's quarters (Figure 91). Both cats and dogs have been identified as key species to control in the Invasive Species Management Plan (IPCA, 2018d) however they have not been included in the mammal checklist.

Figure 91: Cat (*Felis catus*) caught on camera trap near the Park Ranger living quarters
Photo credit: JICA Camera Trap Program, 27-Sep-2015

4.3.5.1. Rodents

Hiaso (1998) studied rodent ecology in the Park and documented the occurrence of seven species: *Melomys lutillus*, *M. rufescens*, *Paramelomys moncktoni*, *P. platyops*, *Rattus verecundus*, *Uromys caudimaculatus*, and *Pogonomys* sp. In addition, the JICA camera traps have subsequently confirmed the presence of an eighth species, *Hydromys chrysogaster*. IPCA surveys confirmed that of the three world-

wide human commensal rodents, viz. *Mus musculus*, *Rattus norvegicus*, and *R. rattus* which could be expected to occur in the Park only the Black Rat (*R. rattus*) has been confirmed as present. As such, nine species of rodent are confirmed to occur within the Park and have been recorded on the checklist. An additional eight species are firmly believed to occur in the Park.

Figure 92: Chestnut Tree Mouse (*Pogonomys macrourus*)
The Chestnut Tree Mouse is highly arboreal and was frequently observed in primary forest at night. Photo credit: Angus Fraser

4.3.5.2. Marsupials and Monotremes

Fourteen species of marsupial and one monotreme have been recorded from the Park with an additional six species firmly believed to occur in the Park but are yet to be confirmed.

Hopkins and Hiaso (1994) recorded nine species of marsupials including: the New Guinea Quoll (*Dasyurus albopunctatus*), two macropods, the Agile Wallaby (*Macropus agilis*) and Dusky Pademelon (*Thylogale brunii*), at least two species of bandicoots (*Isoodon macrourus* (Figure 93) and *Peroryctes broadbenti*), two species of cuscus (phalangerids) comprising, Southern Common Cuscus (*P. orientalis,* which is now regarded as *P. intercastellanus*) (Figure 94) and Common Spotted Cuscus (*Spilocuscus maculates*), in addition to the striped possum (*Dacrylopsila trivirgatai*), and the sugar glider (*Petaurus breviceps*) (Figure 95).

Figure 93: Northern Brown Bandicoot (*Isoodon macrourus*), VNP
Photo credit: Angus Fraser

Figure 94: Southern Common Cuscus (*Phalanger intercastellanus*)
Photo credit: Angus Fraser

Figure 95: Sugar Glider (*Petaurus breviceps*), VNP
Photo credit: Angus Fraser

More recently, JICA's Camera Trap Program confirmed the occurrence of three more species - the Ground Cuscus (*Phalanger gymnotis*), Gray Dorcopsis (*Dorcopsis luctuosa*) and the New Guinea Spiny Bandicoot (*Echymipera kalubu*). IPCA have subsequently confirmed the presence of two additional records for the Park – the Lowland Ringtail Possum (*Pseudochirulus canescens*) and the Feather Tailed Possum (*Distoechurus pennatus*) (Dutson pers.com).

One species of monotreme, the Long Beaked Echidna (*Tachyglossus aculeatus*) was reported to occur within the Park by Hopkins and Hisao (1994) who implied that it was probably relatively common. Although Long Beaked Echidnas are typically nocturnal and difficult to observe, discussions with Kisea, the long term serving Park Ranger who commenced work in VNP in 1979 revealed that he had never observed an echidna in the Park (Kisea, pers.com). Despite the uncertainty regarding the status of the echidna in the Park, it is retained on the species checklist until its absence is demonstrated. As with the quoll this species has not been detected during the JICA Camera Trap Program, which commenced in Septmeber 2015 (JICA, 2017).

IPCA conducted targeted spotlight surveys for marsupials and observed all species listed by Hopkins & Hisao (1994) with the exception of the Spotted Cuscus and the quoll. The Spotted Cuscus species is reportedly regularly seen eating the flower stems of Spiked Pepper (*Piper aduncum*), which is also a favoured food of other phalangerids found within the Park.

Five other marsupial species are thought to occur in the Park but to date have yet to be detected. During Hiaso's (1998) study of murid rodents in eucalypt savannah, secondary and primary forest within the Park, 3100 trap nights were undertaken which obtained 138 returns, a trapping success rate of around 4%. This is fairly standard for New Guinea. Although one of his study sites was in savannah Hiaso did not report capturing *Planigale novaeguineae* (a species of small carnivorous marsupial) but implied that it may have been present. Flannery (1995) gives its altitudinal distribution as 250 m and below, suggesting it is not unreasonable to expect the animal to occur within the lower elevations of the Park, which ranges from 630 – 833 m. Although not confirmed, it is suspected that this species does occur in eucalypt savannah within the Park. It is also strongly suspected that three other species of Dasyurids occur within the Park and an additional bandicoot species – the Rufous Spiny Bandicoot (*Echymipera rufescens*). These species are included in the 'probable' section of the mammal checklist.

4.3.5.3. Bats

The bat fauna of the Park remains largely unknown. IPCA recorded 7 species of bats during targeted mist net surveys. The capture of two species in particular is interesting given that the Spurred Horseshoe Bat (*Hipposideros calcaratus*) and Rohu's Bat (*Philetor brachypterus*) were both recorded at elevations outside their reported range of 40-350 m and 1,600-2,100 m respectively (Flannery, 1995). The seven species of bats netted during survey are listed below:

- Diadem Horseshoe Bat (*Hipposideros diadema*) with reported range of 50 – 1,210 m;
- Spurred Horseshoe Bat (*Hipposideros calcaratus*) with reported range of 40 – 350 m (Figure 96);
- Small eared Nyctophilus (*Nyctophilus microtis*) with reported range of 200 – 2,600 m;
- Common Tube Nose Bat (*Nyctimene albiventer*) with reported range from sea level – 1,860 m (Figure 97);
- Unstriped Tube Nose Bat (*Paranyctimene raptor*) with reported range from sea level – 1,350 m;
- Rohu's Bat (*Philetor brachypterus*) with reported range of 1,600-2,100; and

- Common Blossom Bat (*Syconycteris australis*) with reported range from sea level – 3,000 m (Figure 98).

Figure 96: Spurred Horseshoe Bat (*Hipposideros calcaratus*) VNP
Photo credit: Angus Fraser

Figure 97: Common Tube Nose Bat (*Nyctimene albiventer*) VNP
Photo credit: Angus Fraser

Figure 98: Common Blossom Bat (*Syconycteris australis*), VNP
Photo credit: Angus Fraser

Wing beats of large fruit bats were regularly heard around the Main Picnic Area and sections of primary forest at night, however these species were not positively identified. The checklist contains sixteen species that are considered 'probable' Park residents however further surveys are required to verify their presence in the Park.

4.4. Species with Scheduled Conservation Significance

The IUCN Red List establishes seven categories of 'extinction risk', which can only be applied to a species if sufficient ecological data is available to make an informed decision against established assessment criteria (Figure 99).

Species that have been assigned as Vulnerable (VU), Endangered (EN), or Critically Endangered (CR) are classified as 'Threatened'. If threatening processes continue unmitigated these species are expected to become extinct.

Species, which have been assigned a Near Threatened (NT) status, have been assessed against established criteria and do not currently meet any of the 'Threatened' categories. However, Near Threatened taxa are considered to be of high risk in subsequently being classified as 'Threatened' in the absence of mitigating strategies.

4.4.1. Near Threatened Species

Under the IUCN Red List criteria, 78 'Near Threatened' taxa occur in Papua New Guinea of which three species occur within the Park (APPENDIX 8). Two species are birds, namely the Forest Bittern (*Zonerodius heliosylus*) and Gurney's Eagle (*Aquila gurneyi*).

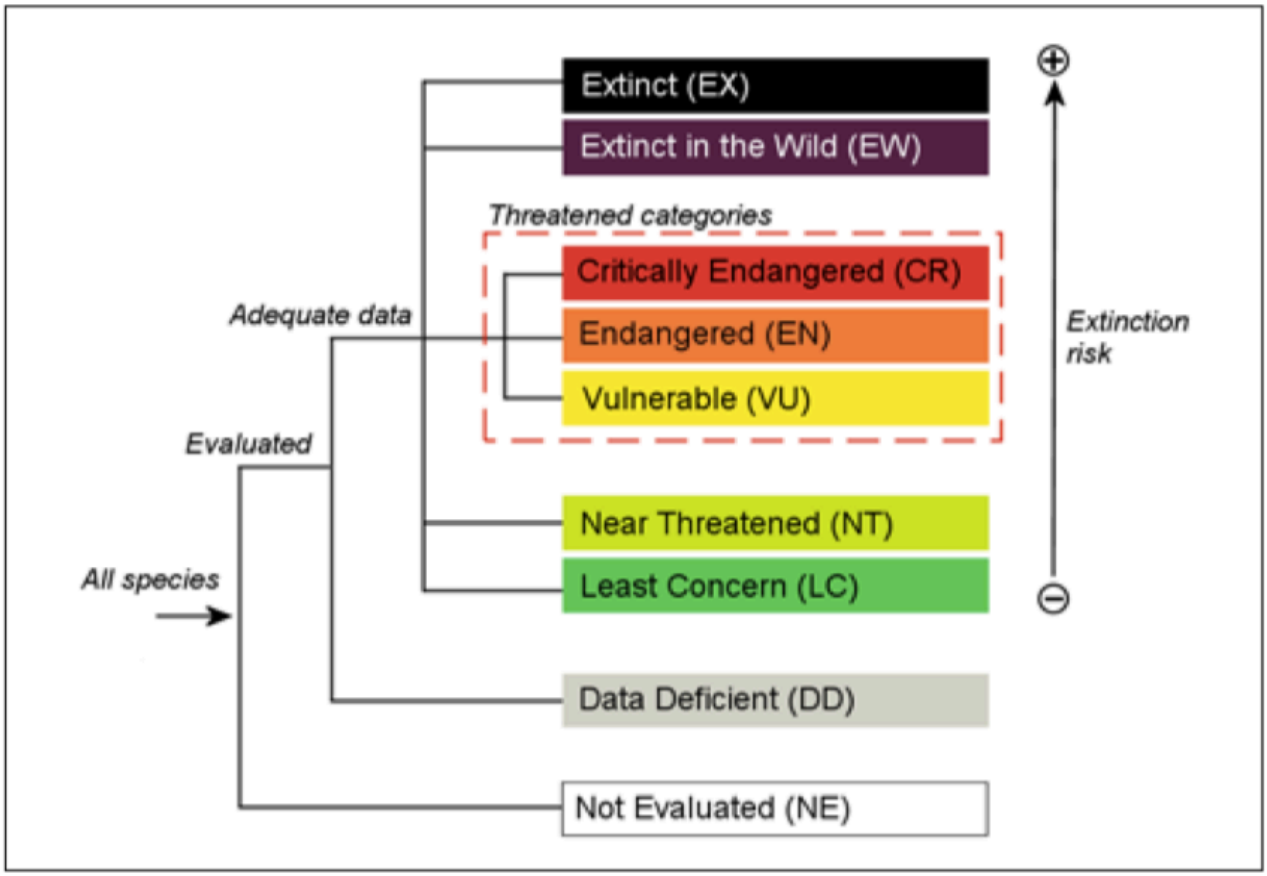


Figure 99: IUCN Red List Conservation Categories
Source: IUCN, 2018

The third species is a marsupial, the New Guinea Quoll (*Dasyurus albopunctatus*).

The rare Forest Bittern (*Zonerodius heliosylus*), is a lowland species, which has been subject to broad scale range reduction primarily due to habitat loss. It is shy and difficult to observe. Gurney's Eagle is a widespread but low density lowland species that occurs up to 1,000 m although it has been observed at 1,500 m. Both these species were observed during conduct of the biodiversity surveys.

The New Guinea Quoll is widespread and patchily distributed throughout its range. It has been recorded from sea level to 3,600 m but most often between 1,000 – 1,300 m. Key threats to this species are habitat loss, hunting pressure and possibly competition from feral cat populations (IUCN, 2018). It's status in the Park has not been confirmed since Hopkins & Hisao (1994).

4.4.2. Endangered Species

Under the IUCN Red List criteria, 68 'Endangered' or 'Critically Endangered' species of animals occur in Papua New Guinea, one of these species, the Giant Bandicoot, (*Peroryctes broadbenti)*, which is classed as 'Endangered', is known from the Park (Figure 100). There are no 'Critically Endangered' species in the Park.

Peroryctes broadbenti is endemic to the south-eastern peninsula of Papua New Guinea (Figure 101) and is thought to mainly be a lowland species, but is known from localities up to 1,000 m elevation (Flannery, 1995). It is uncommon to rare throughout its range. Although its status is not well known, its population is thought to be declining due to loss of habitat (Shearman et al., 2015) and over-hunting (IUCN Red List). *Peroryctes broadbenti* is the largest bandicoot in the world at nearly 5 kg and would fetch a high price in the bush meat trade.

Figure 100: Giant Bandicoot (*Peroryctes broadbenti*)
Photo credit: Roy Mackay

Hopkins and Hiaso (1994) report that it has been seen in the Park and its presence has subsequently been confirmed through JICA's camera trap program. IPCA's Field Survey Team also reported seeing a specimen near Monomu Lodge, which is surrounded by secondary forest.

Although the IUCN Red List account suggests that it is found mostly in primary rain forest, often in association with creeks and rivers, the findings of the camera trap program and biodiversity survey results suggests that it also utilises Secondary Forest. Based on what little is known of its ecology and distribution it is difficult to map its distribution in the park but it is reasonable to conclude that its distribution would largely coincide with primary medium-crowned hill forest in the southern sections of the Park, primarily the proposed special protection zones designated by CEPA & JICA.

The proposed distribution of this species is presented in Figure 102.

Figure 101: Distribution of Giant Bandicoot (Peroryctes broadbenti), IUCN Red List

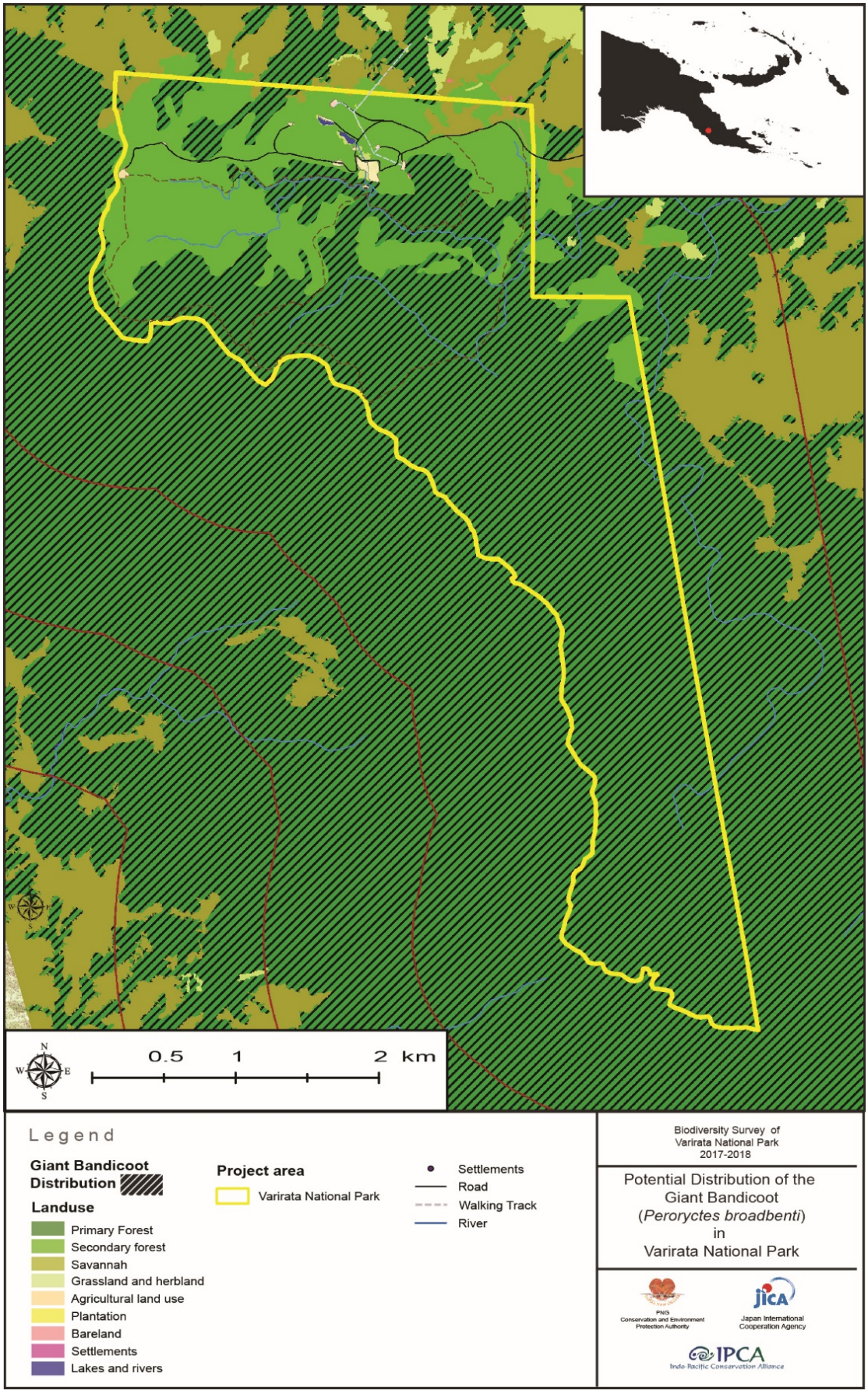


Figure 102: Distribution of Giant Bandicoot based on habitat preference

4.5. Introduced Species

The introduced fauna of VNP includes eight species of vertebrate animals (Table 8). Domestic cats and dogs, are also considered as introduced, and while there does not appear to be any feral populations of dogs established within the Park, the status of feral cats is currently unclear. Except for the Rusa Deer, these introduced species occur throughout Papua New Guinea and their presence in Varirata National Park is unremarkable.

Table 8: Exotic species of vertebrates known from Varirata National Park

COMMON NAME	SCIENTIFIC NAME	GROUP
Mozambique Tilapia	*Oreochromis mossambicus*	Fish
Guppy	*Poecilia reticulata*	Fish
Cane Toad	*Rhinella marina*	Amphibian
Black Rat	*Rattus rattus*	Mammal
Domestic Cat	*Felis catus*	Mammal
Domestic Dog	*Canis familiaris*	Mammal
Feral Pig	*Sus scrofa*	Mammal
Rusa Deer	*Cervus timorensis*	Mammal

4.6. Invasive Species of Concern

Four of the eight introduced species are categorised as 'Invasive Species of Concern' and are the subject of proposed management plans detailed in IPCA's Invasive Species Management Plan (IPCA, 2018d). These include: feral pigs, Rusa Deer and domestic dogs and cats. These species, or evidence of them is often encountered regularly at certain locations presented in Figure 103.

4.6.1. Wild Pigs

Evidence of wild pigs was observed in all three forest habitats (eucalypt savannah, secondary and primary forest) within VNP. Their wallows are readily apparent in the primary and secondary forest, especially along water courses and their distinctive grass nests are occasionally encountered in eucalypt savannah (Figure 81 to Figure 84). Long established in PNG since at least the Late Holocene (Flannery, 1995) they are considered important game species and as such are extremely wary and not often observed. Feral pigs are considered to be a Key Threatening Process in Australia's World Heritage Listed Wet Tropics Region due to predation, habitat, degradation, competition and disease transmission (DPI, 2018). They are highly adaptable species and omnivorous, opportunistic feeders with capability to cause widespread environmental degradation. Wild pigs are known to predate on eggs from ground nesting birds, and reptiles and they selectively eat certain species of plants such as tree ferns and can eliminate these from forests. Their habit of 'turning the soil' searching for invertebrates, rhizomes and plant roots (commonly referred to as 'rooting'), makes soil susceptible to increased erosion, particularly along streams, and can promote ideal conditions for the establishment of invasive plant species.

Pigs are known to eat Clidemia berries and are vectors for spreading this noxious weed as demonstrated by studies conducted in Peninsula Malaysia (Fujinuma & Harrison, 2012). It is therefore also highly likely that pigs along with certain species of birds are key mechanisms for dispersal of Clidemia into old-growth Primary Forest within VNP.

4.6.2. Rusa Deer

The Rusa Deer was introduced to Indonesian New Guinea in 1900 (Long, 2003; Reeder and Wilson, 2005) and quickly spread across the border to Western Province in Papua New Guinea. They have spread from there to other parts of eastern New Guinea and were also introduced to New Britain. Rusa Deer appear to have reached Central Province relatively recently and the population in the Park is assumed to be small based on field observations. They are commonly seen in small family groups along the roads in early morning, and at the Lake Lifilikatabu complex during the dry season.

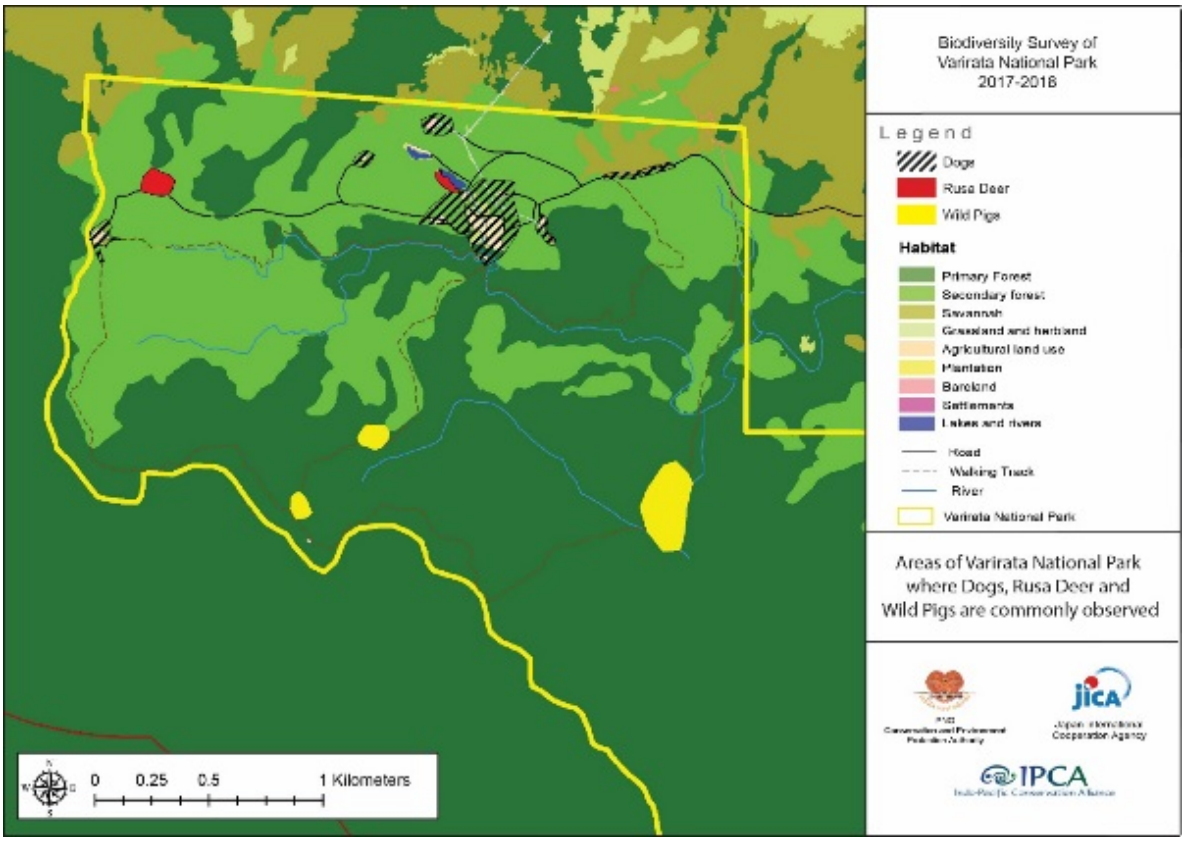


Figure 103: Locations of invasive vertebrate species observed during Field Survey

Rusa Deer, in the absence of predators have become extraordinarily abundant in Western Province where they inhabit open grasslands, retreating to gallery forests during the wet season. Opportunistic feeders, if left unchecked, Rusa Deer can drive changes in floristics (plant species composition) over large areas in time through selective grazing. They have capability to both graze and browse and studies conducted in Australia's Royal National Park confirm that Rusa Deer feed on no fewer than 69 native plant species (DAF, 2016; Keith & Pellow, 2005).

4.6.3. Domesticated Cats & Dogs

Cats and dogs observed in the Park are suspected to be animals belonging to Park staff residing within the Park or are vagrants from neighbouring communities.

Gunshots and dogs were occasionally heard along the northern perimeter of the Park during IPCA's Biodiversity Surveys. IPCA's Field Survey Team confirmed that this was highly likely to be hunters and dogs in pursuit of large game in secondary forests and eucalypt savannah of the Park's buffer zone. Dogs are often critical to successful hunts and are indiscriminate in their pursuit of large game species (wild pig, bandicoot, deer, bush fowl, wallaby, and cassowary) and would not be deterred if led into the Park whilst in pursuit of quarry.

Evidence of their damage to saplings and trees through 'ringbarking' is commonly observed throughout secondary forests within the Park. Rusa Deer game trails often promote soil erosion and create suitable conditions for invasive plant species to establish.

It is suspected that they compete with native wallaby species for forage. They are regarded by Koiari hunters as prise game species and are hunted in the eucalypt savannah and secondary forests adjacent to the Park.

The JICA camera trap program has separately recorded hunters, dogs predating on bush fowl eggs within the Park and cats. Cats in particular are highly adaptable animals and

very efficient predators that can have devastating, localized impacts on small vertebrate populations in tropical environments (Frank et.al, 2014). Their establishment in VNP could have severe consequences for small mammals, in particular the Endangered (IUCN red List) Giant Bandicoot (*Peroryctes broadbenti*).

5. TRAINING

First aid training and snake bite management techniques were provided to the field survey team at the Port Moresby Nature Centre on 9th September 2017. This was relevant given the occurrence of several dangerous, venomous snakes within the Park, including the Papuan Black, Small-eyed Snake and the Death Adder.

The University of Papua New Guinea provided a two-week training programme supported by the Mama Graun Foundation between 11 September and 23 September 2017. The Biology Department of the University of Papua New Guinea conducted several field trips to Varirata National Park during the course of the field survey program. These excursions, involving 10-50 biology students supervised by faculty, were also informally supported by IPCA's field team who provided knowledge to students regarding the various species of biota and key habitats found within the Park.

Staff from CEPA's head office were also invited to visit IPCA's field camp to gain exposure to the field survey program and obtain practical training in field techniques. CEPA were unable to attend given the requirement to relocate office in 2017.

6. FIELD GUIDE BROCHURES

In addition to the checklists prepared for each group of taxa, six separate Field Guide Brochures have been prepared for a selection of common and intriguing species likely to be of interest to Park patrons. These brochures briefly describe key characteristics to assist Park visitors in their identification of species contained within each brochure. The Field Guide Brochures are as follows:

1. Plants;
2. Invertebrates;
3. Frogs;
4. Reptiles (turtles, lizards and snakes);
5. Birds; and
6. Mammals.

The Field Guide Brochures listed as items 2-6 above are presented in APPENDIX 9 The Field Guide Brochure for Plants is presented in IPCA's Biodiversity Survey (Flora) Report (IPCA, 2018b).

7. CONCLUSIONS

The diversity and abundance of Varirata National Park's fauna is intricately dependent on habitat quality. The Park's primary rainforest comprising medium crowned lowland hill forest, secondary forest dominated by Gymnostoma (*Gymnostoma papuana*), eucalypt savannah and aquatic habitats are biodiverse and species rich. This is clearly demonstrated with VNP containing nearly 10% (>1,000 species) of PNG's vascular plants, emphasising the ecological significance of the Park in context of its area. Currently, two invasive plant species, Clidemia (*Miconia crenata*) and Spiked Pepper (*Piper aduncum*) are well established in the park and require management action given the ecological risks that they pose. This is further discussed in the IPCA's Biodiversity (Flora) Survey Report (IPCA, 2018c); the Invasive Species Management Plan (IPCA, 2018d); and the Environmental Monitoring Plan (IPCA, 2018a).

7.1. Invertebrate Diversity

Invertebrates are the dominant group of animals globally comprising approximately 95% of all species on earth (CSIRO, 2018). The number of invertebrate species within the Park is estimated to range between 3,000 – 5,000 species with an inordinate number of these likely yet to be described given the taxonomy of PNG's invertebrates is generally very poorly known (Miller, 1994).

Insects are the most prolific of invertebrates and comprise approximately 75% of all animal species on earth (CSIRO, 2018). Estimates of PNG's insect diversity range between a staggering 300,000 to 400,000 species (Miller, 1994).

Despite the paucity of knowledge regarding most of PNG's invertebrate fauna, the Lepidoptera (butterflies and moths) are reasonably well described with PNG ranked 12th in the world for endemism in large butterfly fauna (Miller, 1994; Parsons 1998). Appraisal of butterfly species richness as a key indicator of biodiversity in VNP is revealing. A rich proportion of the country's 820 described species are likely to occur in the Park.

A preliminary review of the Park's Odonata fauna (dragonflies and damselflies) further demonstrates VNP's invertebrate diversity and high ecological integrity. The Odonata are often used as indicators of habitat quality given their dependence on aquatic ecosystems and good water quality (Orr & Kalkman, 2015; Kalkman & Orr 2013). Approximately 10% of PNG's dragonfly taxa, which is characterised by high levels of endemism, occur in VNP.

7.2. Freshwater Fish Diversity

The freshwater fish fauna of PNG is depauperate and comprises approximately 2% of the worlds total with only 324 native species currently described. Literature indicates three native species occur within the Park, comprising the Four Spined Perchlet (*Tetracentrum apogonoides*), Moresby Mogrunda (*Mogurnda pulchra*), and the Goldie River Rainbow Fish (*Melanotaenia goldiei*). IPCA recorded the Short Finned Tandan (*Neosilurus brevidorsalis*) in Nairogo Creek and its tributaries. These species have also been recorded from Central Province and the Laloki River of which Nairogo Creek is a tributary.

Two introduced species, the Mozambique Tilapia (*Oreochromis mossambicus*) and the Common Guppy (*Poecilia reticulata*) are widespread in Central Province and also occur within the Park. It is suspected that Tilapia was deliberately released into the Lifilikatabu complex as a food resource.

7.3. Amphibian Diversity

PNG's amphibian taxa are entirely composed of frogs with 370 native species currently described of which 288 are endemic. PNG is recognized as one of the most species rich regions in the world for frog fauna (Menzies, 2006). Field surveys of VNP confirm the presence of at least 23 native species, representing approximately 6% of the country's total frog fauna. One introduced

amphibian is also present, the Cane Toad (*Rhinella marina*) which is widespread throughout the country. There is little doubt new records and new species of frogs are yet to be described from VNP.

7.4. Reptile Diversity

There are five families, 32 genera, and 346 species of reptiles known from PNG. This includes 18 marine and freshwater turtles, two species of crocodiles, 210 species of lizards and 116 species of snakes (both terrestrial and marine species).

PNG's reptilian fauna is well represented in the Park with 26 species of lizards and 17 species of snakes comprising approximately 12% and 15% of the country's lizard and snake fauna respectively. One species of freshwater turtle - The Red Bellied Short Necked Turtle (*Emydura subglobosa*) also occurs in the Park.

7.5. Avifauna Diversity

The diversity and richness of PNG's avifauna places it unequivocally as one of the world's great tropical regions of avian biodiversity (Beehler & Pratt, 2015). There are 99 families, 335 genera and 813 species of birds known from PNG. The Park includes a rich proportion of these, with 58 families, 150 genera and 231 species currently recorded equating to approximately 28% of the country's species. Excluding marine species and most groups of water birds (for which there is little suitable habitat within the Park), VNP's avifauna includes nearly 50% of forest bird species found within Papua New Guinea. This is a remarkable representation of PNG's avian biodiversity.

The Park's avifauna and ease of access from Port Moresby ensures it is internationally recognized as a prime birding locality, with many international eco-tourism ventures bringing their groups to the Park.

7.6. Mammalian Diversity

There are 25 families, 117 genera and 293 species of mammals (including 30 species of marine mammals) found in PNG of which 82 species (approximately 28%) are endemic. The checklist of mammals for the Park currently comprises 30 confirmed native species, which combined with the three introduced species comprises approximately 13% of the country's mammalian taxa. The three species of introduced mammals include: the Black Rat (*Rattus rattus*); Feral Pig (*Sus scrofa*); and Rusa Deer (*Cervus timorensis*).

The mammalian taxa for the Park is very poorly known and further targeted surveys will certainly reveal new species records for rodents, marsupials and particularly bats. The checklist of probable species contains an additional 29 taxa, which if confirmed will raise the proportion of PNG's terrestrial species in the Park to an incredible 24%. This is considered a very realistic scenario.

Anecdotal evidence suggests that the Short Beaked Echidna (*Tachyglossus aculeatus*) and the New Guinea Quoll (*Dasyurus albopunctatus*) previously recorded by Hopkins and Hisao (1994) as occurring in VNP may no longer occur in the Park.

7.7. Species with Conservation Significance

Two species of birds and one mammal species listed under the IUCN Red List as 'Near Threatened' occur in the Park. They comprise the Forest Bittern (*Zonerodius heliosylus*), Gurney's Eagle (*Aquila gurneyi*) and the New Guinea Quoll (*Dasyurus albopunctatus*).

The Giant Bandicoot (*Peroryctes broadbenti*) is scheduled as 'Endangered' under the IUCN Red List.

7.8. Invasive Species

The introduced fauna of Varirata National Park includes six confirmed species of vertebrate animals. These comprise: two species of fish, a toad, and three species of mammals as listed below:

- Mozambique Tilapia (*Oreochromis mossambicus*)
- Guppy (*Poecilia reticulata*)
- Cane Toad (*Rhinella marina*);

- Black Rat (*Rattus rattus*);
- Feral Pig (*Sus scrofa*);
- Rusa Deer (*Cervus timorensis*).

Domesticated dogs (*Canis familiaris*) are frequently observed in the Park as either vagrants or itinerants and it is suspected that they are pets and not part of an established feral population. Domesticated cats (*Felis catus*) have also been recorded in the Park and while they are thought to be pets belonging to Park staff, it is less clear as to whether a feral cat population exists. Further fieldwork is necessary to confirm this.

7.9. Ecological Value of Varirata National Park

The Park's incredibly biodiversity, environmental values, cultural significance and educational and ecotourism potential dictates that Varirata National Park represents an outstanding natural asset of high ecological value in PNG's protected area portfolio. It is expected that with further targeted field surveys, additional species records for frogs and mammals will certainly be added to the Park's checklists. The potential for describing new species of taxa from the park is considered enormous.

8. REFERENCES

ABC Science, 2015. Butterfly Farming in PNG. https://www.youtube.com/watch?v=STJ-IJ3FS3Q

ALA (Atlas of Living Australia) 2018. Orthoptera https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:0192736e-0955-4830-9977-61e07c843b28

Alcorn, J.B., B.M. Beehler, J.F. Swartzendruber, Biodiversity Support Program, and Papua New Guinea. Department of Environment and Conservation. 1993. Papua New Guinea Conservation Needs Assessment. Biodiversity Support Program andGovt. of Papua New Guinea, Dept. of Environment and Conservation, Washington, D.C. and Boroko, Papua New Guinea

Ali I, G., Sheridan g., French, R. J., & Ahmed, B. M. 2013. Ecological Benefits of Termite Soil Interaction and Microbial Symbiosis in the Soil Ecosystem. Journal of Earth Sciences and Geotechnical Engineering, vol. 3, no. 4 63-85

Allen, J. 1972. Nebira 4: An early Austronesian site in central Papua. Archaeology and Physical Anthropology in Oceania 7(2):92-124.

Allison, A., F. Kraus, and M. Mcshane. 2004. Patterns of species richness in the Papuan region: a preliminary assessment using amphibians and reptiles. Report prepared for The Nature Conservancy, p. 9. Bishop Museum, Honolulu.

Allison, A. 2007 [2006]. Introduction to the fauna of Papua, p. 479-494. *In:* The Ecology of Papua. Vol. 1. A. J. Marshall and B. M. Beehler (eds.). Periplus Editions, Singapore.

Allison, A. 2007 [2006]. Herpetofauna of Papua, p. 564-616. *In:* Ecology of Papua. Vol. 1. A. J. Marshall and B. M. Beehler (eds.). Periplus Editions, Singapore.

Allison, A. 2014. Listing of plant collections made by Henry Ogg Forbes [Visual Foxpro Database Listing].

Allison, A., and O. Talowin. 2015. Occurrence and status of Papua New Guinea vertebrates, p. 87-101. *In:* The State of the Forests of Papua New Guinea 2014: Measuring Change Over the Period 2002-2014. J. E. Bryan and P. L. Shearman (eds.). University of Papua New Guinea, Port Moresby.

Allison, A., and O. Tallowin. 2016. Distribution, diversity and conservation status of the biota along the Kokoda Track with recommendations for its protection. Bishop Museum Technical Report 66:1-281.

Anonymous. 1880. Evangelical Magazine and Missionary Chronicle 1880. Hodder and Stoughton, London. 864 pp.

Anonymous. 1880. Geographical Notes. Proceedings of the Royal Geographical Society and Monthly Record of Geography 2(5):310-318.

Anonymous. 1883. Later [Letter] from New Guinea [Morrison Expedition to the Owen Stanley Mountains]. *In:* Illustrated Sydney News 29SEP1883 Page 14.

Anonymous. 1885. NEWSPAPER ARTICLE EX NATIONAL LIBRARY OF AUSTRALIA: Burrowa News 16JAN1885 - Moroka.

Anonymous. 1886. Geographical notes. Scottish Geographical Magazine 2(8):499-506.

Anonymous. 1886. Mr. H.O. Forbes's progress in New Guinea [from Northern Standard, Charters Towers]. *In:* South Australian Register.

Anonymous. 1886. Neu Guinea. Deutsche Geographische Blätter 9:249-253.

Anonymous. 1898. NEWSPAPER ARTICLE EX NATIONAL LIBRARY OF AUSTRALIA: Queenslander 12FEB1898 - Moroka.

Anonymous. 1898. Sir William Macgregor's late inspection [details on 03 January 1898 Report], p. 312-313. *In:* Queenslander, Brisbane.

Anonymous. 1933. Obituary. Dr. H.O. Forbes. Nature 131(3309):460-461.

Anonymous. 1951. Mount Lamington eruption. Commonwealth of Australia. Territory of Papua Annual Report for the the period 1st July, 1950 to 30th June, 1951:34-36.

Anonymous. 1980. June field outing - Varirata National Park. Papua New Guinea Bird Society Newsletter:3.

Anonymous. 1980. May field outing to Ilimo Farm (Laloki River). Papua New Guinea Bird Society Newsletter:2-3.

Anonymous. 1981. March field outing to Varirata National Park. Papua New Guinea Bird Society Newsletter:2.

Anonymous. 1981. September field outing to D.P.I. Station, Laloki. Papua New Guinea Bird Society Newsletter:1-3.

Anonymous. 1981. July field outing to lower Laloki River and Moitaka. Papua New Guinea Bird Society Newsletter:3.

Anonymous. 1981. August field outing to Owers Corner. Papua New Guinea Bird Society Newsletter:4.

Anonymous. 1982. Problems in the Pacific, with related information. Sogeri National High School, S.l. 19 pp.

Anonymous. 1982. Field outing to Owers Corner: 6th June, 1982. Papua New Guinea Bird Society Newsletter:2-3.

Anonymous. 1982. August field outing to Vanapa River swamp forest. Papua New Guinea Bird Society Newsletter:4.

Anonymous. 1983. Little stint *Calidris minutus* at Aroa Lagoon C.P. Second record for the New Guinea region. Papua New Guinea Bird Society Newsletter:3-4.

Anonymous. 1983. Observations August 1982 - April 1983. Papua New Guinea Bird Society Newsletter:32-38.

Anonymous. 1984. Long-billed dowitcher Limnodromus scolopaceus at Aroa Lagoon, Central Province. First record for New Guinea and the entire Australasian region. Papua New Guinea Bird Society Newsletter:4.

Anonymous. 1990. The Sogeri Village. Expressive Arts Department, Sogeri National High School, Boroko, Papua New Guinea. 46 pp.

Anonymous. 2012. Preliminary Historic Assessment of Blamey's Garden and Other Selected other WWII Sites in Port Moresby for PNG Department of Environment and Conservation, p. 105. Archaeological & Heritage Management Solutions Pty Ltd, Sydney.

Aplin, K.P., K.M. Helgen, and D.P. Lunde. 2010. A Review of *Peroryctes broadbenti*, the Giant Bandicoot of Papua New Guinea. American Museum Novitates 3696:1-41.

Argus - Australian Newspapers. 1884-1900. Miscellaneous articles dealing with Henry Ogg Forbes expedition to Papua New Guinea [downloaded from National Library of Australia].

Australian Museum 2018. https://australianmuseum.net.au/australian-museum-entomology-collection

Australian National University. Department of Anthropology and Sociology. 1968. An ethnographic bibliography of New Guinea. Australian National University Press, Canberra,

Australian News and Information Bureau. 1962. Papua and New Guinea 1962.

Balke, M., D. Larson, L. Hendrich, and E. Konyorah. 2000. A revision of the New Guinea water beetle genus *Philaccolilus* Guignot, stat. n. (Coleoptera, Dytiscidae). Mitteilungen aus dem Museum fuer Naturkunde in Berlin Deutsche Entomologische Zeitschrift 47(1):29-50.

Ballantine, D. 1898. Enclosure 6 in Appendix A [Sogeri and Uberi Patrol]. Annual Report of British New Guinea from 1st July, 1897 to 30th June, 1898; with Appendices:16-18.

Ballantine, D. 1900. Appendix R. Report on inland journey. Annual Report of British New Guinea from 1st July, 1898 to 30th June, 1899; with Appendices:77-80.

Basedow, T., and S. Krull. 2005. The occurrence of weeds and the composition and abundance of predatory arthropods in newly sown maize fields in the Central Province of Papua New Guinea. Zeitschrift fuer

Pflanzenkrankheiten und Pflanzenschutz 112(3):304-311.

Beaver, W.N. 1920. Unexplored New Guinea: A Record of the Travels, Adventures, and Experiences of a Resident Magistrate Amongst the Head Hunting Savages and Cannibals of the Unexplored Interior of New Guinea. Seeley, Service & Co. limited, London. 320 pp.

Beehler, B.M., and J.P. Dumbacher. 1990. Interesting observations of birds at Varirata National Park, June-July 1989. Muruk 4(3):111-112.

Beehler, B.M., and R. Bino. 1995. Yellow-eyed Starling *Aplonis mystacea* in Central Province, Papua New Guinea. Emu 95(1):68-70.

Beehler, B.M., and J.P. Dumbacher. 1996. More examples of fruiting trees visited predominantly by birds of paradise. Emu 96(2):81-88.

Beehler, B.M., and T.K. Pratt. 2016. Birds of New Guinea: Distribution, Taxonomy, and Systematics. Princeton University Press, Princeton.

Bell, H.L. 1981. Information on New Guinean kingfishers, Alcedinidae. Ibis 123(1):51-61.

Bell, H.L. 1982. Sexual differences in the foraging behaviour of the frill-necked flycatcher *Arses telescophthalmus* in New Guinea. Australian Journal of Ecology 7(2):137-147.

Bell, H.L. 1982. Social organization and feeding of the rufous babbler *Pomatostomus isidori*. Emu 82(1):7-11.

Bell, H.L. 1982. A bird community of lowland rainforest in New Guinea. 4. Birds of secondary vegetation. Emu 82(4):217-224.

Bell, H.L. 1982. Abundance and seasonality of the savanna avifauna at Port Moresby, Papua New Guinea. Ibis 124(3):252-274.

Bell, H.L. 1982c. A bird community of New Guinean Lowland Rainforest. 3. Vertical Distribution of the Avifauna. Emu 82(3):143-162.

Bell, H.L. 1982d. A Bird Community of Lowland Rainforest in New Guinea. 4. Birds of Secondary Vegetation. Emu 82d(4):217-224.

Bell, H.L. 1982e. A bird community of lowland rainforest in New Guinea. 5. Mixed-species feeding flocks. Emu 82(5):256-275.

Bell, H.L. 1983. Mannikins *Lonchurra* spp. eating animal excreta. Papua New Guinea Bird Society Newsletter:18.

Bell, H.L. 1984. The importance of foothill forest in the diversity of rainforest birds in New Guinea. Emu 84(4):225-235.

Bell, H.L. 1984. A bird community of lowland rainforest in New Guinea. 6. Foraging ecology and community structure of the avifauna. Emu 84(3):142-158.

Beolens, B., M. Watkins, and M. Grayson. 2009. The Eponym Dictionary of Mammals, p. xiii+574. Johns Hopkins University Press,, Baltimore.

Beolens, B., M. Grayson, and M. Watkins. 2011. The Eponym Dictionary of Reptiles, p. 313. Johns Hopkins University Press,, Baltimore.

Beolens, B., M. Watkins, and M. Grayson. 2013. The Eponym Dictionary of Amphibians. Pelagic Pub., Exeter [England]. xiii+244 pp.

Beolens, B., M. Watkins, and M. Grayson. 2014. The Eponym Dictionary of Birds. Bloomsbury, London ; New York. 624 pp.

Berra, T.M., R. Moore, and L.F. Reynolds. 1975. The Freshwater Fishes of the Laloki River System of New Guinea. Copeia 1975(2):316-326.

Bethell, L.S. 1954. Descriptive list of Papuan papers : accession CP 1, series I, Commonwealth Archives. Department of History, Research School of Social Sciences, Australian National University, Canberra. 156 pp.

Beveridge, I. 1985. Three new species of *Progamotaenia* (Cestoda: Anoplocephalidae) from Australasian marsupials. Systematic Parasitology 7(2):91-102.

Blake, D.H., J.C. Saunders, J.R. Mcalpine, and K. Paijmans. 1973. No. 32 Land-form Types and Vegetation of Eastern Papua. CSIRO Land Research Surveys 2010(1):1-164.

Bolton, B. 2000. The ant tribe Dacetini. Part 1. Memoirs of the American Entomological Institute (Gainesville) 65(1):1-491.

Boucek, Z., and E.J. Brough. 1985. *Bruchophagus muli* sp. n. (Hymenoptera: Eurytomidae), a wasp which galls the fruit of lime in Papua New Guinea. Bulletin of Entomological Research 75(2):347-351.

Bourguignon, T., and Y. Roisin. 2011. Revision of the termite family Rhinotermitidae (Isoptera) in New Guinea. ZooKeys (148):55-103.

British New Guinea - Administrator. 1890. British New Guinea : annual report by Her Majesty's Administrator of the Government from 1st July 1889 to 30th June 1890 : with appendices and maps. James C. Beal, Government Printer, Brisbane

British New Guinea - Administrator. 1893. Annual report on British New Guinea from 1st July 1891 to 30th June 1892 with appendices. James C. Beal, Government Printer, Brisbane

British New Guinea - Administrator. 1897. Annual report on British New Guinea, from 1st July, 1895, to 30th June, 1896 : with appendices. Edmund Gregory, Government Printer, Brisbane

British New Guinea - Administrator. 1898. Annual report on British New Guinea from 1st July, 1896, to 30th June, 1897 : with appendices. Edmund Gregory, Government Printer, Brisbane

British New Guinea - Administrator. 1899. Annual report on British New Guinea from 1st July, 1897, to 30th June, 1898 : with appendices. Edmund Gregory, Government Printer, Brisbane

British New Guinea - Administrator. 1901. Annual report on British New Guinea from 1st July, 1899, to 30th June, 1900 : with appendices. Edmund Gregory, Government Printer, Brisbane

Brough, E.J. 1983. Seasonal changes in the damage caused by the citrus leaf miner, *Phyllocnistis citrella* (Lepidoptera: Phyllocnistidae) in a lowland orchard in Papua New Guinea. Science in New Guinea 10(3):166-171.

Brown, M.J.F., and University of Papua and New Guinea. Department of Geography. 1970. The Sogeri Plateau. Dept. of Geography, University of Papua and New Guinea, Port Moresby,. 30 pp.

Brown, W.C. 1991. Lizards of the genus *Emoia* (Scincidae) with observations on their ecology and biogeography. Memoirs of the California Academy of Sciences 15:1-94.

Brown, E.D., and M.J.G. Hopkins. 1995. A test of pollinator specificity and morphological convergence between nectarivorous birds and rainforest tree flowers in New Guinea. Oecologia (Berlin) 103(1):89-100.

Brown, E.D., and M.J.G. Hopkins. 1996. How New Guinea rainforest flower resources vary in time and space: implications for nectarivorous birds. Australian Journal of Ecology 21(4):363-378.

Brown, E.D., and M.J.G. Hopkins. 2002. Tests of disperser specificity between frugivorous birds and rainforest fruits in New Guinea. Emu 102(2):137-146.

Brune, P. 2003. A Bastard of a Place: The Australians in Papua : Kokoda, Milne Bay, Gona, Buna, Sanananda. Allen & Unwin, Crows Nest, NSW. ix+691 pp.

Bryan, J.E., and P.L. Shearman. 2015. The State of the Forests of Papua New Guinea 2014: Measuring Change Over the Period 2002-2014, p. 209. University of Papua New Guinea, Port Moresby.

Burrows, I. 1989. Field trip to Varirata National Park 7th May 1989. Papua New Guinea Bird Society Newsletter:1.

Burrows, I. 1992. March 1992 - outing to Varirata. Papua New Guinea Bird Society Newsletter:3.

Burrows, I. 1992. Monthly outing to Varirata National Park - 12 April 1992. Papua New Guinea Bird Society Newsletter:6-7.

Bursey, C.R., S.R. Goldberg, and F. Kraus. 2008. New species of *Parathelandros* (Nematoda : Pharyngodonidae) in Nyctimystes trachydermis (Anura : Hylidae) from Papua New Guinea. Journal of Parasitology 94(1):191-193.

Burton, J. 2010. Hydro Tasmanis. Naoro-Brown Hydropower Project: Draft Feasibility - Social Baseline Study. ANU Enterprise, Canberra.

Burton, J. 2015. The Kokoda Initiative – Subcatchment Mapping of Koiari Rural LLG Ward 18, p. 143. ANU edge, Canberra.

Cartwright, D.I. 1998. New species and a new record of *Ecnomus* McLachlan (Trichoptera: Ecnomidae) from Papua New Guinea and Irian Jaya. Memoirs of Museum Victoria 57(1):73-87.

Cassola, F. 1987. Studi sui cicindelidi. LI. I. Cicindelidae (Coleoptera) della Nuova Guinea. Annali del Museo Civico di Storia Naturale de Genoa 86:281-434.

Chainey, J.E. 1989. A review of the genus *Lilaea* Walker (Diptera: Tabanidae). Invertebrate Taxonomy 2(6):749-753.

Chalmers, J. 1880. Geographical Notes. Proceedings of the Royal Geographical Journal 2(5):310-318.

Chalmers, J. 1885. Adventures in New Guinea. The Religious Tract Society, London

Chalmers, J., and W.W. Gill. 1885. Work and adventure in New Guinea, 1877 to 1885. Religious Tract Society, London. 288 pp.

Chalmers, J. 1887. Explorations in South-Eastern New Guinea. Proceedings of the Royal Geographical Society and Monthly Record of Geography 9(2):71-86.

Chalmers, J. 1887. Pioneering in New Guinea. Religious Tract Society, London,. x+343 pp.

Chalmers, J. 1895. Pioneer life and work in New Guinea, 1877-1894. The Religious Tract Society, London,. xiv+19+255 pp.

Chapman, A.G. 2003. Breaking new ground-Part 6: Efogi Mission: Entering New Guinea. Journal of Pacific Adventist History 3(2):6-9.

Chapman, A.G. 2003. Breaking new ground — Part 5: the Koiari School, Bisiatabu, Papua New Guinea. Journal of Pacific Adventist History 3(1):12-14.

Chester, H.N. 1898. Extracts from diary [Enclosure 1 in Appendix A. Annual Report of British New Guinea from 1st July, 1897 to 30th June, 1898; with Appendices:7-9.

Clarke, A.R., S. Balagawi, B. Clifford, R.a.I. Drew, L. Leblanc, A. Mararuai, D. Mcguire, D. Putulan, T. Romig, S. Sar, and D. Tenakanai. 2004. Distribution and biogeography of *Bactrocera* and *Dacus* species (Diptera: Tephritidae) in Papua New Guinea. Australian Journal of Entomology 43(Part 2):148-156.

Cleland, D.M. 1964. Address by His Honor the Administrator to the House of Assembly Seminar, Sogeri, on 12th May, 1964, Port Moresby,. 5 . pp.

Coates, B.J. 1985. The Birds of Papua New Guinea Including the Bismarck Archipelago and Bougainville. Vol 1. Dove Publications, Alderley, Qld., Australia. 464 pp.

Coates, B.J. 1985. The Birds of Papua New Guinea Including the Bismarck Archipelago and Bougainville. Vol 2. Dove Publications, Alderley, Qld., Australia. 576 pp.

Coates, B. 1995. Maned duck (Australian wood duck) *Chenonetta jubata* near Port Moresby: the first record for the New Guinea region. Muruk 7(2):73-74.

Coates, B.J. 2014. A Pocket Guide to the Birds of Port Moresby, Papua New Guinea. Tourist Promotion Authority, Port Moresby. 2 pp.

Coates, B.J. 2015. A Pocket Guide to the Birds of Paradise of Papua New Guinea. Tourist Promotion Authority, Port Moresby. 2 pp.

Commonwealth of Australia. 1902. Annual Report on British New Guinea from 1st July, 1900, to 30th June, 1901 with Appendices. Government Printer for the Commonwealth of Australia, Brisbane

Connolly, S., A.J. Trevett, N.C. Nwokolo, D.G. Lalloo, S. Naraqi, D. Mantle, I.S. Schofield, P.R.W. Fawcett, J.B. Harris, and D.A. Warrell. 1995. Neuromuscular effects of Papuan taipan snake venom. Annals of Neurology 38(6):916-920.

Conservation and Environmental Protection Authority (Cepa), and Japan International Cooperation Agency (Jica). 2016. Management Assessment and Improvement Action Plan for Varirata National Park [Version 1, February 2016].

Couthard-Clark, C.D. 2000. Australia's Military Map-Makers: The Royal Australian Survey Corps 1915-96. Oxford University Press, South Melbourne, Australia. 246 pp.

Cumming, I.S. 1969. Preliminary investigation of the geology of the proposed Rouna No. 3 Hydro - Electric Power Station, Port Moresby, Papua. Commonwealth of Australia, Department of National Development, Bureau of mineral Resources, Geology and Geophysics Record 69(106):1-8.

CSIRO 2018. http://www.ento.csiro.au/education/index.html

DAF (Queensland Department of Agriculture and Fisheries) 2016. Rusa Deer Fact Sheet. https://www.daf.qld.gov.au/__data/assets/pdf_file/0007/62773/IPA-Rusa-Deer-Factsheet.pdf

Dasmann, R.F. 1988. Biosphere reserves, buffers and boundaries. BioScience 38(7):487-489.

Davies, S.M. 2012. Catalogue of Papuan artefacts associated with Andrew Goldie in the Queensland Museum and the Museum of the Cumbraes, Mlllport, Scotland. Memoirs of the Queensland Museum. Culture 6:163-208.

Davis, W.E., Jr., and B.M. Beehler. 1993. Dual singing between an adult and fledgling marbled frogmouth. Corella 17(4):111-113.

Davis, W.E., Jr., and B.M. Beehler. 1994. Nesting behavior of a raggiana bird of paradise. Wilson Bulletin 106(3):522-530.

Di Gennaro, F., Museo Nazionale Preistorico Ethnografico, and A. Allison. 2013. CORRESPONDENCE: Letters and E-mail correspondence between Allen Allison and Francesco di Gennaro regarding Lambero Loria's 1893 expedition to Moroka, Papua New Guinea.

Diamond, J.M. 1989. This fellow frog, name belong him Dawko. Natural History 98:16,18-20,23.

Dingle, H. 2004. The Australo-Papuan bird migration system: another consequence of Wallace's Line. Emu 104:95-108.

Disney, R.H.L. 1990. A key to *Diplonevra* males of the Australasian and Oriental regions, including two new species (Diptera, Phoridae). Entomologica Fennica 1(1):33-39.

Disney, R.H.L., and Y. Roisin. 2000. The first termitophilous scuttle fly (Diptera: Phoridae) reported from Papua New Guinea. Sociobiology 35(1):17-24.

Donnellan, S.C., K.P. Aplin, and T. Bertozzi. 2010. Species boundaries in the *Rana arfaki* group (Anura: Ranidae) and phylogenetic relationships to other New Guinean Rana. Zootaxa 2496:49-62.

Douglas, J. 1889. Annual report of British New Guinea from 4th September, 1888 to 30th June, 1889 with appendices.

DPI (Department of Primary Industries) 2018. NSW Government Feral Pig Fact Sheet: https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests/pest-animals-in-nsw/feral-pigs/feral-pig-biology

Drummond, R.M. 1908. Appendix F. Report on lands and surveys *in* Murray, J.H.P. Annual Report. Parliament of the

Commonwealth of Australia. Papua Annual Report for the year ending 30th June, 1907:67-71.

Dumbacher, J.P. 1991. Bird watching in Kagi. Muruk 5(1):19-21.

Dumbacher, J.P. 1999. Evolution of toxicity in pitohuis: 1. Effects of homobatrachotoxin on chewing lice (order Phthiraptera). Auk 116(4):957-963.

Dumbacher, J.P., K. Deiner, L. Thompson, and R.C. Fleischer. 2008. Phylogeny of the avian genus Pitohui and the evolution of toxicity in birds. Molecular Phylogenetics and Evolution 49(3):774-781.

Duran, S.M. 2015. Plant biodiversity effects on aboveground carbon storage in second-growth and old-growth tropical forests. University of Alberta.

Dutson, G. 2017. Personal Communication confirming Feather Tail Possum sighted in VNP

Dutton, T.E. 1969. The peopling of central Papua. Pacific Linguistics series B 9:i-vii+1-182.

Dutton, T.E. 2010. The dialects of Koiari revisited, p. 111-137. *In:* A mosaic of language and culture: Studies celebrating the career of Karl J. Franklin. K. A. McElhanon and G. Reesink (eds.). SIL International, Dallas.

Eastwood, C.H.B. 1988. Field outing report. Varirata 10th July. Papua New Guinea Bird Society Newsletter:1.

Eastwood, C. 1989. Notes on the birds of Dorobisoro, Central Province. Muruk 4(1):18-20.

Eastwood, C. 1990. When Varirata is good it is very good. Muruk 4(3):113-114.

Eaton, P. 2005. Land tenure, conservation and development in Southeast Asia. RoutledgeCurzon, London ; New York, NY. xii+178 pp.

Faliu, B. 1989. Les morsures de serpents chez les Mekeo de Papouasie-Nouvelle-Guinee. Journal de la Societe des Oceanistes 88-89(1-2):19-43.

Filewood, L.W. 1983. The possible occurrence in New Guinea of the ghost bat (*Macroderma gigas*; Chiroptera, Megadermatidae). Australian Mammalogy 6(1):35-36.

Finch, B.W. 1981. The survivors - unusual species as relicts in Port Moresby's patches of gallery forest along the Laloki River plus a comprehensive list of the species found in the Laloki Valley near Port Moresby. Papua New Guinea Bird Society Newsletter:23-42.

Finch, B.W. 1981. Mountain white-eyes Zosterops novaeguineae associating with black-fronted white-eyes *Zosterops atrifrons* at Owers Corner, Central Province. Papua New Guinea Bird Society Newsletter:23.

Finch, B.W. 1982. Field outing to D.P.I. Station, Laloki: 7th February 1982. Papua New Guinea Bird Society Newsletter:1-2.

Finch, B.W. 1982. Sight record of the obscure berrypecker *Melanocharis arfakianus* near Owers Corner, Central Province. Papua New Guinea Bird Society Newsletter:11-12.

Finch, B.W. 1982. Changes in status of freshwater terns or yet further anomalies to confuse the understanding of their movements(?). Papua New Guinea Bird Society Newsletter:7-12.

Finch, B.W. 1983. February field outing to D.P.I. Laloki. Papua New Guinea Bird Society Newsletter:16-17.

Finch, B.W. 1983. Party of seven straited swallows *Hirundo* (*daurica*) *striolata* at Moitaka/Waigani Swamp C.P. Papua New Guinea Bird Society Newsletter:14.

Finch, B. 1984. Moitaka Nature Reserve outing - 8th April 1984. Papua New Guinea Bird Society Newsletter:16.

Finch, B.W. 1984. Welcome swallows *Hirundo neoxena* at Hsiu Lagoon - second record for the New Guinea region. Papua New Guinea Bird Society Newsletter:4-5.

Finch, B.W. 1985. Hisiu Lagoon - when it's good it's really good. Papua New Guinea Bird Society Newsletter:2-6.

Finch, B.W. 1985. Noteworthy observations in Papua New Guinea and Solomons. Papua New Guinea Bird Society Newsletter:6-12.

Finch, B.W. 1986. Baird's sandpiper *Calidris bairdii* at Kanosia Lagoon - first record for the New Guinea region. Muruk 1(3):17-19.

Finch, B.W. 1986. Black tern, *Chlidonias niger*, at Moitaka Settling Ponds, Central Province - first record for the New Guinea region. Muruk 1(1):26-28.

Finch, B.W., R. Hicks, J. Oliver, M. Oliver, M. Hopkins, H. Hopkins, J.P. Silcock, and I. Burrows. 1986. Recent sightings. Papua New Guinea Bird Society Newsletter:5-9.

Fisher, N.H. 1941. Geological Report on the Sapphire-Moresby King, Laloki, and other Mines, Astrolabe Mineral Field, Papua. Department of National Development, Bureau of Mineral Resources, Geology and Geophysics: Records 1941/9.

Fisher, N.H. 1941. Geological Report on the Sapphire-Moresby King, Laloki, and other Mines, Astrolabe Mineral Field, Papua. Commonwealth of Australia, Department of National Development, Bureau of Mineral Resources, Geology and Geophysics Records 1941/9:1-13.

Fitter, R. 1973. Varirata, the first national park in Papua New Guinea, was officially opened in October 1973. Oryx.

Flannery, T.F. 1995. Mammals of the South-West Pacific & Moluccan Islands. Comstock/Cornell, Ithaca, N.Y. 464 pp.

Forbes, H.O. 1885. MAP - 1888 [Included with Annual Report of British New Guinea for 1887 published in 1888] Held in the State library of New South Wales.

Forbes, H.O. 1887. The Geographical Society and Mr. H.O. Forbes. *In:* Argus, Melbourne.

Forbes, H.O. 1888. On attempts to reach Owen Stanley Peak. Scottish Geographical Magazine 4(8):401-415.

Forbes, H.O. 1890. The Owen Stanley Range, New Guinea. Proceedings of the Royal Geographical Society and Monthly Record of Geography 12(9):558-563.

Francescato, E., S. Turillazzi, and M.H. Hansell. 1993. Glandular apparatus associated with the gastral tergal tegument in males of *Stenogaster concinna* and *Anischnogaster laticeps* (Hymenoptera: Stenogastrinae). Insectes Sociaux 40(3):313-317.

Frank, A.S.K, Johnson, C. N., Potts, J. M, Fisher, A., Lawes, M. J., Woinarski, J, C, Z., Tuft, K., Radford, I., J, Gordon, I, J., Collis M. A., and Legge S (2014). Experimental evidence that feral cats cause local extirpation of small mammals in Australia's tropical savannas. Journal of Applied Ecology: Vol, 51, 1486–1493

Freeman, J. 2014. [Details on map holdings in the State Library of Queensland relating to Henry Ogg Forbes and his expeditions to the Owen Stanley Range, New Guinea].

Frith, C.B. 1979. Ornithological literature of the Papuan subregion, 1915 to 1976: an annotated bibliography. Bulletin of the American Museum of Natural History 164(3):377-465.

Frodin, D.G., and J.L. Gressitt. 1982. Biological exploration in New Guinea, p. 87-130. *In:* Biogeography and Ecology of Papua New Guinea. Vol. 1. J. L. Gressitt (ed.). Dr W. Junk Publishers, The Hague.

Frodin, D.F. 2007. Biological Exploration of New Guinea, p. 14-107. *In:* The Ecology of Papua. Part Two. A. J. Marshall and B. M. Beehler (eds.). Periplus, Singapore.

Frost, D.R. 2015. Amphibian Species of the World - *Mantophryne menziesi*.

Fujinuma J, & Harrison R. D, 2012. Wild Pigs (Sus scrofa) Mediate Large-Scale Edge Effects in a Lowland Tropical Rainforest in Peninsular Malaysia. PLoS One. 2012; 7(5): e37321

Gardzinska, J., and B. Patoleta. 1997. Notes on the genus *Thorelliola* Strand, 1942 (Araneae: Salticidae). Memoirs of the Queensland Museum 42(1):213-222.

Gare, N. 1986. The marking of a national park. Parks 11(4):13-18.

Geographic, A. 2011. MAP: The Kokoda Trail, Papua New Guinea. Walker's map and poster. Adventure Kokoda Pty Ltd, P.O. Box Camden, NSW, Australia.

Gibson, G.H., J. Gibson, and G.H. Gibson. 1935. Papers of Graham Gibson, 1935-1987, p. 4.76 m. (34 boxes).

Gilliard, E.T. 1950. Notes on birds of southeastern Papua. American Museum Novitates 1453:1-40.

Gilliard, E.T. 1969. Birds of Paradise and Bower Birds. Weidenfeld & Nicolson, London. xxiii+485 pp.

Glucksman, J., G. West, and T.M. Berra. 1976. The introduced fishes of Papua New Guinea with special reference to Tilapia mossambica. Biological Conservation 9(1):37-44.

Glynn, W. 1988. Brown River. Papua New Guinea Bird Society Newsletter:1.

Glynn, W. 1990. Varirata National Park 11th February 1990. Papua New Guinea Bird Society Newsletter:2.

Glynn, W.F. 1995. Nesting observation of grey crow (*Corvus tristis*) at Varirata National Park November 1994. Muruk 7(3):121-122.

Goldberg, S.R. 2011. *Tropidonophis doriae* (Barred Keelback). Reproduction: Maximum clutch size. Herpetological Review 42(4):621.

Goldman, L. 2009. Papua New Guinea Liquefied Natural Gas Project. Social Impact Assessment 2008.

Goodger, D.R. 1954. Papua New Guinea patrol reports and related correspondence, 1954-1988. Pacific Manuscripts Bureau, Canberra. 1 microfilm reel pp.

Goodger, D.R. 1955. Patrol reports and correspondence of D.R. Goodger, Papua New Guinea.

Grafe, T.U., and R.J. Kohout. 2013. A new case of ants nesting in *Nepenthes* pitcher plants. Biotropica 19:77-80.

Greer, A.E., and F. Parker. 1973. Two new lygosomine skinks from New Guinea with comments on the loss of the external ear in lygosomines and observations on previously described species. Breviora 406:1-25.

Greer, A.E., and F. Parker. 1974. The *fasciatus* species group of *Sphenomorphus* (Lacertilia: Scincidae): notes on eight previously described species and descriptions of three new species. Papua New Guinea Sci. Soc. Proc. 25:31-61.

Greer, A.E., and F. Parker. 1979. On the identity of the New Guinea scincid lizard *Lygosoma fragile* Macleay 1877, with notes on its natural history. Journal of Herpetology 13(3):221-225.

Gregory, P. 2017. Birds of New Guinea including Bismarck Archipelago and Bougainville. Lynx Edicions, Barcelona. 464 pp.

Gregory-Smith, R., and J. Gregory-Smith. 1989. Beach kingfisher at Wallai Island 17-18 December 1988. Army Bird Watching Society Bulletin 1989(1):B19-B20.

Gregory-Smith, R., and J. Gregory-Smith. 1989. Bird notes from Wallai Island. Muruk 4(1):21.

Gregory-Smith, R., and J. Gregory-Smith. 1989. House sparrows Passer domesticus on Yule Island, Central Province. Muruk 4(1):23.

Gregory-Smith, R. 1990. Scaly thrush *Zoothera dauma* at Varirata National Park. Muruk 4(3):114.

Gressitt, J.L. 1982. Biogeography and Ecology in New Guinea, p. 983. Dr. W. Junk, The Hague.

Gressitt, J.L. 1984. Systematics and biogeography of the longicorn beetle Tribe Tmesisternini. Pacific Insects Monograph 41:1-263.

Grimshaw, B. 1911. The New New Guinea. Hutchinson, London. viii+322 pp.

Haddon, A.C. 1894. The ethnography of British New Guinea. II. Guide to the literature. Science Progress 2:226-248.

Haddon, A.C. 1900. Studies in the Anthropogeography of British New Guinea (Continued). The Geographical Journal 16(4):414-440.

Haddon, A.C. 1900. Studies in the Anthropogeography of British New Guinea. Geographical Journal 16(4):414-440.

Hancock, D.L., and R.a.I. Drew. 2004. Notes on the genus *Euphranta* Loew (Diptera: Tephritidae), with description of four new species. Australian Entomologist 31(4):151-168.

Hancock, D.L., and R.a.I. Drew. 2016. A review of the subgenus *Austrodacus* Perkins of Bactrocera Macquart (Diptera: Tephritidae: Dacinae). Australian Entomologist 43(2):75-82.

Hawthorne, S. 2003. The Kokoda Trail: A History. Central Queensland University Press, Queensland. xiv+269 pp.

Hawthorne, S. 2011. Port Moresby: Taim Bipo. Boolarong Press, Moorooka, Qld. x+310 pp.

Hays, T.E. 2014. [New Guinea Anthropology Bibliography].

Hays, T.E. 2015. FIND DATA FILES: Central Province, Papua New Guinea.

Heads, M. 2002. Birds of paradise, vicariance biogeography and terrane tectonics in New Guinea. Journal of Biogeography 29(2):261-283.

Heads, M. 2002. Regional patterns of biodiversity in New Guinea animals. Journal of Biogeography 29(2):285-294.

Healey, C. 1932. Patrol Report - Owen Stanley Range - Port Moresby District - extracted from National Archives & Public Records Services of Papua New Guinea 1928-1932 Patrol Reports. District: Central. Station: Port Moresby. Volume 1. Accession No. 498 1928-1932.

Heiss, E. 1984. Uber Aradacanthia Costa, 1864, samt Beschreibung von zwei neuen Arten (Heteroptera, Aradidae). Reichenbachia 22(17):133-139.

Helgen, K.M., T. Leary, G. Doria, and A. Giovanni. 2008. Catalogue of Melanesian Rodents in the Museum of Genova (Mammalia, Rodentia). Annali del Museo Civico di Storia Naturale G.Doria 99:653-686.

Helgen, K.M., T. Leary, and K.P. Aplin. 2010. A review of *Microhydromys* (Rodentia: Murinae), with description of a new species from southern New Guinea. American Museum Novitates 3676:1-22.

Hennessy, J.M. 1896. A few months' experience in New Guinea. Proceedings of the Queensland Branch of the Geographical Society of Australasia 1:106-116.

Heyligers, P.C. 1965. Lands of the Port Moresby - Kairuku area, Papua - New Guinea. Part VIII. Vegetation and ecology of the Port Moresby - Kairuku area. CSIRO Aust. Land Res. Ser. No. 14:146-173.

Hiaso, J. 1998. A study of murids (Rodentia: Muridae) in a eucalyptus savanna and hill forest in Varirata National Park, Papua New Guinea. Science in New Guinea 23(3):103-120.

Hicks, R.K., C.H.B. Eastwood, and W.F. Glynn. 1988. White pygmy-goose - a new species for the Port Moresby area. Muruk 3(1):5.

Hicks, R.K. 1992. Observations of birds feeding at a flowering *Syzygium*. Muruk 5(3):107-108.

Hitchcock, P., and A.J. Gabriel. 2015. World Heritage tentative listed sites In Papua New Guinea, p. 224. OCConsulting, Cairns, Australia.

Holthuis, L.B. 1974. Notes on the localities, habitats, biology, color and vernacular names of New Guinea freshwater crabs (Crustacea Decapoda, Sundathelphusidae). Zoologische Mededelingen (Leiden) 137(1):1-47.

Hood, C.S., and J.D. Smith. 1984. Histology of a sexually dimorphic integumentary gland in *Macroglossus lagochilus* (Chiroptera: Pteropodidae). Journal of Mammalogy 65(1):1-9.

Hood, C.S., and J.D. Smith. 1989. Sperm storage in a tropical nectar-feeding bat, *Macroglossus minimus* (Pteropodidae). Journal of Mammalogy 70(2):404-406.

Hook, M. 2013 [downloaded]. Lotu bilong Sevenday: Early Adventism in Papua

New Guinea. Booklet 27. Adventist Education. South Pacific Department of Education, Wahroonga, NSW, Australia. 22 pp.

Hopkins, M. 1985. Kerea 15th December 1985. Papua New Guinea Bird Society Newsletter:8.

Hopkins, H. 1986. Seventh Day Adventist College 11 May 1986. Papua New Guinea Bird Society Newsletter:3-4.

Hopkins, M. 1988. 12 wire spot (Lower Vanapa) 11 September 1988. Papua New Guinea Bird Society Newsletter:1.

Hopkins, H.C.F., and M.J.G. Hopkins. 1993. Rediscovery of *Mucuna macropoda* (Leguminosae: Papilionoideae), and its pollination by bats in Papua New Guinea. Kew Bulletin 48(2):297-305.

Hopkins, M., and J. Hiaso. 1994. Varirata: National Park, Trail Guide. Christensen Research Institute. Publication 11, Madang. 80 pp.

Horner, P. 2007. Systematics of the snake-eyed skinks, *Cryptoblepharus* Wiegmann (Reptilia: Squamata: Scincidae) - an Australian-based review. Beagle Supplement 3:21-198.

Horner, P., and M. Adams. 2007. A molecular systematic assessment of species boundaries in Australian *Cryptoblepharus* Wiegmann (Reptilia: Squamata: Scincidae) - a case study for the combines use of allozymes and morphology to explore cryptic biodiversity. Beagle Supplement 3:1-19.

Hoskin, C.J., and P.J. Couper. 2012. Description of two new *Carlia* species (Reptilia: Scincidae) from north-east Australia, elevation of *Carlia pectoralis inconnexa* Ingram & Covacevich 1989 to full species status, and redescription of *Carlia pectoralis* (de Vis 1884). Zootaxa 3546:1-28.

Huber, B.A. 2011. Revision and cladistic analysis of *Pholcus* and closely related raxa (Araneae, Pholcidae). Bonner Zoologische Monographien (58):8.

Hughes, C., J. Broken-Brow, H. Parnaby, S. Hamilton, and L.K.P. Leung. 2014. Rediscovery of the New Guinea Big-eared Bat *Pharotis imogene* from Central Province, Papua New Guinea. Records of the Australian Museum 66(4):225-232.

Independent State of Papua New Guinea - Ministry of Agriculture and Livestock. 2007. National Agriculture Development Plan 2007-2016.

Iova, B.A. 1993. Birds near Laronu village, Dorobisoro, Central Province. Muruk 6(1):26-27.

Indo-Pacific Conservation Alliance. 2018a Environmental Monitoring Plan, Biodiversity Survey of Varirata National Park: Project for Biodiversity Conservation Through Implementation of the Papua New Guinea Policy on Protected Areas. IPCA Doc No. 023

Indo-Pacific Conservation Alliance. 2018b Biodiversity (Flora) Survey of Varirata National Park: Project for Biodiversity Conservation Through Implementation of the Papua New Guinea Policy on Protected Areas. IPCA Doc No. 024

Indo-Pacific Conservation Alliance. 2018d Invasive Species Management Plan, Biodiversity Survey of Varirata National Park: Project for Biodiversity Conservation Through Implementation of the Papua New Guinea Policy on Protected Areas. IPCA Doc No. 022

Irwin, P.F. 1913. Report on the affairs and working of the Central Division for the year ended 30th June, 1913. Parliament of the Commonwealth of Australia. Papua Annual Report for the year 1912-1913:90-93.

Ison, B. 1974. Report of the cultural visit by students of Sogeri Senior High School to Irian Jaya during the national Independence Day celebrations. Publisher not identified, Port Moresby. 32 pp.

Ison, B., and Sogeri Senior High School. 1975. Asimba : a collection of designs by young artists from Sogeri Senior High School. Expressive Arts Department, Sogeri Senior High School, Sogeri, Papua New Guinea. 40 pp.

Ison, B., and Sogeri Senior High School. Expressive Arts Department. 1975. Tairu : commemorating the independence of Papua New Guinea. Sogeri Senior High School, Sogeri, P.N.G. 124 pp.

James, K. 2009. “The track” A historical desktop study of the Kokoda Track, p. 73. Department of Environment, Water, Heritage, and the Arts, Canberra.

Jennings, J.T., and A.D. Austin. 2006. Aulacid wasps (Hymenoptera: Aulacidae) of New Guinea, with descriptions of five new species. Zootaxa 1365:19-35.

JICA 2017. Report for Camera Trap Monitoring at Varirata National Park, Koiari, Central Province. Version 1, November 2017. Unpublished Report

Johnston, F. 1934. Papers, 1934-1990. 1 microfilm reel pp.

Johnston, A.L., and E.L. Johnston. 1944. Papers, 1944-1983. 1 microfilm reel pp.

Johnston, A.L., E.L. Johnston, E.M. Johnston, and J. Bridge. 1993. Johnston family papers : correspondence, miscellaneous papers, certificates, maps, photographs, 1934-1990. *In:* Pmb 1054. Pacific Manuscripts Bureau,, Canberra, ACT.

Kaestner, P. 1982. Rufous owl (*Ninox rufa*) at Varirata National Park. Papua New Guinea Bird Society Newsletter:3.

Kaestner, P. 1984. MacGregors's bird of paradise, or bust! Papua New Guinea Bird Society Newsletter:8-11.

Kailola, P.J. 1975. A catalogue of the fish reference collection at the Kanudi Fisheries Research Laboratory, Port Moresby. Research Bulletin - Department of Agriculture, Stock and Fisheries, Papua New Guinea 16:1-277.

Kalkman, V. & Orr, A., 2013. Field Guide to the damselflies of New Guinea.

Kieth D., Pellow B. 2005. Effects of Javan rusa deer (Cervus timorensis) on native plant species in the Jibbon-Bundeena Area, Royal National Park, New South Wales. Linnean Society of New South Wales 126:99-110

King, B., and P.J. Hughes. 1998. Protected Areas in Papua New Guinea, p. 383-405. *In:* Modern Papua New Guinea. L. Zimmer-Tamakoshi (ed.). Thomas Jefferson University Press, Kirksville, Mo.

Kisea, 2018. Pers.com Varirata National Park Ranger. 1979-2018.

Klein, W.C., A.J. Beversluis, and A.F. Kuysten. 1953. Nieuw Guinea: De Ontwikkeling op Economisch, Sociaal en Cultureel Gebied, en Nederlands en Australisch Nieuw Guinea. Met Tijdelijke Redactionele Medewerking [Volume 03]. Staatsdrukkerij- en Uitgeverijbedrijf, 's-Gravenhage,. 3 volumes. pp.

Knibb, W.R. 1983. Chromosome inversion polymorphisms in *Drosophila melanogaster* 3. Gametic disequilibria and the contributions of inversion clines to the Adh and Gpdh clines in Australasia. Genetica (Dordrecht) 61(2):139-146.

Knight, W.J. 2010. Leafhoppers (Cicadellidae) of the Pacific. An annotated systematic checklist of the leafhoppers recorded in the Pacific region during the period 1758 – 2000. http://www.tymbal.org/publicat/KnightCatalogue.pdf.

Kohout, R.J. 2012. A review of the Australian Polyrhachis ants of the subgenera *Myrma* Billberg, *Myrmatopa* Forel, *Myrmothrinax* Forel and *Polyrhachis* Fr. Smith (Hymenoptera: Formicidae: Formicinae). Memoirs of the Queensland Museum - Nature 56(1):25-59.

Kojima, J.I. 1989. A new polistine species of *Ropalidia* Hymenoptera Vespidae from Papua New Guinea. Japanese Journal of Entomology 57(1):143-147.

Kokoda Initiative. 2013. Joint Planning Meeting - 4-6 March 2013 - PNG National Museum.

Kokoda Initiative. 2014. Annual Report 2012-2013.

Kokoda Initiative. 2016. Annual Report 2014-2015.

Korniushin, A.V. 2006. Revision of some little known collections of Sphaeriidae from New Guinea, with the description of a new species. Heldia 6(1-2):1-10.

Kraus, F. 2010. More range extensions for Papuan reptiles and amphibians. Herpetological Review 41(2):246-248.

Krieger, M. 1899. Neu-Guinea [excerpt on exploration]. A. Schall, Berlin,. xii+535 pp.

Krieger, M. 1899. Neu-Guinea. A. Schall, Berlin,. xii+535 pp.

Krull, S.M.E., and T. Basedow. 2005. Evaluation of the biological control of the pink wax scale *Ceroplastes rubens* Maskell (Hom., Coccidae) with the introduced parasitoid *Anicetus beneficus* Ishii & Yasumatsu (Hym., Encyrtidae) in the Central province of Papua New Guinea. Journal of Applied Entomology 129(6):323-329.

Krull, S., and T. Basedow. 2006. Studies on the biology of Deanolis sublimbalis Snellen (Lepidoptera, Pyralidae) and its natural enemies on mango in Papua New Guinea. Mitteilungen der Deutschen Gesellschaft fuer Allgemeine und Angewandte Entomologie 15:273-276.

Kruseman, M.J.V.S., and Nationaal Herbarium Nederland. 2013. Cyclopaedia of Collectors: William George Lawes.

Lal, B.V., and V. Luker. 2008. Telling Pacific Lives: Prisms of Process

Lalloo, D.G., A.J. Trevett, A. Saweri, S. Naraqi, R.D.G. Theakston, and D.A. Warrell. 1995. The epidemiology of snake bite in Central Province and National Capital District, Papua New Guinea. Transactions of the Royal Society of Tropical Medicine and Hygiene 89(2):178-182.

Lambley, P. 1986. Hadaina Island, Central Province. Papua New Guinea Bird Society Newsletter:6.

Lambley, P. 1987. Camp-out at Varirata National Park 14th-15th November. Papua New Guinea Bird Society Newsletter:2.

Lane-Poole, C.E. 1925. The forest resources of the territories of Papua and New Guinea:. Government Printer for the government of the Commonwealth of Australia, 1925

Lawes, W.G. 1884. Recent Explorations in South-Eastern New Guinea. Proceedings of the Royal Geographical Society and Monthly Record of Geography 6(4):216-218.

Lawes, P., and Sogeri National High School. Expressive Arts Department. 1978. Wati kui : drawings. Sogeri National High School, Expressive Arts Dept., Sogeri. 45 leaves pp.

Lea, D.a.M., N. Clark, and R.G. Ward. 1975. Geographers in Papua New Guinea: a preliminary bibliography. Australian Geographer 13(2):104-145.

Lecroy, M. 2010. Type specimens of birds in the American Museum of Natural History. Part 8. Passeriformes: Pachycephalidae, Aegithalidae, Remizidae, Paridae, Sittidae, Neosittidae, Certhiidae, Rhabdor Nithidae, Climacteridae, Dicaeidae, Pardalotidae, and Nectariniidae. Buttetin of the American Museum of Natural History 333:1-178.

Legra, L., X. Li, and A. Townsend Peterson. Biodiversity consequences of sea level rise in New Guinea. Pacific Conservation Biology 14(3):191-199.

Legra, L. 2009. Biogeography, ecology and conservation of Paradisaeidae: consequences of environmental and climatic changes. *In:* Ecology and Evolutionary Biology and the Graduate Faculty. Vol. MA. University of Kansas.

Lennox, C. 1902. James Chalmers of New Guinea, missionary, pioneer, martyr. A. Melrose, London. xv+208 pp.

Lever, C. 2001. The Cane Toad. Westbury Academic and Scientific Publishing,, Otley, UK

Lewis, D.C. 1996. The Plantation Dream [details on Alearce Savery Anthony]. Journal of Pacific History, Australian National University, Canberra

Lewis, D.C. 1996. The Plantation Dream [details on Alearce Savery Anthony]. Journal of Pacific History, Australian National University, Canberra

Lieftinck, M.A. 1971. A catalogue of the type-specimens of Odonata preserved in The Netherlands with a supplementary list of the Odonata types described by Dutch scientists deposited in foreign institutional collections. Tijdschrift Voor Entomologie 114(2):65-139.

Light Railways Society of Australia. 2017. Index - Contents. Light Railways of Australia,.

Linck, E.B., Z.R. Hanna, A. Sellas, and J.P. Dumbacher. 2017. Evaluating hybridization capture with RAD probes as a tool for museum genomics with historical bird specimens. Ecology and Evolution:1-13.

Lindley, I.D. 2001. Tertiary echinoids from Papua New Guinea. Proceedings of the Linnean Society of New South Wales (123):119-139.

Lindt, J.W. 1887. Picturesque New Guinea. Longmans, Green and Co., London. xviii + 194 pp.

Long, J.L. 2003. Introduced Mammals of the World : Their History, Distribution and Influence, p. 612 p. CSIRO PUBLISHING,, Melbourne.

Loria, L. 1891. Dall'interno della Nuova Guinea. Bollettino della Società Geografica Italiana 28:905-911.

Loveridge, A. 1948. New Guinean reptiles and amphibians in the Museum of Comparative Zoology and the United States National Museum. Bulletin of the Museum of Comparative Zoology 101(2):305-430.

Lucky, A., and P.S. Ward. 2010. Taxonomic revision of the ant genus Leptomyrmex Mayr (Hymenoptera: Formicidae). Zootaxa 2688:1-67.

Mabbutt, J.A., P.C. Heyligers, R. Pullen, R.M. Scott, and J.G. Speight. 1965. Lands of the Port Moresby - Kairuku area, Papua - New Guinea. Part III. Land systems of the Port Moresby - Kairuku area. CSIRO Aust. Land Res. Ser. No. 14:19-82.

Mabbutt, J.A., P.C. Heyligers, R.M. Scott, R. Pullen, E.A. Fitzpatrick, J.R. Mcalpine, and J.G. Speight. 1965. No. 14 Lands of the Port Moresby–Kairuku Area, Territory of Papua New Guinea. CSIRO Land Research Surveys 2010(1):1-192.

Macgregor, W. 1885. British New Guinea. Scottish Geographical Magazine 11(4):161-180.

Macgregor, W. 1897. British New Guinea country and people. John Murray, London. 100 pp.

Macgregor, W. 1898. Annual Report. Annual Report of British New Guinea from 1st July, 1897 to 30th June, 1898; with Appendices: V-XLVI+1-18.

Macgregor, W. 1898. Appendix A. Despatch reporting visit of inspection to district lying between Port Moresby and the headwaters of the Goldie and Brown rivers. Annual Report of British New Guinea from 1st July, 1897 to 30th June, 1898; with Appendices:1-18.

Mack, A.L. 1998. A Biological Assessment of the Lakekamu Basin, Papua New Guinea, p. 187. *In:* RAP Working Papers. Vol. 9. Conservation International, Washington, D.C.

Mack, A.L., and D.D. Wright. 2011. Training Manual for Field Biologists in Papua New Guinea. Green Capacity. 173 pp.

Mackay, K. 1909. Across Papua. Witherby & co., London,. xvi+192 pp.

Mackay, R.D. 1970. The Birds of Port Moresby and District. Thomas Nelson (Australia), Melbourne,. 74 pp.

Mackay, R.D. 1986. Varirata National Park 0530-1000 hrs. Papua New Guinea Bird Society Newsletter:6-7.

Macqueen, P., A.W. Goldizen, J.J. Austin, and J.M. Seddon. 2011. Phylogeography of the pademelons (Marsupialia: Macropodidae: *Thylogale*) in New Guinea reflects both geological and climatic events during the Plio-Pleistocene. Journal of Biogeography 38(9):1732-1747.

Maddison, W.P. 2009. New cocalodine jumping spiders from Papua New

Guinea (Araneae: Salticidae: Cocalodinae). Zootaxa 2021:1-22.

Maddison, W., and J. Zhang. 2011. Salticid spiders of Papua New Guinea. RAP Bulletin of Biological Assessment 60:186-189.

Maddison, W.P. 2015. A phylogenetic classification of jumping spiders (Araneae: Salticidae). Journal of Arachnology 43(3):231-292.

Maitland, A.G. 1893. Geological observations in British New Guinea in 1891. Annual Report of British New Guinea from 1st July 1891, to 30th June, 1892; with Appendices:53-84.

Malnate, E.V., and G. Underwood. 1988. Australasian natricine snakes of the genus *Tropidonophis*. Proceedings of the Academy of Natural Sciences of Philadelphia 140(1):59-201.

Manser, W. 1974. Earth science abstracts, Papua New Guinea, to 1971. Bulletin, Department of Minerals and Energy, Bureau of Mineral Resources, Geology and Geophysics 143:i-iv+1-444.

Mantero, G. 1899. Viaggio di Lamberto Loria nella Papuasia Orientale. XXV. Mutillidae e Scoliidae. Annali del Museo Civico di Storia Naturale di Genova 40:580-592.

Markwell, K. 2015. Animals and Tourism: Understanding Diverse Relationships, p. 328. Channel View Publications Bristol, UK.

Martini, A.M.Z., P. Fiaschi, A.M. Amorim, and J.L. Da Paixão. 2007. A hot-point within a hot-spot: a high diversity site in Brazil's Atlantic Forest. Biodiversity Conservation 16:3111-3128.

Mathis, W. 1992. The first shore fly of the genus Glenanthe Haliday from the Australasian region (Diptera: Ephydridae). Proceedings of the Entomological Society of Washington 94(1):78-82.

Mathis, W.N. 1992. The first shore fly of the genus *Glenanthe* Haliday from the Australasian Region Diptera Ephydridae. Proceedings of the Entomological Society of Washington 94(1):78-82.

Mathis, W.N., and T. Zatwarnicki. 2002. A phylogenetic study of the tribe Dryxini Zatwarnicki (Diptera: Ephydridae). Smithsonian Contributions to Zoology (617):i.

May, R.J. 1984. Kaikai Aniani: A Guide to Bush Foods, Markets, and Culinary Arts of Papua New Guinea. Robert Brown & Associates, Bathurst, N.S.W., Australia. 192 pp.

Mayo, J. 1969. The Protectorate of British New Guinea 1884-1888: an oddity of empire, p. 77-99. *In:* The history of Melanesia : papers delivered at a seminar sponsored jointly by the University of Papua and New Guinea, the Australian National University, the Administrative College of Papua and New Guinea, and the Council of New Guinea Affairs held at Port Moresby from 30 May to 5 June 1968. K. S. Inglis (ed.). University of Papua and New Guinea and Research School of Pacific Studies, Australian National University, Port Moresby and Canberra.

Mayo, J. 1969. The German Empire in Melanesia 1884-1914: a German self-analysis, p. 45-76. *In:* The history of Melanesia : papers delivered at a seminar sponsored jointly by the University of Papua and New Guinea, the Australian National University, the Administrative College of Papua and New Guinea, and the Council of New Guinea Affairs held at Port Moresby from 30 May to 5 June 1968. K. S. Inglis (ed.). University of Papua and New Guinea and Research School of Pacific Studies, Australian National University, Port Moresby and Canberra.

Mayr, E., and A.L. Rand. 1941. The birds of the 1933-1934 Papuan Expedition. Bulletin of the American Museum of Natural History 73(1):1-248.

Mcalpine, D.K. 1998. Review of the Australian stilt flies (Diptera: Micropezidae) with a phylogenetic analysis of the family. Invertebrate Taxonomy 12(1):55-134.

Mcapline, D.K. 2001. Review of the Australasian genera of signal flies (Diptera: Platystomatidae). Records of the Australian Museum 53(2):113-199.

Mccarthy, D., and Australian War Memorial. 1959. South-west Pacific Area - First Year : Kokoda to Wau. Australian War Memorial, Canberra. xiv+656 pp.

Mcdowell, S.B. 1975. A catalogue of the snakes of New Guinea and the Solomons, with special reference to those in the Bernice P. Bishop Museum. Part II. Aniliodea and Pythoninae. Journal of Herpetology 9(1):1-79.

Mcneely, J.A., D.C. Pitt, and International Union for Conservation of Nature and Natural Resources. 1985. Culture and conservation : the human dimension in environmental planning. Croom Helm, London ; Dover, N.H. xi+308 pp.

Menzies, J.I., and G.R. Zug. 1979. Papuan tree frogs of the *Litoria thesaurensis* group (Salientia: Hylidae). Micronesica 15(1):325-333.

Menzies, J.I. 1987. A taxonomic revision of the Papuan *Rana* (Amphibia: Ranidae). Australian Journal of Zoology 35:373-418.

Menzies, J.I. 1992. Ecological and taxonomic notes on ranid frogs (Amphibia: Ranidae) from far western New Guinea. Science in New Guinea 18(3):115-122.

Menzies, J.I. 1994. [Scripts for Frog Call Tape Recordings Deposited in the New Guinea Collection at the University of Papua New Guinea.

Menzies, J.I. 1996. A systematic revision of *Melomys* (Rodentia: Muridae) of New Guinea. Australian Journal of Zoology 44:367-426.

Menzies, J.I. 1999. A study of *Albericus* (Anura: Microhylidae) of New Guinea. Australian Journal of Zoology 47(4):327-360.

Menzies, J.I. 2006. The Frogs of New Guinea and the Solomon Islands. Pensoft, Sofia - Moscow

Menzies, J.I., S.J. Richards, and M.J. Tyler. 2008. Systematics of the Australo-Papuan tree frogs known as *Litoria bicolor* (Anura: Hylidae) in the Papuan region. Australian Journal of Zoology 56:257-280.

Miller S. (Ed). 1994. Status of biodiversity in Papua New Guinea: Papua New Guinea Country Report on Biological Diversity. Waigani: The Department of Environment and Conservation, Conservation Resource Centre and the Africa Centre for Resources and Environment (ACRE); 67-95.

Moore, C. 2003. New Guinea: Crossing Boundaries and History. University of Hawai`i Press, Honolulu. xiv+274 pp.

Mueller, F.V., R.W. Home, A.M. Lucas, S. Maroske, D.M. Sinkora, J.H. Voigt, and M. Wells. 1998. Regardfully Yours: Selected Correspondence of Ferdinand von Mueller [material relating to Henry Ogg Forbes]. Peter Lang, Bern; New York

Munro, I.S.R. 1958. The fishes of the New Guinea region [Reprinted from the Papua New Guinea Agricultural Journal Vol. 10, No 4]. Territory of Papua New Guinea Fisheries Bulletin 1:97-369.

Murray, J.H.P. 1912. Papua: or, British New Guinea. T. Fisher Unwin, London. 388 pp.

Murray, J.H.P., and Australia. Department of Territories. Territory of Papua. 1922. Index to British New Guinea annual reports, 1886 to 1906. E.G. Baker, Port Moresby. 44 pp.

Murray, J.H.P. 1925. Papua of To-day or an Australian Colony in the Making [excerpts on exploration]. P. S. King, London,. xvi+308 pp.

Murray, N. 2010. Education officer, T.P.N.G. : a story of my first five years teaching in the territory of Papua and New Guinea, 1958-1962. Neil Murray, Cairns, Qld. 247 pp.

Musser, G.G., K.M. Helgen, and D.P. Lunde. 2008. Systematic review of New Guinea *Leptomys* (Muridae, Murinaei) : with descriptions of two new species ; , no. 3624. American Museum Novitates (3624):1-60.

Nairne, W.P. 1913. Greatheart of Papua (James Chalmers). H. Milford, London; New York. 229 pp.

National Library of Australia. [Biographical cuttings on Don McColm, former manager of the Tiaba Estates, on Sogeri Road, PNG, containing one or more cuttings from newspapers or journals]

Nelson, H. 2003. Kokoda: The Track from History to Politics. Journal of Pacific History 38(1):109-127.

Nelson, H. 2007. Kokoda: and two national histories. Journal of Pacific History 42(1):63-88.

Nelson, H., C. Ballard, J. Burton, N. Haley, D. Temu, E. Maidment, and K. Moloney. 2009. Kokoda Track-Brown River Catchment Region Preliminary Social Mapping Study. ANU Enterprise, Canberra.

Newsome, D. 2015. Conflict between cultural attitudes, development and ecotourism: the case of bird watching tours in Papua New Guinea, p. 194-210. *In:* Animals and Tourism: Understanding Diverse Relationships. K. Markwell (ed.).

Nielsen, B.W. 2000. Hold og opdræt af Irian Jayatæppepython, *Morelia spilota variegata*. Nordisk Herpetologisk Forening 42(6):166-175.

Noku, S.K., J.O. Espi, and H. Matsueda. 2012. Magmatic contributions to the mineralization of the Laloki and Federal Flag strata-bound massive sulfide deposits, Papua New Guinea: Sulfur isotope evidence. *In:* PNG Research, Science and Technology Conference (Pacific Adventist Univ., Port Moresby, June 25–29, 2012), At Pacific Adventist University, Port Moresby, Papua New Guinea.

Noku, S.K., H. Matsueda, J.O. Espi, and M. Akasaka. 2012. Petrology, Geochemistry, and Fluid Inclusion Microthermometry of Sphalerite from the Laloki and Federal Flag Strata-Bound Massive Sulfide Deposits, Papua New Guinea: Implications for Gold Mineralization. Resource Geology 62(2):187-207.

Noku, S.K., J.O. Esp, and H. Matsueda. 2015. Involvement of magmatic fluids at the Laloki and Federal Flag massive sulfide Cu–Zn–Au–Ag deposits, Astrolabe mineral district, Papua New Guinea: sulfur isotope evidence. Mineralium Deposita 50:55-64.

Nye, P.B., and N.H. Fisher. 1954. The mineral deposits and mining industry of Papua-New Guinea. Commonwealth of Australia, Department of National Development, Bureau of Mineral Resources, Geology and Geophysics. Rewport No. 9.

Nye, P.B., and N.H. Fisher. 1954. The mineral deposits and the mining industry of Papua - New Guinea. Commonwealth of Australia, Department of National Development, Bureau of Mineral Resources, Geology and Geophysics Records 1954/9:1-34.

Ohff, H.-J.R. 2008. Empires of enterprise: German and English commercial interests in East New Guinea 1884 to 1914, p. 449. *In:* School of History and Politics. Vol. PhD. University of Adelaide, Adelaide.

Oláh, J. 2012. Taxonomic list of Trichoptera described and recorded from New Guinea region. Folia historico Naturalia Musei Matraensis 36:105-122.

Oliver, P., S.J. Richards, B. Tjaturadi, and D. Iskandar. 2007. A new large green species of *Litoria* (Anura: Hylidae) from western New Guinea. Zootaxa 1519:17-26.

O'malley, J.T., and T. Miller. 1914. Magisterial reports: Central Division [Rigo Patrols - includes map of Sogeri - Moroka area]. Parliament of the Commonwealth of Australia. Papua Annual Report for the year ending 30th June, 1914:26-30.

Orapa, W.E. 1991. Biodiversity, abundance and distribution of beetles and other arthropods sampled by canopy fogging of some lauraceous tree species in a Papua New Guinean rainforest. *In:* Faculty of Science. Vol. Post-Graduate

Diploma in Science. University of Papua New Guinea.

Orr, A., & Kalkman, V. 2015. Field Guide to the dragonflies of New Guinea.

Osborne, T., and L. Osborne. 1991. A short week in Papua New Guinea. Muruk 5(1):21-23.

O'shea, M. 1991. The reptiles of Papua New Guinea. British Herpetological Society Bulletin 37:15-32.

O'shea, M. 1996. A Guide to the Snakes of Papua New Guinea. Independent Publishing, Port Moresby, Papua New Guinea. 239 pp.

O'shea, M. 2007. Wokabaut long kisim poisen snek. Part 1: All work and no play ... no way! Herptile 32(3):92-108.

Pain, C.F. 1983. Volcanic rocks and surfaces as indicators of landform age: the astrolabe agglomerate, Papua New Guinea. Australian Geographer 15(6):376-381.

Paine, J.R., International Union for Conservation of Nature and Natural Resources, South Pacific Regional Environment Programme, and Iucn Commission on National Parks and Protected Areas. 1991. IUCN directory of protected areas in Oceania. IUCN, Gland, Switzerland. xxiv+447 pp.

Papua New Guinea Bird Society. 1965-1997. NEWSLETTER - COMPLETE SET. Newsletter of the Papua New Guinea Bird Society 1-291.

Papua New Guinea Bird Society. 1986-2000. All Issues Combined Into One Searchable File. Muruk.

Papua New Guinea Electoral Commission. 2012. [Details on village polling stations for the 23 June 2012 polling scheduled for the Kairuku-Hire Electorate - includes details on villages in the Moroka District].

Papua New Guinea Forest Stewardship Council National Initiative, and Wwf Papua New Guinea. 2006. High conservation value forest toolkit for Papua New Guinea Papua New Guinea Forest Stewardship Council National initiative, WWF Papua New Guinea, Boroko

Papua New Guinea Sustainable Development Program. 2011. Annual Report Summary 2010.

Papua New Guinea. Department of Works and Supply., K.B. Saville, and M.B. Oubuku. 1982. Longitudal section of the Kokoda Trail : as in May 1982. DWS, Department of Works and Supply ;, Boroko, Papua New Guinea.

Papua New Guinea. National Mapping Bureau., and Papua New Guinea. Department of Natural Resources. 1977. "Varirata" National Park. National Mapping Bureau,, Port Moresby?

Papua New Guinea. National Mapping Bureau. 1978. Port Moresby street directory. The Bureau,, Port Moresby, Papua New Guinea?

Parker, F. 1982. The snakes of Western Province. Wildlife in Papua New Guinea 82(1):1-78.

Parsons, M. 1998. The Butterflies of Papua New Guinea: Their Systematics and Biology [Section on Mimicry Complex - pp 94-103]. Academic Press, San Diego, California. xvi+736 pp.

Parsons, M. 1998. The Butterflies of Papua New Guinea: Their Systematics and Biology [Section on *Ornithoptera* - pp 223-245]. Academic Press, San Diego, California. xvi+736 pp.

Parsons, M. 1998 [1999]. The Butterflies of Papua New Guinea: Their Systematics and Biology. [APPENDICES - INCLUDING CHECKLIST]. Academic Press, San Diego, Calif. xvi+736 pp.

Parsons, M. 1998 [1999]. Appendix XI. Checklist of New Guinea butterflies (including species occurring only in Irian Jaya, Indonesia, pp 657-683 *In* The Butterflies of Papua New Guinea: Their Systematics and Biology. Academic Press, San Diego, Calif.

Parsons, M. 1999. The Butterflies of Papua New Guinea: Their Systematics and Biology. [Species accounts for *Chaetocneme antipodes, Sabera fusca, Potanthus taxilus, Graphium felixi, Philiris luscecens, Arhopala eucolpis,*

Euploea usipetes, Morphopsis angustifascia, Euthalia aeropa, and *Symbrenthia hylaeus* and all species of *Delias*]. Academic Press, San Diego, Calif. xvi+736 pp.

Percy, D.M., P.T. Butterill, and I. Malenovský. 2016. Three new species of gall-forming psyllids (Hemiptera: Psylloidea) from Papua New Guinea, with new records and notes on related species. Journal of Natural History 50(17-18):1073-1101.

Perembo, R. 1983. Stratigraphy of Delena Headland, Central Province, Papua New Guinea. Science in New Guinea 10(3):137-165.

Perkins, P.D. 2011. New species (130) of the hyperdiverse aquatic beetle genus *Hydraena* Kugelann from Papua New Guinea, and a preliminary analysis of areas of endemism (Coleoptera: Hydraenidae). Zootaxa 2944:1-417.

Pernetta, J.C., and D. Black. 1983. Species of gecko (*Lepidodactylus*) in the Port Moresby area, with the description of a new species. Journal of Herpetology 17(2):121-128.

Pernetta, J.C., and D. Black. 1983. Species of gecko (*Lepidodactylus*) in the Port Moresby area, with the description of a new species. Journal of Herpetology 17(2):121-128.

Pieters, P.E. 1978. 1:250,000 Geological Series -- Explanatory Notes. Port Moresby - Kalo-Aroa, Papua New Guinea Sheets SC/55-6, 7, 11 International index. Australian Government Publishing Service, Canberra. 55 pp.

Pippet, J.R. 1975. The marine toad, *Bufo marinus*, in Papua New Guinea. Papua New Guinea Agricultural Journal 27(1):23-30.

Poggi, R. 1991. Descrizione di una nuova specie papuana del genere Sarothrias Grouvelle (Col. Jacobsoniidae). Annali del Museo Civico di Storia Naturale "Giacomo Doria" 88:677-683.

Polhemus, J.T., and D.A. Polhemus. 1994. The Trepobatinae (Heteroptera: Gerridae) of New Guinea and surrounding regions with a review of the world fauna. Part 2. Tribe Naboandelini. Entomologica Scandinavica 25(3):333-359.

Polhemus, J.T., and I. Lansbury. 1997. Revision of the genus *Hydrometra* Latreille in Australia, Melanesia and the southwest Pacific (Heteroptera: Hydrometridae). Bishop Museum Occasional Papers 47:1-67.

Polhemus, D.A., and J.T. Polhemus. 1999. Naucoridae (Heteroptera) of New Guinea. 6. A revision of the genera *Sagocoris* and *Aptinocoris*, with descriptions of new species. Journal of the New York Entomological Society 107(4):331-371.

Polhemus, D.A., R.A. Englund, and G.R. Allen. 2004. Freshwater biotas of New Guinea and nearby islands: analysis of endemism, richness, and threats, p. 62. Bishop Museum, Honolulu.

Polhemus, D.A., and G.R. Allen. 2007 [2006]. Freshwater biogeography, p. 207-245. *In:* Ecology of Papua. Vol. 1. A. J. Marshall and B. M. Beehler (eds.). Periplus Editions, Singapore.

Pounder, G.M. 1973. Summary of groundwater data for the Laloki Valley and Sogeri Plateau. Geological Survey of Papua New Guinea, Dept. of Lands, Surveys and Mines, Port Moresby. 19 leaves in various foliations pp.

Pratt, T.K., and B.M. Beehler. 2014. Birds of New Guinea. Second Edition. Princeton University Press, Princeton, New Jersey, USA and Woodstock, Oxfordshire, UK 528 pp.

Proctor, P. 1986. Kanosia Lagoon, Cape Suckling. Papua New Guinea Bird Society Newsletter:3-4.

Province, P.R.-C. 1928. Sogeri Plateau [Moroka] - August 1928.

Province, P.R.-C. 1929. Sogeri Plateau [Moroka] - September 1929.

Province, P.R.-C. 1932. Sogeri Plateau [Moroka] - May 1932.

Province, P.R.-C. 1943. Sogeri Plateau [Moroka] - January 1943.

Province, P.R.-C. 1944. Sogeri Plateau [Moroka] - June 1944.

Pu Yu, A. 1974. Letters to Mrs E.M. Johnston, 1974 Mar. - 1992 Sept. 1 microfilm reel pp.

Quanchi, M., and Proquest (Firm). 2007. Photographing Papua representation, colonial encounters and imaging in the public domain, p. xx+369. Cambridge Scholars Pub.,, Newcastle.

Queensland. 1893. Annual report of British New Guinea from 1st July, 1891 to 30th June, 1892 with appendices.

Queensland. 1893. Annual Report of British New Guinea from 1st July, 1891 to 30th June, 1892; with Appendices.

Queensland. 1898. Annual report of British New Guinea from 4th September, 1888 to 30th June, 1889 with appendices.

Queensland. 1898. Annual Report of British New Guinea from 1st July, 1896 to 30th June, 1897; with Appendices [ex Google via Hathi]

Queensland. 1902. Annual report of British New Guinea from 1st July, 1900 to 30th June, 1901 with appendices.

Quinnell, M. 2015. Sir William Macgregor's Itinerary in British New Guinea 1888-1898.

Ramsay, E.P. 1883. Contributions to the zoology of New Guinea. Notes on Birds from Mount Astrolabe, with descriptions of tavo new species. Proceedings of the Linnean Society of New South Wales 10(2):242-244.

Ramsay, E.P. 1883. Contributions to the Zoology of New Guinea, Part YII. Proceedings of the Linnean Society of New South Wales 8(1):15-29.

Rand, A.L., and L.J. Brass. 1940. Results of the Archbold Expeditions. No. 29. Summary of the 1936-1937 New Guinea expedition. Bulletin of the American Museum of Natural History 77(3):341-380.

Rand, A.L., and E.T. Gilliard. 1967. Handbook of New Guinea birds. Weidenfeld & Nicolson, London,. x + 612 pp.

Raven, R.J. 1994. Mygalomorph spiders of the Barychelidae in Australia and the western Pacific. Memoirs of the Queensland Museum 32(2):291-706.

Ray, S.H. 1895. A comparative vocabulary of the dialects of British New Guinea. Society for Promoting Christian Knowledge, London. 40 pp.

Ray, S.H. 1929. The Languages of the Central Division of Papua. The Journal of the Royal Anthropological Institute of Great Britain and Ireland 59:65-96.

Rhodin, A.G.J. 1993. Range extension for *Emydura subglobosa* in Papua New Guinea. Journal of Chelonian Conservation and Biology 1(1):47-48.

Rhodin, A.G.J. 1994. Chelid turtles of the Australasian Archipelago: 1. A new species of Chelodina from southeastern Papua New Guinea. Breviora 497:1-36.

Richards, S.J., P. Oliver, C. Dahl, and B. Tjaturadi. 2006. A new species of large green treefrog (Anura: Hylidae: *Litoria*) from northern New Guinea. Zootaxa 1208:57-68.

Richards, S.J., and P.M. Oliver. 2006. Two new species of large green canopy-dwelling frogs (Anura: Hylidae: Litoria) from Papua New Guinea. Zootaxa 1295:41-60.

Richards, S.J., and P.M. Oliver. 2007. A new species of *Cophixalus* (Anura: Microhylidae) from Misima Island, Papua New Guinea. Pacific Science 61(2):279-287.

Richards, S.J., and P.M. Oliver. 2010. A new scansorial species of *Cophixalus* (Anura: Microhylidae) from the Kikori River Basin, Papua New Guinea. Journal of Herpetology 44(4):555-562.

Riedel, A. 2001. Revision of the Euops quadrifasciculatus-group (Coleoptera: Curculionoidea: Attelabidae) from the Australian region, with a discussion of shifts between Nothofagus and Eucalyptus host plants. Invertebrate Taxonomy 15(4):551-587.

Riedel, A., K. Sagata, S. Surbakti, R. Tänzler, and M. Balke. 2013. One hundred and one new species of *Trigonopterus* weevils from New Guinea. ZooKeys (280):1-150.

Ritako, T.B. 2011. Arise Sir Thomas : an autobiography from Papua New

Guinea. University of Papua New Guinea Press and Bookshop, Port Moresby. xxi+255 pp.

Ritchie, J. 2012. Ebia Olewale: A Life of Service. x+292 pp.

Rivera, J.A., F. Kraus, A. Allison, and M.A. Butler. 2017. Molecular phylogenetics and dating of the problematic New Guinea microhylid frogs (Amphibia: Anura) reveals elevated speciation rates and need for taxonomic reclassification. Molecular Phylogenetics and Evolution.

Robinson M.H. 1982. The ecology and biogeography of spiders in Papua New Guinea. In: Gressitt J.L. (eds) Biogeography and Ecology of New Guinea. Monographiae Biologicae, vol 42. Springer, Dordrecht

Rochfort. 1898. Enclosure 4 in Appendix A. Annual Report of British New Guinea from 1st July, 1897 to 30th June, 1898; with Appendices:11-13.

Rochfort. 1898. Visit to the main range, September and October, 1897 [Enclosure 5 in Appendix A]. Annual Report of British New Guinea from 1st July, 1897 to 30th June, 1898; with Appendices:13-16.

Rogerson, R., D.W. Haig, and S.T.S. Nion. 1981. Geology of Port Moresby. Report 1981/16. University of Papua New Guinea, Waigani.

Roisin, Y., and J. Pasteels. 1996. The nasute termites (Isoptera : Nasutitermitinae) of Papua New Guinea. Invertebrate Systematics 10(3):507-616.

Roisin, Y., and J.M. Pasteels. 2000. The genus *Microcerotermes* (Isoptera: Termitidae) in New Guinea and the Solomon Islands. Invertebrate Taxonomy 14(2):137-174.

Romilly, H.H. 1889. From My Verandah in New Guinea. D. Nutt, London. xxvi+277 pp.

Romilly, H.H., and S.H. Romilly. 1893. Letters from the western Pacific and Mashonaland 1878-1891. D. Nutt, London,. xii+384 pp.

Ross, K., and A. Webb. 1974. Port Moresby and Sogeri climbing guide. K. Ross, Sogeri, P.N.G. **27** pp.

Rowe, D.J. 2012. Some Arboreal Ant-house Plants of Australasia and the southwest Pacific. Cactus and Succulent Journal 84(2):60-68.

Sabi, J., A. Taplin, and Papua New Guinea Department of Environment and Conservation (Dec). 2010. Kokoda Initiative/Terrestrial Ecosystems Management - 2010 (Jul-Dec) Budget. Papua New Guinea Department of Environment and Conservation (DEC), Waigani, Papua New Guinea.

Salvadori, T. 1880. Ornitologia della Papuasia e delle Molucche [Vols 1-3] [EX BHL - AMNH]. Stamperia reale G.B. Paravia e co. di I. Vigliardi, Torino

Sands, D.P.A. 1981. The ecology, biogeography and systematics of the Tribe Luciini (Lepidoptera: Lycaenidae). *In:* Department of Entomology. University of Queensland.

Sands, D.P.A. 1986. A revision of the genus *Hypochrysops* C. & R. Felder (Lepidoptera: Lycaenidae). Entomonograph 7:1-116.

Sands, D.P.A., P. Bakker, and F.M. Dori. 1993. *Cotesia erionotae* (Wilkinson) (Hymenoptera: Braconidae), for biological control of banana skipper, *Erionota thrax* (L.) (Lepidoptera: Hesperiidae) in Papua New Guinea. Micronesica Supplement 4:99-105.

Sar, S.A. 2006. The use of sticky traps to study seasonal dispersal activity of the sweet potato weevil, Cylas formicarius (Fabricius), in Papua New Guinea. Australian Centre for International Agricultural Research. 31-35 pp.

Saucke, H., F. Dori, and H. Schmutterer. 2000. Biological and integrated control of *Plutella xylostella* (Lep., Yponomeutidae) and *Crocidolomia pavonana* (Lep., Pyralidae) in brassica crops in Papua New Guinea. Biocontrol Science and Technology 10(5):595-606.

Schleip, W.D. 2008. Revision of the Genus *Leiopython* Hubrecht 1879 (Serpentes:

Pythonidae) with the Redescription of Taxa Recently Described by Hoser (2000) and the Description of New Species. Journal of Herpetology 42(4):645-667.

Seago, A.E., J.A. Giorgi, J. Li, and A. Ślipiński. 2011. Phylogeny, classification and evolution of ladybird beetles (Coleoptera: Coccinellidae) based on simultaneous analysis of molecular and morphological data. Molecular Phylogenetics and Evolution 60(1):137-151.

Sekhran, N., and S.E. Miller. 1994. Papua New Guinea Country Study on Biological Diversity. Papua New Guinea Department of Environment and Conservation, [Waigani, Papua New Guinea]

Seligman, C.G., F.R. Barton, and E.L. Giblin. 1910. The Melanesians of British New Guinea. The University Press, Cambridge. xxiii+766 pp.

Seligmann, C.G. 1909. A Classification of the Natives of British New Guinea. Journal of the Royal Anthropological Institute of Great Britain and Ireland 39:314-333.

Sharpe, E.B. 1883. Contributions to the Ornithology of New Guinea. Part VIII. Journal of the Linnean Society - Zoology 16(94):422-447.

Shea, G.M., and F. Kraus. 2007. A list of herpetological type specimens in the collections of the Papua New Guinea National Museum and Art Gallery and University of Papua New Guinea. Zootaxa 1514:37-60.

Sheppard, S., and L. Cranfield. 2012. Geological Framework and Mineralization of Papua New Guinea – An Update. Mineral Resources Authority, Port Moresby, Papua New Guinea. iv+62 pp.

Sherley, G. 2000. Invasive species in the Pacific: A technical review and draft regional strategy. South Pacific Regional Environment Programme, Apia, Samoa.

Simpson, C.C. 1907. Across the Owen Stanley Range, British New Guinea. Victorian Naturalist 23(9):156-167.

Simson, C.C. 1907. On the habits of the birds-of-paradise and bowerbirds of British New Guinea. Ibis 9th ser 1(3):380-387.

Slater, K.R. 1956. On the New Guinea taipan. Memoirs of the National Museum of Victoria 20:201-205.

Smith, H.M., D. Chiszar, K. Tepedelen, and F. Van Breukelen. 2001. A revision of the bevelnosed boas (*Candoia carinata* complex) (Reptilia: Serpentes). Hamadryad 26(2):283-315.

Society, P.N.G.B. 1965. All Issues Consolidated into One Searchable File. Newsletter.

Sogeri National High School. Sogerinumu, p. v. Sogeri National High School., Sogeri.

Sogeri National High School. Papua New Guinea culture today and yesterday at Sogeri National High School. Publisher not identified, Place of publication not identified. 8 pp.

Sogeri National High School. Emai. Sogeri Senior High School, Sogeri, Papua New Guinea. v. pp.

Sogeri National High School. Sogeri : the magazine of the territory's senior high school. Sogeri National High School, Sogeri, Papua New Guinea. v pp.

Sogeri National High School. 1979. Traditional dancing, p. volumes. Sogeri National High School, Boroko, Papua New Guinea.

Sogeri National High School. 1980. Death, mourning and funeral feasts. Sogeri National High School, Sogeri. 11 leaves pp.

Sogeri National High School. 1980. Sogeri traditional dancing, p. volumes. Sogeri National High School, Boroko, Papua New Guinea.

Sogeri National High School. Expressive Arts Department., and B. Ison. 1976. Pukari : voices of Papua New Guinea. Tofua Press, San Diego. ix+95 pp.

Sogeri Rubber Plantations Ltd. Annual report, balance sheet and accounts. The Firm., Port Moresby. v. pp.

Sogeri Rubber Plantations Ltd., A.L. Johnston, E.L. Johnston, and J. Bridge. 1993. Minutes, reports, balance sheets, correspondence : 1944-1993. *In:* Pmb 1052. Pacific Manuscripts Bureau,, Canberra, ACT.

Sogeri Senior High School. Papua New Guinea-Australia cultural exchange : newsletter, Sogeri.

Sogeri Senior High School. 1973. Sogeri '73 : the magazine of Sogeri Senior High School. Sogeri Senior High School, Sogeri. 70 pp.

Sogeri Senior High School. 1974. Taim Bipo, Taim Nau: A Selection of Oral Histories, Creative Writing and Designs. Sogeri Senior High School, Sogeri. 54 pp.

Sogeri Senior High School. 1974. Toemwasala. Expressive Arts Dept., Sogeri Senior High School, Sogeri. 48 pp.

Sogeri Senior High School., and B. Ison. 1975. Emai. The School, Sogeri. 40 pp.

Sohi, A.S., and J.S. Mann. 1992. Fourteen new species and some new records of Asian Erythroneurini (Insecta, Auchenorrhyncha, Cicadellidae: Typhlocybinae). Reichenbachia 29(2):123-143.

Souter, G. 1963. New Guinea: The Last Unknown. Angus and Robertson, Sydney

Sowei, J.W.-A. 2001. Demonstrating the value of biodiversity conservation at Ogotana Village, Sogeri Plateau,Central Province. United Nations University Project on People, Papua New Guinea. 18 pp.

Spanner, S. 1992. Varirata National Park - 24/05/92. Papua New Guinea Bird Society Newsletter:2.

Spanner, S. 1992. Report on outing to Varirata National Park, 8th December, 1991. Papua New Guinea Bird Society Newsletter:1.

Storer, P. 1986. An extended Easter in Myola, 28 March to 3rd April 1986. Papua New Guinea Bird Society Newsletter:3-5.

Stuart, I. 1973. Port Moresby: Yesterday and Today. Pacific Publications, Sydney. 368 pp.

Sugiyama, E., S. Shinonaga, and R. Kano. 1988. The tribe Sarcophagini from New Guinea with the description of a new species (Diptera, Sarcophagidae). Japanese Journal of Sanitary Zoology 39(3):283-292.

Symon, D.E. 1985. The Solanaceae of New Guinea. Journal of the Adelaide Botanical Garden 8(1-171).

Tallowin, O., A. Allison, A.C. Algar, F. Kraus, and S. Meiri. 2017. Papua New Guinea terrestrial-vertebrate richness: elevation matters most for all except reptiles. Journal of Biogeography [In Press].

Tänzler, R., K. Sagata, S. Surbakti, M. Balke, and A. Riedel. 2012. DNA barcoding for community ecology - how to tackle a hyperdiverse, mostly undescribed Melanesian fauna. PLoS ONE 7(1):e28832.

Tate, G.H.H. 1951. Results of the Archbold Expeditions. No. 65. The rodents of Australia and New Guinea. Bulletin of the American Museum of Natural History 97(4):183-430.

Taylor, J.M., J.H. Calaby, and H.M. Van Deusen. 1982. A revision of the genus *Rattus* (Rodentia, Muridae) in the New Guinean region. Bulletin of the American Museum of Natural History 173(3).

Taylor, L. 1988. Taim Bipo: The Disappearing Traditions and Practices of Papua New Guinea as Seen through the Eyes of Young Sogeri Artists. Expressive Arts Department, Sogeri National High School, Sogeri

Taylor, L., and Sogeri National High School. Expressive Arts Department. 1988. Kalamimi : poetry from Sogeri. s.n., s.l. 67 pp.

Taylor, L. 1990. Sogeri During the War: A Brief History and Guide. Expressive Arts Department, Sogeri National High School, Boroko, Papua New Guinea. 69 pp.

Taylor, L. 1991. Pasin Bilong Mipela (Our Way). Traditional Life in The Provinces of Papua New Guinea Depicted In Art

and in Essay. Expressive Arts Department, Sogeri National High School, Sogeri, Papua New Guinea. 158 pp.

Taylor, L. 1992. Snake Road: A Guide to the History, People and Places of the Sogeri district. Sogeri National High School, Boroko, Papua New Guinea. xviii+350 pp.

Taylor, L. 2002. Sogeri: The School that Helped to Shape a Nation: A History 1944 - 1994. Research Publications, Vermont, Vic. xv+342 pp.

Thompson, C., N. Stronach, E. Verheij, T. Mamu, S. Schmitt, and M. Wright. 2011. Final Frontier: Newly Discovered Species in New Guinea (1998-2008). WWF Western Melanesia Programme Office, Port Moresby, Papua New Guinea. 55 pp.

Thomson, J.P. 1892. British New Guinea. George Philip & Son, London. 336 pp.

Thomson, J.P. 1896. On Sir W. Macgregors journey in New Guinea. Journal of the Manchester Geographical Society 7(4-6):201-203.

Tolhurst, L.P. 1987. Varirata National Park. Papua New Guinea Bird Society Newsletter:3-4.

Tolhurst, L.P. 1990. Three lesser golden plovers spend winter near Port Moresby. Muruk 4(3):108-109.

Tomlinson, P.B. 1992. Deforestation Provides a Renewable Resource. Conservation Biology 6(2):306-307.

Tortonese, E. 1964. Contributo allo studio sistematico e biogeografico dei pesci della Nuova Guinea. Annali del Museo Civicio di Storia Naturale "Giacomo Doria" 75:13-98.

Trevett, A.J., D.G. Lalloo, N.C. Nwokolo, R.D.G. Theakston, S. Naraqi, and D.A. Warrell. 1995. Venom detection kits in the management of snakebite in Central Province, Papua New Guinea. Toxicon 33(5):703-705.

Trotter, C. 1884. New Guinea: a summary of our present knowledge with regard to the island. Proceedings of the Royal Geographical Society and Monthly Record of Geography 6(4):196-216.

Ubaidillah, R., J. Lasalle, and D.L.J. Quicke. 2000. A peculiar new genus and species of Entedoninae (Chalcidoidea: Eulophidae) from Southeast Asia. Journal of Hymenoptera Research 9(1):170-175.

University of California, S.D., Library,. 2013. Papua New Guinea: Central Province Patrol Reports.

Van Der Lande, V.M. 1994. Haemadipsid leeches of New Guinea: a review of their biology and a guide to identification. Science In New Guinea 20(1):9-22.

Van Der Lande, V.M. 1994. Cavemicolous leeches in Papua New Guinea. Helictite 32(2):35-39.

Van Der Sande, G.a.J. 1910. Ethnography and anthropology *in* Résultats de l'Expédition Scientifique Néerlandaise à la Nouvelle-Guinée en 1903 sous les auspices de Arthur Wichmann. Nova Guinea 3:1-384.

Van Gorsel, J.T. 2013. Bibliography of the Geology of Indonesia and Surrounding Areas

Vlaardingerbroek, B. 1984. Notes on freshwater zooplankton found in Central Province, Papua New Guinea, 1981-2. Journal and Proceedings of the Royal Society of New South Wales 117(1-2):63-66.

Vlaardingerbroek, B. 1989. Water level and temperature and zooplankton population abundances in Lake Surinumu Papua New Guinea. International Journal of Biometeorology 33(3):180-183.

Von Mueller, F. 1885. [Letter to Edward Strickland ML MSS.2134/1, Royal Geographical Society of Australasia (NSW Branch) papers, Mitchell Library, State Library of New South Wales, Sydney][Letter mentioning Henry Ogg Forbes].

Wa-Ai Sowei, J. 2001. Demonstrating the Value of Biodiversity Conservation at Ogotana Village, Sogeri Plateau, Central

Province. United Nations University Project on People, Land Management, and Environmental Change, Papua New Guinea Cluster.

Wahlberg, N. 1986. Varirata National Park 9 March 1986. Papua New Guinea Bird Society Newsletter:2-3.

Wahlberg, N. 1987. Haidana Island Centre Province. Papua New Guinea Bird Society Newsletter:5-6.

Wahlberg, N. 1988. Varirata National Park Sunday 7th February. Papua New Guinea Bird Society Newsletter:1.

Wahlberg, N. 1988. Veimauri-Hisiu 7th August. Papua New Guinea Bird Society Newsletter:1.

Wahlberg, N. 1988. Twelve-wire Spot 19th June, 1988. Papua New Guinea Bird Society Newsletter:1.

Wahlberg, N. 1990. Straw necked ibis *Threskiornis spinicollis* at Kanosia Lagoon, Central Province. Muruk 4(3):109.

Wahlberg, N. 1992. Observations of birds feeding in a fruiting fig *Ficus* sp. in Varirata National Park. Muruk 5(3):109-110.

Walker, A.S. 1957. The Island Campaigns. Australian War Memorial, Canberra. xvi+426 pp.

Walker, M. 1978. Transition, a developing style of the arts in Papua New Guinea. Publisher not identified, Sogeri, Papua New Guinea. 4 leaves pp.

Wallach, V. 1996. Two new blind snakes of the *Typhlops ater* species group from Papua New Guinea (Serpentes: Typhlopidae). Russian Journal of Herpetology 3(2):107-118.

Warner, J.N., and C.O. Gassl. 1958. The 1957 sugar cane expedition to Melanesia. Hawaiian Planters' Record 55(3):209-236.

Watson, R.E. 1994. *Awaous* (*Awaous*) *acritosus*, a new species of freshwater goby from southern New Guinea and northeastern Australia (Teleostei: Gobiidae). Ichthyological Exploration of Freshwaters 5(4):371-376.

Wawikiak, H. 1977. Common cane toads *Bufo marinus*. Papua New Guinea Museum and Art Gallery Natural History Department Leaflet 1:1-3.

Weaver, D.B. Strategies for the development of deliberate ecotourism in the South Pacific. Source: Pacific Tourism Review 2(1):53-66.

West, F.J. 1968. Hubert Murray; the Australian pro-consul. Oxford University Press, Melbourne, New York etc. vii+296 pp.

Weston, I.L. 1983. A report on four species of the genus *Meliphaga* in Papua New Guinea. Sunbird: Journal of the Queensland Ornithological Society 13(3):45-53.

Wetherell, D. 1974. Christian missionaries in eastern New Guinea: A study of European, South Sea Island and Papuan influences, p. 462. Vol. PhD. Australian National University.

Wichmann, A. 1910. Entdeckungsgeschichte von Neu-Guinea, 1828-1902. E.J. Brill, Leiden. 1026 pp.

Wichmann, A. 1910. Entdechungsgeschichte von Neu-Guinea 1828 bis 1885 *in* Résultats de l'Expédition Scientifique Néerlandaise à la Nouvelle-Guinée en 1903 sous les auspices de Arthur Wichmann. Nova Guinea 2 (1re. partie):i-xiv + 369.

Wichmann, A. 1912. [EXTRACTS - Forbes 1887 pp 444-446] Entdechungsgeschichte von Neu-Guinea 1885 bis 1902 *in* Résultats de l'Expédition Scientifique Néerlandaise à la Nouvelle-Guinée en 1903 sous les auspices de Arthur Wichmann. Nova Guinea.

Wichmann, A. 1912. [EXTRACTS - MacFarlane 1885 p 391] Entdechungsgeschichte von Neu-Guinea 1885 bis 1902 *in* Résultats de l'Expédition Scientifique Néerlandaise à la Nouvelle-Guinée en 1903 sous les auspices de Arthur Wichmann. Nova Guinea.

Wichmann, A. 1912. [EXTRACTS - Forbes 1886 pp 401-403] Entdechungsgeschichte von Neu-Guinea 1885 bis 1902 *in* Résultats de l'Expédition Scientifique

Néerlandaise à la Nouvelle-Guinée en 1903 sous les auspices de Arthur Wichmann. Nova Guinea.

Wichmann, A. 1912. Entdechungsgeschichte von Neu-Guinea 1885 bis 1902 *in* Résultats de l'Expédition Scientifique Néerlandaise à la Nouvelle-Guinée en 1903 sous les auspices de Arthur Wichmann. Nova Guinea 2 (2ème partie):i-xvi + 371-1026.

Wichmann, A. 1912. [EXTRACTS - Forbes 1885 pp 389-391] Entdechungsgeschichte von Neu-Guinea 1885 bis 1902 *in* Résultats de l'Expédition Scientifique Néerlandaise à la Nouvelle-Guinée en 1903 sous les auspices de Arthur Wichmann. Nova Guinea.

Wichmann, A. 1912. [EXTRACTS - Douglas 1885 p 391] Entdechungsgeschichte von Neu-Guinea 1885 bis 1902 *in* Résultats de l'Expédition Scientifique Néerlandaise à la Nouvelle-Guinée en 1903 sous les auspices de Arthur Wichmann. Nova Guinea.

Wiles, P.R. 1997. The water mites (Acari: Hydrachnidia) of New Guinea. Raffles Bulletin of Zoology 45(2):375-418.

Williams, F.E. 1932. Sex affiliation and its implications. The Journal of the Royal Anthropological Institute of Great Britain and Ireland 62:51-81.

Williams, F.E. 1960. The Bush Koiari people of the Sogeri Plateau, Central Division, Territory of Papua 1932 : sex affiliation and it's implications. s.n., Port Moresby? 38 pp.

Williams, D.J. 1989. The mealybug genus Rastrococcus Ferris (Hemiptera: Pseudococcidae). Systematic Entomology 14(4):433-486.

Williams, B. 1993. The Knowledge: A Guide to Living in Port Moresby. IMPS Research, Port Moresby, Papua New Guinea. 320 pp.

Williams, D.J. 1996. Snakebite in Papua New Guinea - an overview. Far North Queensland Journal of Herpetology 1(1):2-11.

Williamson, R.W. 1912. The Mafulu mountain people of British New Guinea. Macmillian and Co., London. xxiii+361 pp.

Wilson, E.O. 1959. Studies on the ant fauna of Melanesia. VI. The tribe Cerapachyini. Pacific Insects 1(1):39-57.

Wilson, D.E., and D.M. Reeder. 2005. Mammal Species of the World: A Taxonomic and Geographic Reference. Johns Hopkins University Press, Baltimore. xxxv+2142 pp.

Winn, J.R.D., and P. Pousai. 2010. Synorogenic alluvial-fan - fan-delta deposition in the Papuan foreland basin: Plio-Pleistocene Era Formation, Papua New Guinea. Australian Journal of Earth Sciences 57(5):507-523.

Worldwide Fund for Nature. 2010. Final Frontier - Newly Discovered Species of New Guinea [Draft - February 2010].

Worldwide Fund for Nature. 2018. http://wwf.panda.org/knowledge_hub/where_we_work/new_guinea_forests/area_forests_new_guinea/plants_animals_new_guinea_forests/invertebrates_forests_new_guinea/

Yates, K.R., and R.Z. De Ferranti. 1967. Geology and Mineral Deposits Port Moresby/Kemp Welch Area, Papua. Commonwealth of Australia. Department of National Development, Bureau of Mineral Resources, Geology and Geophysics. Report 105:1-117.

Yates, K.R., and R.Z. De Ferranti. 1967. Geology and Mineral Deposits Port Moresby/Kemp Welch Area, Papua. Commonwealth of Australia. Department of National Development, Bureau of Mineral Resources, Geology and Geophysics. Report 105:1-117.

Zabka, M. 1991. Salticidae (Arachnida: Araneae) of Oriental, Australian and Pacific regions, 5. Genus *Holoplatys* Simon, 1885. Records of the Australian Museum 43(2):171-240.

Zabka, M. 1996. Bulolia, a new genus of Salticidae (Arachnida: Araneae) from Papua New Guinea. Revue Suisse de Zoologie Volume Hors Serie 2:701-707.

Zabka, M. 1999. Salticidae (Arachnida: Araneae) of Oriental, Australian and

Pacific regions, 12. Marengo Peckham & Peckham 1892 from Papua New Guinea. Memoirs of the Queensland Museum 43(2):893-905.

Zhang, J.-X., and W.P. Maddison. 2012. New euophryine jumping spiders from Papua New Guinea (Araneae: Salticidae: Euophryinae). Zootaxa 3491:1-74.

Zug, G.R. 2004. Systematics of the *Carlia* "*fusca*" lizards (Squamata: Scincidae) of New Guinea and nearby islands. Bishop Museum Bulletin in Zoology 5:i-viii+1-83.

Zweifel, R.G. 1972. Results of the Archbold Expeditions. No. 97. A revision of the frogs of the subfamily Asterophryinae Family Microhylidae. Bulletin of the American Museum of Natural History 148(3):415-546.

Zweifel, R.G. 2000. Partition of the Australopapuan microhylid frog genus *Sphenophryne* with descriptions of new species. Bulletin of the American Museum of Natural History 253:1-130.

9. GLOSSARY OF TERMS

Biomass: The total mass of organisms in a given area.

Disturbed Areas: Areas that extensively altered by human activity.

Endemic: refers to whether an organism is native to and restricted to a specific geographic area. For example, a species endemic to Varirata National Park would be found only there; similarly a species endemic to Papua New Guinea would be found only within the political borders of PNG; a species endemic to New Guinea would restricted to the island of New Guinea.

Ecosystem: The complete assemblage of plants and animals in an area.

Ecotone: A region of transition between two biological communities.

Introduced: A species of plant of animal that is not native to an area and has been has been accidently or deliberately introduced by human activity.

Invasive: An introduced species of plant or animal that is able to spread into and adversely impact native ecosystems.

Native: A species of plant or animal that occurs naturally in a given area.

10. ACKNOWLEDGEMENTS

IPCA would like to formally thank the staff from the JICA office in Port Moresby, particularly, Hitoshi Watanabe, Koji Asano, Hiroshi Imae, Ted Mamu, Ayako Ochi, John Dege, Biatus Bito and Nancy Bobora. JICA have provided outstanding support and logistical assistance throughout the conduct of the Biodiversity Surveys and IPCA are profoundly grateful. Mr Ted Mamu, Mr John Dege, Mr Biatus Bito were extremely helpful in facilitating the fieldwork program and without their active support IPCA's delivery of the contract would have been inordinately more difficult. John Dege's assistance in transporting staff, supplies and equipment to and from the Park has also been highly appreciated. His driving skills and knowledge of the Sogeri Road are unmatched. In particular, IPCA acknowledges Mr Ted Mamu who is deserving of special mention given his crucial role in assisting our field team through field logistics, technical support, local knowledge and Project Management skills. Mr Mamu was professional at all times and instrumental in our success. We sincerely acknowledge his efforts as they have been greatly appreciated. Ms. Ayako Ochi (JICA) has an impressive command of Geographic Information Systems and has been very helpful in developing a grid system to guide the Clidemia study. She has also provided essential maps and IPCA very much appreciate the support that she has provided. As the Japanese Project Focal Point, Hiroshi Imae has been collaborative, insightful and demonstrated thorough professionalism throughout his tenure in this role. It has been a pleasure delivering this commission together. Working collaboratively with the JICA team on the Varirata National Park Biodiversity Surveys has been a thoroughly rewarding professional experience.

IPCA would also like to acknowledge the assistance received from colleagues from the Conservation and Environmental Protection Authority (CEPA), in particular Benside Thomas, Kay Kalim and James Sabi. The faculty and staff of the University of Papua New Guinea have been generous in their support. This includes Prof. Simon Saulei, Pius Piskaut and Dan Kundun.

The care, attention and rigour that Dr. Shelley James put into the development of her checklist of vascular plants of Papua New Guinea is extraordinary and has been critical to this commission.

IPCA have also received considerable assistance from scientific colleagues, including Dr. Gerald Allen from the Western Australian Museum (fishes), Dr. Kristopher Helgen from the University of South Australia and Dr. Tanya Leary from the New South Wales National Park Service (mammals), Dr. Bruce Beehler from the Smithsonian Institution and Dr. Thane Pratt from Bishop Museum (birds).

Several colleagues have helped identify insects, including Dr. Dan Polhemus and Dr. G. Allan Samuelson from Bishop Museum and Dr. Scott Miller of the Smithsonian Institution.

Nittya Simard demonstrated her skill as an outstanding field scientist and contributed a very high standard of professionalism in all stages of project delivery. We also thank Andrew McInnis and Christo Ferguson for their work in assisting to document the distribution of Clidemia within the Park and initiating community outreach programs promoting biodiversity conservation to surrounding villages on behalf of IPCA.

Maya Trevidy, who spent a month at Bishop Museum in July 2017 on an internship, did a superb job of compiling a composite database of Cedric Carr's 1935-36 plant collections from PNG. This important material – now well studied and identified – was crucial to the development of our plant checklist.

Dr. Phil Shearman of the PNG Remote Sensing Centre provide crucial GIS mapping and analysis assistance.

Our informal driver, Koipa Dei, has provided essential transportation around Port Moresby.

We are extremely grateful to Koiari landowners from the surrounding area. It is a privilege to work with them and to learn from them.

Our colleagues from Bishop Museum, particularly Tracie Mackenzie has assisted our efforts in many ways, as has the collections manager for vertebrates, Molly Hagemann.

The chairman of the Indo-Pacific Conservation Alliance, Burke Burnett, has helped with financial and administrative matters, as has the book keeper, Grace Jiho. Molly Hagemann did a superb job of editing and formatting the document.

Finally, Allen Allison would like to thank his spouse, Isabella Forster, for her continuing support of field work in Papua New Guinea – thirty years and counting!

APPENDIX 1. SCOPE OF WORK

Summary of Biodiversity Surveys Scope of Works

Section	Fauna	Flora
4.1 (a)	Conduct a literature review of relevant scientific publications, reports, GIS shape files, specimen database records, on the fauna diversity of VNP and prepare a check list of species	Conduct a literature review of relevant scientific publications, reports, GIS shape files, specimen database records, on the fauna diversity of VNP and prepare a check list of species
4.2 (a)	Preparation of a **habitat classification** map: Prepare a **habitat classification** map based on satellite imagery and ground truthing techniques. A high resolution satellite image (World View 2) will be provided by the consultant	Preparation of a **vegetation map and habitat classification** map: Prepare a **vegetation map** based on satellite imagery and ground truthing techniques. A high resolution satellite image (World View 2) will be provided by the consultant
4.3	Conduct field surveys targeting the following: a) Vertebrate taxa; (i) Freshwater fishes (ii) Amphibians; (iii) Reptiles; (iv) Birds; (v) Mammals b) Invertebrate taxa; Insects (visually appealing, iconic, or scientifically interesting species) Other invertebrates of interest	Conduct field surveys targeting the following: (a) Vascular plant taxa;
4.4 (a)	Not Stated	Development of a monitoring program Prepare a comprehensive monitoring program targeting indicator species of **fauna and flora** for the National Park and surrounding area. Assess specific ecological requirements of selected groups of **fauna** and **flora** which may require specific management measures and are potential targets for ecotourism Propose a management actions for conservation and protection of selected groups of flora and fauna
4.5	Not Stated	Production of Field Guide Brochures a) Produce field guides / Biodiversity Information Brochures for selected groups of fauna and flora below, with a brief description of their natural history will be printed for visitors to learn about the biodiversity of VNP for VNP: b) The field guide will be used for the general public, tourists and students, hence the descriptions must be simplified without too much scientific jargon. ▪ Common Vascular Plants ▪ Vertebrate ○ Amphibians ○ Common reptiles ○ Common birds ○ Common mammals ▪ Common invertebrates

Section	Fauna	Flora
4.6	NA	Biodiversity Seminar a) A biodiversity (fauna & flora) seminar aiming to disseminate information obtained through the project will be conducted in POM at the end of the project. The target audience will be 80 people and stakeholders will include researchers, students, residents of the Koairi LLG etc. Details to be confirmed with the CEPA – JICA team. b) A seminar report will be prepared

APPENDIX 2. CHECKLIST OF COMMON INVERTEBRATES OF VNP

Phylum Mollusca

Family Ariophantidae (Land Snails)

Euplecta minor

Phylum Annelida

Family Haemadipsidae (Land Leeches)

Chtonobdella sp.

Phylum Arthropoda (Subphylum: Crustacea)

Family Sundathelphusidae (Freshwater Crabs)

Holuthisana papuana

Phylum Arthropoda (Subphylum Chelicerata)

Nephila sp [Golden orb spider]

Argiope sp.

Gastracantha sp.

Nihoa verireti [a tarantula known only from the Park but likely to be widespread on the Sogeri Plateau]

Phylum Arthropoda (Class Insecta)

Order Odonata (Dragonflies & Damselflies)

Ictinogomphus australis lieftincki
Neurothemis stigmatizans
Orthetrum villosovittatum
Rhyothemis sp.
Argiolestes sp. 1
Argiolestes sp. 2
Idiocnemis sp.

Order Lepidoptera (Butterflies and Moths)

Ornithoptera priamus
Papilio Ulysses
Taenaris sp.
Nyctemera sp.
Hydroclada sp.
Pingasa sp.
Pygospila sp.
Parotis sp.
Hyposidra sp.

Order Coleoptera (Beetles)

Dineutes sp.
Alaus arfakianus

APPENDIX 3. CHECKLIST OF THE FISHES OF VNP

Species endemic to PNG are shown in bold

AMBASSIDAE

***Tetracentrum apogonoides* Macleay, 1884 [Four-Spined Glass Perchlet]**

CICHLIDAE

Oreochromis mossambicus (Peters, 1852) [Mozambique Tilapia] [**INTRODUCED**]

ELEOTRIDAE

***Morgurnda pulchra* Horsthemke & Staeck, 1990 [Moresby Mogurnda]**

PLOTOSIDAE

Neosilurus brevidorsalis (Günther, 1867) [Short-Finned Tandan]

MELANOTAENIIDAE

***Melanotaenia goldiei* (Macleay, 1883) [Goldie River Rainbowfish]**

POECILIIDAE

Poecilia reticulata (Peters, 1859) [GUPPY] [**INTRODUCED**]

APPENDIX 4. CHECKLIST OF THE AMPHIBIANS (FROGS) OF VNP

Total Species Occurring in the Park: 24 confirmed species: 23 native; 1 introduced

Species Endemic to PNG shown in **bold**.

Frequency of occurrence

C = common (seen on most days)

F = fairly common (seen regularly)

S = scarce (seen infrequently)

R = rare (recorded only one or few times)

Habitat

f = forested habitats

s = open habitats (savanna)

e = forest edge

w = on or close to water

d = disturbed areas – e.g., buildings

RANIDAE

Papurana arfaki (Meyer, 1874) [S – w]

Papurana daemeli (Steindachner, 1868) [C – w]

Papurana garritor **(Menzies, 1987)** [F – w]

Papurana grisea **(van Kampen, 1913)** [C – w]

HYLIDAE

Litoria chloristona **Menzies, Richards, and Tyler, 2008 [C – w]**

Litoria eucnemis (Lönnberg, 1900) [S – w]

Litoria impura **(Peters and Doria, 1878) [C – w]**

Litoria nasuta (Gray, 1841) [C – w]

Litoria prora **(Menzies, 1969) [S – fw]**

Litoria thesaurensis (Peters, 1878) [S – w]

Litoria vocivincens **Menzies, 1972 [C – w]**

Litoria **sp. [S – fw]**

Nyctimystes infrenatus (Günther, 1867) [C – w]

Nyctimystes semipalmatus **Parker, 1936 [F – w]**

MICROHYLIDAE:

Cophixalus ateles **(Boulenger, 1898) [C – f]**

Cophixalus verrucosus **(Boulenger, 1898) [S – w]**

Copiula oxyrhina **(Boulenger, 1898) [S – f]**

Hylophorbus rufescens Macleay, 1898 [C – f]

Mantophryne lateralis Boulenger, 1887 [C – f]

Mantophryne menziesi **(Zweifel, 1972) [C –ed]**

Oreophryne loriae **(Boulenger, 1898) [S –f]**

Paedophryne amauensis **Rittmeyer,**

Allison, Gründler, Thompson, and Austin, 2012 [C – f]

MYOBATRACHIDAE

Lechriodus melanopyga **(Doria, 1874) [S – fw]**

BUFONIDAE

Rhinella marina (Linnaeus, 1758) [INTRODUCED] [C **–** d]

The following species are predicted by shapefile analysis to occur in the Park. These species are yet to be confirmed however their presence in the Park is considered likely:

MICROHYLIDAE

Choerophryne gunnari (Menzies, 1999)

Litoria graminea (Boulenger, 1905) [S – f]

HYLIDAE

Litoria timida Tyler and Parker, 1972

APPENDIX 5. CHECKLIST OF THE REPTILES OF VNP

Total Number of Reptile Species:

Turtles: 1

Lizards: 26

Snakes: 17

Species shown in **bold** are endemic to Papua New Guinea

Taxonomy based on Papua New Guinea Species Information Management System (Allison, Oct 2017 update)

Frequency of occurrence

C = common (seen on most days)

F = fairly common (seen regularly)

S = scarce (seen infrequently)

R = rare (recorded only one or few times)

Habitat

f = forested habitats

s = open habitats (savanna)

e = forest edge

w = on or close to water

d = disturbed areas – e.g., buildings

TURTLES:

CHELIDAE

Emydura subglobosa (Krefft, 1876) [S – w]

LIZARDS:

AGAMIDAE

Hypsilurus modestus (Meyer, 1874) [S – f]

Hypsilurus papuensis (Macleay, 1877) [S – f]

GEKKONIDAE

Hemidactylus frenatus Duméril and Bibron, 1836 [C – d]

Hemiphyllodactylus typus Bleeker, 1860 [C – d]

Lepidodactylus lugubris (Duméril and Bibron, 1836) [S – d]

Lepidodactylus orientalis Brown and Parker, 1977 [S – df]

Lialis burtonis Gray, 1834 [S – s]

Nactus sp. [C – f]

SCINCIDAE

Carlia bicarinata (Macleay, 1877) [C – s]

Carlia luctuosa (Peters and Doria, 1878) [C – sed]

Cryptoblepharus yulensis Horner, 2007 [C – d]

Emoia kordoana (Meyer, 1874) [S – d]

Emoia longicauda (Macleay, 1877) [S – df]

Emoia obscura (de Jong, 1927) [C – df]

Emoia pallidiceps de Vis, 1890 [C – f]

Emoia physicae (Duméril and Bibron, 1839) [S – f]

Emoia submetallica (Macleay, 1877) [C – df]

Lygisaurus curtus (Boulenger, 1897) [C – f]

Sphenomorphus jobiensis (Meyer, 1874) [C – f]

Sphenomorphus forbesii (Boulenger, 1888) [S – f]

Sphenomorphus nigrolineatus (Boulenger, 1897) [S – f]

Sphenomorphus simus (Sauvage, 1879) [R – f]

Sphenomorphus solomonis (Boulenger, 1887) [C – f]

Tiliqua gigas (Schneider, 1801) [S – f]

VARANIDAE

Varanus jobiensis Ahl, 1932 [C – fs]

Varanus prasinus (Schlegel, 1839) [S – f]

SNAKES:

PYTHONIDAE

Bothrochilus meridionalis (Schleip, 2014) [S – fs]

Morelia spilota (Lacépède, 1804) [S – s]

Morelia viridis [S – f]

Simalia amethistina (Schneider, 1801) [R – fs]

COLUBRIDAE

Boiga irregularis (Merrem, 1802) [F – dfs]

Dendrelaphis calligaster (Günther, 1867) [S – f]

Stegonotus cucullatus (Duméril, Bibron and Duméril, 1854) [S – f]

Stegonotus diehli Lindholm, 1905 [S – f]

Tropidonophis mairii (Gray, 1841) [S – f]

ELAPIDAE: ELAPINAE

Acanthophis laevis Macleay, 1877 [S – f]

Aspidomorphus lineaticollis (Werner, 1903) [R – f]

Furina tristis (Günther, 1858) [R – f]

Micropechis ikaheka (Lesson, 1826) [R – f]

Oxyuranus scutellatus (Peters, 1867) [R – s]

Pseudechis papuanus Peters and Doria, 1878 [R – f]

GERRHOPILIDAE

Gerrhopilus inornatus (Boulenger, 1888) [R – f]

TYPHLOPIDAE

Indotyphlops braminus (Daudin, 1803) [S – d]

The following species are predicted by shapefile analysis or are known from the Sogeri Plateau and can be expected to occur in the Park but have yet to be confirmed to occur there:

GEKKONIDAE

Cyrtodactylus loriae (Boulenger, 1898)

Gehyra insulensis (Girard, 1857)

Gehyra membranacruralis King and Horner, 1989

SCINCIDAE

Cryptoblepharus virgatus (Garman, 1901)

Emoia caeruleocauda (de Vis, 1892)

Eugongylus rufescens (Shaw, 1802)

Glaphyromorphus nigricaudis (Macleay, 1877)

Sphenomorphus fragilis (Macleay, 1877)

Sphenomorphus papuae (Kinghorn, 1928)

BOIDAE

Candoia aspera (Günther, 1877)

PYTHONIDAE

Liasis papuana Peters and Doria, 1878

COLUBRIDAE

Dendrelaphis lineolatus (Jacquinot and Guichenot, 1853)

Dendrelaphis macrops (Günther, 1877)

Stegonotus modestus (Schlegel, 1837)

Tropidonophis doriae (Boulenger, 1897) [S – fw]

Tropidonophis picturatus (Schlegel, 1837) [S – fw]

Tropidonophis multiscutellatus (Brongersma, 1948)

ELAPIDAE: ELAPINAE

Aspidomorphus muelleri (Schlegel, 1837)

The following species were predicted to occur in the Park from shapefile analysis but on the basis of field surveys don't appear to occur within the Park

AGAMIDAE

Hypsilurus dilophus (Duméril and Bibron, 1837)

GEKKONIDAE

Lialis jicari Boulenger, 1903

GERRHOPILIDAE

Gerrhopilus fredparkeri (Wallach, 1996)

Gerrhopilus mcdowelli (Wallach, 1996)

APPENDIX 6. CHECKLIST OF THE BIRDS OF VNP

6.1 Checklist of Birds of Varirata National Park

CHECKLIST OF BIRDS OF VARIRATA NATIONAL PARK
[v20 October 2017]

Note: Scientific names, common names and phylogenetic order follows Pratt and Beehler. 2014. Birds of New Guinea. Princeton University Press

This Checklist was compiled from the original checklist published by Mike Hopkins and Jones Hiaso (1994) that included 205 species.

An additional 26 species were added on the basis of reports in the Newsletter of the PNG Bird Society, the journal Muruk (also published by the PNG Bird Society) and from suggestions made by Thane K. Pratt who reviewed the list.

Species shown in **bold** are endemic to Papua New Guinea

Frequency of occurrence

C = common (seen or heard most days)

F = fairly common (seen or heard regularly)

S = scarce (seen infrequently)

R = rare (recorded only one or few times)

Habitat

f = forested habitats

s = open habitats (savanna)

e = forest edge

w = on or close to water

Other notes

h = more often heard than seen

nv = numbers variable (e.g. migrants)

CASUARIIDAE - Cassowaries

Casuarius bennetti Gould, 1857 [Dwarf Cassowary] [S – f]

Casuarius casuarius (Linnaeus, 1758) [Southern Cassowary] Single record; Requires confirmation [S –f]

MEGAPODIIDAE - Megapodes

Talegalla fuscirostris Salvadori, 1877 [Yellow-legged Brushturkey] [C – f] [h]

Megapodius reinwardt Dumont, 1823 [Orange-footed Scrubfowl] [S –fs]

PHASIANIDAE - Pheasants, Partridges, and Quail

Coturnix ypsilophora Bosc, 1792 [Brown Quail]

ANATIDAE - Ducks, Geese, and Swans

Dendrocygna guttata Schlegel, 1866 [Spotted Whistling Duck] [R – w]

PODICIPEDIDAE - Grebes

Tachybaptus novaehollandiae (Stephens, 1826) [Australasian Grebe] [C – w]

ARDEIDAE - Herons and Bitterns

Zonerodius heliosylus (Lesson & Garnot, 1828) [Forest Bittern] [R – f]

Nycticorax caledonicus (Gmelin, JF, 1789) [Nankeen Night-Heron] [R – w]

Ardea modesta Gray JE, 1831 [Eastern Great Egret]

Ardea intermedia Wagler, 1829 [Intermediate Egret]

PHALACROCORACIDAE - Cormorants

Microcarbo melanoleucos (Vieillot, 1817) [Little Pied Cormorant] [R – w]

Phalacrocorax sulcirostris (von Brandt, JF, 1837) [Little Black Cormorant] [R – w]

ACCIPITRIDAE - Hawks and Eagles

Aviceda subcristata (Gould, 1838) [Pacific Baza] [S – e]

Henicopernis longicauda (Lesson & Garnot, 1828) [Long-tailed Buzzard] [F – f]

Haliastur sphenurus (Vieillot, 1818) [Whistling Kite]

Haliastur indus (Boddaert, 1783) [Brahminy Kite] [C – s]

Circus approximans Peale, 1848 [Swamp Harrier]

Accipiter hiogaster (Müller, S, 1841) [Variable Goshawk]

Accipiter fasciatus (Vigors & Horsfield, 1827) [Brown Goshawk] [S – s]

Accipiter poliocephalus Gray, GR, 1858 [Grey-headed Goshawk] [S – f]

Accipiter cirrocephalus (Vieillot, 1817) [Collared Sparrowhawk]

Accipiter meyerianus (Sharpe, 1878) [Meyer's Goshawk] [R – f]

Megatriorchis doriae Salvadori & D'Albertis, 1875 [Doria's Hawk] [R – f]

Butastur indicus (Gmelin, JF, 1788) [Grey-faced Buzzard] Record requires confirmation; Visitor not known east of Trans-Fly

Harpyopsis novaeguineae Salvadori, 1875 [New Guinea Harpy-Eagle] [R – f]

Aquila gurneyi Gray, GR, 1861 [Gurney's Eagle] [S – f]

Hieraaetus weiskei (Reichenow, 1900) [Pygmy Eagle]

FALCONIDAE - Falcons

Falco severus Horsfield, 1821 [Oriental Hobby] [S – e]

Falco berigora Vigors & Horsfield, 1827 [Brown Falcon] [R – f]

Falco peregrinus Tunstall, 1771 [Peregrine Falcon] [R – s]

RALLIDAE - Rails

Rallina tricolor Gray, GR, 1858 [Red-necked Crake] [R – f]

Gymnocrex plumbeiventris (Gray, GR, 1862) [Bare-eyed Rail] [R – f]

Porzana cinerea (Vieillot, 1819) [White-browed Crake]

Porzana tabuensis (Gmelin, JF, 1789) [Spotless Crake] [R – w]

Amaurornis moluccana (Wallace, 1865) [Rufous-tailed Bush-hen]

TURNICIDAE - Buttonquail

Turnix maculosus (Temminck, 1815) [Red-backed Buttonquail]

CHARADRIIDAE - Plovers and Lapwings

Vanellus miles (Boddaert, 1783) [Masked Lapwing]

Pluvialis fulva (Gmelin, JF, 1789) [Pacific Golden Plover]

SCOLOPACIDAE - Sandpipers and Snipes

Actitis hypoleucos (Linnaeus, 1758) [Common Sandpiper] [R – w]

COLUMBIDAE - Pigeons and Doves

Columba vitiensis Quoy & Gaimard, 1832 [White-throated Pigeon] [R – s]

Reinwardtoena reinwardti (Temminck, 1824) [Great Cuckoo-Dove] [S – f]

Macropygia amboinensis (Linnaeus, 1766) [Brown Cuckoo-Dove] [C – f]

Macropygia nigrirostris Salvadori, 1876 [Black-billed Cuckoo-Dove] [S – f]

Gallicolumba rufigula (Pucheran, 1853) [Cinnamon Ground-Dove] [S – f]

Alopecoenas jobiensis (Meyer, AB, 1875) [White-bibbed Ground-Dove] [S – f] [nv]

Geopelia placida Gould, 1844 [Peaceful Dove]

Trugon terrestris Gray, GR, 1849 [Thick-billed Ground-Pigeon]

Otidiphaps nobilis Gould, 1870 [Pheasant Pigeon] [F –f] [h]

Chalcophaps longirostris Gould, 1848 [Pacific Emerald Dove]

Chalcophaps stephani Pucheran, 1853 [Stephan's Emerald Dove] [F –f]

Ptilinopus magnificus (Temminck, 1821) [Wompoo Fruit-Dove] [C –f] [h]

Ptilinopus perlatus (Temminck, 1835) [Pink-spotted Fruit-Dove] [F – fs]

Ptilinopus ornatus Schlegel, 1871 [Ornate Fruit-Dove] [R – f]

Ptilinopus superbus (Temminck, 1809) [Superb Fruit-Dove] [C – f]

Ptilinopus coronulatus Gray, GR, 1858 [Coroneted Fruit-Dove] [S – f]

Ptilinopus pulchellus (Temminck, 1835) [Beautiful Fruit-Dove] [F – f] [h]

Ptilinopus rivoli (Prévost, 1843) [White-bibbed Fruit-Dove] [R – f]

Ptilinopus iozonus Gray, GR, 1858 [Orange-bellied Fruit-Dove] [F – s]

Ptilinopus nainus (Temminck, 1835) [Dwarf Fruit-Dove]

Ducula rufigaster (Quoy & Gaimard, 1832) [Purple-tailed Imperial Pigeon] [S – f]

Ducula zoeae (Lesson, 1826) [Zoe's Imperial Pigeon] [C – f] [h]

Ducula spilorrhoa (Gray, GR, 1858) [Torresian Imperial Pigeon]

Gymnophaps albertisii Salvadori, 1874 [Papuan Mountain-Pigeon] [S –f] [nv]

CACATUIDAE - Cockatoos

Probosciger aterrimus (Gmelin, JF, 1788) [Palm Cockatoo] [R – f]

Cacatua galerita (Latham, 1790) [Suphur-crested Cockatoo] [F – f]

PSITTACULIDAE - Australasian Parrots

Charmosyna placentis (Temminck, 1835) [Red-flanked Lorkeet] [S – fs]

Lorius lory (Linnaeus, 1758) [Black-capped Lory] [F – f]

Pseudeos fuscata (Blyth, 1858) [Dusky Lory] [R – f]

Chalcopsitta scintillata (Temminck, 1835) [Yellow-streaked Lory] [S –f]

Trichoglossus haematodus (Linnaeus, 1771) [Rainbow Lorikeet] [C – s]

Loriculus aurantiifrons Schlegel, 1871 [Orange-fronted Hanging Parrot]

Alisterus chloropterus (Ramsay, EP, 1879) [Papuan King-Parrot] [F – f]

Eclectus roratus (Statius Müller, 1776) [Eclectus Parrot] [S – f]

Geoffroyus geoffroyi (Bechstein, 1811) [Red-cheeked Parrot] [C – f]

Geoffroyus simplex (Meyer, AB, 1874) [Blue-collared Parrot] [S – f] [nv]

Micropsitta pusio (Sclater, PL, 1866) [Buff-faced Pygmy Parrot] [S – f]

Micropsitta bruijnii (Salvadori, 1875) [Red-breasted Pygmy Parrot]

CENTROPODIDAE - Coucals

Centropus phasianinus (Latham, 1801) [Pheasant Coucal] [C – s]

CUCULIDAE - Old World Parasitic Cuckoos

Microdynamis parva (Salvadori, 1876) [Dwarf Koel] [S – f] [h]

Eudynamys orientalis (Linnaeus, 1766) [Eastern Koel] Probable occurrence; No confirmed records

Scythrops novaehollandiae Latham, 1790 [Channel-billed Cuckoo] [S – s] [nv]

Chalcites meyerii (Salvadori, 1874) [White-eared Bronze Cuckoo]

Chalcites minutillus (Gould, 1859) [Little Bronze Cuckoo]

Caliechthrus leucolophus (Müller, S, 1840) [White-crowned Cuckoo]

Cacomantis castaneiventris (Gould, 1867) [Chestnut-breasted Cuckoo] [F – f] [h]

Cacomantis variolosus (Vigors & Horsfield, 1827) [Brush Cuckoo] [S – fs] [h]

Cuculus optatus Gould, 1845 [Oriental Cuckoo]

TYTONIDAE - Barn-Owls

Tyto tenebricosa (Gould, 1845) [Sooty Owl]

Tyto delicatula (Gould, 1837) [Australian Barn-Owl]

STRIGIDAE - Owls

Ninox rufa (Gould, 1846) [Rufous Owl] [R – s]

Ninox connivens (Latham, 1801) [Barking Owl]

Ninox theomacha (Bonaparte, 1855) [Papuan Boobook] [S – f]

Uroglaux dimorpha (Salvadori, 1874) [Papuan Hawk-Owl] Probable occurrence; No confirmed records

PODARGIDAE - Frogmouths

Podargus ocellatus Quoy & Gaimard, 1832 [Marbled Frogmouth] [F –f] [h]

Podargus papuensis Quoy & Gaimard, 1832 [Papuan Frogmouth] [F – fs] [h]

CAPRIMULGIDAE - Nightjars

Eurostopodus papuensis (Schlegel, 1866) [Papuan Nightjar] Records require confirmation; Normally < 400 m

Caprimulgus macrurus Horsfield, 1821 [Large-tailed Nightjar] [C – fs] [h]

AEGOTHELIDAE - Owlet-Nightjars

Aegotheles bennettii Salvadori & D'Albertis, 1875 [Barred Owlet-nightjar] [S – se]

Aegotheles cristatus (Shaw, 1790) [Australian Owlet-nightjar]

HEMIPROCNIDAE - Treeswifts

Hemiprocne mystacea (Lesson & Garnot, 1827) [Moustached Treeswift] [R – s]

APODIDAE - Swifts

Collocalia esculenta (Linnaeus, 1758) [Glossy Swiftlet] [C – s]

Aerodramus vanikorensis (Quoy & Gaimard, 1832) [Uniform Swiftlet] [C – s]

Hirundapus caudacutus (Latham, 1801) [White-throated Needletail] [R – s]

CORACIIDAE - Rollers

Eurystomus orientalis (Linnaeus, 1766) [Oriental Dollarbird] [C – s]

HALCYONIDAE - Woodland Kingfishers

Tanysiptera sylvia Gould, 1850 [Buff-breasted Paradise-Kingfisher] [R – f]

Tanysiptera danae Sharpe, 1880 [Brown-headed Paradise-Kingfisher] [F – f] [h]

Melidora macrorrhina (Lesson, 1827) [Hook-billed Kingfisher] [F – f] [h]

Clytoceyx rex Sharpe, 1880 [Shovel-billed Kookaburra] Probable occurrence; No confirmed records

Dacelo leachii Vigors & Horsfield, 1827 [Blue-winged Kookaburra] [C – s]

Dacelo gaudichaud Gaimard, 1823 [Rufous-bellied Kookaburra] [F – e]

Todiramphus macleayii (Jardine & Selby, 1830) [Forest Kingfisher] [F – e]

Todiramphus sanctus (Vigors & Horsfield, 1827) [Sacred Kingfisher] [F – s] [nv]

Syma torotoro Lesson, 1827 [Yellow-billed Kingfisher] [C – f] [h]

ALCEDINIDAE - River Kingfishers

Ceyx solitarius Temminck, 1836 [Papuan Dwarf Kingfisher]

Ceyx azureus (Latham, 1801) [Azure Kingfisher]

MEROPIDAE - Bee-Eaters

Merops ornatus Latham, 1801 [Rainbow Bee-eater] [C – s] [nv]

BUCEROTIDAE - Hornbills

Rhyticeros plicatus (Forster, JR, 1781) [Blyth's Hornbill] [R – f]

PITTIDAE - Pittas

Erythropitta erythrogaster (Temminck, 1823) [Red-bellied Pitta] [S – f] [h]

Pitta sordida (Statius Müller, 1776) [Hooded Pitta] [S – f] [h]

PTILONORHYNCHIDAE - Bowerbirds and Catbirds

Ailuroedus buccoides (Temminck, 1836) [White-eared Catbird] [F – s]

Ailuroedus melanotis (Gray, GR, 1858) [Black-eared Catbird]

Amblyornis subalaris Sharpe, 1884 [Streaked Bowerbird]

Chlamydera cerviniventris Gould, 1850 [Fawn-breasted Bowerbird] [F – se]

MALURIDAE - Fairywrens and Allies

Sipodotus wallacii (Gray, GR, 1862) [Wallace's Fairywren] [R – f]

Malurus alboscapulatus Meyer, AB, 1874 [White-shouldered Fairywren] [F – s]

MELIPHAGIDAE - Honeyeaters

Myzomela obscura Gould, 1843 [Dusky Myzomela] [S – se]

Myzomela eques (Lesson & Garnot, 1827) [Ruby-throated Myzomela] [S – f]

Myzomela cruentata Meyer, AB, 1874 [Red Myzomela] [S – f]

Myzomela nigrita Gray, GR, 1858 [Papuan Black Myzomela] [C – f]

Myzomela adolphinae Salvadori, 1876 [Elfin Myzomela] [C – fe] [h]

Glycichaera fallax Salvadori, 1878 [Green-backed Honeyeater]

Pycnopygius ixoides (Salvadori, 1878) [Plain Honeyeater] [R – e]

Pycnopygius stictocephalus (Salvadori, 1876) [Streak-headed Honeyeater] [S – e]

Xanthotis flaviventer (Lesson, 1828) [Tawny-breasted Honeyeater] [S – f]

Xanthotis polygrammus (Gray, GR, 1862) [Spotted Honeyeater] [F – f]

Philemon meyeri Salvadori, 1878 [Meyer's Friarbird] [R – fe]

Philemon buceroides (Swainson, 1838) [Helmeted Friarbird] [C – fse]

Melithreptus albogularis Gould, 1848 [White-throated Honeyeater] [C – f]

Melilestes megarhynchus (Gray, GR, 1858) [Long-billed Honeyeater] [F – f]

Ramsayornis modestus (Gray, GR, 1858) [Brown-backed Honeyeater] [S – w]

Meliphaga aruensis (Sharpe, 1884) [Puff-backed Meliphaga] [C – f]

Meliphaga flavirictus (Salvadori, 1880) [Yellow-gaped Meliphaga] Probable occurrence; No confirmed records

Meliphaga mimikae (Ogilvie-Grant, 1911) [Mottled Meliphaga] [S – f]

Meliphaga cinereifrons Rand, 1936 [Elegant Meliphaga]

Meliphaga orientalis (Meyer, AB, 1894) [Mountain Meliphaga] [S – f]

Meliphaga analoga (Reichenbach, 1852) [Mimic Meliphaga] [C – f]

Meliphaga albonotata (Salvadori, 1876) [Scrub Meliphaga] [R – e]

ACANTHIZIDAE - Australasian Warblers

Pachycare flavogriseum (Meyer, AB, 1874) [Goldenface] Records require confirmation; Normally > 800 m [S – f]

Crateroscelis murina (Sclater, PL, 1858) [Rusty Mouse-Warbler] [C – f] [h]

Crateroscelis nigrorufa (Salvadori, 1894) [Bicoloured Mouse-Warbler] Numerous records; Requires confirmation; Normally > 1200 m [S – f]

Sericornis spilodera (Gray, GR, 1859) [Pale-billed Scrubwren] [F – f] [h]

Sericornis arfakianus (Salvadori, 1876) [Grey-green Scrubwren] Records require confirmation; Normally > 1100 m [R – f]

Gerygone chrysogaster Gray, GR, 1858 [Yellow-bellied Gerygone] [S – f]

Gerygone olivacea (Gould, 1838) [White-throated Gerygone] [S – s]

Gerygone chloronota Gould, 1843 [Green-backed Gerygone] [C – f] [h]

Gerygone palpebrosa Wallace, 1865 [Fairy Gerygone] [F – f]

MELANOCHARITIDAE - Berrypeckers and Longbills

Melanocharis arfakiana (Finsch, 1900) [Obscure Berrypecker] [C – f]

Melanocharis nigra (Lesson, 1830) [Black Berrypecker] [C – f]

Oedistoma iliolophus (Salvadori, 1876) [Spectacled Longbill] [C – f]

Oedistoma pygmaeum Salvadori, 1876 [Pygmy Longbill] [S – f]

Toxorhamphus poliopterus (Sharpe, 1882) [Slaty-headed Longbill] [C – f]

CINCLOSOMATIDAE - Jewel-Bablers and Quail Thrushes

Ptilorrhoa castanonota (Salvadori, 1876) [Chestnut-backed Jewel-babbler] [C – f] [h]

Cinclosoma ajax (Temminck, 1836) [Painted Quail-thrush] [S – f]

MACHAERIRHYNCHIDAE - Boatbills

Machaerirhynchus flaviventer Gould, 1851 [Yellow-breasted Boatbill] [S – f]

CRACTICIDAE - Butcherbirds and Allies

Peltops montanus Stresemann, 1921 [Mountain Peltops] [S – f]

Cracticus quoyi (Lesson & Garnot, 1827) [Black Butcherbird] [F – f] [h]

Cracticus mentalis Salvadori & D'Albertis, 1875 [Black-backed Butcherbird] [F – s]

Cracticus cassicus (Boddaert, 1783) [Hooded Butcherbird] [C – fe]

ARTAMIDAE - Woodswallows

Artamus leucorynchus (Linnaeus, 1771) [White-breasted Woodswallow] [F – s]

CAMPEPHAGIDAE - Cuckooshrikes

Coracina caeruleogrisea (Gray, GR, 1858) [Stout-billed Cuckooshrike] [F – f]

Coracina lineata (Swainson, 1825) [Barred Cuckooshrike] [C – f] [h]

Coracina boyeri (Gray, GR, 1846) [Boyer's Cuckooshrike] [S – f]

Coracina novaehollandiae (Gmelin, JF, 1789) [Black-faced Cuckooshrike] [S – se]

Coracina papuensis (Gmelin, JF, 1788) [White-bellied Cuckooshrike] [C – se]

Campochaera sloetii (Schlegel, 1866) [Golden Cuckooshrike] [R – e]

Lalage tricolor (Swainson, 1825) [White-winged Triller]

Lalage leucomela (Vigors & Horsfield, 1827) [Varied Triller] [F – s]

Edolisoma montanum (Meyer, AB, 1874) [Black-bellied Cicadabird] Records require confirmation; normally > 800 m

Edolisoma incertum (Meyer, AB, 1874) [Papuan Cicadabird]

Edolisoma tenuirostre (Jardine, 1831) [Common Cicadabird] [F – f] [nv]

Edolisoma melas (Lesson, 1828) [Black Cicadabird]

OREOICIDAE - Austro-Papuan Bellbirds

Ornorectes cristatus (Salvadori, 1876) [Piping Bellbird]

PACHYCEPHALIDAE - Whistlers and Allies

Colluricincla megarhyncha (Quoy & Gaimard, 1832) [Little Shrikethrush] [C – f]

Colluricincla harmonica (Latham, 1801) [Grey Shrikethrush] [F – s]

Pseudorectes ferrugineus (Bonaparte, 1850) [Rusty Pitohui] [C – fe]

Pachycephala soror Sclater, PL, 1874 [Sclater's Whistler] [R – f]

Pachycephala simplex Gould, 1843 [Grey Whistler] [C – f]

Pachycephala leucogastra Salvadori & D'Albertis, 1875 [White-bellied Whistler]

Pitohui dichrous (Bonaparte, 1850) [Hooded Pitohui] [C – fe]

ORIOLIDAE - Orioles and Figbirds

Oriolus szalayi (Madarász, 1900) [Brown Oriole] [F – fe]

MONARCHIDAE - Monarchs

Myiagra rubecula (Latham, 1801) [Leaden Flycatcher]

Myiagra cyanoleuca (Vieillot, 1818) [Satin Flycatcher] [R – e]

Arses telescopthalmus (Lesson & Garnot, 1827) [Frilled Monarch] [C – f]

Grallina bruijnii Salvadori, 1876 [Torrentlark]

Symposiachrus axillaris (Salvadori, 1876) [Fantailed Monarch]

Symposiachrus guttula (Lesson & Garnot, 1829) [Spot-winged Monarch] [C – f]

Monarcha melanopsis (Vieillot, 1818) [Black-faced Monarch] [F – f] [h]

Monarcha frater Sclater, PL, 1874 [Black-winged Monarch] [F – f]

DICRURIDAE - Drongos

Dicrurus bracteatus Gould, 1843 [Spangled Drongo]

RHIPIDURIDAE - Fantails

Chaetorhynchus papuensis Meyer, AB, 1874 [Pygmy Drongo] [F – f]

Rhipidura leucophrys (Latham, 1801) [Willie Wagtail] [S – s]

Rhipidura maculipectus Gray, GR, 1858 [Black Thicket-Fantail] [S – e]

Rhipidura leucothorax Salvadori, 1874 [White-bellied Thicket-Fantail]

Rhipidura threnothorax Müller, S, 1843 [Sooty Thicket-Fantail]

Rhipidura hyperythra Gray, GR, 1858 [Chestnut-bellied Fantail] [C – f]

CORVIDAE - Crows and Allies

Corvus tristis Lesson & Garnot, 1827 [Grey Crow] [C – f]

Corvus orru Bonaparte, 1850 [Torresian Crow] [F – s]

PARADISAEIDAE - Birds of Paradise

Phonygammus keraudrenii (Lesson & Garnot, 1826) [Trumpet Manucode] [R – fe]

Manucodia chalybatus (Forster, JR, 1781) [Crinkle-collared Manucode] [F – f]

Manucodia ater (Lesson, 1830) [Glossy Manucode] [S – s]

Ptiloris magnificus (Vieillot, 1819) [Magnificent Riflebird] [C – f] [h]

Diphyllodes magnificus (Forster, JR, 1781) [Magnificent Bird of Paradise] [F – f]

Paradisaea raggiana Sclater, PL, 1873 [Raggiana Bird of Paradise] [C – fse]

PETROICIDAE - Australasian Robins

Pachycephalopsis poliosoma Sharpe, 1882 [White-eyed Robin]

Kempiella griseoceps (De Vis, 1894) [Yellow-legged Flycatcher] [S – f]

Kempiella flavovirescens (Gray, GR, 1858) [Olive Flycatcher] [S – f]

Drymodes beccarii Salvadori, 1876 [Papuan Scrub-Robin]

Tregellasia leucops (Salvadori, 1876) [White-faced Robin] [C – f]

HIRUNDINIDAE - Swallows and Martins

Hirundo tahitica Gmelin, JF, 1789 [Pacific Swallow] [F – sw]

PHYLLOSCOPIDAE - Leaf-Warblers and Allies

Phylloscopus poliocephalus (Salvadori, 1876) [Island Leaf-Warbler]

ZOSTEROPIDAE - White-Eyes

Zosterops atrifrons Wallace, 1864 [Black-fronted White-eye] [C – f]

CISTICOLIDAE - Cisticolas and Allies

Cisticola exilis (Vigors & Horsfield, 1827) [Golden-headed Cisticola] [S – s]

STURNIDAE - Starlings

Mino dumontii Lesson, 1827 [Yellow-faced Myna] [C – fs]

TURDIDAE - Thrushes

Zoothera heinei (Cabanis, 1850) [Russet-tailed Thrush]

NECTARINIIDAE - Sunbirds and Flowerpeckers

Dicaeum geelvinkianum Meyer, AB, 1874 [Red-capped Flowerpecker]

Leptocoma aspasia (Lesson and Garnot, 1828) [Black Sunbird]

ESTRILDIDAE - Waxbills, Mannikins, and Allies

Erythrura trichroa (Kittlitz, 1833) [Blue-faced Parrotfinch] [R – fe]

Lonchura tristissima (Wallace, 1865) [Streak-headed Mannikin]

Lonchura grandis (Sharpe, 1882) [Grand Mannikin] [S – s]

Lonchura caniceps (Salvadori, 1876) [Grey-headed Mannikin] [C – s]

6.2 Checklist of Birds Found in Forested Habitats

Note: Scientific names, common names and phylogenetic order follows Pratt and Beehler. 2014. Birds of New Guinea. Princeton University Press

This Checklist was compiled from the original checklist published by Mike Hopkins and Jones Hiaso (1994) that included 205 species.

An additional 26 species were added on the basis of reports in the Newsletter of the PNG Bird Society, the journal Muruk (also published by the PNG Bird Society) and from suggestions made by Thane K. Pratt who reviewed the list.

Species shown in **bold** are endemic to Papua New Guinea

Frequency of occurrence

C = common (seen or heard most days)

F = fairly common (seen or heard regularly)

S = scarce (seen infrequently)

R = rare (recorded only one or few times)

Habitat

f = forested habitats

s = open habitats (savanna)

e = forest edge

w = on or close to water

Other notes

h = more often heard than seen

nv = numbers variable (e.g. migrants)

CASUARIIDAE - Cassowaries

Casuarius bennetti Gould, 1857 [Dwarf Cassowary] [S – f]

Casuarius casuarius (Linnaeus, 1758) [Southern Cassowary] Single record; Requires confirmation [S –f]

MEGAPODIIDAE - Megapodes

Talegalla fuscirostris Salvadori, 1877 [Yellow-legged Brushturkey] [C – f] [h]

Megapodius reinwardt Dumont, 1823 [Orange-footed Scrubfowl] [S –fs]

ARDEIDAE - Herons and Bitterns

Zonerodius heliosylus (Lesson & Garnot, 1828) [Forest Bittern] [R – f]

ACCIPITRIDAE - Hawks and Eagles

Henicopernis longicauda (Lesson & Garnot, 1828) [Long-tailed Buzzard] [F – f]

Accipiter hiogaster (Müller, S, 1841) [Variable Goshawk] [S - f]

Accipiter poliocephalus Gray, GR, 1858 [Grey-headed Goshawk] [S – f]

Accipiter cirrocephalus (Vieillot, 1817) [Collared Sparrowhawk] [R – f]

Accipiter meyerianus (Sharpe, 1878) [Meyer's Goshawk] [R – f]

Megatriorchis doriae Salvadori & D'Albertis, 1875 [Doria's Hawk] [R – f]

Butastur indicus (Gmelin, JF, 1788) [Grey-faced Buzzard] Record requires confirmation; Visitor not known east of Trans-Fly [R – f]

Harpyopsis novaeguineae Salvadori, 1875 [New Guinea Harpy-Eagle] [R – f]

Aquila gurneyi Gray, GR, 1861 [Gurney's Eagle] [S – f]

Hieraaetus weiskei (Reichenow, 1900) [Pygmy Eagle] [R – f]

FALCONIDAE - Falcons

Falco berigora Vigors & Horsfield, 1827 [Brown Falcon] [R – f]

RALLIDAE - Rails

Rallina tricolor Gray, GR, 1858 [Red-necked Crake] [R – f]

Gymnocrex plumbeiventris (Gray, GR, 1862) [Bare-eyed Rail] [R – f]

COLUMBIDAE - Pigeons and Doves

Reinwardtoena reinwardti (Temminck, 1824) [Great Cuckoo-Dove] [S – f]

Macropygia amboinensis (Linnaeus, 1766) [Brown Cuckoo-Dove] [C – f]

*Macropygia nigrirostri*s Salvadori, 1876 [Black-billed Cuckoo-Dove] [S – f]

Gallicolumba rufigula (Pucheran, 1853) [Cinnamon Ground-Dove] [S – f]

Alopecoenas jobiensis (Meyer, AB, 1875) [White-bibbed Ground-Dove] [S – f] [nv]

Trugon terrestris Gray, GR, 1849 [Thick-billed Ground-Pigeon] [R – f]

Otidiphaps nobilis Gould, 1870 [Pheasant Pigeon] [F –f] [h]

Chalcophaps longirostris Gould, 1848 [Pacific Emerald Dove] [S – f][

Chalcophaps stephani Pucheran, 1853 [Stephan's Emerald Dove] [F –f]

Ptilinopus magnificus (Temminck, 1821) [Wompoo Fruit-Dove] [C –f] [h]

Ptilinopus perlatus (Temminck, 1835) [Pink-spotted Fruit-Dove] [F – fs]

Ptilinopus ornatus Schlegel, 1871 [Ornate Fruit-Dove] [R – f]

Ptilinopus superbus (Temminck, 1809) [Superb Fruit-Dove] [C – f]

Ptilinopus coronulatus Gray, GR, 1858 [Coroneted Fruit-Dove] [S – f]

Ptilinopus pulchellus (Temminck, 1835) [Beautiful Fruit-Dove] [F – f] [h]

Ptilinopus rivoli (Prévost, 1843) [White-bibbed Fruit-Dove] [R – f]

Ptilinopus nainus (Temminck, 1835) [Dwarf Fruit-Dove] [R – f]

Ducula rufigaster (Quoy & Gaimard, 1832) [Purple-tailed Imperial Pigeon] [S – f]

Ducula zoeae (Lesson, 1826) [Zoe's Imperial Pigeon] [C – f] [h]

Gymnophaps albertisii Salvadori, 1874 [Papuan Mountain-Pigeon] [S –f] [nv]

CACATUIDAE - Cockatoos

Probosciger aterrimus (Gmelin, JF, 1788) [Palm Cockatoo] [R – f]

Cacatua galerita (Latham, 1790) [Suphur-crested Cockatoo] [F – f]

PSITTACULIDAE - Australasian Parrots

*Charmosyna placen*tis (Temminck, 1835) [Red-flanked Lorkeet] [S – fs]

Lorius lory (Linnaeus, 1758) [Black-capped Lory] [F – f]

Pseudeos fuscata (Blyth, 1858) [Dusky Lory] [R – f]

Chalcopsitta scintillata (Temminck, 1835) [Yellow-streaked Lory] [S –f]

Loriculus aurantiifrons Schlegel, 1871 [Orange-fronted Hanging Parrot] [R – f]

Alisterus chloropterus (Ramsay, EP, 1879) [Papuan King-Parrot] [F – f]

Eclectus roratus (Statius Müller, 1776) [Eclectus Parrot] [S – f]

Geoffroyus geoffroyi (Bechstein, 1811) [Red-cheeked Parrot] [C – f]

Geoffroyus simplex (Meyer, AB, 1874) [Blue-collared Parrot] [S – f] [nv]

Micropsitta pusio (Sclater, PL, 1866) [Buff-faced Pygmy Parrot] [S – f]

Micropsitta bruijnii (Salvadori, 1875) [Red-breasted Pygmy Parrot] [R – f]

CUCULIDAE - Old World Parasitic Cuckoos

Microdynamis parva (Salvadori, 1876) [Dwarf Koel] [S – f] [h]

Eudynamys orientalis (Linnaeus, 1766) [Eastern Koel] Probable occurrence; No confirmed records [R – f]

Chalcites meyerii (Salvadori, 1874) [White-eared Bronze Cuckoo] [R – f]

Chalcites minutillus (Gould, 1859) [Little Bronze Cuckoo] [S – f]

Caliechthrus leucolophus (Müller, S, 1840) [White-crowned Cuckoo] [R – f]

Cacomantis castaneiventris (Gould, 1867) [Chestnut-breasted Cuckoo] [F – f] [h]

Cacomantis variolosus (Vigors & Horsfield, 1827) [Brush Cuckoo] [S – fs] [h]

TYTONIDAE - Barn-Owls

Tyto tenebricosa (Gould, 1845) [Sooty Owl] [R – f]

STRIGIDAE - Owls

Ninox theomacha (Bonaparte, 1855) [Papuan Boobook] [S – f]

Uroglaux dimorpha (Salvadori, 1874) [Papuan Hawk-Owl] Probable occurrence; No confirmed records [R – f]

PODARGIDAE - Frogmouths

Podargus ocellatus Quoy & Gaimard, 1832 [Marbled Frogmouth] [F –f] [h]

Podargus papuensis Quoy & Gaimard, 1832 [Papuan Frogmouth] [F – fs] [h]

CAPRIMULGIDAE - Nightjars

Eurostopodus papuensis (Schlegel, 1866) [Papuan Nightjar] Records require confirmation; Normally < 400 m [R – f]

Caprimulgus macrurus Horsfield, 1821 [Large-tailed Nightjar] [C – fs] [h]

HALCYONIDAE - Woodland Kingfishers

Tanysiptera sylvia Gould, 1850 [Buff-breasted Paradise-Kingfisher] [R – f]

***Tanysiptera danae* Sharpe, 1880 [Brown-headed Paradise-Kingfisher] [F – f] [h]**

Melidora macrorrhina (Lesson, 1827) [Hook-billed Kingfisher] [F – f] [h]

Clytoceyx rex Sharpe, 1880 [Shovel-billed Kookaburra] Probable occurrence; No confirmed records [R – f]

Syma torotoro Lesson, 1827 [Yellow-billed Kingfisher] [C – f] [h]

ALCEDINIDAE - River Kingfishers

Ceyx solitarius Temminck, 1836 [Papuan Dwarf Kingfisher] [S – f]

BUCEROTIDAE - Hornbills

Rhyticeros plicatus (Forster, JR, 1781) [Blyth's Hornbill] [R – f]

PITTIDAE - Pittas

Erythropitta erythrogaster (Temminck, 1823) [Red-bellied Pitta] [S – f] [h]

Pitta sordida (Statius Müller, 1776) [Hooded Pitta] [S – f] [h]

PTILONORHYNCHIDAE - Bowerbirds and Catbirds

Ailuroedus melanotis (Gray, GR, 1858) [Black-eared Catbird] [R – f]

***Amblyornis subalaris* Sharpe, 1884 [Streaked Bowerbird] [S – f]**

MALURIDAE - Fairywrens and Allies

Sipodotus wallacii (Gray, GR, 1862) [Wallace's Fairywren] [R – f]

MELIPHAGIDAE - Honeyeaters

Myzomela eques (Lesson & Garnot, 1827) [Ruby-throated Myzomela] [S – f]

Myzomela cruentata Meyer, AB, 1874 [Red Myzomela] [S – f]

Myzomela nigrita Gray, GR, 1858 [Papuan Black Myzomela] [C – f]

Myzomela adolphinae Salvadori, 1876 [Elfin Myzomela] [C – fe] [h]

Glycichaera fallax Salvadori, 1878 [Green-backed Honeyeater] [R – fe]

Xanthotis flaviventer (Lesson, 1828) [Tawny-breasted Honeyeater] [S – f]

Xanthotis polygrammus (Gray, GR, 1862) [Spotted Honeyeater] [F – f]

Philemon meyeri Salvadori, 1878 [Meyer's Friarbird] [R – fe]

Philemon buceroides (Swainson, 1838) [Helmeted Friarbird] [C – fse]

Melithreptus albogularis Gould, 1848 [White-throated Honeyeater] [C – f]

Melilestes megarhynchus (Gray, GR, 1858) [Long-billed Honeyeater] [F – f]

Meliphaga aruensis (Sharpe, 1884) [Puff-backed Meliphaga] [C – f]

Meliphaga flavirictus (Salvadori, 1880) [Yellow-gaped Meliphaga] Probable occurrence; No confirmed records [R – fe]

Meliphaga mimikae (Ogilvie-Grant, 1911) [Mottled Meliphaga] [S – f]

***Meliphaga cinereifrons* Rand, 1936 [Elegant Meliphaga] [R – fes]**

Meliphaga orientalis (Meyer, AB, 1894) [Mountain Meliphaga] [S – f]

Meliphaga analoga (Reichenbach, 1852) [Mimic Meliphaga] [C – f]

ACANTHIZIDAE - Australasian Warblers

Pachycare flavogriseum (Meyer, AB, 1874) [Goldenface] Records require confirmation; Normally > 800 m [S – f]

Crateroscelis murina (Sclater, PL, 1858) [Rusty Mouse-Warbler] [C – f] [h]

Crateroscelis nigrorufa (Salvadori, 1894) [Bicoloured Mouse-Warbler] Numerous records; Requires confirmation; Normally > 1200 m [S – f]

Sericornis spilodera (Gray, GR, 1859) [Pale-billed Scrubwren] [F – f] [h]

Sericornis arfakianus (Salvadori, 1876) [Grey-green Scrubwren] Records require confirmation; Normally > 1100 m [R – f]

Gerygone chrysogaster Gray, GR, 1858 [Yellow-bellied Gerygone] [S – f]

Gerygone chloronota Gould, 1843 [Green-backed Gerygone] [C – f] [h]

Gerygone palpebrosa Wallace, 1865 [Fairy Gerygone] [F – f]

MELANOCHARITIDAE - Berrypeckers and Longbills

Melanocharis arfakiana (Finsch, 1900) [Obscure Berrypecker] [C – f]

Melanocharis nigra (Lesson, 1830) [Black Berrypecker] [C – f]

Oedistoma iliolophus (Salvadori, 1876) [Spectacled Longbill] [C – f]

Oedistoma pygmaeum Salvadori, 1876 [Pygmy Longbill] [S – f]

Toxorhamphus poliopterus (Sharpe, 1882) [Slaty-headed Longbill] [C – f]

CINCLOSOMATIDAE - Jewel-Bablers and Quail Thrushes

Ptilorrhoa castanonota (Salvadori, 1876) [Chestnut-backed Jewel-babbler] [C – f] [h]

Cinclosoma ajax (Temminck, 1836) [Painted Quail-thrush] [S – f]

MACHAERIRHYNCHIDAE - Boatbills

Machaerirhynchus flaviventer Gould, 1851 [Yellow-breasted Boatbill] [S – f]

CRACTICIDAE - Butcherbirds and Allies

Peltops montanus Stresemann, 1921 [Mountain Peltops] [S – f]

Cracticus quoyi (Lesson & Garnot, 1827) [Black Butcherbird] [F – f] [h]

Cracticus cassicus (Boddaert, 1783) [Hooded Butcherbird] [C – fe]

CAMPEPHAGIDAE - Cuckooshrikes

Coracina caeruleogrisea (Gray, GR, 1858) [Stout-billed Cuckooshrike] [F – f]

Coracina lineata (Swainson, 1825) [Barred Cuckooshrike] [C – f] [h]

Coracina boyeri (Gray, GR, 1846) [Boyer's Cuckooshrike] [S – f]

Edolisoma montanum (Meyer, AB, 1874) [Black-bellied Cicadabird] Records require confirmation; normally > 800 m [S – f]

Edolisoma incertum (Meyer, AB, 1874) [Papuan Cicadabird] [S – fe]

Edolisoma tenuirostre (Jardine, 1831) [Common Cicadabird] [F – f] [nv]

Edolisoma melas (Lesson, 1828) [Black Cicadabird] [S – f]

OREOICIDAE - Austro-Papuan Bellbirds

Ornorectes cristatus (Salvadori, 1876) [Piping Bellbird] [S – f]

PACHYCEPHALIDAE - Whistlers and Allies

Colluricincla megarhyncha (Quoy & Gaimard, 1832) [Little Shrikethrush] [C – f]

Pseudorectes ferrugineus (Bonaparte, 1850) [Rusty Pitohui] [C – fe]

Pachycephala soror Sclater, PL, 1874 [Sclater's Whistler] [R – f]

Pachycephala simplex Gould, 1843 [Grey Whistler] [C – f]

Pachycephala leucogastra Salvadori & D'Albertis, 1875 [White-bellied Whistler] [R – fs]

Pitohui dichrous (Bonaparte, 1850) [Hooded Pitohui] [C – fe]

ORIOLIDAE - Orioles and Figbirds

Oriolus szalayi (Madarász, 1900) [Brown Oriole] [F – fe]

MONARCHIDAE - Monarchs

Arses telescopthalmus (Lesson & Garnot, 1827) [Frilled Monarch] [C – f]

Grallina bruijnii Salvadori, 1876 [Torrentlark] [R – f]

Symposiachrus axillaris (Salvadori, 1876) [Fantailed Monarch] [R – f]

Symposiachrus guttula (Lesson & Garnot, 1829) [Spot-winged Monarch] [C – f]

Monarcha melanopsis (Vieillot, 1818) [Black-faced Monarch] [F – f] [h]

Monarcha frater Sclater, PL, 1874 [Black-winged Monarch] [F – f]

RHIPIDURIDAE - Fantails

Chaetorhynchus papuensis Meyer, AB, 1874 [Pygmy Drongo] [F – f]

Rhipidura leucothorax Salvadori, 1874 [White-bellied Thicket-Fantail] [S – fe]

Rhipidura threnothorax Müller, S, 1843 [Sooty Thicket-Fantail] [R – f]

Rhipidura hyperythra Gray, GR, 1858 [Chestnut-bellied Fantail] [C – f]

CORVIDAE - Crows and Allies

Corvus tristis Lesson & Garnot, 1827 [Grey Crow] [C – f]

PARADISAEIDAE - Birds of Paradise

Phonygammus keraudrenii (Lesson & Garnot, 1826) [Trumpet Manucode] [R – fe]

Manucodia chalybatus (Forster, JR, 1781) [Crinkle-collared Manucode] [F – f]

Ptiloris magnificus (Vieillot, 1819) [Magnificent Riflebird] [C – f] [h]

Diphyllodes magnificus (Forster, JR, 1781) [Magnificent Bird of Paradise] [F – f]

***Paradisaea raggiana* Sclater, PL, 1873 [Raggiana Bird of Paradise] [C – fse]**

PETROICIDAE - Australasian Robins

Pachycephalopsis poliosoma Sharpe, 1882 [White-eyed Robin] [S – f]

Kempiella griseoceps (De Vis, 1894) [Yellow-legged Flycatcher] [S – f]

Kempiella flavovirescens (Gray, GR, 1858) [Olive Flycatcher] [S – f]

Drymodes beccarii Salvadori, 1876 [Papuan Scrub-Robin] [R – f]

Tregellasia leucops (Salvadori, 1876) [White-faced Robin] [C – f]

PHYLLOSCOPIDAE - Leaf-Warblers and Allies

Phylloscopus poliocephalus (Salvadori, 1876) [Island Leaf-Warbler] [S – f]

ZOSTEROPIDAE - White-Eyes

Zosterops atrifrons Wallace, 1864 [Black-fronted White-eye] [C – f]

STURNIDAE - Starlings

Mino dumontii Lesson, 1827 [Yellow-faced Myna] [C – fs]

TURDIDAE - Thrushes

Zoothera heinei (Cabanis, 1850) [Russet-tailed Thrush] [R – f]

NECTARINIIDAE - Sunbirds and Flowerpeckers

Dicaeum geelvinkianum Meyer, AB, 1874 [Red-capped Flowerpecker] [S - f]

Leptocoma aspasia (Lesson and Garnot, 1828) [Black Sunbird] [S – fs]

ESTRILDIDAE - Waxbills, Mannikins, and Allies

Erythrura trichroa (Kittlitz, 1833) [Blue-faced Parrotfinch] [R – fe]

Lonchura tristissima (Wallace, 1865) [Streak-headed Mannikin] [R – fe]

6.3 CHECKLIST OF Bird Species likely to be Observed in Savanna Habitat

Note: Scientific names, common names and phylogenetic order follows Pratt and Beehler. 2014. Birds of New Guinea. Princeton University Press

This Checklist was compiled from the original checklist published by Mike Hopkins and Jones Hiaso (1994) that included 205 species.

An additional 26 species were added on the basis of reports in the Newsletter of the PNG Bird Society, the journal Muruk (also published by the PNG Bird Society) and from suggestions made by Thane K. Pratt who reviewed the list.

Species shown in **bold** are endemic to Papua New Guinea

Frequency of occurrence

C = common (seen or heard most days)

F = fairly common (seen or heard regularly)

S = scarce (seen infrequently)

R = rare (recorded only one or few times)

Habitat

f = forested habitats

s = open habitats (savanna)

e = forest edge

w = on or close to water

Other notes

h = more often heard than seen

nv = numbers variable (e.g. migrants)

MEGAPODIIDAE - Megapodes

Megapodius reinwardt Dumont, 1823 [Orange-footed Scrubfowl] [S –fs]

PHASIANIDAE - Pheasants, Partridges, and Quail

Coturnix ypsilophora Bosc, 1792 [Brown Quail] [C – s]

ACCIPITRIDAE - Hawks and Eagles

Haliastur sphenurus (Vieillot, 1818) [Whistling Kite] [S – s]

Haliastur indus (Boddaert, 1783) [Brahminy Kite] [C – s]

Circus approximans Peale, 1848 [Swamp Harrier] [S – s]

Accipiter fasciatus (Vigors & Horsfield, 1827) [Brown Goshawk] [S – s]

FALCONIDAE - Falcons

Falco peregrinus Tunstall, 1771 [Peregrine Falcon] [R – s]

TURNICIDAE - Buttonquail

Turnix maculosus (Temminck, 1815) [Red-backed Buttonquail] [C – s]

CHARADRIIDAE - Plovers and Lapwings

Vanellus miles (Boddaert, 1783) [Masked Lapwing] [S - se]

Pluvialis fulva (Gmelin, JF, 1789) [Pacific Golden Plover] [S – se]

COLUMBIDAE - Pigeons and Doves

Columba vitiensis Quoy & Gaimard, 1832 [White-throated Pigeon] [R – s]

Geopelia placida Gould, 1844 [Peaceful Dove] [S – s]

Ptilinopus perlatus (Temminck, 1835) [Pink-spotted Fruit-Dove] [F – fs]

Ptilinopus iozonus Gray, GR, 1858 [Orange-bellied Fruit-Dove] [F – s]

Ducula spilorrhoa (Gray, GR, 1858) [Torresian Imperial Pigeon] [S – s]

PSITTACULIDAE - Australasian Parrots

*Charmosyna placen*tis (Temminck, 1835) [Red-flanked Lorkeet] [S – fs]

Trichoglossus haematodus (Linnaeus, 1771) [Rainbow Lorikeet] [C – s]

CENTROPODIDAE - Coucals

Centropus phasianinus (Latham, 1801) [Pheasant Coucal] [C – s]

CUCULIDAE - Old World Parasitic Cuckoos

Scythrops novaehollandiae Latham, 1790 [Channel-billed Cuckoo] [S – s] [nv]

Cacomantis variolosus (Vigors & Horsfield, 1827) [Brush Cuckoo] [S – fs] [h]

Cuculus optatus Gould, 1845 [Oriental Cuckoo] [S – se]

STRIGIDAE - Owls

Ninox rufa (Gould, 1846) [Rufous Owl] [R – s]

Ninox connivens (Latham, 1801) [Barking Owl] [S – s]

PODARGIDAE - Frogmouths

Podargus papuensis Quoy & Gaimard, 1832 [Papuan Frogmouth] [F – fs] [h]

CAPRIMULGIDAE - Nightjars

Caprimulgus macrurus Horsfield, 1821 [Large-tailed Nightjar] [C – fs] [h]

AEGOTHELIDAE - Owlet-Nightjars

Aegotheles bennettii Salvadori & D'Albertis, 1875 [Barred Owlet-nightjar] [S – se]

Aegotheles cristatus (Shaw, 1790) [Australian Owlet-nightjar] [S – s]

HEMIPROCNIDAE - Treeswifts

Hemiprocne mystacea (Lesson & Garnot, 1827) [Moustached Treeswift] [R – s]

APODIDAE - Swifts

Collocalia esculenta (Linnaeus, 1758) [Glossy Swiftlet] [C – s]

Aerodramus vanikorensis (Quoy & Gaimard, 1832) [Uniform Swiftlet] [C – s]

Hirundapus caudacutus (Latham, 1801) [White-throated Needletail] [R – s]

CORACIIDAE - Rollers

Eurystomus orientalis (Linnaeus, 1766) [Oriental Dollarbird] [C – s]

HALCYONIDAE - Woodland Kingfishers

Dacelo leachii Vigors & Horsfield, 1827 [Blue-winged Kookaburra] [C – s]

Todiramphus sanctus (Vigors & Horsfield, 1827) [Sacred Kingfisher] [F – s] [nv]

MEROPIDAE - Bee-Eaters

Merops ornatus Latham, 1801 [Rainbow Bee-eater] [C – s] [nv]

PTILONORHYNCHIDAE - Bowerbirds and Catbirds

Ailuroedus buccoides (Temminck, 1836) [White-eared Catbird] [F – s]

Chlamydera cerviniventris Gould, 1850 [Fawn-breasted Bowerbird] [F – se]

MALURIDAE - Fairywrens and Allies

Malurus alboscapulatus Meyer, AB, 1874 [White-shouldered Fairywren] [F – s]

MELIPHAGIDAE - Honeyeaters

Myzomela obscura Gould, 1843 [Dusky Myzomela] [S – se]

Philemon buceroides (Swainson, 1838) [Helmeted Friarbird] [C – fse]

***Meliphaga cinereifrons* Rand, 1936 [Elegant Meliphaga] [R – fes]**

ACANTHIZIDAE - Australasian Warblers

Gerygone olivacea (Gould, 1838) [White-throated Gerygone] [S – s]

CRACTICIDAE - Butcherbirds and Allies

Cracticus mentalis Salvadori & D'Albertis, 1875 [Black-backed Butcherbird] [F – s]

ARTAMIDAE - Woodswallows

Artamus leucorynchus (Linnaeus, 1771) [White-breasted Woodswallow] [F – s]

CAMPEPHAGIDAE - Cuckooshrikes

Coracina novaehollandiae (Gmelin, JF, 1789) [Black-faced Cuckooshrike] [S – se]

Coracina papuensis (Gmelin, JF, 1788) [White-bellied Cuckooshrike] [C – se]

Lalage tricolor (Swainson, 1825) [White-winged Triller] [R – s]

Lalage leucomela (Vigors & Horsfield, 1827) [Varied Triller] [F – s]

PACHYCEPHALIDAE - Whistlers and Allies

Colluricincla harmonica (Latham, 1801) [Grey Shrikethrush] [F – s]

Pachycephala leucogastra Salvadori & D'Albertis, 1875 [White-bellied Whistler] [R – fs]

MONARCHIDAE - Monarchs

Myiagra rubecula (Latham, 1801) [Leaden Flycatcher] [R – s]

RHIPIDURIDAE - Fantails

Rhipidura leucophrys (Latham, 1801) [Willie Wagtail] [S – s]

CORVIDAE - Crows and Allies

Corvus orru Bonaparte, 1850 [Torresian Crow] [F – s]

PARADISAEIDAE - Birds of Paradise

Manucodia ater (Lesson, 1830) [Glossy Manucode] [S – s]

***Paradisaea raggiana* Sclater, PL, 1873 [Raggiana Bird of Paradise] [C – fse]**

HIRUNDINIDAE - Swallows and Martins

Hirundo tahitica Gmelin, JF, 1789 [Pacific Swallow] [F – sw]

CISTICOLIDAE - Cisticolas and Allies

Cisticola exilis (Vigors & Horsfield, 1827) [Golden-headed Cisticola] [S – s]

STURNIDAE - Starlings

Mino dumontii Lesson, 1827 [Yellow-faced Myna] [C – fs]

NECTARINIIDAE - Sunbirds and Flowerpeckers

Leptocoma aspasia (Lesson and Garnot, 1828) [Black Sunbird] [S – fs]

ESTRILDIDAE - Waxbills, Mannikins, and Allies

Lonchura grandis (Sharpe, 1882) [Grand Mannikin] [S – s]

Lonchura caniceps (Salvadori, 1876) [Grey-headed Mannikin] [C – s]

6.4 Checklist of Birds likely to be Observed in Forest Edge Habitats

Note: Scientific names, common names and phylogenetic order follows Pratt and Beehler. 2014. Birds of New Guinea. Princeton University Press

This Checklist was compiled from the original checklist published by Mike Hopkins and Jones Hiaso (1994) that included 205 species.

An additional 26 species were added on the basis of reports in the Newsletter of the PNG Bird Society, the journal Muruk (also published by the PNG Bird Society) and from suggestions made by Thane K. Pratt who reviewed the list.

Species shown in **bold** are endemic to Papua New Guinea

Frequency of occurrence

C = common (seen or heard most days)

F = fairly common (seen or heard regularly)

S = scarce (seen infrequently)

R = rare (recorded only one or few times)

Habitat

f = forested habitats

s = open habitats (savanna)

e = forest edge

w = on or close to water

Other notes

h = more often heard than seen

nv = numbers variable (e.g. migrants)

ACCIPITRIDAE - Hawks and Eagles

Aviceda subcristata (Gould, 1838) [Pacific Baza] [S – e]

FALCONIDAE - Falcons

Falco severus Horsfield, 1821 [Oriental Hobby] [S – e]

CHARADRIIDAE - Plovers and Lapwings

Vanellus miles (Boddaert, 1783) [Masked Lapwing] [S - se]

Pluvialis fulva (Gmelin, JF, 1789) [Pacific Golden Plover] [S – se]

CUCULIDAE - Old World Parasitic Cuckoos

Cuculus optatus Gould, 1845 [Oriental Cuckoo] [S – se]

TYTONIDAE - Barn-Owls

Tyto delicatula (Gould, 1837) [Australian Barn-Owl] [R – e]

AEGOTHELIDAE - Owlet-Nightjars

Aegotheles bennettii Salvadori & D'Albertis, 1875 [Barred Owlet-nightjar] [S – se]

HALCYONIDAE - Woodland Kingfishers

Dacelo gaudichaud Gaimard, 1823 [Rufous-bellied Kookaburra] [F – e]

Todiramphus macleayii (Jardine & Selby, 1830) [Forest Kingfisher] [F – e]

PTILONORHYNCHIDAE - Bowerbirds and Catbirds

Chlamydera cerviniventris Gould, 1850 [Fawn-breasted Bowerbird] [F – se]

MELIPHAGIDAE - Honeyeaters

Myzomela obscura Gould, 1843 [Dusky Myzomela] [S – se]

Myzomela adolphinae Salvadori, 1876 [Elfin Myzomela] [C – fe] [h]

Glycichaera fallax Salvadori, 1878 [Green-backed Honeyeater] [R – fe]

Pycnopygius ixoides (Salvadori, 1878) [Plain Honeyeater] [R – e]

Pycnopygius stictocephalus (Salvadori, 1876) [Streak-headed Honeyeater] [S – e]

Philemon meyeri Salvadori, 1878 [Meyer's Friarbird] [R – fe]

Philemon buceroides (Swainson, 1838) [Helmeted Friarbird] [C – fse]

Meliphaga flavirictus (Salvadori, 1880) [Yellow-gaped Meliphaga] Probable occurrence; No confirmed records [R – fe]

***Meliphaga cinereifrons* Rand, 1936 [Elegant Meliphaga] [R – fes]**

Meliphaga albonotata (Salvadori, 1876) [Scrub Meliphaga] [R – e]

CRACTICIDAE - Butcherbirds and Allies

Cracticus cassicus (Boddaert, 1783) [Hooded Butcherbird] [C – fe]

CAMPEPHAGIDAE - Cuckooshrikes

Coracina novaehollandiae (Gmelin, JF, 1789) [Black-faced Cuckooshrike] [S – se]

Coracina papuensis (Gmelin, JF, 1788) [White-bellied Cuckooshrike] [C – se]

Campochaera sloetii (Schlegel, 1866) [Golden Cuckooshrike] [R – e]

Edolisoma incertum (Meyer, AB, 1874) [Papuan Cicadabird] [S – fe]

PACHYCEPHALIDAE - Whistlers and Allies

Pseudorectes ferrugineus (Bonaparte, 1850) [Rusty Pitohui] [C – fe]

Pitohui dichrous (Bonaparte, 1850) [Hooded Pitohui] [C – fe]

ORIOLIDAE - Orioles and Figbirds

Oriolus szalayi (Madarász, 1900) [Brown Oriole] [F – fe]

MONARCHIDAE - Monarchs

Myiagra cyanoleuca (Vieillot, 1818) [Satin Flycatcher] [R – e]

DICRURIDAE - Drongos

Dicrurus bracteatus Gould, 1843 [Spangled Drongo] [S – e]

RHIPIDURIDAE - Fantails

Rhipidura maculipectus Gray, GR, 1858 [Black Thicket-Fantail] [S – e]

Rhipidura leucothorax Salvadori, 1874 [White-bellied Thicket-Fantail] [S – fe]

PARADISAEIDAE - Birds of Paradise

Phonygammus keraudrenii (Lesson & Garnot, 1826) [Trumpet Manucode] [R – fe]

***Paradisaea raggiana* Sclater, PL, 1873 [Raggiana Bird of Paradise] [C – fse]**

ESTRILDIDAE - Waxbills, Mannikins, and Allies

Erythrura trichroa (Kittlitz, 1833) [Blue-faced Parrotfinch] [R – fe]

Lonchura tristissima (Wallace, 1865) [Streak-headed Mannikin] [R – fe]

6.5 Checklist of Birds likely to be Observed Near Ponds and Streams

Note: Scientific names, common names and phylogenetic order follows Pratt and Beehler. 2014. Birds of New Guinea. Princeton University Press

This Checklist was compiled from the original checklist published by Mike Hopkins and Jones Hiaso (1994) that included 205 species.

An additional 26 species were added on the basis of reports in the Newsletter of the PNG Bird Society, the journal Muruk (also published by the PNG Bird Society) and from suggestions made by Thane K. Pratt who reviewed the list.

Species shown in **bold** are endemic to Papua New Guinea

Frequency of occurrence

C = common (seen or heard most days)

F = fairly common (seen or heard regularly)

S = scarce (seen infrequently)

R = rare (recorded only one or few times)

Habitat

f = forested habitats

s = open habitats (savanna)

e = forest edge

w = on or close to water

Other notes

h = more often heard than seen

nv = numbers variable (e.g. migrants)

ANATIDAE - Ducks, Geese, and Swans

Dendrocygna guttata Schlegel, 1866 [Spotted Whistling Duck] [R – w]

PODICIPEDIDAE - Grebes

Tachybaptus novaehollandiae (Stephens, 1826) [Australasian Grebe] [C – w]

ARDEIDAE - Herons and Bitterns

Nycticorax caledonicus (Gmelin, JF, 1789) [Nankeen Night-Heron] [R – w]

Ardea modesta Gray JE, 1831 [Eastern Great Egret] [S – w]

Ardea intermedia Wagler, 1829 [Intermediate Egret] [S – w]

PHALACROCORACIDAE - Cormorants

Microcarbo melanoleucos (Vieillot, 1817) [Little Pied Cormorant] [R – w]

Phalacrocorax sulcirostris (von Brandt, JF, 1837) [Little Black Cormorant] [R – w]

RALLIDAE - Rails

Porzana cinerea (Vieillot, 1819) [White-browed Crake] [S – w]

Porzana tabuensis (Gmelin, JF, 1789) [Spotless Crake] [R – w]

Amaurornis moluccana (Wallace, 1865) [Rufous-tailed Bush-hen] [S – w]

SCOLOPACIDAE - Sandpipers and Snipes

Actitis hypoleucos (Linnaeus, 1758) [Common Sandpiper] [R – w]

ALCEDINIDAE - River Kingfishers

Ceyx azureus (Latham, 1801) [Azure Kingfisher] [C – w]

MELIPHAGIDAE - Honeyeaters

Ramsayornis modestus (Gray, GR, 1858) [Brown-backed Honeyeater] [S – w]

OREOICIDAE - Austro-Papuan Bellbirds

Ornorectes cristatus (Salvadori, 1876) [Piping Bellbird] [S – f]

HIRUNDINIDAE - Swallows and Martins

Hirundo tahitica Gmelin, JF, 1789 [Pacific Swallow] [F – sw]

6.6 Checklist of Bird Species from Varirata National Park Known to Migrate from Australia to New Guinea during the Austral Winter

Note: Scientific names, common names and phylogenetic order follows Pratt and Beehler. 2014. Birds of New Guinea. Princeton University Press

This Checklist was compiled from the original checklist published by Mike Hopkins and Jones Hiaso (1994) that included 205 species.

An additional 26 species were added on the basis of reports in the Newsletter of the PNG Bird Society, the journal Muruk (also published by the PNG Bird Society) and from suggestions made by Thane K. Pratt who reviewed the list.

Species shown in **bold** are endemic to Papua New Guinea

Frequency of occurrence

C = common (seen or heard most days)

F = fairly common (seen or heard regularly)

S = scarce (seen infrequently)

R = rare (recorded only one or few times)

Habitat

f = forested habitats

s = open habitats (savanna)

e = forest edge

w = on or close to water

Other notes

h = more often heard than seen

nv = numbers variable (e.g. migrants)

CUCULIDAE - Old World Parasitic Cuckoos

Eudynamys orientalis (Linnaeus, 1766) [Eastern Koel] Probable occurrence; Not confirmed

Cacomantis variolosus (Vigors & Horsfield, 1827) [Brush Cuckoo] [S – fs] [h]

HALCYONIDAE - Woodland Kingfishers

Todiramphus sanctus (Vigors & Horsfield, 1827) [Sacred Kingfisher] [F – s] [nv]

CORACIIDAE - Rollers

Eurystomus orientalis (Linnaeus, 1766) [Oriental Dollarbird] [C – s]

MEROPIDAE - Bee-Eaters

Merops ornatus Latham, 1801 [Rainbow Bee-eater] [C – s] [nv]

MONARCHIDAE - Monarchs

Monarcha melanopsis (Vieillot, 1818) [Black-faced Monarch] [F – f] [h]

DICRURIDAE - Drongos

Dicrurus bracteatus Gould, 1843 [Spangled Drongo]

APPENDIX 7. CHECKLIST OF THE MAMALS OF VNP

ACROBATIDAE

Distoechurus pennatus (Peters, 1874) Feather Tailed Possum

CERIVIDAE

Cervus timorensis Blainville, 1822 [INTRODUCED] [C – fe] Rusa Deer

DASYURIDAE

Dasyurus albopunctatus Schlegel, 1880 [R – f] New Guinea Quoll

HIPPOSIDERIDAE

Hipposideros diadema (Geoffroy, 1813) Diadem Horseshoe Bat

Hipposideros calcaratus (Dobson, 1877) Spurred Horseshoe Bat

MACROPODIDAE

Dorcopsis luctuosa (D'Albertis, 1874) Gray Dorcopsis

Macropus agilis (Gould, 1841) [C – es] Agile Wallaby

Thylogale brunii (Schreber, 1778) [C – es] Dusky Pademelon

MURIDAE

Hydromys chrysogaster E. Geoffroy, 1804 [S – fe] Water Rat

Melomys lutillus (Thomas, 1913) [C – fs] Papua Grassland Melomys

Melomys rufescens (Alston, 1877) [C – fs] Black Tailed Melomys

***Paramelomys moncktoni* (Thomas, 1904) [C – fs] Moncton's Mosaic Tailed Rat**

Paramelomys platyops (Thomas, 1906) [C – fs] Lowland Mosaic Tailed Rat

Pogonomys macrourus (Milne-Edwards, 1877) Chestnut Tree Mouse

Rattus verecundus (Thomas, 1904) [C – fs] Slender rat

Rattus rattus (Linnaeus, 1758) [INTRODUCED] Balck Rat

Uromys caudimaculatus (Krefft, 1867) [C – fs] Giant White Tailed Rat

PERAMELIDAE

Echymipera kalubu (Fischer, 1829) [F – se] New Guinea Spiny Bandicoot

Isoodon macrourus (Gould, 1842) [F – fs] Northern Brown Bandicoot

Peroryctes broadbenti (Ramsay, 1879) [R – f] Giant Bandicoot

PETAURIDAE

Dactylopsila trivirgata Gray, 1858 [S – f] Striped Possum

Petaurus breviceps Waterhouse, 1838 [C – fs] Sugar Glider

PHALANGERIDAE

Phalanger gymnotis Peters and Doria, 1875 [S – f] Ground Cuscus

Phalanger intercastellanus Thomas, 1895 [S – f] Southern Common Cuscus

Spilocuscus maculatus (E. Geoffroy, 1803) [R – f] Common Spotted Cuscus

PSEUDOCHEIRIDAE

Pseudochirulus canescens (Waterhouse, 1846) Lowland Ringtail Possum

PTEROPODIDAE

Syconycteris australis (Peters, 1867) Common Blossum Bat

Nyctimene albiventer (Gray, 1863) Common Tube Nose Bat

Paranyctimene raptor (Tate, 1924) Unstriped Tube Nose Bat

SUIDAE

Sus scrofa Linnaeus, 1758 [INTRODUCED] [C – fe] Wild Pig

TACHYGLOSSIDAE

Tachyglossus aculeatus (Shaw, 1792) [R – f] Short Beaked Echidna

VESPERTILIONIDAE

Nyctophilus microtis (Thomas, 1888) Small eared Nyctophilus

Philetor brachypterus (Temminck, 1840) Rohu's Bat

7.2 Checklist of the Mammals on the Sogeri Plateau (probable species) which are considered likely to occur in Varirata National Park

The following species are predicted by shapefile analysis or are known from the Sogeri Plateau and can be expected to occur in the Park but have yet to be confirmed to occur there:

DASYURIDAE

Murexia longicaudata (Schlegel, 1866) Short Fur Antechinus

Murexia melanurus (Thomas, 1899) Black Tailed Antechinus

Planigale novaeguineae (Tate and Archbold, 1941) Papuan Planigale

Sminthopsis virginiae (de Tarragon, 1847) Red Cheeked Dunnart

EMBALLONURIDAE

Mosia nigrescens (Gray, 1843) Dark Sheath Tailed Bat

Saccolaimus flaviventris (Peters, 1866) Yellow Bellied Sheath Tailed Bat

MURIDAE

Leptomys elegans (Thomas, 1897) Long Footed Water Rat

Melomys leucogaster (Jentink, 1908) White Bellied Melomys

Microhydromys argenteus (Helgen, Leary, and Aplin, 2010) Southern Groove-toothed Moss Mouse

Paramelomys levipes (Thomas, 1897) Long Nosed Mosaic Tailed Rat

Rattus exulans (Peale, 1848) Pacific Rat

Rattus leucopus (Gray, 1867) Cape York Rat

Rattus mordax (Thomas, 1904) Eastern Rat

Rattus sordidus (Gould, 1857) Dusky Field Rat

MOLOSSIDAE

Mormopterus loriae (Thomas, 1897) Loria's Free Tailed Bat

PERAMELIDAE

Echymipera rufescens (Peters and Doria, 1875) Rufous Spiny Bandicoot

PTEROPODIDAE

Dobsonia minor (Dobson, 1878) Lesser Naked Backed Fruit Bat

Dobsonia moluccensis (Quoy and Gaimard, 1830) Moluccan Naked Backed Fruit Bat

Macroglossus minimus (E. Geoffroy, 1810) Lesser Long-tongued Fruit Bat

Pteropus macrotis (Peters, 1867) Large Eared Flying Fox

Rousettus amplexicaudatus (E. Geoffroy, 1810) Geoffroy's Rousette

RHINOLOPHIDAE

Rhinolophus megaphyllus (Gray, 1834) Eastern Horseshoe Bat

VESPERTILIONIDAE

Chalinolobus nigrogriseus (Gould, 1852) Hoary Wattled Bat

Miniopterus oceanensis (Maeda, 1982) Eastern Bent-wing Bat

Miniopterus tristis (Waterhouse, 1845) Great Bent-wing Bat

Myotis moluccarum (Thomas, 1915) Arafura Large-footed Bat

Pipistrellus angulatus (Peters, 1880) New Guinea Pipistrelle

Pipistrellus papuanus (Peters and Doria, 1881) Lesser Papuan Pipistrelle

Pipistrellus wattsi (Kitchener, Caputi, and Jones, 1986) Watt's Pipistrelle

7.2 Checklist of the Mammals predicted to occur in Varirata National Park

The following species were predicted by shapefile analysis to occur in Varirata National Park. Field Surveys will be required to verify their occurrence in the Park.

BURRAMYIDAE

Cercartetus caudatus (Milne-Edwards, 1877) Long Tailed Pygmy Possum

EMBALLONURIDAE

Emballonura raffrayana (Dobson, 1878) Raffray's Sheath Tailed Bat

HIPPOSIDERIDAE

Hipposideros ater (Templeton, 1848) Dusky leaf-nosed Bat

Hipposideros cervinus (Gould, 1854) Fawn Coloured Leaf Nosed Bat

Hipposideros maggietaylorae (Smith and Hill, 1981) Maggie Taylor's Roundleaf Bat

Hipposideros muscinus (Thomas and Doria, 1886) Fly River Roundleaf Bat

MACROPODIDAE

Dendrolagus dorianus (Ramsay, 1883) Doria's Tree Kangaroo

MURIDAE

Chiruromys lamia (Thomas, 1897) Broad Headed Tree Mouse

Lorentzimys nouhuysi (Jentink, 1911) New Guinean Jumping Mouse

Pogonomys loriae (Thomas, 1897) Large Tree Mouse

Pogonomys sylvestris (Thomas, 1920) Grey Bellied Tree Mouse

Xenuromys barbatus (Milne-Edwards, 1900) Rock Dwelling Giant Rat

PERAMELIDAE

Peroryctes raffrayana (Milne-Edwards, 1878) Raffray's Bandicoot

PTEROPODIDAE

Nyctimene aello (Thomas, 1900) Broad Striped Tube-nosed Fruit Bat

Paranyctimene tenax (Bergmans, 2001) Steadfast Tube Nosed-Bat

Pteropus conspicillatus (Gould, 1849) Spectacled Flying Fox

Pteropus neohibernicus (Peters, 1876) Bismarck Flying Fox

PHALANGERIDAE

Phalanger carmelitae (Thomas, 1898) Mountain Cuscus

PSEUDOCHEIRIDAE

Pseudochirulus forbesi (Thomas, 1887) Painted Ring Tail Possum

RHINOLOPHIDAE

Rhinolophus euryotis (Temminck, 1835) Broad-eared Horseshoe Bat

VESPERTILIONIDAE

Kerivoula muscina (Tate, 1941) Fly River Trumpet Eared Bat

Miniopterus macrocneme (Revilliod, 1914) Small Melanesian Bent-wing Bat

Miniopterus medius (Thomas and Wroughton, 1909) Intermediate Long Fingered Bat

Phoniscus papuensis (Dobson, 1878) Golden Tipped Bat

Scotorepens sanborni (Troughton, 1937) Northern Broad Nosed Bat

APPENDIX 8. SCHEDULED, ENDEMIC AND INTRODUCED SPECIES WITHIN VNP

The following four species of mammals have scheduled conservation significance under the IUCN Red List. IUCN status Fact Sheets for each species are presented in this Appendix.

Endangered Species:

Giant Bandicoot (*Peroryctes broadbenti*)

Near Threatened Species:

Forest Bittern (*Zonerodius heliosylus*)

Gurney's Eagle (*Aquila gurneyi*)

New Guinea Quoll (*Dasyurus albopunctatus*)

Endemic Species:

Because the Park is so small (1063 ha) with no obvious barriers to other parts of the Sogeri Plateau, it is unlikely that there are any species that are truly endemic to the Park. However, there is a species of tarantula that was named in 1994 by Robert Raven from VNP. This species, *Nihoa verireti*, is currently only known from within the Park. It is very likely that it occurs more widely on the Sogeri Plateau but until this is documented this tarantula must be considered endemic to the Park:

Varirata Tarantula (*Nihoa verireti*)

Introduced Species:

Fishes:

- Mosambique Tilapia (Oreochromis mossambicus)
- Guppy (Poecilia reticulata)

Amphibians:

- Cane Toad (Rhinella marina)

Mammals:

- Black Rat (Rattus rattus)
- Rusa Deer (Cervus timorensis)
- Wild Pig (Sus scrofa)

In addition domestic cats and dogs have also been observed in the Park. They appear to be itinerants or belong to Park employees. There do not appear to be any feral populations of dogs established in the Park although the status for feral cats is currently unclear.

IUCN Red List Fact Sheets For Species with Scheduled Conservation Significance

SUMMARY OF THE FIVE CRITERIA (A-E) USED TO EVALUATE IF A TAXON BELONGS IN AN IUCN RED LIST THREATENED CATEGORY (CRITICALLY ENDANGERED, ENDANGERED OR VULNERABLE).[1]

A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered	Endangered	Vulnerable
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3 & A4	≥ 80%	≥ 50%	≥ 30%

A1 Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible AND understood AND have ceased.

A2 Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction projected, inferred or suspected to be met in the future (up to a maximum of 100 years) *[(a) cannot be used for A3]*.

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

- **(a)** direct observation *[except A3]*
- **(b)** an index of abundance appropriate to the taxon
- **(c)** a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality
- **(d)** actual or potential levels of exploitation
- **(e)** effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)

	Critically Endangered	Endangered	Vulnerable
B1. Extent of occurrence (EOO)	< 100 km²	< 5,000 km²	< 20,000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2,000 km²
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented **OR** Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** area, extent and/or quality of habitat; **(iv)** number of locations or subpopulations; **(v)** number of mature individuals			
(c) Extreme fluctuations in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** number of locations or subpopulations; **(iv)** number of mature individuals			

C. Small population size and decline

	Critically Endangered	Endangered	Vulnerable
Number of mature individuals	< 250	< 2,500	< 10,000
AND at least one of C1 or C2			
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):	25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2. An observed, estimated, projected or inferred continuing decline AND at least 1 of the following 3 conditions:			
(a) **(i)** Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
(a) **(ii)** % of mature individuals in one subpopulation =	90–100%	95–100%	100%
(b) Extreme fluctuations in the number of mature individuals			

D. Very small or restricted population

	Critically Endangered	Endangered	Vulnerable
D. Number of mature individuals	< 50	< 250	**D1.** < 1,000
D2. *Only applies to the VU category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	**D2.** typically: AOO < 20 km² or number of locations ≤ 5

E. Quantitative Analysis

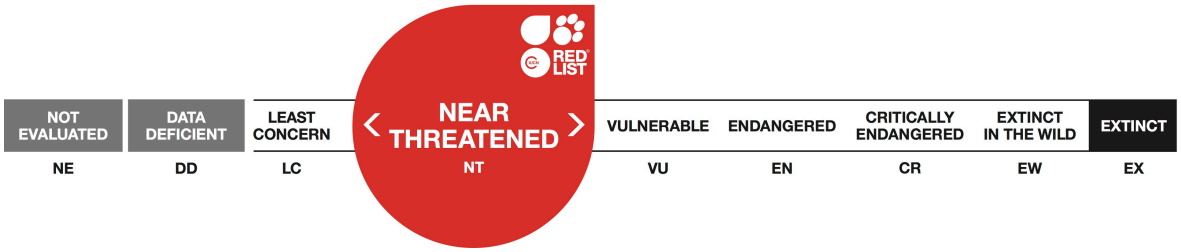
	Critically Endangered	Endangered	Vulnerable
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

1 Use of this summary sheet requires full understanding of the *IUCN Red List Categories and Criteria* and *Guidelines for Using the IUCN Red List Categories and Criteria*. Please refer to both documents for explanations of terms and concepts used here.

The IUCN Red List of Threatened Species™
ISSN 2307-8235 (online)
IUCN 2008: T22697274A117210228
Scope: Global
Language: English

Zonerodius heliosylus, Forest Bittern

Assessment by: BirdLife International



View on www.iucnredlist.org

Citation: BirdLife International. 2017. *Zonerodius heliosylus. The IUCN Red List of Threatened Species 2017*: e.T22697274A117210228. http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22697274A117210228.en

Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Chordata	Aves	Pelecaniformes	Ardeidae

Taxon Name: *Zonerodius heliosylus* (Lesson, 1828)

Common Name(s):

- English: Forest Bittern

Taxonomic Source(s):

del Hoyo, J., Collar, N.J., Christie, D.A., Elliott, A. and Fishpool, L.D.C. 2014. *HBW and BirdLife International Illustrated Checklist of the Birds of the World. Volume 1: Non-passerines*. Lynx Edicions BirdLife International, Barcelona, Spain and Cambridge, UK.

Assessment Information

Red List Category & Criteria: Near Threatened ver 3.1

Year Published: 2017

Date Assessed: October 1, 2017

Justification:

This species qualifies as Near Threatened because it has a moderately small population which is thought to be undergoing a slow to moderate decline owing to habitat degradation. Further evidence to suggest that the rate of decline may be slower than previously assessed may mean that this species warrants downlisting in the future.

Previously Published Red List Assessments

2017 – Near Threatened (NT)
http://dx.doi.org/10.2305/IUCN.UK.2017-1.RLTS.T22697274A113057130.en

2016 – Near Threatened (NT)
http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22697274A104780091.en

2012 – Near Threatened (NT)
http://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T22697274A38251878.en

2008 – Near Threatened (NT)

2006 – Near Threatened (NT)

2004 – Near Threatened (NT)

2000 – Lower Risk/near threatened (LR/nt)

1994 – Lower Risk/near threatened (LR/nt)

1988 – Lower Risk/least concern (LR/lc)

http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22697274A117210228.en

Geographic Range

Range Description:

Zonerodius heliosylus occurs throughout New Guinea (Papua, formerly Irian Jaya, **Indonesia** and **Papua New Guinea**) and on the adjacent islands of Salawati and Aru, Indonesia. There are few recent records but it appears to be widespread from the lowlands to 1,650 m (Sam and Koane 2014, Beehler and Pratt 2016).

Country Occurrence:

Native: Indonesia; Papua New Guinea

http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22697274A117210228.en

Distribution Map

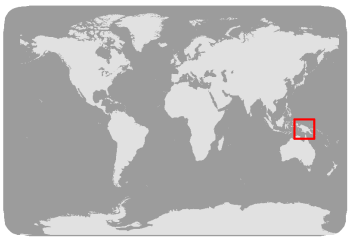
Zonerodius heliosylus

Range

Extant (resident)

Compiled by:

BirdLife International and Handbook of the Birds of the World (2016)



The boundaries and names shown and the designations used on this map do not imply any official endorsement, acceptance or opinion by IUCN.

http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22697274A117210228.en

Population

Fewer than 10,000 individuals are estimated to survive (unpublished information supplied by Wetlands International Specialist Groups), so it is placed in the band 2,500-9,999 individuals here. This equates to 1,667-6,666 mature individuals, rounded here to 1,500-7,000 mature individuals.

Trend Justification

The population is suspected to be slowly declining owing to ongoing habitat destruction. Across the mainland coastal provinces of Papua New Guinea, 1.3% forest was lost plus 2.5% was logged between 2002 and 2014 (Bryan and Shearman 2015). Although the species' tolerance of logged forest is not known, all records appear to have been from old-growth forest, and its rate of population decline is assessed as 1-9% in three generations (22 years).

Current Population Trend: Decreasing

Habitat and Ecology (see Appendix for additional information)

It frequents streams, pools and swamps in forest to 1,650 m (Sam and Koane 2014) and forages on the edges of forest creeks and pools on fish, reptiles, crustaceans and insects (Pratt and Beehler 2015, Sam and Koane 2014). Bulky nests are built in forest midstory (Pratt and Beehler 2015).

Systems: Terrestrial, Freshwater

Threats (see Appendix for additional information)

Although it is not hunted (B. M. Beehler *in litt.* 1994) and there are still huge areas of suitable habitat left, it may be threatened by the extensive logging of lowland forest (I. Burrows *in litt.* 1994, R. Burrows *in litt.* 1994), especially as it occurs along watercourses (A. Mack *in litt.* 1999).

Conservation Actions (see Appendix for additional information)

Conservation Actions Underway

None is known. **Conservation Actions Proposed**

Survey to better understand the abundance and distribution of the species. Protect large areas of lowland rainforest. Ensure protection of forests along watercourses.

Credits

Assessor(s): BirdLife International

Reviewer(s): Symes, A.

Contributor(s): Beehler, B., Bishop, P., Burrows, I., Burrows, R., Gibbs, D., Mack, A. & Dutson, G.

Facilitators(s) and Compiler(s): Benstead, P., Derhé, M., Dutson, G., Mahood, S., O'Brien, A., Pilgrim, J., Wheatley, H.

http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22697274A117210228.en

Bibliography

Beehler, B. M. and Pratt, T. K. 2016. *Birds of New Guinea. Distribution, taxonomy, and systematics*. Princeton University Press, Princeton, New Jersey.

Bryan, J.E. and Shearman, P.L. (Eds). 2015. The State of the Forests of Papua New Guinea 2014: Measuring change over the period 2002-2014. University of Papua New Guinea, Port Moresby.

Delany, S. and Scott, D. 2006. *Waterbird population estimates*. Wetlands International, Wageningen, The Netherlands.

IUCN. 2017. The IUCN Red List of Threatened Species. Version 2017-3. Available at: www.iucnredlist.org. (Accessed: 7 December 2017).

Pratt, T. K. and Beehler, B. M. 2015. *Birds of New Guinea*. Princeton University Press, Princeton.

Sam, K. & Koane, B. 2014. New avian records along the elevational gradient of Mt. Wilhelm, Papua New Guinea. *Bull. B. O. C* 134: 116-133.

Citation

BirdLife International. 2017. *Zonerodius heliosylus. The IUCN Red List of Threatened Species 2017*: e.T22697274A117210228. http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22697274A117210228.en

Disclaimer

To make use of this information, please check the Terms of Use.

External Resources

For Images and External Links to Additional Information, please see the Red List website.

Appendix

Habitats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Habitat	Season	Suitability	Major Importance?
1. Forest -> 1.6. Forest - Subtropical/Tropical Moist Lowland	Resident	Suitable	Yes
5. Wetlands (inland) -> 5.1. Wetlands (inland) - Permanent Rivers/Streams/Creeks (includes waterfalls)	Resident	Suitable	Yes
5. Wetlands (inland) -> 5.7. Wetlands (inland) - Permanent Freshwater Marshes/Pools (under 8ha)	Resident	Suitable	Yes

Threats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Threat	Timing	Scope	Severity	Impact Score
5. Biological resource use -> 5.3. Logging & wood harvesting -> 5.3.3. Unintentional effects: (subsistence/small scale) [harvest]	Ongoing	Minority (50%)	Slow, significant declines	-
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation		

Conservation Actions in Place

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Actions in Place
In-Place Research, Monitoring and Planning
Action Recovery plan: Yes
Systematic monitoring scheme: No
In-Place Land/Water Protection and Management
Conservation sites identified: Yes, over part of range
Occur in at least one PA: No
Invasive species control or prevention: No
In-Place Species Management
Successfully reintroduced or introduced beningly: No
Subject to ex-situ conservation: No
In-Place Education

http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22697274A117210228.en

Conservation Actions in Place
Subject to recent education and awareness programmes: No
Included in international legislation: No
Subject to any international management/trade controls: No

Conservation Actions Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Actions Needed
1. Land/water protection -> 1.2. Resource & habitat protection
5. Law & policy -> 5.1. Legislation -> 5.1.2. National level

Research Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Research Needed
1. Research -> 1.2. Population size, distribution & trends

Additional Data Fields

Distribution
Continuing decline in area of occupancy (AOO): Yes
Extreme fluctuations in area of occupancy (AOO): No
Estimated extent of occurrence (EOO) (km^2): 1270000
Continuing decline in extent of occurrence (EOO): Unknown
Extreme fluctuations in extent of occurrence (EOO): No
Continuing decline in number of locations: Unknown
Extreme fluctuations in the number of locations: No
Lower elevation limit (m): 100
Upper elevation limit (m): 1650
Population
Number of mature individuals: 1500-7000
Continuing decline of mature individuals: Yes
Extreme fluctuations: No
Population severely fragmented: No

http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22697274A117210228.en

Population
Continuing decline in subpopulations: Unknown
Extreme fluctuations in subpopulations: No
All individuals in one subpopulation: No
Habitats and Ecology
Continuing decline in area, extent and/or quality of habitat: Yes
Generation Length (years): 7.4
Movement patterns: Not a Migrant

The IUCN Red List Partnership

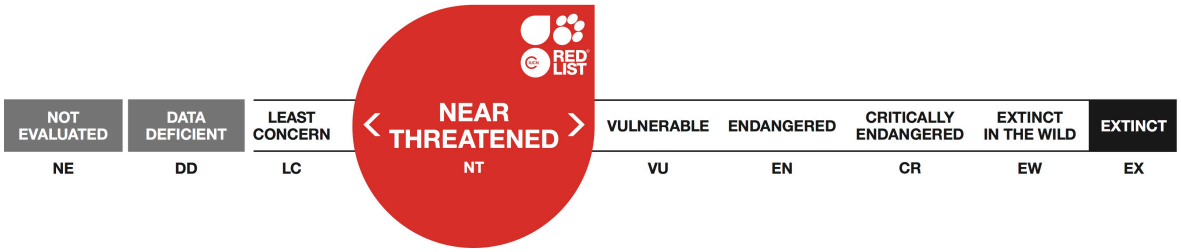
The IUCN Red List of Threatened Species™ is produced and managed by the IUCN Global Species Programme, the IUCN Species Survival Commission (SSC) and The IUCN Red List Partnership.

The IUCN Red List Partners are: Arizona State University; BirdLife International; Botanic Gardens Conservation International; Conservation International; NatureServe; Royal Botanic Gardens, Kew; Sapienza University of Rome; Texas A&M University; and Zoological Society of London.

The IUCN Red List of Threatened Species™
ISSN 2307-8235 (online)
IUCN 2008: T22696056A93541423
Scope: Global
Language: English

Aquila gurneyi, Gurney's Eagle

Assessment by: BirdLife International



View on www.iucnredlist.org

Citation: BirdLife International. 2016. *Aquila gurneyi. The IUCN Red List of Threatened Species 2016*: e.T22696056A93541423. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22696056A93541423.en

Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Chordata	Aves	Accipitriformes	Accipitridae

Taxon Name: *Aquila gurneyi* Gray, 1860

Common Name(s):

- English: Gurney's Eagle
- Spanish: Aguila Moluqueña

Taxonomic Source(s):

del Hoyo, J., Collar, N.J., Christie, D.A., Elliott, A. and Fishpool, L.D.C. 2014. *HBW and BirdLife International Illustrated Checklist of the Birds of the World*. Lynx Edicions BirdLife International, Barcelona, Spain and Cambridge, UK.

Assessment Information

Red List Category & Criteria: Near Threatened ver 3.1

Year Published: 2016

Date Assessed: October 1, 2016

Justification:

This species is classified as Near Threatened because it has a moderately small population which is declining owing to habitat loss.

Previously Published Red List Assessments

2012 – Near Threatened (NT) – http://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T22696056A38273742.en

2008 – Near Threatened (NT)

2004 – Near Threatened (NT)

2000 – Lower Risk/near threatened (LR/nt)

1994 – Lower Risk/near threatened (LR/nt)

1988 – Lower Risk/least concern (LR/lc)

Geographic Range

Range Description:

Aquila gurneyi is a wide-ranging species of the Moluccas, **Indonesia** and New Guinea (Papua, formerly Irian Jaya, Indonesia and **Papua New Guinea**). There are no estimates of population sizes or trends but in Lakekamu Basin it is sparsely distributed in lowland alluvial forest (A. Mack *in litt.* 1999). Recent

sightings include a subadult and juvenile at Danau Tolire on Ternate (Rheindt *et al.* 2014) and individuals at Tofu Blewen (Irham 2012) and Seram (Reeve *et al*. 2014). Surveys on Obi island failed to find the species, though locals were familiar with the species (Mittermeier *et al.* 2013).

Country Occurrence:

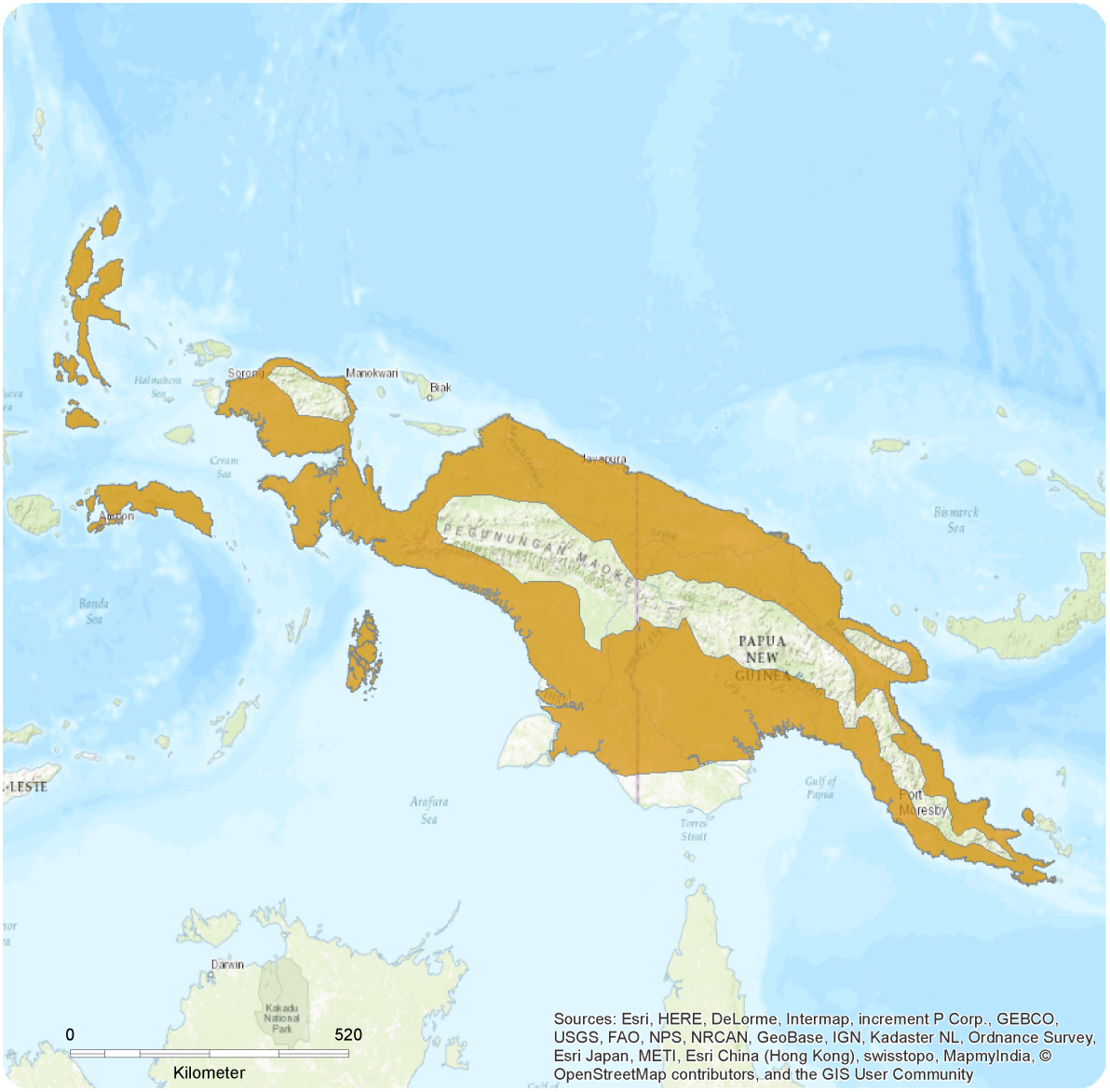
Native: Indonesia; Papua New Guinea

Vagrant: Australia

http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22696056A93541423.en

Distribution Map

Aquila gurneyi

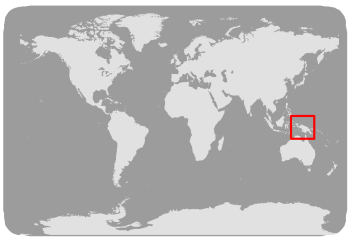


Range

Extant (resident)

Compiled by:

BirdLife International and Handbook of the Birds of the World (2016)



The boundaries and names shown and the designations used on this map do not imply any official endorsement, acceptance or opinion by IUCN.

http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22696056A93541423.en

Population

Population numbers are not known.

Trend Justification

There are no data on population trends; however, the species is suspected to be in decline owing to habitat loss and degradation.

Current Population Trend: Decreasing

Habitat and Ecology (see Appendix for additional information)

It appears to be widespread in a variety of forested habitats to 1,000 m, although it seems to prefer primary forest, it has been seen to 1,500 m (Coates 1985, Beehler *et al.* 1986). Is thought to prey on arboreal mammals such as possums (Pratt and Beehler 2015).

Systems: Terrestrial

Threats (see Appendix for additional information)

It clearly occurs at low population densities and is likely to be declining slowly through habitat loss and degradation.

Conservation Actions (see Appendix for additional information)

Conservation Actions Underway

CITES Appendix II. **Conservation Actions Proposed**

Survey to determine density and the affect of disturbance. Effectively protect large areas of lowland rainforest.

Credits

Assessor(s): BirdLife International

Reviewer(s): Butchart, S. & Symes, A.

Contributor(s): Mack, A.

Facilitators(s) and Compiler(s): Benstead, P., Derhé, M., Dutson, G., Mahood, S., O'Brien, A., North, A.

http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22696056A93541423.en

Bibliography

Beehler, B. M.; Pratt, T. K.; Zimmerman, D. A. 1986. *Birds of New Guinea*. Princeton University Press, Princeton.

Coates, B. J. 1985. *The birds of Papua New Guinea,* 1: *non-passerines*. Dove, Alderley, Australia.

Ferguson-Lees, J. and Christie, D.A. 2001. *Raptors of the world*. Christopher Helm, London.

Irham, M. 2012. Avifauna diversity at central Halmahera North Maluku, Indonesia. *Zoo Indonesia* 21(1): 17-31.

IUCN. 2016. The IUCN Red List of Threatened Species. Version 2016-3. Available at: www.iucnredlist.org. (Accessed: 07 December 2016).

Mittermeier, J.C., Cottee-Jones, H.E.W., Purba, E.C., Ashuri, N.M., Hesdianti, E. & Supriatna, J. 2013. A survey of the avifauna of Obi island, North Moluccas, Indonesia. *Forktail* 29: 128-137.

Pratt, T. K. and Beehler, B. M. 2015. *Birds of New Guinea*. Princeton University Press, Princeton.

Reeve, A. H., Haryoko, T., Poulsen, M. K., Fabre, P-H. and & Jonsson, K. A. 2014. New ornithological records from Buru and Seram, south Maluku, Indonesia, 1995–2012. *Forktail* 30 : 10–22.

Rheindt, F. E., Prawiradilaga, D. M., Suparno, Ashari, H. and Wilton, P. R. 2014. New and significant island records, range extensions and elevational extensions of birds in Eastern Sulawesi, its nearby satellites, and Ternate. *Treubia* 41: 67-97.

Citation

BirdLife International. 2016. *Aquila gurneyi. The IUCN Red List of Threatened Species 2016*: e.T22696056A93541423. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22696056A93541423.en

Disclaimer

To make use of this information, please check the Terms of Use.

External Resources

For Images and External Links to Additional Information, please see the Red List website.

Appendix

Habitats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Habitat	Season	Suitability	Major Importance?
1. Forest -> 1.6. Forest - Subtropical/Tropical Moist Lowland	Resident	Suitable	Yes
1. Forest -> 1.8. Forest - Subtropical/Tropical Swamp	Resident	Suitable	No
1. Forest -> 1.9. Forest - Subtropical/Tropical Moist Montane	Resident	Suitable	No
14. Artificial/Terrestrial -> 14.1. Artificial/Terrestrial - Arable Land	Resident	Marginal	-

Threats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Threat	Timing	Scope	Severity	Impact Score
5. Biological resource use -> 5.3. Logging & wood harvesting -> 5.3.3. Unintentional effects: (subsistence/small scale) [harvest]	Ongoing	Minority (50%)	Slow, significant declines	-
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation		

Conservation Actions in Place

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Actions in Place
In-Place Research, Monitoring and Planning
Action Recovery plan: No
Systematic monitoring scheme: No
In-Place Land/Water Protection and Management
Conservation sites identified: Yes, over part of range
Occur in at least one PA: No
Invasive species control or prevention: No
In-Place Species Management
Successfully reintroduced or introduced beningly: No
Subject to ex-situ conservation: No
In-Place Education
Subject to recent education and awareness programmes: No

http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22696056A93541423.en

Conservation Actions in Place
Included in international legislation: No
Subject to any international management/trade controls: Yes

Conservation Actions Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Actions Needed
1. Land/water protection -> 1.2. Resource & habitat protection

Research Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Research Needed
1. Research -> 1.2. Population size, distribution & trends

Additional Data Fields

Distribution
Continuing decline in area of occupancy (AOO): Unknown
Extreme fluctuations in area of occupancy (AOO): No
Estimated extent of occurrence (EOO) (km^2): 1690000
Continuing decline in extent of occurrence (EOO): Unknown
Extreme fluctuations in extent of occurrence (EOO): No
Continuing decline in number of locations: Unknown
Extreme fluctuations in the number of locations: No
Upper elevation limit (m): 1500
Population
Continuing decline of mature individuals: Yes
Extreme fluctuations: No
Population severely fragmented: No
Continuing decline in subpopulations: Unknown
Extreme fluctuations in subpopulations: No
All individuals in one subpopulation: No
No. of individuals in largest subpopulation: 100

http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22696056A93541423.en

Habitats and Ecology
Continuing decline in area, extent and/or quality of habitat: Yes
Generation Length (years): 16.8
Movement patterns: Not a Migrant

The IUCN Red List Partnership

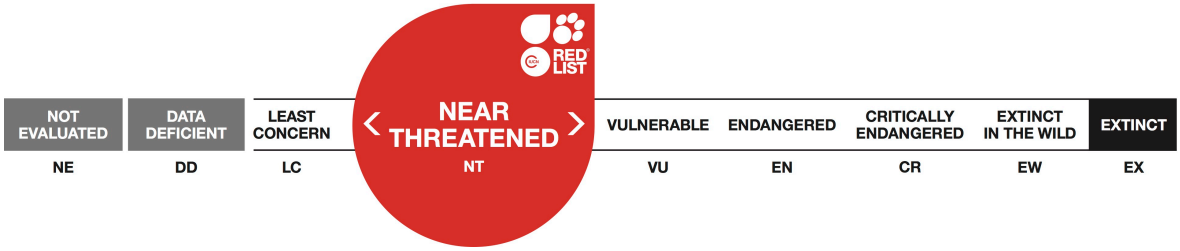
The IUCN Red List of Threatened Species™ is produced and managed by the IUCN Global Species Programme, the IUCN Species Survival Commission (SSC) and The IUCN Red List Partnership.

The IUCN Red List Partners are: Arizona State University; BirdLife International; Botanic Gardens Conservation International; Conservation International; NatureServe; Royal Botanic Gardens, Kew; Sapienza University of Rome; Texas A&M University; and Zoological Society of London.

The IUCN Red List of Threatened Species™
ISSN 2307-8235 (online)
IUCN 2008: T6299A21946965

Dasyurus albopunctatus, New Guinea Quoll

Assessment by: Woolley, P., Leary, T., Seri, L., Flannery, T., Wright, D., Hamilton, S., Helgen, K., Singadan, R., Menzies, J., Allison, A. & James, R.



View on www.iucnredlist.org

Citation: Woolley, P., Leary, T., Seri, L., Flannery, T., Wright, D., Hamilton, S., Helgen, K., Singadan, R., Menzies, J., Allison, A. & James, R. 2016. *Dasyurus albopunctatus. The IUCN Red List of Threatened Species 2016*: e.T6299A21946965. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T6299A21946965.en

Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Chordata	Mammalia	Dasyuromorphia	Dasyuridae

Taxon Name: *Dasyurus albopunctatus* Schlegel, 1880

Synonym(s):

- *Satanellus albopunctatus* (Schlegel, 1880)

Common Name(s):

- English: New Guinea Quoll, New Guinean Quoll
- French: Chat Marsupial De Nlle-guinée

Assessment Information

Red List Category & Criteria: Near Threatened ver 3.1

Year Published: 2016

Date Assessed: June 29, 2016

Justification:

Listed as Near Threatened because, although widespread and locally abundant, declines have been recorded at a number of localities due to impacts of people (expanding agriculture) and hunting with dogs. There are also possible threats from feral cats and the potential loss of the lowland habitats to oil palms. The Australian species in this genus have declined dramatically due to impacts of predation and competition from invasive predators and disease. Almost qualifies as threatened under criterion A2.

Previously Published Red List Assessments

2008 – Near Threatened (NT) – http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T6299A12600801.en

1996 – Vulnerable (VU)

Geographic Range

Range Description:

The New Guinea Quoll is widespread throughout much of New Guinea (Indonesia and Papua New Guinea), but has a patchy distribution across its range. It has a wide elevational range (sea level to 3,600 m) most often occurring 1,000-1,300 m asl; it is absent from the south-western lowlands (Flannery 1995). It is not certain if the species occurs in the Vogelkop region of Papua, although the map is drawn to include that area. The New Guinea Quoll is also found on Yapen Island.

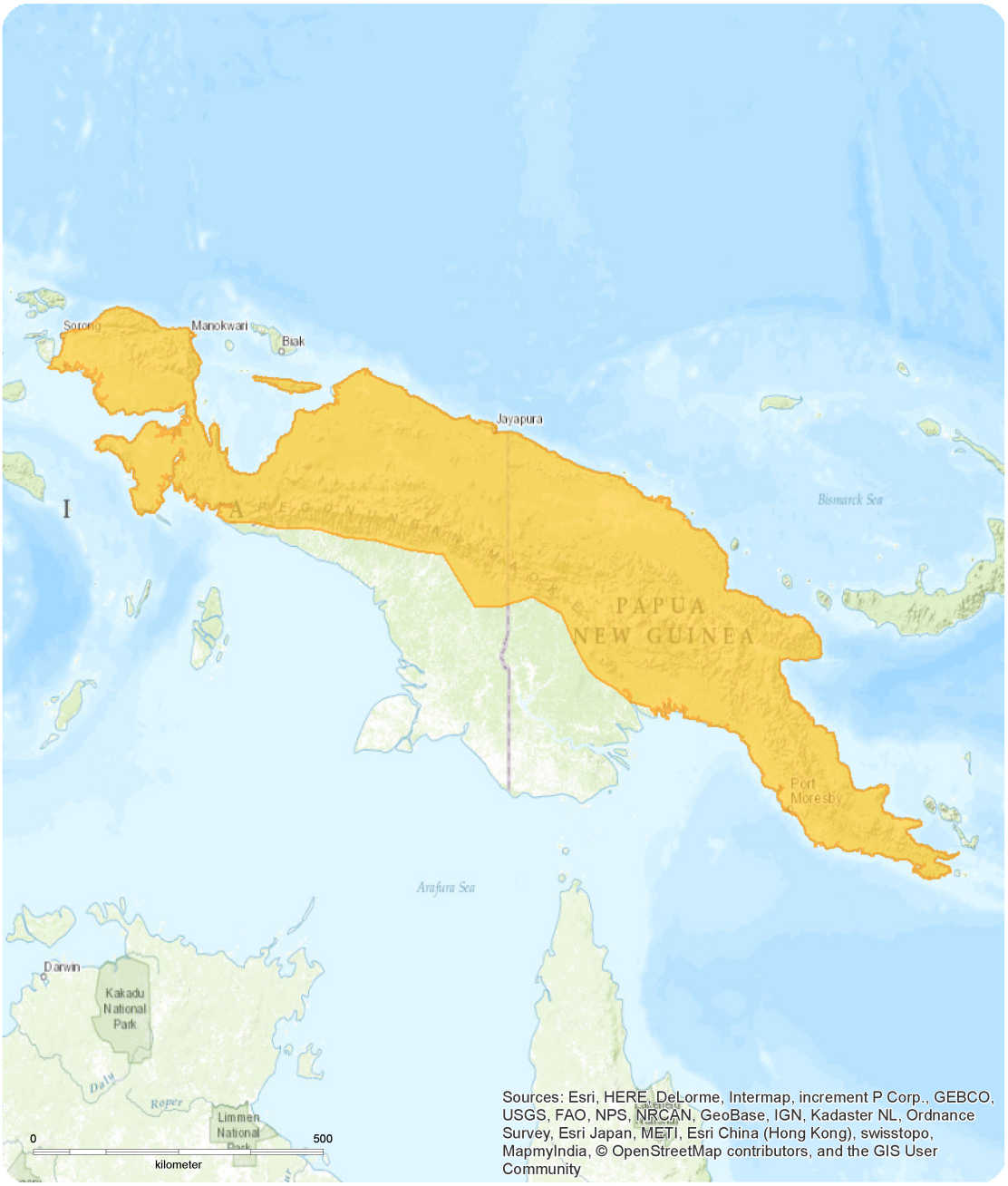
Country Occurrence:

Native: Indonesia; Papua New Guinea

http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T6299A21946965.en

Distribution Map

Dasyurus albopunctatus



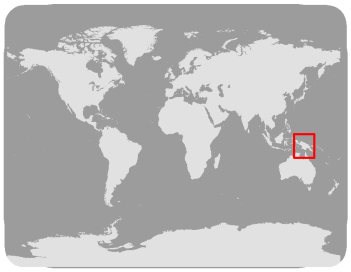
Dasyurus albopunctatus

NE | DD | LC | **NT** NEAR THREATENED | VU | EN | CR | EW | EX

Range

Extant (resident)

Compiled by:
IUCN (International Union for Conservation of Nature)



The boundaries and names shown and the designations used on this map do not imply any official endorsement, acceptance or opinion by IUCN.

http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T6299A21946965.en

Population

This species may be locally common, but declines have been noted especially in areas where human impact has increased. Quolls are hunted, and are branded as "stilman" (thief) because they take domesticated chickens and ducks from villages. Therefore they are killed on sight as a pre-emptive measure to protect poultry. Local people also say that they are good to eat. Hunting records from the YUS Conservation Area on the Huon Peninsula during 2012 and 2014 show that significant numbers of quolls are hunted, but the kill frequency is lower than for other prey species. Camp dogs may also reduce numbers close to villages.

Current Population Trend: Decreasing

Habitat and Ecology **(see Appendix for additional information)**

The New Guinea Quoll is widespread throughout tropical moist forest including areas of disturbed forest. It has been reported from rural gardens and entering villages to prey on rats. Very little is known about the biology of this species. It is, however, clear from a study of museum specimens (Woolley 1994) that breeding occurs throughout the year. The New Guinea Quoll is a top-level predator in New Guinea. Local people report that it spends more time hunting in trees than on the ground.

Systems: Terrestrial

Use and Trade

It is killed and eaten incidentally, but is generally not targeted by hunters.

Threats **(see Appendix for additional information)**

Increasing human populations, hunting by dogs, and expanding land-use may have an impact on this species (particularly the potential loss of the lowland habitats to oil palms). It is possible that it is affected by competition with introduced cats, but studies are needed for confirmation.

Conservation Actions **(see Appendix for additional information)**

The New Guinea Quoll has been recorded from a number of protected areas, including the YUS Conservation Area on the Huon Peninsula. It is not currently protected by any government legislation and deserves some attention and targeted research as a key predator.

Credits

Assessor(s): Woolley, P., Leary, T., Seri, L., Flannery, T., Wright, D., Hamilton, S., Helgen, K., Singadan, R., Menzies, J., Allison, A. & James, R.

Reviewer(s): Pacifici, M.

Facilitators(s) and Compiler(s): Johnson, C.N.

http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T6299A21946965.en

Bibliography

Flannery, T.F. 1995. *The Mammals of New Guinea, 2nd edition*. Reed Books, Sydney, Australia.

IUCN. 2016. The IUCN Red List of Threatened Species. Version 2016-2. Available at: www.iucnredlist.org. (Accessed: 04 September 2016).

Woolley, P. A. 1994. The dasyurid marsupials of New Guinea: use of museum specimens to assess seasonality of breeding. *Science in New Guinea* 20: 49-55.

Citation

Woolley, P., Leary, T., Seri, L., Flannery, T., Wright, D., Hamilton, S., Helgen, K., Singadan, R., Menzies, J., Allison, A. & James, R. 2016. *Dasyurus albopunctatus. The IUCN Red List of Threatened Species 2016*: e.T6299A21946965. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T6299A21946965.en

Disclaimer

External Resources

For Images and External Links to Additional Information, please see the Red List website.

Appendix

Habitats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Habitat	Season	Suitability	Major Importance?
1. Forest -> 1.6. Forest - Subtropical/Tropical Moist Lowland	-	Suitable	-
1. Forest -> 1.9. Forest - Subtropical/Tropical Moist Montane	-	Suitable	-
14. Artificial/Terrestrial -> 14.4. Artificial/Terrestrial - Rural Gardens	-	Suitable	-
14. Artificial/Terrestrial -> 14.6. Artificial/Terrestrial - Subtropical/Tropical Heavily Degraded Former Forest	-	Suitable	-

Threats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Threat	Timing	Scope	Severity	Impact Score
1. Residential & commercial development -> 1.1. Housing & urban areas	Ongoing	-	-	-
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation		
2. Agriculture & aquaculture -> 2.1. Annual & perennial non-timber crops -> 2.1.1. Shifting agriculture	Ongoing	-	-	-
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation		
2. Agriculture & aquaculture -> 2.1. Annual & perennial non-timber crops -> 2.1.2. Small-holder farming	Ongoing	-	-	-
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation		
2. Agriculture & aquaculture -> 2.1. Annual & perennial non-timber crops -> 2.1.3. Agro-industry farming	Ongoing	-	-	-
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation		
5. Biological resource use -> 5.1. Hunting & trapping terrestrial animals -> 5.1.2. Unintentional effects (species is not the target)	Ongoing	-	-	-
	Stresses:	2. Species Stresses -> 2.1. Species mortality		
5. Biological resource use -> 5.3. Logging & wood harvesting -> 5.3.5. Motivation Unknown/Unrecorded	Ongoing	-	-	-
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation		

http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T6299A21946965.en

8. Invasive and other problematic species, genes & diseases -> 8.1. Invasive non-native/alien species/diseases -> 8.1.2. Named species (Felis catus)	Future	-	-	-
	Stresses:	2. Species Stresses -> 2.1. Species mortality		

Conservation Actions in Place

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Actions in Place
In-Place Land/Water Protection and Management
Conservation sites identified: Yes, over entire range

Conservation Actions Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Actions Needed
5. Law & policy -> 5.1. Legislation -> 5.1.2. National level

Research Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Research Needed
1. Research -> 1.5. Threats

Additional Data Fields

Distribution
Lower elevation limit (m): 0
Upper elevation limit (m): 3600
Population
Population severely fragmented: No

http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T6299A21946965.en

The IUCN Red List Partnership

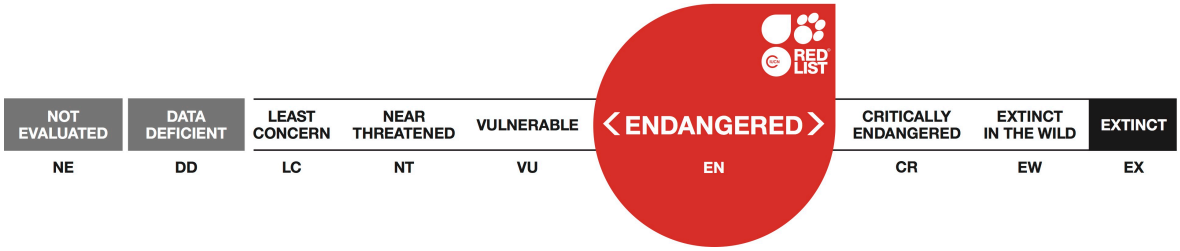
The IUCN Red List of Threatened Species™ is produced and managed by the IUCN Global Species Programme, the IUCN Species Survival Commission (SSC) and The IUCN Red List Partnership.

The IUCN Red List Partners are: Arizona State University; BirdLife International; Botanic Gardens Conservation International; Conservation International; NatureServe; Royal Botanic Gardens, Kew; Sapienza University of Rome; Texas A&M University; and Zoological Society of London.

The IUCN Red List of Threatened Species™
ISSN 2307-8235 (online)
IUCN 2008: T16710A21965270

Peroryctes broadbenti, Giant Bandicoot

Assessment by: Leary, T., Wright, D., Hamilton, S., Singadan, R., Menzies, J., Bonaccorso, F., Helgen, K., Seri, L., Allison, A., Aplin, K., Dickman, C. & Salas, L.



View on www.iucnredlist.org

Citation: Leary, T., Wright, D., Hamilton, S., Singadan, R., Menzies, J., Bonaccorso, F., Helgen, K., Seri, L., Allison, A., Aplin, K., Dickman, C. & Salas, L. 2016. *Peroryctes broadbenti. The IUCN Red List of Threatened Species 2016*: e.T16710A21965270. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T16710A21965270.en

Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Chordata	Mammalia	Peramelemorphia	Peramelidae

Taxon Name: *Peroryctes broadbenti* (Ramsay, 1879)

Common Name(s):

- English: Giant Bandicoot
- French: Péramèle Géant

Taxonomic Notes:

Was under family Peroryctidae.

Assessment Information

Red List Category & Criteria: Endangered A4cd ver 3.1

Year Published: 2016

Date Assessed: June 30, 2016

Justification:

Listed as Endangered because of a serious population decline, estimated/projected to be more than 50% within three generations (1 generation or 4 years in the past, and 2 generations/8 years into the future), due to direct exploitation from hunting and to habitat loss with lowland forests in southeastern New Guinea being converted to agriculture.

Previously Published Red List Assessments

2008 – Endangered (EN) – http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T16710A6302300.en

1996 – Data Deficient (DD)

1994 – Endangered (E)

Geographic Range

Range Description:

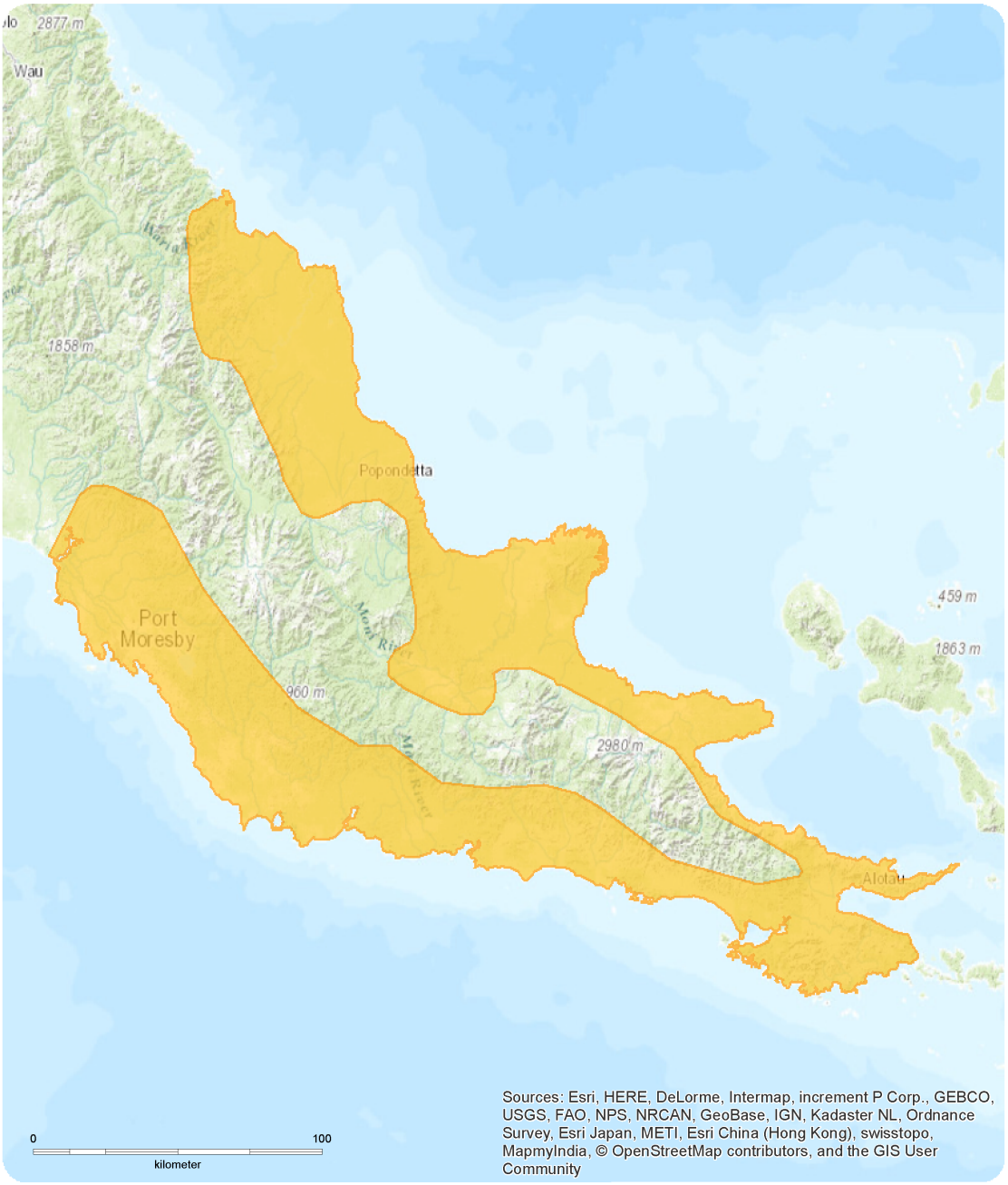
This species is endemic to the south-eastern lowlands of Papua New Guinea. It is broadly distributed throughout its range but at low densities. It has been recorded from sea level and the upper limit of altitudinal range is probably about 1,000 m asl.

Country Occurrence:

Native: Papua New Guinea

Distribution Map

Peroryctes broadbenti



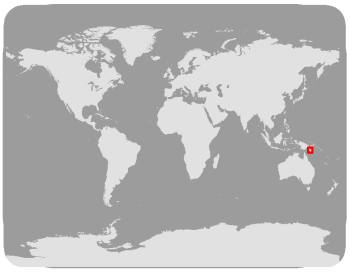
Peroryctes broadbenti

Range

Extant (resident)

Compiled by:
IUCN (International Union for Conservation of Nature)

NE DD LC NT VU EN ENDANGERED CR EW EX



The boundaries and names shown and the designations used on this map do not imply any official endorsement, acceptance or opinion by IUCN.

http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T16710A21965270.en

Population

It is rarely encountered and the local abundance is suspected to be naturally low.

Current Population Trend: Decreasing

Habitat and Ecology (see Appendix for additional information)

The Giant Bandicoot is the largest bandicoot in the world: males attain body weights up to 4.9 kg and females are around 1.4 kg. It occurs in dense lowland tropical moist forest and gallery forests, typically along creeks or rivers. The only information on diet is that the stomach of one specimen contained only vegetable matter; bandicoots are trypically ominvorous. The species is evidently rare, and has not been collected in the last three decades (Aplin et al 2010). It may be naturally rare, but is probably in decline.

Systems: Terrestrial

Threats (see Appendix for additional information)

Peroryctes broadbenti is threatened by hunting for food by local people and by habitat loss due to conversion of forest to small-scale agricultural land and commercial agriculture, especially oil palm plantations. Both threats are intensifying as a result of increasing human population density in its lowland range. Bushmeat has increased substantially in value – this species would sell for 84 Kina in the markets (J. Menzies pers. comm.).

Conservation Actions (see Appendix for additional information)

This species has not been recorded from any protected areas despite the fact that there are many throughout its range. The protected areas of the Central Province are not well managed, and many villagers access them to seek game and firewood. Thus, this species may be hunted out of the protected areas (L. Salas pers. comm. 2008).

Credits

Assessor(s): Leary, T., Wright, D., Hamilton, S., Singadan, R., Menzies, J., Bonaccorso, F., Helgen, K., Seri, L., Allison, A., Aplin, K., Dickman, C. & Salas, L.

Reviewer(s): Pacifici, M. & Johnson, C.N.

http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T16710A21965270.en

Bibliography

Flannery, T.F. 1995. *The Mammals of New Guinea, 2nd edition*. Reed Books, Sydney, Australia.

IUCN. 2016. The IUCN Red List of Threatened Species. Version 2016-2. Available at: www.iucnredlist.org. (Accessed: 04 September 2016).

Citation

Leary, T., Wright, D., Hamilton, S., Singadan, R., Menzies, J., Bonaccorso, F., Helgen, K., Seri, L., Allison, A., Aplin, K., Dickman, C. & Salas, L. 2016. *Peroryctes broadbenti. The IUCN Red List of Threatened Species 2016*: e.T16710A21965270. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T16710A21965270.en

Disclaimer

To make use of this information, please check the Terms of Use.

External Resources

For Images and External Links to Additional Information, please see the Red List website.

Appendix

Habitats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Habitat	Season	Suitability	Major Importance?
1. Forest -> 1.6. Forest - Subtropical/Tropical Moist Lowland	-	Suitable	-

Threats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Threat	Timing	Scope	Severity	Impact Score
2. Agriculture & aquaculture -> 2.1. Annual & perennial non-timber crops -> 2.1.2. Small-holder farming	Ongoing	-	-	-
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation		
2. Agriculture & aquaculture -> 2.1. Annual & perennial non-timber crops -> 2.1.3. Agro-industry farming	Ongoing	-	-	-
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation		
5. Biological resource use -> 5.1. Hunting & trapping terrestrial animals -> 5.1.1. Intentional use (species is the target)	Ongoing	-	-	-
	Stresses:	2. Species Stresses -> 2.1. Species mortality		

Conservation Actions Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Actions Needed
1. Land/water protection -> 1.1. Site/area protection
2. Land/water management -> 2.1. Site/area management
3. Species management -> 3.1. Species management -> 3.1.1. Harvest management

Research Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Research Needed
1. Research -> 1.2. Population size, distribution & trends
1. Research -> 1.3. Life history & ecology

http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T16710A21965270.en

Research Needed
1. Research -> 1.5. Threats
1. Research -> 1.6. Actions

Additional Data Fields

Distribution
Lower elevation limit (m): 0
Upper elevation limit (m): 1000
Population
Population severely fragmented: No
Habitats and Ecology
Generation Length (years): 4

http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T16710A21965270.en

The IUCN Red List Partnership

The IUCN Red List of Threatened Species™ is produced and managed by the IUCN Global Species Programme, the IUCN Species Survival Commission (SSC) and The IUCN Red List Partnership.

The IUCN Red List Partners are: Arizona State University; BirdLife International; Botanic Gardens Conservation International; Conservation International; NatureServe; Royal Botanic Gardens, Kew; Sapienza University of Rome; Texas A&M University; and Zoological Society of London.

APPENDIX 9. FIELD GUIDE BROCHURES FOR THE FAUNA OF VNP

Over 95% of the world's fauna (approximately 15-30 million species) are invertebrates, which comprise animals that have evolved without a backbone. PNG has a very rich diversity of invertebrate fauna and you have an excellent chance of observing some of PNG's most beautiful butterflies and moths, dragonflies and damselflies, and an astounding variety of beetles in VNP. It is likely that invertebrates represent more than 90% of the animals in the Park and include at least 5000 species.

You will likely hear the noisy cicadas and may also encounter less appealing invertebrates such as centipedes and spiders. Don't attempt to pick them up or harm them and you will avoid a nasty bite. In the wet season leeches are common in the primary forests but don't let these put you off visiting VNP!

Two of the eight major invertebrate groups (Phyla) are represented in this Field Guide Brochure: Phylum Arthropoda (arthropods) and Phylum Annelida (annelids).

Annelids are soft bodied 'segmented worms' and the group includes marine worms, earthworms and leeches. Earthworms are extremely beneficial to soils for enhancing nutrient cycling processes, while leeches are parasites that feed on the blood of other animals and have medicinal applications often used to reduce swelling after surgery.

Arthropods have segmented bodies, jointed legs and often have a rigid external protective covering called an exoskeleton. Arthropods include the following four major groups: Insects; Spiders; Millipedes and Centipedes; and Crustaceans. It is estimated that a staggering 80% of all animals on earth are arthropods and 75% of all animals are insects!

Phylum Arthropoda (Arachnids)
Arachnids have eight legs, and specialised jaws (mandibles) adapted for piercing and chewing. Spiders, harvestmen, scorpions, ticks, and mites are all arachnids and some are venomous and can cause health complications, give nasty stings or infections. These animals should be treated with care and not handled.

Phylum Arthropoda
(Myriapoda - millipedes and centipedes)
Millipedes and centipedes both have long segmented bodies. Centipedes have one pair of legs per segment and millipedes have two pairs of legs per segment. Millipedes are generally decomposers in forest ecosystems while centipedes are venomous predators and can inflict a painful bite. Both occur in VNP.

Phylum Arthropoda (Crustaceans)
Crustaceans are primarily aquatic animals (live in water) and include crabs, crayfish, shrimps, and barnacles. Widespread in marine systems, some have also evolved to live in freshwater, with species shrimps and crabs both occurring in VNP. With patience, you can observe these animals along Narirogo Creek.

Phylum Arthropoda (Insects)
Insects have six legs and usually one or two pairs of wings although some insects do lack wings. There are 29 Orders of insects including: Lepidoptera (butterflies and moths); Coleoptera (beetles and weevils); Orthoptera (grasshoppers and katydids); Blattodae (termites) Hymenoptera (ants, wasps and bees); Diptera (flies and mosquitoes); Mantodeae (mantids); Odonata (dragonflies); Hemiptera (Cicadas); and Phasmatodea (stick insects). Many colourful butterflies and dragonflies are easily observed within VNP. With careful observation you can also see more cryptic (camouflaged) species of moth, beetle, katydid, grass hopper, and giant stick insects to name a few.

It is often very difficult to correctly identify invertebrates to species level. Therefore for most of the animals pictured in this brochure, the much broader biological category of the Order to which they belong is used.

INVERTEBRATES

Varirata National Park (VNP) is PNG's first national park, declared on 10th December 1969 and officially opened on 18th October 1973. It is on state land on the Sogeri Plateau at an elevation of 600–900 m and covers an area of 1,063 ha. It is 48km east of Port Moresby City and accessible by road. The land was locally called *Wodobonomu* and was the traditional hunting ground of the Koiari people.

VNP has scenic views and beautiful rainforests, savannah grasslands and secondary regrowth. The average annual rainfall is 1400–2000 mm. The Park is inhabited by some unique plants and animals such as forest wallabies, possums, bandicoots, cassowaries, the raggiana bird of paradise, as well as many extraordinary reptile and frog species, and a rich variety of remarkable insects.

The Park is one of the best places in the country to learn about biodiversity. It is visited by dozens of nature tours each year and attracts researchers from throughout the world. It is also an important training site for students from surrounding universities.

Conservation & Environment Protection Authority
Level 5 Dynasty Tower A Savannah Heights Waigani Drive
PO Box 6601 BOROKO NCD Papua New Guinea
Tel: (+675) 301 4500 email: kkalim@dec.gov.pg

www.jica.go.jp/png/english/activities/activity
www.facebook.com/pngbiodiv/

Photography and text Angus Fraser, Design Mike McCoy
Publication funded by JICA

PNG
Conservation and Environment
Protection Authority

Termites
Order Blattodea
Masses of flying termites congregate under specific environmental conditions of temperature and humidity to mate and form new colonies. Approximately 25 mm in length with forewings and hind wings similarly sized.

Longhorn beetle
Order Coleoptera, *Agrianome* sp.
Large tan coloured longhorn beetle, with prominent mandibles and long antennae. Emits hissing sound if alarmed and will bite if handled incorrectly. Attracted to lights at night.

Scarab beetle
Order Coleoptera, *Orcytes* sp.
Medium sized beetle, hemispherical varying in colour from dark tan and black on the dorsal side and pale ventrally. Attracted to lights at night and emits a hissing sound if alarmed.

Scarab beetle
Order Coleoptera, *Pelopides schraderi*
Medium sized, stout black beetle with terminal segments of the antennae club like. Forelegs adapted to digging and primarily active at dusk or nocturnal. Larvae comprise white grubs are found in soil, and soft rotting timber.

New Guinea Tarantula
Order Araneae, *Selenocosmia* sp.
Large burrowing spider, variable in colour, occurring in savannah and primary forests. Silken lined cylindrical burrow that can extend to 1 m deep. Typically a nocturnal predator. Venomous.

Order Arhynchobellida, Haemadipsid Leech
A small segmented parasitic annelid with a preference for moist wet forest environments. Occurs on forest floor and low level vegetation. Abundant during wet season rains and can survive long dry periods.

Millipede
Order Myriapoda
Long segmented arthropod. Typically grey with yellow margins and black markings laterally on each segment. Generally inhabits forest floor leaf litter, but a capable climber. Active during the day (diurnal).

Freshwater crab
Order Decapoda, *Holthisana papuana*
A small freshwater crab with cryptic colouration; rusty brown and mottled orange dorsally, but pale ventrally. Well suited to the rocky substrate of watercourses throughout VNP

Weevil Beetle
Order Coleoptera, *Eupholus* sp.
Small beetle with cylindrical body and rounded abdomen. Approximately 10 mm in length. Long and slender snout, forward pointing. This genus of beetle can be found across all vegetation types within VNP.

Cicada
Order Hemiptera
A large cicada approximately 100 mm in length. Green brown body, with green to yellowish venation in translucent wings. Male cicadas use their tymbal organ (vibrating membrane under the wing) to generate extraordinarily loud 'singing' at dusk.

Cicada
Order Hemiptera
A medium sized cicada approximately 40 mm in length. Green body and translucent wings. Abundant in VNP and nocturnal. Attracted to lights.

Bumblebee
Order Hymenoptera
A large bumble bee with black head, yellow thorax and black abdomen and dark blue translucent wings. An active bee found in secondary forests, savannah and often seen frequenting flowers.

Rainbow Ant
Order Hymenoptera
A strikingly coloured ant characterised with iridescent dark blue head, a magenta and copper gold thorax and aquamarine abdomen. Occurs in primary forest.

Butterfly
Order Lepidoptera
A common primary forest butterfly which is predominantly white with dark brown forewing and hindwing margins. Two large yellow, brown and black coloured 'eyes' apparent on each hindwing as a strategy to deter predators.

Geometrid Moth
Order Lepidoptera
A cryptically coloured pale moth, superbly camouflaged against eucalyptus tree bark in savannah woodland habitats in VNP. Approximately 50 mm wingspan. Attracted to lights.

Blue Tiger Butterfly
Order Lepidoptera, *Tirumala hamata*
A beautifully coloured butterfly with black wings interspersed with striking blue spots. Wingspan of approximately 70 mm. A migrant species and widespread globally. Commonly observed in VNP picnic areas.

New Guinea Birdwing
Order Lepidoptera, *Ornithoptera priamus*
A uncommon large butterfly growing to a wingspan of 125 mm for males, females to 150 mm. The butterfly pictured above is a male. Adults fly with a gliding or sailing flight.

Saturn Moth
Order Lepidoptera, *Syntherata janetta*
A strikingly coloured moth, predominantly yellow with dark rusty brown mottling on forewings and hindwings. 'Eyes' present on the forewings, large antennae and yellow abdomen. Unmistakable and commonly attracted to lights.

Green Mantis
Order Mantodea
A large green mantid with yellow colouration on the abdomen. Cryptic on forest vegetation. Green elytra and translucent wings. A renown predator often attracted to lights where it hunts other insects**.**

Damselfly
Order Odonata, *Idiocnemis* sp.
A small damselfly with striking blue colouration on the thorax and abdomen and dark blue translucent wings and large black eyes. Found adjacent to waterways this insect is active during the day and common within VNP.

Red-legged Dragonfly
Order Odonata, *Argiolestes* sp.
A beautiful dragonfly, with striking orange-red legs, green thorax (dorsally) and large black eyes and clear translucent wings. Commonly found adjacent to watercourses within VNP.

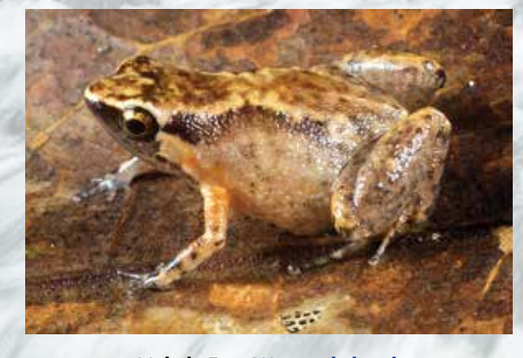
Katydid
Order Orthoptera
A large cryptically coloured katydid, mottled brown body and wings and relatively long antennae. Perfectly camouflaged against leaf litter, this species is commonly found in secondary forests and often found at night while spotlighting.

Katydid
Order Orthoptera
A large eclectically coloured katydid, characterised by forest green body and wings. Yellow blotches on both ventral sides and bright red–pink hind legs. Active at night in primary forest.

Spiny Leaf Insect
Order Phasmatodea, *Extatosoma* sp.
A juvenile phasmid or stick insect, found in secondary forest. Cryptically coloured with mottled browns and irregularly shaped limbs, this animal is difficult to see.

Moroker Rainforest Frog Hidi kaharah
***Cophixalus verrucosus* Microhylid**

Length to 27 mm. Terrestrial and scansorial. Found along creek edges. The call is a wooden rattle of notes in rapid succession. The head is broad with a pointed snout, fingers and toes with large disks. The upper body is mottled brown or green with a 'W' mark. The posterior belly and hind limbs are intense yellow. Endemic. Uncommon



Mehely Frog Watawa kaharah
***Cophixalus ateles* Microhylid**

Length to 15 mm. Terrestrial and scansorial. Found among leaf litter. The call is an irregular slow series of plaintive, high frequency notes. The snout is pointed, fingers and toes with disks. The upper body is reddish brown with irregular raised warts on the back limbs. The iris of the eye is bronze to red-gold. Endemic. Common

Mehely Frog Watawa kaharah
***Copiula oxyrhina* Microhylid**

Length to 33 mm. Terrestrial, found in the forest. The call is a short series of 1 to 4 notes with a 'scratchy' impression. The snout is rounded, the eyes are small. The upper body is smooth, coloured grey/yellow/red-brown, with or without a mid-dorsal stripe. The hidden surfaces of the thighs are bright orange. Endemic. Uncommon

Red Mawatta Frog Watawa kaharah
***Hylophorbus rufescens* Microhylid**

Length to 30 mm. Terrestrial, found in the forest. The males call from concealed places under leaves, the call is a short series of loud rough notes in rapid succession. Large eyes. The upper body is warty, a dark olive-brown or reddish colour. The belly is mottled grey and white and yellow to red towards the posterior. Endemic. Common

Wokan Cannibal Frog Watawa kaharah
***Lechriodus melanopyga* Myobatrachid**

Length to 60 mm. This terrestrial frog is found in the forest, often near streams and ponds. The call is a series of loud snorts. The upper body is smooth with raised longitudinal ridges with black underneath. The head is broad and the eyes are large. The colour is a mottled grey-brown. Endemic. Uncommon

Foothill Reed Frog Mudela kaharah
***Litoria chloristona* Hylid**

Length to 35 mm. Aquatic and scansorial, found along large water bodies. The call is a series of irregular notes, harsh squeaky "chik-chaak". The snout is angular. The upper body is a leaf green mottled with occasional darker yellow spots. The concealed surfaces of the hind limbs are bright orange. The belly and throat are creamy white. Endemic. Common

Fringed Free Frog Hidi kaharah
***Litoria eucnemis* Hylid**

Length to 70 mm. Arboreal, found in forest and near slow running creeks. The call is a quiet series of notes sounding: "waa, waa, waa…". The colouration is highly variable. There are fringes apparent on the edges of front and back legs, the heels are soft and pointy. The iris of the eye is gold with a green upper margin. Uncommon

Southern New Guinea Tree Frog Hidi kaharah
***Litoria impura* Hylid**

Length to 55 mm. Terrestrial and scansorial, found along forest edges and near lakes. The call is a succession of long moaning, rising notes. The upper body is beige to dark brown with or without dark spots. A dark stripe runs from the snout to the ears. The belly is white. The concealed surfaces of the thighs are brown with yellow spots. Endemic. Common

Frogs are found all over Papua New Guinea and most occur nowhere else, these are termed endemic species. There are 6 families of frogs in Papua New Guinea, and 5 of them are found in Varirata National Park. There are 24 species of frogs found in the Park, representing 6% of PNG's total of 371 species.

Hylids are mostly frogs that prefer living in trees (arboreal), and so are commonly called tree frogs. Some of the hylid frogs are ground dwelling (terrestrial) and others are semi-aquatic.

Ranids are terrestrial and aquatic frogs. They are found around water bodies such as ponds, creeks and lakes.

Myobatrachids are terrestrial frogs that are found mainly in the leaf litter on the forest floor.

The ***bufonids*** are toads. There are two toad species in New Guinea, both are introduced and are considered serious invasive pests.

Frogs from these four families lay eggs in water. The eggs hatch into free-living tadpoles that eventually change into juvenile frogs. This process is called indirect development or metamorphosis.

The fifth family, the ***microhylids***, are frogs that have many different characteristics. Some are arboreal, while others are terrestrial or may perch on low vegetation to call (scansorial). The microhylid frogs lay eggs that hatch directly into small frogs. This process is called direct development where there is no metamorphosis.

Water is very important for frogs because they use water for breeding, drinking, and for breathing. Frogs have very thin skin through which they can breathe and drink by absorbing the water and its oxygen around their skin.

All the frogs in the Park are nocturnal, meaning they are mainly active during the night. Sometimes if the weather has been overcast and it has been raining, frogs will start becoming active in late afternoon or at dusk.

Therefore, frogs must always have moist skin and live near water or in wet areas like the rainforest. They can also absorb water from the food they eat. The diet of frogs include a diversity of insects like ants, termites, and beetles.

The frogs can be very colourful and many frogs even have the ability to change their skin colour. The skin colour tends to match the colour of the environment to blend in, like camouflage, so that predators cannot spot the frog so easily. For example, a tree frog will be green to blend with the leaves of trees, whereas a ground frog will be grey-brown coloured to resemble to the ground.

If you cannot spot a frog, you can probably hear them calling. Only male frogs call by using their inflatable vocal sacs below their jaws. Males call to advertise their presence for two reasons: to attract females to reproduce, and to scare off other male competitors. Each frog species has its own specific call, so you can recognize a frog species by its call without seeing it.

Frogs are very important animals as they can indicate how healthy the environment is. If there are many different species of frogs around you, it means the environment is healthy! They also have an important role in the food chain, where they eat many insects and are themselves eaten by many different species of snakes and birds.

Frogs are vulnerable and very sensitive to environmental change. The biggest threats to frogs are habitat degradation and destruction, and diseases. Luckily, Varirata National Park protects many species of animals including frogs from and destruction, and diseases. Luckily, Varirata National Park protects many species of animals including frogs from habitat degradation and destruction. However, diseases can still invade the Park and affect the frogs. There is a deadly fungus affecting frogs from all over the world, called the Chytrid fungus. This disease has not yet been introduced to Papua New Guinea, though it occurs in Australia. To prevent any disease transmission to frogs, we recommend that you do not catch frogs in the Park. If you see a sick frog with its belly up and not moving, please inform the Park authorities.

FROGS

The Park is one of the best places in the country to learn about biodiversity. It is visited by dozens of nature tours each year and attracts researchers from throughout the world. It is also an important training site for students from surrounding universities.

Varirata National Park (VNP) is PNG's first national park, declared on 10th December 1969 and officially opened on 18th October 1973. It is on state land on the Sogeri Plateau at an elevation of 600–900 m and covers an area of 1,063 ha. It is 48 km east of Port Moresby City and accessible by road. The land was locally called *Wodobonomu* and was the traditional hunting ground of the Koiari people, and wherever possible Koiari names are included with the common names for each species depicted in this brochure.

VNP has scenic views and beautiful rainforests, savannah grasslands and secondary regrowth. The average annual rainfall is 1400–2000 mm. The Park is inhabited by some unique plants and animals such as forest wallabies, possums, bandicoots, cassowaries, the raggiana bird of paradise, as well as many extraordinary reptile and frog species, and a rich variety of remarkable insects.

Photography Angus Fraser, Text Nittya Simard, Design Mike McCoy
Publication funded by JICA

Conservation & Environment Protection Authority
Level 5 Dynasty Tower A Savannah Heights Waigani Drive
P.O Box 6601 BOROKO NCD Papua New Guinea
Tel: (+675) 301 4500 email: kkalim@dec.gov.pg

www.jica.go.jp/png/english/activities/activity
www.facebook.com/pngbiodiv/

PAPUA NEW GUINEA
PNG
Conservation and Environment
Protection Authority

VARIRATA NATIONAL PARK
Papua New Guinea

JICA
VARIRATA NATIONAL PARK
Papua New Guinea
Indo-Pacific Conservation Alliance

Striped Rocket Frog Arebada
Litoria nasuta Hylid
Length to 45 mm. Terrestrial, commonly occurs along the margins of lakes. The call is a rapid series of chattering notes. The legs are long and the snout is long and pointed. The upper body with black and light brown longitudinal bands. The chest is white and the belly is yellowish. Common

Efogi Tree Frog Hidi kaharah
Litoria prora Hylid
Length to 42 mm. Arboreal, found in forest about 1-3m above the ground. The call is a short series of 2-7 bleating notes. It has a rostral spike. There are scalloped fringes on the arms and legs. The upper body is warty. The colouration is mottled green/grey, the backs of the thighs are brown/purple with white spots. The belly is white. Endemic. Uncommon

Tree Frog Hidi kaharah
***Litoria* sp.** Hylid
Length to 65 mm. Arboreal, found in forest near lakes. The call is a rattling succession of notes that slow down. The head is broad, the eyes are large, the iris is gold with a diamond shaped pupil. The upper body is brown with green spots or white-cream with brown-green spots. The sides and belly are white. Endemic. Uncommon

Treasury Island Tree Frog Hidi kaharah
Litoria thesaurensis Hylid
Length to 60 mm. Arboreal, found in forest. The call is a series of short buzzing notes. The upper body colour is variable: dark/light brown/pale green with or without white spots. The belly is white. The eyes are edged with green. The bones are green (visible in the underside of the thighs). Uncommon

Brown River Tree Frog Hidi kaharah
Litoria vocivincens Hylid
Length to 27 mm. Arboreal, found in forest, disturbed areas and along water bodies. The call is a continuous succession of buzzes. There are two colour patterns: (1) upper body green with black spots, (2) upper body dull olive with yellow stripes. The eyes are large. Endemic. Common

Victoria Archipelago Frog Watawa kaharah
Mantophryne lateralis Microhylid
Length to 55 mm. Terrestrial, found in forest. The call is a very long succession of notes, sounds like rough barking. The legs are short. The upper body is dark brown to almost black. There are dark bands on the sides of the body with white lower edges. Two warts on the chin. Common

Iowari School Frog Watawa kaharah
Mantophryne menziesi Microhylid
Length to 38 mm. Terrestrial, found in forest, forest edges and disturbed habitats. The call is a short series of rough notes. It is a squat frog with large eyes. The upper body is warty grey-brown. There is a distinct dark spot towards the posterior near the hind legs. Endemic. Common

White-lipped Tree Frog Hidi kaharah
Nyctimystes infrafrenatus Hylid
Length to 130 mm. Arboreal, found perched in trees in forest, plantations, gardens, and near water bodies. The call is a loud barking. The head is broad and long. The legs are long. The upper body is bright plain green. The belly is white. The lower lip is white. The iris of the eye is gold. Common

Kokoda Big-eyed Tree Frog Hidi kaharah
Nyctimystes semipalmatus Hylid
Length to 84 mm. Arboreal, found in forest. The call is similar to the sound of a horse galloping. The nostrils are closely spaced. There are golden veins over the large eyes. The legs are long and there are pointed lappets on the heels. There are large finger and toe discs. The upper body is patchy grey/brown. Endemic. Uncommon

Port Moresby Cross Frog Hidi kaharah
Oreophryne loriae Microhylid
Length to 27 mm. Arboreal, found in forest. The call is a series of long notes that sound harmonic. The upper body is pale brown with darker markings, pale bands on the sides. The belly is yellowish brown, darker on the throat. Endemic. Uncommon

Amau Microfrog Watawa kaharah
Paedophryne amauensis Microhylid
Length to 9 mm, this is the smallest frog in the world. Terrestrial, found in leaf litter on the forest floor. The call is a series of very high-pitched insect-like peeps. The body is brown with darker brown patches. The eyes are reddish. Often overlooked because of its size. Endemic. Common

Arfak Mountains Frog Haiti kaharah
Papurana arfaki Ranid
Length to 160 mm. Terrestrial and aquatic, found along creeks and streams. The call is a squeaky note. The upper body is very warty and rough. The colouration is plain brown with or without irregular white patches. The belly is white. Endemic. Uncommon

Water Frog Haita kaharah
Papurana daemeli Ranid
Length to 80 mm. Terrestrial and aquatic, found along water bodies such as creeks. The call is a short series of 3-4 wavering notes sounds like a duck: “quik quaak quaak”. The snout is projecting and rounded. The sides of the snout are dark like a mask. Common

Eilogo Estate Frog Haita kaharah
Papurana garritor Ranid
Length to 95 mm. Terrestrial and aquatic, found along water bodies such as creeks. The call is a loud chattering series of notes: “crek-crek-crek…”. The snout is projecting and angular. The ear is large and round. Uncommon

Mountain Swamp Frog Haita kaharah
Papurana grisea Ranid
Length to 100 mm. Terrestrial and aquatic, found along water bodies such as creeks and lakes. The call is a short series of squeaky notes. The snout is projecting and rounded. The sides of the snout dark like a mask. Endemic. Common

Cane Toad Mao **INTRODUCED**
Rhinella marina Bufonid
Length to 100mm. Terrestrial, found in forest and disturbed areas. The call is a melodious trill lasting 3 to 4 seconds. There are distinctive poison glands on the back of the head behind the ears. **Introduced to PNG from South America and considered a serious pest.**

A. Fraser

Red-bellied Shortneck Turtle Vero
Emydura subglobosa

Shell length to 26 cm. Aquatic, found in the lakes of the Park. A yellow-cream band runs from the snout to the ear passing over the eyes. The lower jaw with orange-red markings. The carapace (upper shell) is dark brown with orange-red edges, the plaston (lower shell) is bright orange, yellow or pinkish. The body is dark grey. Common

M. McCoy

Common House Gecko Kae
Hemidactylus frenatus

Total length to 120 mm, the tail about 60 mm. This gecko is almost exclusively an inhabitant of houses, feeding at night on insects attracted to the house lights. It has a distinctive chirping call. At night, when it is active, this lizard is a uniform light pinkish-tan, during the day its colouration is grey-brown with darker markings. SE Asia-Pacific. Common

A. Fraser

Common Dwarf Gecko Boromai-kae
Hemiphyllodactylus typus

Total length to 95 mm of which the tail is 50 mm. An arboreal gecko found in houses and also in the forest. The body colour is brown to pale tan to cream with irregular light and darker markings. There are expanded pads on the fingers and toes. The eyes are large with vertical pupils and a gold iris. The skin is smooth. SE Asia to Oceania. Common

A. Fraser

Ground Gecko Boromai-dubu
***Nactus* sp.**

Total length to 180 mm, the tail length to 100 mm. A terrestrial gecko found in leaf litter, under rocks or logs in savannah and forest. Dark brown base colour with or without striped pattern on upper body and tail. Long, thin bent fingers and toes which are strongly clawed. Pointed snout, large eyes. The skin is rough and pimply. Endemic. Common

A. Allison

Burton's Snake-lizard
Lialis burtonis

Total length to 500 mm. A terrestrial lizard found in forests and savannahs. The colour is highly variable, usually a shade of grey or brown with darker markings. Limbs are absent. Feeds mostly on smaller lizards and also insects. Occurs in Australia and Papua New Guinea. Uncommon

A. Fraser

Bicarinate Rainbow Skink Boromai
Carlia bicarinata

Total length to 130 mm, tail length to 85 mm. A terrestrial lizard found in the open vegetation of savannahs. The upper body is brown with lighter longitudinal stripes along the sides. The throat is whitish. It has four fingers and five toes. Endemic. Common

A. Fraser

Yule Island Snake-eyed Skink Boromai
Cryptoblepharus yulensis

Total length to 100 mm, the tail length to 60 mm. A small terrestrial skink found around rocks in savannah. There are two distinct creamy bands along the brown body. The snout is pointed. The eye is large and covered with a transparent scale. Endemic. Common

A. Fraser

Slender Emo Skink Boromai
Emoia physicae

Total length to 175 mm, tail length to 110 mm. A terrestrial lizard found in the forest among the leaf litter. The head is gold-brown. The upper body is olive-brown with darker markings. The sides are dark brown with lighter spots. Endemic. Common

Papua New Guinea has a rich diversity of reptiles in eleven major groups that includes snakes, lizards, crocodiles, and turtles. With the exception of the crocodiles, each group is represented in Varirata, and of the 346 species of reptiles known from PNG, 61 of these occur in the Park.

Turtles belong to the **Cheliid** family and there is one species of freshwater turtle found in the lakes and streams of the Park. It can occasionally be seen basking in the sun on a log or rock beside the water.

Five groups of lizards may be found in VNP. Geckos or **Gekkonids** occur worldwide. There are two types of geckos in the Park. The arboreal geckos that live in trees and the terrestrial geckos that live under rocks and rotten logs. One species, the common house gecko, lives only in houses. Geckos are nocturnal animals, they feed largely on insects and spiders.

Snake-lizards are **Pygopodids**. They are closely related to the geckos. Two species occur in PNG. They are terrestrial, limbless and snake-like in appearance. Like the geckos and skinks, they can drop their tail as a predator defence.

Skinks or **Scincids** belong to the largest and one of the most diverse families of lizards in the world. Most skinks are active during the day. Depending on the species they can be found under logs, actively foraging in the leaf litter or in trees. Most are largely insectivores, though the Bluetongues will also eat fallen fruit. Some skinks, like the Emo Skinks (*Emoia*) are egg-layers, other species such as the Bluetongue have live young.

Dragon lizards are **Agamids**. There are two species in VNP and both are arboreal. They have long legs with strongly clawed hands and feet, and very long tails. They have a distinctive crest of spine-like scales at the back of their heads. They are agile lizards and active during the day.

The largest lizards in the world belong to the **Varanid** family. They are commonly called goannas or monitors. At least one species of this family is present in the Park. It is a very shy animal that will flee from humans if disturbed. Its diet comprises arthropods, birds, lizards and occasionally small mammals. Varanids typically have long tails, pointed snouts and a forked tongue like a snake which they flick in and out, "tasting" their surroundings.

There are four groups of snakes occurring in the Park. The smallest are the Blindsnakes or **Typhlopids**. These are worm-like snakes that are burrowers and feed mostly on the larvae and eggs of ants and termites. They are harmless, though they can emit a foul odour if disturbed.

Pythons and Boas belong to the **Boid** family. Both occur in PNG, though only pythons are found in the Park. They are non-venomous and kill their prey by constriction, causing suffocation. Pythons can be very large snakes but they will not attack humans unless provoked. They prey upon birds and mammals, and occasionally other reptiles.

Colubrid snakes belong to the largest and most diverse family of snakes in the world. The snakes in this family are mostly solid-toothed and non-venomous, though some in New Guinea are mildly, but not dangerously, venomous.

The snakes of the **Elapid** family are all venomous, though not all are dangerous. However the group does include the most highly venomous and dangerous snakes of New Guinea of which several are found in the Park. These are the Papuan Taipan, the Papuan Black Snake, the Death Adder, and the Small-eyed Snake. If any of these snakes are encountered, move away from them slowly and quietly. Avoid disturbing them in any way.

Reptiles tend to be secretive animals, very wary of human approach. Although there are many species in the Park, with the exception of the small, active Emo and Rainbow Skinks, most reptiles are not often seen by the casual visitor. Additionally, a number of reptiles, such as the geckos and some of the snakes, are nocturnal. Although many people have a fear of reptiles, particularly snakes, reptiles are nonetheless fascinating animals and are a vital and integral component of the Park's broader environment.

Photography Angus Fraser, Allen Allison, Scott Eipper, Mike McCoy
Text Nitya Smard Design Mike McCoy
Publication funded by JICA

Conservation & Environment Protection Authority
Level 5 Dynasty Tower A Savannah Heights Waigani Drive
P.O Box 6601 BOROKO NCD Papua New Guinea
Tel: (+675) 301 4500 email: kkalim@dec.gov.pg
www.jica.go.jp/png/english/activities/activity18.html
www.facebook.com/pngbiodiv/

Varirata National Park (VNP) is PNG's first national park, declared on 10th December 1969 and officially opened on 18th October 1973. It is on state land on the Sogeri Plateau at an elevation of 600–900 m and covers an area of 1,063 ha. It is 48 km east of Port Moresby City and accessible by road. The land was locally called *Wodobonomu* and was the traditional hunting ground of the Koiari people, and wherever possible Koiari names are included with the common names for each species depicted in this brochure.

VNP has scenic views and beautiful rainforests, savannah grasslands and secondary regrowth. The average annual rainfall is 1400–2000 mm. The Park is inhabited by some unique plants and animals such as forest wallabies, possums, bandicoots, cassowaries, the raggiana bird of paradise, as well as many extraordinary reptile and frog species, and a rich variety of remarkable insects.

The Park is one of the best places in the country to learn about biodiversity. It is visited by dozens of nature tours each year and attracts researchers from throughout the world. It is also an important training site for students from surrounding universities.

REPTILES

PAPUA NEW GUINEA
PNG
Conservation and Environment Protection Authority

VARIRATA NATIONAL PARK
Papua New Guinea

JICA
VARIRATA NATIONAL PARK
Papua New Guinea
Indo-Pacific Conservation Alliance

A. Fraser

Jobi Skink Eveboro
Spenomorphus jobiensis

Total length to 230 mm, tail length to 150 mm. Terrestrial, found in the forest among leaf litter and under rotten logs. Stout brown body, large eyes with white eyelids. A distinctive dark round spot near the ear. Lighter vertical barring on the body and tail. Endemic to the New Guinea region. Uncommon

M. McCoy

New Guinea Bluetongue Hodo Kae
Tiliqua gigas

This is the largest of the New Guinea skinks, growing to a total length of around 60 cms. It is a terrestrial lizard, found in forest and savannah. It is an omnivore; eating both plant and animal material. Its colouration is a shade of light brown patterned with darker cross bands. It occurs from Indonesia to New Guinea. Uncommon

A. Fraser

Forest Dragon Kesoua
Hypsilurus modestus

Total length to 320 mm, tail length to 230 mm. Arboreal, perching and foraging on branches and vines in the forest. Bright green colouration, brownish posteriorly. The legs and tail with darker bands. A serrated crest is present on the neck. It feeds on insects and spiders, and some plant material. Endemic. Uncommon

A. Allison

Papuan Tree Dragon
Hypsilurus papuensis

Total length to 600 mm, tail length around 350 mm. This is a large, long-tailed lizard with a spectacular crest on its neck. The colour is a variable shade of yellowish-brown. It is found in forest and forest edges and is almost totally arboreal. It feeds on arthropods and some plant material such as flowers and fruits. Endemic. Uncommon

S. Eipper

Peach-throated Monitor Efoka
Varanus jobiensis

This monitor grows to a total length of around 1.2 m with a tail length of 500 mm. It is partly terrestrial, foraging on the ground in forests, though it also readily climbs trees, to search for food or if disturbed on the ground. It feeds on small mammals, birds - particularly nestlings, and reptiles including snakes. It occurs from Indonesia to New Guinea. Uncommon

A. Fraser

Montane Blindsnake
Gerrhopilus inornatus

Length to 230 mm. A burrowing worm-like snake found in forest areas, usually in the loose soil under rotting logs. The whole body is smooth and glossy. The head with minute eyes which appear as dark spots. The tail is rounded and blunt. It feeds largely on the larvae of ants and termites. It is a harmless snake. Endemic. Uncommon

M. McCoy

Brown Tree Snake Nanahuma
Boiga irregularis

Body length to 2.3 m. Largely arboreal, found in forests, and sometimes also in houses. Very slender with a broad head. Light brown to red-brown body, light yellowish belly. The eyes are large with vertical pupils. Nocturnal (active at night). Feeds on geckos, birds and small mammals. Found in the Australia-Pacific region. Mildly venomous. Common

A. Fraser

Slatey-grey Snake Varaka-kae
Stegonotus cucullatus

Body length to 1 m. Terrestrial, found in forest among leaves and under rocks and fallen timber. It is active at night (nocturnal). The body is light to dark grey-brown, the scales are black-edged. The eyes are large with round pupils. This snake can be aggressive and bites readily if disturbed. Found in the Indo-Australian Region. Non-venomous. Uncommon

A. Fraser

Common Keelback Nanahuma
Tropidonophis mairii

Body length to 900 mm. Semi-aquatic and terrestrial, found in the forest near water bodies. The body is slender and the head is distinct from the neck. Colouration is a shade of brown to greenish-brown with dark brown spots. It feeds mainly on frogs. Found in the Indo-Australian Region. Non-venomous. Common

A. Fraser

Southern White-lipped Python Moe
Bothrochilus meridionalis

Length to 2.5 m. Terrestrial; found in forest near water bodies. A heavily built python, the head is long and distinct from neck. The body is uniformly dark brown with a strong iridescent sheen. The lips are white. It feeds on mammals such as bandicoots. Southern NG and islands of Torres Strait. Non-venomous. Uncommon

A. Fraser

Amethistine Python Hiniku
Morelia amethistinus

Body length to 5 m. PNG's longest snake. Terrestrial and arboreal. Found in savannah, forest and along river banks. The body is slender, the head is large and elongate. The colouration is highly variable from dark grey-brown to sandy brown with darker markings. The body has an iridescent sheen. Indo-Australian region. Non-venomous. Uncommon

M. McCoy

Green Python Boreka
Morelia viridis

Body length to 1.5 mm; Mainly arboreal, found in forest, savannah and disturbed areas. The body is long and laterally compressed. Adult snakes are bright green with or without white spots, juveniles are bright yellow with scattered brown markings. Feeds on small mammals and occasionally birds. Indo-Australian Region. Non-venomous. Uncommon

A. Fraser

New Guinea Death Adder Tahadu DANGEROUS
Acanthopis laevis

Body length to 500 mm. Terrestrial, occurs in rainforest, savannah and plantations. The body is quite stout, the head is large and broad and distinct from the neck. The eyes are large with vertical pupils. The colour is variable, basically brown with darker markings. It feeds mainly on small mammals. Found in the Indo-Australian region. Common

HIGHLY VENOMOUS

A. Fraser

Small-eyed Snake Matabea DANGEROUS
Micropechis ikaheka

Body length to 2 m. Terrestrial, found in forest. Stocky body with narrow head barely distinct from the neck. The eyes are very small. The head is dark grey, the body is yellow-cream, darker posteriorly. Darker banding may be distinct or indistinct. Feeds on small mammals and reptiles including other snakes. Potentially aggressive. Uncommon

HIGHLY VENOMOUS

A. Allison

Papuan Taipan Yarama DANGEROUS
Oxyuranus scutellatus canni

Body length to 3 m. Terrestrial, found in savannah and in the vicinity of human habitations. This snake is very swift moving and potentially aggressive. It is large and slender snake with an elongate head and large eyes. The body is grey-brown, distinctly reddish posteriorly. This is an endemic subspecies of the Australian taipans. Uncommon

HIGHLY VENOMOUS

A. Allison

Papuan Black Snake Yarama DANGEROUS
Pseudechis papuanus

Length to 2 m. Terrestrial, found in savannah and forest edges. The body is stout, the head broad with a rounded snout, and not distinct from the neck. The colour is uniformly black above and below, the lips and chin are whitish. Occurs in NG and several islands in Torres Strait. Uncommon

HIGHLY VENOMOUS

Fawn Breasted Bowerbird Vosereka
Chlamydera cerviniventris

A medium sized (28-30 cm) bowerbird, grey-tan back and wings, orange buff underbelly with pale scalloping on chest. Occurs in secondary forest and eucalyptus woodland within VNP. Male builds a two walled avenue bower typically decorated with green fruit and berries. Shy and wary. Calls are highly variable and a combination of rasping, chirring and harsh notes. Common

Hooded Butcherbird Wahuroka
Cracticus cassicus

Medium sized bird (32-35 cm) with distinctive plumage. Black head, throat and upper breast and white underparts. Large prominent pale blue hooked bill. Common woodland species often observed in the early morning. Wonderful songster with a range of calls combining bell-like notes and liquid rollicking phrases, hoarse notes, and croaks. Endemic. Common

Brown Cuckoo Dove Kuooh
Macropygia amboinensis

Medium sized pigeon (34-37 cm) with distinctive long tail feathers. Occurs in secondary forest, woodland and disturbed habitats. Male, grey-brown, tail is long and unbarred, with a rosy grey head and faint green iridescence behind the neck. Female is barred on head and breast. Common

Blythe's Hornbill Hure
Rhyticeros plicatus

PNG's only hornbill, this large (76-91 cm) hornbill is widespread in lowland hill forest and common where not hunted. Often heard in flight with its distinctive loud 'whoosh, whoosh' of its wing beats. Male has orange head and white bill, female has a black head. Call a deep resonate honks and grunts. Wary and difficult to observe but often seen along the Scarp Track within VNP. Common

Varirata National Park has long been recognised as an important bird watching destination both locally and internationally among amateur, enthusiastic and obsessive twitchers alike. Many bird watching tours commence their itinerary in VNP and for good reason. There are 99 families, 335 genera and 813 species of birds known from Papua New Guinea and VNP includes a rich proportion of these, with 58 families, 150 genera and 231 species. These species can be observed in a variety of distinctively different habitats including: savannah and eucalyptus woodland, secondary forest, primary forest, aquatic (waterways and lakes) and the zones where habitats converge (edge zones).

Iconic Species

Many of PNG's iconic species occur within VNP and are well worth searching for. Five species of birds of paradise (Raggiana Birds of Paradise; Magnificent Birds of Paradise; Crowling Riflebird; Crinkle Collared Manucode; Glossy Manucode) the New Guinea Harpy Eagle, two species of Paradise Kingfishers, the rare Forest Bittern, Gurney's Eagle and the very shy and secretive Southern Cassowary all occur in different habitats within VNP. The cacophony of Sulphur Crested Cockatoos and Eclectus Parrots combined with the loud and distinctive 'whoosh, whoosh, whoosh' of a flock of Blythe's Hornbills can often be heard along the escarpment trails. With patience, luck and a good guide you have an excellent chance of seeing some of these species. At least seven species are seasonal migrants coming north from Australia during the austral winter (May to September). These species include the Rainbow Bee-eater, Sacred Kingfisher and the Dollar Bird often seen in secondary forest or open woodland. Other migratory species inhabit VNP's forests including the Buff-breasted Paradise Kingfisher, Red-bellied Pitta, Black-Faced Monarch, and Rufous Fantail.

Bird Watching in VNP

VNP's network of forest trails make excellent bird watching circuits and also provide opportunities to observe other wildlife. An early start, a local guide or the services of a local and reputable specialist tour operator will enhance your chances of seeing the more secretive species within VNP. The photographs presented in this brochure were taken of birds within VNP and many were photographed at fruiting fig trees within the Main Picnic Area and surrounds.

Bird Watching in VNP

VNP's network of forest trails make excellent bird watching circuits and also provide opportunities to observe other wildlife. An early start, a local guide or the services of a local and reputable specialist tour operator will enhance your chances of seeing the more secretive species within VNP. The photographs presented in this brochure were taken of birds within VNP and many were photographed at fruiting fig trees within the Main Picnic Area and surrounds.

The Park is one of the best places in the country to learn about biodiversity. It is visited by dozens of nature tours each year and attracts researchers from throughout the world. It is also an important training site for students from surrounding universities.

Varirata National Park (VNP) is PNG's first national park, declared on 10th December 1969 and officially opened on 18th October 1973. It is on state land on the Sogeri Plateau at an elevation of 600–900 m and covers an area of 1,063 ha. It is 48 km east of Port Moresby City and accessible by road. The land was locally called *Wodobonomu* and was the traditional hunting ground of the Koiari people, and wherever possible Koiari names are included with the common names for each species depicted in this brochure.

VNP has scenic views and beautiful rainforests, savannah grasslands and secondary regrowth. The average annual rainfall is 1400–2000 mm. The Park is inhabited by some unique plants and animals such as forest wallabies, possums, bandicoots, cassowaries, the raggiana bird of paradise, as well as many extraordinary reptile and frog species, and a rich variety of remarkable insects.

Conservation & Environment Protection Authority
Level 5 Dynasty Tower A Savannah Heights Waigani Drive
P.O Box 6601 BOROKO NCD Papua New Guinea
Tel: (+675) 301 4500 email: kkalim@dec.gov.pg
www.jica.go.jp/png/english/activities/activity18.html
www.facebook.com/pngbiodiv/

Photography and text Angus Fraser. Design Mike McCoy
Publication funded by JICA

PAPUA NEW GUINEA
PNG
Conservation and Environment Protection Authority

BIRDS

VARIRATA NATIONAL PARK
Papua New Guinea

jica

Indo-Pacific Conservation Alliance

Grey Crow Gayabora
Corvus tristis

A 51-56 cm crow-like bird with large beak, bare pale face and blue iris and relatively long tail. Adult plumage sooty brown. Call a short pitched nasal *creuw*, often repeated. A social bird, occurs in small flocks often observed along the park's escarpment. Endemic. Common

Crinkle Collared Manucode Ko'akobodu
Manucodia chalybatus

A medium sized (33-37 cm) bird with a red iris and blue–black plumage. Secretive and difficult to observe. Iridescent breast and neck feathers (yellowish green and purple) are apparent in direct light. Occurs in primary and secondary forests in the mid to upper canopy. Favours fig trees. Call is a repeated 'hoo'. Endemic. Common

Pink Spotted Fruit Dove Mabu kamuni
Ptilinopus perlatus

Large fruit dove (25-27 cm) commonly observed in lowland hill forests. Diagnostic pink spots on the shoulder, mustard coloured neck band, white chin. Dark green wings and pale green belly. Frequently observed in the main picnic area visiting fruiting fig trees. NG endemic. Common

Coroneted Fruit Dove Mabu togoro
Ptilinopus coronulatus

Stocky fruit dove (18-19 cm), predominantly dark green with lilac crown edged with a gold band. Yellow under the tail. It occurs in secondary forests and often seen in the main picnic area visiting fruiting fig trees. Solitary and in small flocks. Nests in the understory between 1-5 m above ground. Endemic to NG, Common

Raggiana Bird of Paradise Fanaha
Paradisaea raggiana

A medium sized bird (35 cm) occurring in secondary forest, forest edge, and picnic areas where it often feeds on figs, pandanus and other fruiting trees. Male with orange to deep red flank plumes, yellow head and iridescent dark green chin. Call distinctive 'Wau, wau, wau, wau, wau, wau'. PNG Endemic, PNG's national emblem. Common

Brown Oriole Seo
Oriolus szalayi

Medium sized bird (25-28 cm) predominantly grey brown, with blackish face patch and dark red iris. Head and neck thickly streaked, as is the pale underbelly. Calls are loud and musical. Feeds on insects and fruit. Shy and wary, it is difficult to observe. Endemic to NG and islands. Common

Hooded Pitohui Soroko
Pitohui dichrous

Medium sized bird (22-23 cm) with bold plumage. Head, upperparts and tail are black with chestnut breast and belly. Common in secondary forest and in the vicinity of the Main Picnic Area in VNP. Very unusual species as it is poisonous. Observed in pairs or small groups. A range of calls, the most common is 'pi-to-hui'. NG endemic. Common

Puff-backed Meliphaga Hugu misimisi
Meliphaga aruensis

Medium sized honeyeater (16-18 cm), olive rump tuft has diagnostic white fringe. Pale yellow ear spot and dark brown iris, stout bill. Difficult to differentiate between other meliphaga species. Commonly observed in VNP in secondary forests and lake side. Endemic to NG and Islands. Common

Papuan Frogmouth Humuto
Podargus papuensis

A large bird (46-53 cm) with wide flattened beak and red iris. Plumage is a variable grey–brown, the male with underparts marbled with white blotches and black margins. Female typically lacks marbling. Occurs in secondary forests and often observed in the main picnic area at night. Widespread throughout NG and Australia. Common

Large-tailed Nightjar Tarobuka
Caprimulgus macrurus

Colouration quite variable. Adults characteristically have white patches on primary wing feathers and tail. Shoulders lined with two rows of lighter coloured spots. White based rictal (whiskers) and white chin gape. Size 25-28 cm. Nests on the ground and is expertly camouflaged. Widespread from SEA throughout NG. Common

Azure Kingfisher Heita gigiri
Ceyx azureus

A small kingfisher (16 cm) preferring aquatic habitats feeding on aquatic insects, frogs and fish. Dark blue back, wings and crown with light brown tawny to pale chest. Commonly observed along Narirogo Creek on the Self Guide Track and lakeside. Widespread in NG and Common

Brahminy Kite Duna koruta
Haliastur indus

A medium sized raptor (41-43 cm, wingspan 110-125 cm) which frequents savannah, secondary forest and settlements. Distinctive colouration - white chest and head with chestnut wings and belly. Hunts small prey and also scavenges. Call is a meek 'peeyah' similar to a whistling kite. Widespread, India to NG, and Australia. Common

Yellow-faced Myna Gorane hisidakoro
Mino dumontii

A medium sized bird (25-26 cm) with bright yellow–orange facial skin, yellow belly and black upperparts, and white patches on rump and wings. Gregarious, frequently observed in eucalyptus woodland, secondary forests and adjacent to human habitation. Call is loud guttural twangs. Often in pairs or small flocks. NG Endemic and Islands. Common

Helmeted Friar Bird Kohako
Philemon buceroides

Medium sized bird (33-35 cm) with long slender neck. Face is bare black skin and bill often has a large knob at the base, red iris. Typically vocal and commonly seen in secondary forests, woodland and settlements. Diet consists of insects, and fruit. Widespread throughout NG and islands, also in Australia. Common

Rainbow Lorikeet Kihiri kuruku
Trichoglossus haematodus

A medium sized (25-30 cm) noisy parrot, vibrant red–orange breast, dark blue head, red beak with green back and tail. Often seen in pairs or small groups, occasionally large flocks. Occurs in secondary forests and eucalyptus woodland within the park. Nests in tree hollows. Widespread west of NG, Australia and east to Melanesia. Common

Southern Cassowary Evadubu
Casuarius casuarius

A very large, unmistakeable flightless bird, 1.5m in height. The head has a large bony casque, the face is bare blue, there are double red wattles. The plumage is shiny black, coarse and shaggy. The legs are large and very strongly clawed. Solitary, found in forests, feeds on fallen fruits. Southern NG and northern Australia. **Rarely seen in VNP**.

Mammals are warm-blooded animals that possess hair or fur and nourish their young from special milk producing glands. This group includes humans as well as a very diverse array of other animals such as cats and dogs. There are approximately 5,330 species of land mammals in the world. A total of 293 mammal species (5.4% of the world total) occur in Papua New Guinea and 44 of these (a sixth of the country total) occur in Varirata National Park. There are four general mammal groups represented in Papua New Guinea.

Monotremes. These are egg-laying mammals that are found only in Australia and New Guinea. Two species occur in PNG. One of these, the Short-beaked Echidna *Tachyglossus aculeatus*, has been reported from Varirata National Park but there have not been any recent sightings.

Marsupials. This is actually a diverse group with three main evolutionary branches: (a) carnivorous (meat eating) species such as quolls, (b) the bandicoots and (c) a broad group that includes possums, kangaroos and their relatives. Marsupials differ from other mammals by giving birth to very small, incompletely developed young that are carried in pouches where they suckle and complete development.

Rodents. This group accounts for a third of all the mammals found in PNG and includes such familiar animals as rats and mice. Most species live on the ground but a few are arboreal, meaning that they live in trees. Most rats are vegetarian, eating seeds and fruit. They are generally small but some New Guinea species can reach a weight of at least 1 kg.

Bats. These are the only mammals that are truly adapted for sustained flight. This group includes the large fruit bats or flying foxes familiar to the residents of Port Moresby, as well as the small insect-eating (insectivorous) species that are often seen at dawn and dusk. All of these small insect-eating species use high-frequency sound to locate prey. These bats call as they fly and listen to the reflected echoes to map their surroundings. This system, which is similar to sonar, is called echolocation. Their calls are beyond the range of human hearing but can be detected with special equipment. Each species gives a distinctive call. Interestingly, some species of moths can detect bat calls and take evasive action to avoid being eaten by the bats.

The fruit bats range in size from small flower-feeding species such as the Common Blossom Bat *Sychonycteris australis*, which weighs about 15 g, to large, fruit-eating species such as the Spectacled Fruit Bat *Pteropus conspicillatus* which can weigh up to 1.4 kg. Fruit bats generally lack the capacity for ecolocation, although some species use the sound of their wings to help navigate through forests.

In addition to the native mammals, there are six species of non-native or introduced mammals found in Papua New Guinea. These include the house mouse, two species of rats, wild pigs and Rusa Deer. All but the house mouse and one species of rat are found in Varirata National Park.

Although rats are common in the Park, most species are shy and nocturnal (active only at night), and can be difficult to observe. Rats have a good sense of smell and quickly hide when they sense danger. The insectivorous bats can commonly be seen at dawn and dusk in open areas in the Park but they fly so quickly that it is nearly impossible to identify them to species. The fruit bats often congregate around flowering and fruiting trees and can be seen at night when they are feeding.

With patience, and using a torch to spotlight, marsupials can often be seen by slowly walking along the tracks at night, when most species are active. The wallabies and bandicoots can sometimes be seen along the road verges when they come out to feed at dusk or in the early morning. The Agile Wallaby *Macropus agilis* is active during the day and with luck can be seen in the eucalypt savannah areas.

MAMMALS

Varirata National Park (VNP) is PNG's first national park, declared on 10th December 1969 and officially opened on 18th October 1973. It is on state land on the Sogeri Plateau at an elevation of 600–900 m and covers an area of 1,063 ha. It is 48 km east of Port Moresby City and accessible by road. The land was locally called *Wodobonomu* and was the traditional hunting ground of the Koiari people, and wherever possible Koiari names are included with the common names for each species depicted in this brochure.

VNP has scenic views and beautiful rainforests, savannah grasslands and secondary regrowth. The average annual rainfall is 1400–2000 mm. The Park is inhabited by some unique plants and animals such as forest wallabies, possums, bandicoots, cassowaries, the raggiana bird of paradise, as well as many extraordinary reptile and frog species, and a rich variety of remarkable insects.

The Park is one of the best places in the country to learn about biodiversity. It is visited by dozens of nature tours each year and attracts researchers from throughout the world. It is also an important training site for students from surrounding universities.

Conservation & Environment Protection Authority
Level 5 Dynasty Tower A Savannah Heights Waigani Drive
P.O Box 6601 BOROKO NCD Papua New Guinea
Tel: (+675) 301 4500 email: kkalim@dec.gov.pg

www.jica.go.jp/png/english/activities/activity
www.facebook.com/pngbiodiv/

Photography Angus Fraser, Pavel German, Roy & Margaret Mackay, Mike McCoy Allen Allison, Harold Cogger. Text Allen Allison, Design Mike McCoy
Publication funded by JICA

PNG
Conservation and Environment Protection Authority

P. German

Common Tube-nosed Bat
Nyctimene albiventer

Small fruit bat, up to 32 g. The fur of back and flanks whitish at the base, brown at the tips. The undersides are whitish to golden. The wings are dark brown with yellowish spots. The nose is tubular and the eyes are amber. Widespread in New Guinea up to 1700 m elevation. It primarily forages in the understory of primary forest feeding on nectar and fruit.

A. Fraser

Common Blossom Bat
Syconycteris australis

Small bat, up to 21 g. The fur is dark brown, somewhat paler on the undersides. The tail is absent It is widespread in New Guinea and Australia, up to 3000 m elevation. In VNP it is present in eucalypt savannah and primary and secondary forest. It feeds on nectar, pollen, fruits and probably also insects. It is extremely abundant.

P. German

Eastern Bent-winged Bat
Miniopterus oceanensis

Medium-sized insectivorous bat, up to 18 g. The fur is grey-brown at the base, darker brown to reddish-brown at the tips. The underside similar, often a bit darker. Widespread in New Guinea and Australia. It occurs in New Guinea from sea level to more than 2000 m and is found in both primary and secondary forest. It is a fast flyer as it captures its insect prey. .

P. German

Eastern Horseshoe Bat
Rhinolophus megaphyllus

Relatively small insectivorous bat, up to 11 g. The upper fur is grey-brown, the underside mottled grey and brown. It is widespread in New Guinea and Australia. In New Guinea it occurs up to 1600 m. Its flight is relatively slow and it can hover as it picks its insect prey from vegetation. It is found in both primary and secondary forest.

M. McCoy

Short-beaked Echidna
Tachyglossus aculeatus

Distinctive monotreme mammal up to 1.7 kg. It is easily distinguished from other New Guinea mammals by a dense covering of spines (modified hair) over the upper body and its long, thin, straight snout. It is widespread in New Guinea and Australia. In New Guinea it occurs from lowlands to 1700 m. It feeds on termites, ants and soil invertebrates.

M. McCoy

Agile Wallaby
Macropus agilis

Small kangaroo, up to 20 kg. The fur is coarse, tan on the back and sides, whitish below. There is a distinctive white hip stripe. It is widely distributed in southern and eastern New Guinea and coastal Australia up to around 700 m elevation. It grazes primarily on grass but also eats fruit and foliage. It is generally restricted to open areas such as eucalypt savannah.

A. Allison

Common Bush Wallaby
Thylogale brunii

Moderate-sized wallaby, males to 18 kg, females to around 9 kg. The upper parts are dark brown, The undersides are whitish. The tail is relatively thick and short, carried on the ground. It is widespread in New Guinea, ranging from sea level to the foothills. It is often seen grazing on grass on verges along roads and tracks.

P. German

Long-nosed Echymipera
Echymipera rufescens

Moderate-sized bandicoot, females to 1 kg, males to 2 kg. The fur is coarse, spiny. The colour is generally dark brown with a rust-coloured tinge. It is widely distributed in northern Australia and New Guinea up to 2000 m. It feeds mostly on fruit and fungi, also insects and other invertebrates. It is found throughout VNP, particularly in grasslands and forest edges.

R. Mackay

Giant Bandicoot
Peroryctes broadbenti

Large bandicoot, males up to 5 kg. The fur is coarse and dark brown with reddish flanks. The tail is short, black, often with a white tip. It is endemic to PNG, occurring from lowlands to 1000 m on the SE peninsula of PNG. Its habits are poorly known, thought to feed on fruit, fungi and insects. It is found mainly in primary forest, occasionally in secondary forest.

A. Fraser

Short-snouted Bandicoot
Isoodon macrourus

Moderate-sized bandicoot, females to 1 kg, males to 2 kg. The fur is coarse, brown, fading to white on the lower flanks. The undersides are whitish, as are the feet. It is widely distributed in PNG and northern Australia, up to 1200 m. It feeds mainly on fruit and insects. In VNP it is found mainly in eucalypt savannah and secondary forest.

M. Mackay

New Guinea Quoll
Dasyurus albopunctatus

Moderate-sized marsupial, up to 1 kg. It is the largest carnivorous marsupial occurring in PNG. It is widely distributed in New Guinea, up to 2000 m elevation. The fur is dark brown suffused with black, with distinctive white spots. It is nocturnal and partly arboreal, preying on small reptiles, birds and mammals. It is mainly found in primary forest.

M. McCoy

Short-furred Dasyure
Murexia longicaudata

Small rat-like marsupial, males to 440 g; females to 90 g. The fur is light grey-brown, the undersides light grey. It is endemic to New Guinea where it is widespread to elevations up to 2000 m. Occurs only in primary forest. Carnivorous, feeding mainly on insects, but like other dasyurid mammals it likely also preys on small vertebrates such as lizards.

A. Fraser

Southern Common Cuscus
Phalanger intercastellanus

Moderate-sized cuscus, up to 2.2 kg. The fur is short, greyish white in males, females with a reddish tinge. A dark vertebral stripe from the snout and along the back. The undersides are whitish. Widely distributed in New Guinea up to 1200 m. There is a disjunct population on Cape York in Australia. It is arboreal and nocturnal, feeding mainly on fruits and seeds.

P. German

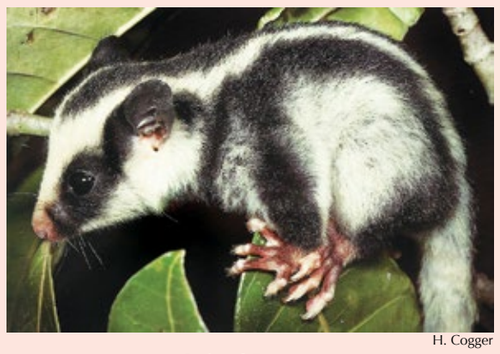
Common Spotted Cuscus
Spilocuscus maculatus

Large cuscus, up to 6 kg. The fur is short and variable in colour. The form in VNP is generally a mottled brown with light brown undersides. The ears are noticeably short. Occurs from eastern Indonesian islands to New Guinea and Cape York Peninsula in Australia, up to 1200 m elevation. It is highly arboreal, feeding on a wide variety of fruit and foliage.

P. German

Sugar Glider
Petaurus breviceps

Small glider up to 165 g. The colour is generally grey or brown above with whitish to yellowish undersides. A black vertebral stripe runs from the snout to the tail. The tail is long, and bushy. It has a furred membrane between legs, extended for gliding. It is widely distributed in Australia and New Guinea. It is highly arboreal, feeding on nectar and insects..



H. Cogger

Striped Possum
Dactylopsila trivigata

Small possum, up to 500 g The colouration is boldly striped black and white. The tail is long, mainly black, with a white tip. The fourth finger is noticeably long. It is distributed across New Guinea up to 2300 m but most common in hill forest. It also occurs on Cape York Peninsula in Australia. It is highly arboreal, feeding primarily on insects and other invertebrates.

A. Allison

Mottled-tailed Giant Rat
Uromys caudimaculata

Large rat up to 700 g. Sandy to grey-brown, underparts whitish. The tail is mottled with brown and whitish patches with a white tip. It is widely distributed in New Guinea and northern Australia from lowlands to nearly 2000 m. It is terrestrial in primary and secondary forest, feeding on fruit, seeds, insects and small vertebrates.

A. Fraser

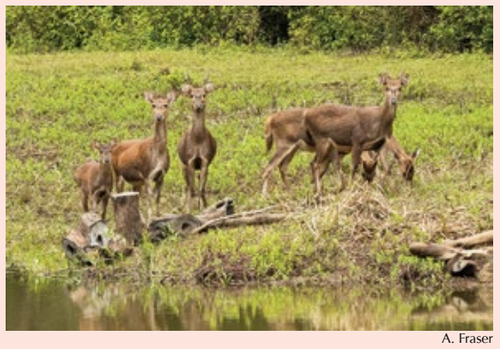
Chestnut Tree Mouse
Pogonomys macrourus

Small rat up to 45 g. The fur is soft, generally light brown to grey-brown, often with a reddish tinge. The undersides are white and the tail is dark brown to black. It is endemic to New Guinea where it occurs from sea level to 1300 m, but mainly is a hill forest species. It is highly arboreal, mainly in low vegetation and likely feeds on seeds and insects.

M. McCoy

Grasslands Melomys
Melomys lutillus

Small rat up to 35 g. The upper parts are light grey-brown, whitish or buff below The tail is nearly naked with non-overlapping scales. It is widely distributed in New Guinea and possibly belongs to the same species as *Melomys* populations in northern Australia. It is terrestrial and in VNP it inhabits eucalypt savannah, feeding on vegetable matter.



A. Fraser

Rusa Deer INTRODUCED
Cervus timorensis

A large deer, females to 80 kg, males to 120 kg. The fur is a greyish-brown with darker hindquarters. The males have antlers. Originally from the islands of Java, Bali and Timor, introduced to western New Guinea in 1928, it has spread throughout much of SW PNG. It is a grazer, active in the early morning and late afternoon, mainly in secondary forest.