

パプアニューギニア国

環境保護・保全公社

パプアニューギニア国
生物多様性保全のための PNG 保護区
政策強化プロジェクト

事業完了報告書
(別冊 1 Vol. 3)

2021 年 8 月

独立行政法人
国際協力機構 (JICA)

日本工営株式会社
国際航業株式会社

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C-3 公園管理の適正化

活動コンポーネントの概要及び主要な成果品 公園管理の適正化

1. 背景及び概要

バリラタ国立公園は首都ポートモレスビー近郊に位置し、多くの潜在的な訪問客を持ち、また公園内には多種多様な動植物が生息しており、特にバードウォッチングサイトとして高いポテンシャルを有している。しかしながら、公園は適切に管理されておらず、それらのポテンシャルを生かしていなかった。大きな問題として、公園管理を担う Park Ranger が配置されておらず入場料の徴収を含む財務管理が適切に実施されていないこと、公園のルールや規則が不明慮であり観光客の管理が行われていないこと、飲酒や火の使用など不適切な利用が放置されていることが挙げられ、その結果、公園を訪れる観光客の人数は近年減少していた。

本プロジェクトでは、バリラタ国立公園の適切な管理のための CEPA の体制強化を行った。具体的には、管理体制や自然・社会環境などの現状分析を行い、その結果を踏まえて財務管理やセキュリティ改善など公園の機能強化のための優先事項を定めた公園管理計画 (revival stage) を策定し、更に様々な活動を実施した。また revival stage を通して得られた知見などを活用して、その後に公園管理計画 (progress stage) を作成し、その実施も支援した。

2. 目的

バリラタ国立公園の管理活動の適正化を行い、更に持続的に公園を管理するための体制を構築する。

3. 活動内容

- (1) Management Improvement Action Plan の作成
- (2) Management Improvement Action Plan の詳細計画の作成
- (3) バリラタ国立公園の管理能力強化活動の実施
- (4) 公園管理計画の作成のために必要なアセスメントの実施
- (5) 公園管理計画の作成
- (6) 公園管理計画に基づく主要な活動の実施

4. 活動経緯と実績

- (1) Management Improvement Action Plan の作成

2015年7月	➤ バリラタ国立公園において METT による分析を行った。
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～9月	<ul style="list-style-type: none"> ➤ ドローンによる現場調査を行い、ショートビデオを作成した。 ➤ メインピクニックエリアとメインルックアウトのオルソモザイクGISデータを準備した。
2015年10月～2016年2月 添付資料 2.3.1	<ul style="list-style-type: none"> ➤ Management Improvement Action Plan を作成した。

(2) Management Improvement Action Plan の詳細計画の作成

2015年8月～9月	<u>生物多様性調査及び野生生物モニタリングの計画策定</u> <ul style="list-style-type: none"> ➤ 公園内の動植物のモニタリング案を検討した。 ➤ カメラトラップによるモニタリング方法を検討した。 ➤ ドローンによるモニタリングプランを作成した。
2016年1月～9月	<u>公園規則の準備</u> <ul style="list-style-type: none"> ➤ CEPA との議論を通じて公園の規則を作成した。 ➤ 規則を周知するための掲示板のデザインを作成し、2つの掲示板を公園へ設置した。
2016年8月～11月	<u>セキュリティー改善のための計画策定</u> <ul style="list-style-type: none"> ➤ CEPA との議論を通じてセキュリティーの懸念事項を取りまとめた。 ➤ セキュリティーを改善するための計画を作成した。
2016年8月～2017年3月	<u>財務管理改善のための計画策定</u> <ul style="list-style-type: none"> ➤ 入場者数の調査結果や今後の訪問者の予測について取りまとめたレポートを作成した。 ➤ 新入場料案を検討し、上記レポートと共に MD へと提出した。 ➤ Financial management improve plan を作成した。
2015年10月～2016年2月 添付資料 2.3.2	<u>バードウォッチングプロジェクト実施のための準備</u> <ul style="list-style-type: none"> ➤ TPA 及び PAU とバードウォッチングプロジェクトについて複数回の会議を実施した。 ➤ バードウォッチングプロジェクトの MOU を作成した。 ➤ バードウォッチングプロジェクトの MOU の署名式典を開催した。

(3) バリラタ国立公園の管理能力強化活動の実施

2015年10月～2017年3月	<u>ドローンによる土地利用及び植生のモニタリング</u> <ul style="list-style-type: none"> ➤ ドローンを用いて航空写真やビデオを撮影した。
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2015年9月 ～2019年2 月	<u>カメラトラップによる野生動物のモニタリング</u> <ul style="list-style-type: none"> ➤ カメラトラップによる野生動物及び訪問者のトライアル調査を実施した。 ➤ カメラトラップモニタリングに係るマニュアルを作成した。 ➤ 調査結果を1st wrap up レポートとして取りまとめた。 ➤ ツカツクリのモニタリング結果を取りまとめ、生物多様性セミナーで発表した。 ➤ トライアル調査の結果に基づいて、Progress stage におけるモニタリングプランを作成した。
2015年9月 ～2018年10 月 添付資料 2.3.3	<u>財務管理の改善</u> <ul style="list-style-type: none"> ➤ カメラトラップを用いて訪問者数の傾向を把握した。 ➤ 訪問者数に係る調査結果をレポートへ取りまとめた。 ➤ 新入場料に係るレターがMD から大臣へと送られた。 ➤ プロジェクトにより提案された新入場料が承認された。
2016年8月 ～2018年10 月	<u>セキュリティーの改善</u> <ul style="list-style-type: none"> ➤ トライアルパトロールの実施方法を検討した。 ➤ 2016年12月～2017年1月の間にトライアルパトロールを実施した。 ➤ Wrap-up ワークショップを開催し、問題点を抽出した。 ➤ セキュリティー業務を担当するPark ranger のTORを作成した。
2016年3月 ～2019年2 月	<u>Bird Watching Project の実施</u> <ul style="list-style-type: none"> ➤ Bird watching project のためのサインボードを設置した。 ➤ 最新の状況に併せてMOU をアップデートした。 ➤ PAU へ設置するサインボードとバードシェルターのデザインを支援した。 ➤ ツアーのニーズについてツアーオペレーターへ聞き取りを行った。 ➤ バリラタ国立公園のBird watching guidebook を作成した。

(4) 公園管理計画の作成のために必要なアセスメントの実施

2017年4月 ～7月	<ul style="list-style-type: none"> ➤ METT により 2017年時点のバリラタ国立公園の分析を行った。
2015年9月 ～2016年6 月	<ul style="list-style-type: none"> ➤ バリラタ国立公園での生物多様性調査のTOR案を作成した。 ➤ 現地再委託の候補先と複数回の打合せを実施した。 ➤ 打合せ結果に基づいてTORを最終化した。
2016年7月 ～2017年2	<ul style="list-style-type: none"> ➤ 現地再委託の候補先3社にコンタクトを取り、そのうちの2社より技術提案書と見積書を受領した。

月	<ul style="list-style-type: none"> ➤ プロポーザルの評価の結果、Indo-Pacific Conservation Alliance と再委託契約を交わした。
2017年1月 ～2018年10 月 添付資料 2.3.4	<ul style="list-style-type: none"> ➤ 再委託先より Inception report を受領した。 ➤ 再委託先より Interim report を受領した。 ➤ 再委託先より Final report を受領した。 ➤ Exxon Mobil と共同で生物多様性セミナーを実施した。

(5) 公園管理計画の作成

2017年7月 ～2019年3 月 添付資料 2.3.5	<ul style="list-style-type: none"> ➤ 公園管理計画の TOC を作成した。 ➤ Draft Conservation Plan を作成した。 ➤ Draft Development Plan を作成した。 ➤ Draft Logistic Plan を作成した。 ➤ 上記の3つの Plan を基に公園管理計画を最終化した。
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(6) 公園管理計画に基づく主要な活動の実施

2019年1月 ～2020年12 月	<p><u>Conservation Plan の実施</u></p> <ul style="list-style-type: none"> ➤ カメラトラップにより公園内の野生動物のモニタリングを実施した。 ➤ カメラトラップモニタリングレポートを作成した。
2019年1月 ～2020年12 月	<p><u>Development and Utilization Plan の実施</u></p> <ul style="list-style-type: none"> ➤ ICC 活用のアイデアをまとめたメモを作成した。 ➤ CEPA と Kae Association によりバリラタ国立公園のトライアルツアーを実施した。 ➤ バリラタ国立公園の Promotion Video を作成した。 ➤ カメラトラップにより公園の訪問者及び車両の数をモニタリングした。 ➤ カメラトラップモニタリングレポートを作成した。
2019年1月 ～2020年12 月	<p><u>Logistic Support Plan の実施</u></p> <ul style="list-style-type: none"> ➤ バリラタ国立公園のための入場チケット、請求書、領収書フォームを作成した。 ➤ 徴収した入場料について月別に整理を行い、CEPA finance へ提出した。 ➤ セキュリティーの強化のために入場ゲート付近にカメラトラップ2台を設置した。また、夜間の車両の出入りなどをモニタリングした。

	➤ Park ranger のための帳簿管理マニュアルを作成した。また、帳簿管理のトレーニングを実施した。
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5. 評価

(1) 成果到達度の評価

評価指標	指標の到達度の自己評価	評価結果
Management Improvement Action Plan が 2016 年 2 月までに作成される。	Achieved	現場調査を通じて Management Improvement Action Plan が 2016 年 2 月に作成された。また、各活動の詳細計画（財務計画、セキュリティ計画等）が作成された。
作成した計画に基づいて公園管理の向上活動が 2018 年 12 月までに実施される。	Achieved	Management Improvement Action Plan に基づき、カメラトラップの導入による野生動物のモニタリングや新入場料の承認、トライアルパトロールなどの実施を通じて公園管理活動の適正化を進めた。
バリラタ国立公園管理計画が 2018 年 12 月までに作成される。	Achieved	プログレスステージにおけるバリラタ国立公園管理計画が 2019 年 1 月に作成された。

(2) 目標到達度の評価

評価指標	指標の到達度	評価結果
公園管理計画に基づき CEPA により公園管理が適切に行われる。	Partially achieved	公園管理の大部分は CEPA 職員及び Park Ranger により実施されている。一方で、Park Ranger の給与は現時点では UNDP-GEF の資金によりサポートされており、CEPA による持続的な公園管理にはバリラタ国立公園の独自の予算管理体制の構築が必要となる。

6. 教訓

(1) カメラトラップ及びドローンの公園管理のための有効活用

カメラトラップは、公園内の野生動物のモニタリングだけではなく、入場ゲートにおける入場者数の把握やセキュリティ改善のための不法侵入者の把握など、公園管理の適正化にも活用できる。またドローンは、森林の違法伐採などを遠隔で把握できる。CEPAにはプロジェクト開始以前のデータがほとんど残っていなかったが、これによりプロジェクト開始以降は継続的に入場者や土地利用などのデータを蓄積することができた。これらの機材は故障の際の修理や購入に費用が必要になるものの、モニタリングする職員を常時配置する必要がなく、結果として費用対効果は高い。

7. 提言

(1) 公園予算及び執行の独立性の確保

入場料徴収のモニタリングから、公園管理に必要な経費（パークレンジャーへの給与支払いや公園施設の修繕費等）の大部分は公園の入場料で賄えることが判明した。しかしながら、現時点では必要な予算を逐一 CEPA へ申請し、CEPA 内の手続きのために経費が支給されるまで時間を要している。そのため、徴収した入場料をそのまま公園管理の予算として使用できるような、バリラタ国立公園で独立した予算体制を構築することが望ましい。プロジェクトで設立を支援した公園管理委員会が、予算の支出の確認や管理を行うなど透明性の高い財務管理を行うことを提案する。

(2) 公園管理計画に沿った管理体制の拡充

現在公園管理業務を担う Park ranger が 10 名雇用されているものの、多岐に渡る公園管理を行うには、公園管理計画に示したような、より責任と役割を分担した管理体制を構築する必要があると考える。例えば、入場料徴収では、財務管理業務を行う Key management staff を配置し、Park ranger を適切に管理する役割を付与する必要がある。また一部の業務については、プロジェクトで立ち上げを支援した生計向上グループ（KAE Association）への業務委託などの検討を行い、より強固なバリラタ国立公園の管理体制を構築すべきである。

(3) 公園管理計画に沿った保全計画、利用計画の実施

プロジェクトで実施した生物多様性調査にて、公園内には喫緊に対策が必要な外来種が存在することが確認された。そのため、プロジェクトが作成した「外来種コントロール計画」を使い、外来種のモニタリングや駆除を適切に行っていく必要がある。また、公園内には ICC や Tree house など様々な施設が存在し、それら施設の適切な管理、戦略的な利用が重要である。プロジェクトが作成を支援した公園管理計画では、プロジェクトを実施する中で得られた知見や経験を基に、動植物の保全計画や公園の利用計画について取りまとめている。これらの公園管理計画をベースに動植物の保全や公園の利用を進めていくべきである。

- (4) 観光業界(TPA、旅行会社、ロッジ等)を巻き込んだブランディングと観光客誘致、収入の更なる確保

プロジェクト期間中に CEPA と KAE Association が中心となり、バリラタ国立公園を対象としたトライアルツアーを2回実施した。トライアルツアーには合計で185名が参加し、バリラタ国立公園の観光地としてのポテンシャルの高さが示された。今後継続的に観光客を獲得していくためには、海外観光客へのプロモーションや複数のツアーオプションの提案が必要になると考えられ、TPAを中心とした観光業界と一体となったプロモーションが必要不可欠である。特に、TPAとは共同でバリラタ国立公園のプロモーションビデオの作成行い、ホームページ上で公開するなど、多くの連携をして来た。このような連携を一過性で終わらせず、継続的にプロモーションをしていくことで更なる観光客の獲得を目指すべきである。

- (5) UPNG、PAU を巻き込んだ研究対象としての価値向上と施設のリサーチステーションとしての活用、収入の更なる確保

本活動で実施したカメラトラップモニタリングや生物多様性調査により、バリラタ国立公園内に多種多様な動植物が生育していることが判明した。一方で、現時点では公園管理のために配置された Park ranger や CEPA 職員のマンパワーの問題もあり、十分なモニタリングや動植物の保全活動が実施されていない状況である。プロジェクトで設置した新インフォメーションセンターには資機材を保管する倉庫やオフィススペースを整備したことから、UPNG や PAU といった大学と連携して研究活動を行う場として活用することを提案する。大学機関と連携して動植物のモニタリングや研究を実施していくことで、モニタリングデータを継続的に収集することができ、バリラタ国立公園の研究対象としての価値を向上させることができると考える。

8. 主要な成果品リスト:

- 1) Management Improvement Action Plan (添付資料 2.3.1)
- 2) MOU of bird watching project (添付資料 2.3.2)
- 3) Gazette new fee system in VNP (添付資料 2.3.3)
- 4) Final reports of Biodiversity Survey (添付資料 2.3.4)
- 5) Varirata National Park Management Plan (添付資料 2.3.5)

以上

添付資料 2.3.1 Management Improvement Action Plan

Management Assessment and
Management Improvement Action Plan
For Varirata National Park

The Activity 2.2 of PDM

Version 2

CEPA-JICA Project Team

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PART I: Varirata National Park Management Assessment

1.0 Brief background of Varirata National Park (VNP)

1.1. General Description

The Varirata National Park was the first Papua New Guinea's (PNG) National Park declared in 1969. The Park is located on the Varirata Plateau appropriately 48 km east of Port Moresby city. Varirata National Park has an area of 1,063 hectares (ha) on the State land (originally belongs to two clans of Koiari people) at an elevation of 630 - 740m. Access to the Park is by road along the Sogeri road branching off to the right at the PNG Power Rouna II married residence, and the park entrance (park) is about 4 km from the main road.

1.2. Physical Condition, Vegetation and Wildlife

The Park has an average annual rainfall of 5080 mm from December to April. The landform of the Park consists of closely spaced narrow accordant ridges and spurs with a relief of 15-30 meters. Rocks found in the Park consist of balastic lava, agglomerate, tuff and dyke origins. The Park consist of the following vegetation types; rainforest, savannah, grassland, gallery forest and secondary regrowth. The natural zone along the Nairogo creek towards Gare's Lookout is all tropical rainforest. From the toll gate to Lifiliwasowaso Lookout and all the way to Varirata Lookout is savannah grassland. Patches of secondary regrowth along the Self Guided Wildlife Track in the Park is rich in bird life. This includes the Raggiana Bird of Paradise (BoP), the Rifle BoP and different species of doves, lorries, pigeons, kites, cockatoos, kingfishers, megapods, fantails and swallows. Bird of Paradise can be observed from the marked display tree between the months of mid-March to end of August, which is the mating season. The animal life in the Park composed of introduced Rusa deer, forest wallabies, possums, cuscus, bandicoots, rodents, wild boas, frogs, odanates, butterflies, other insects and different species of reptiles including pythons and monitor lizards.

1.3. History

The land on which the Park lies was acquired under the Section 12 of the National Parks and Gardens Ordinance 1966 (Part 2 of Crown Land Ordinance 180) on 23rd October 1986. The land was known to Koiaris then as Wodobonumu. The Park is located on the traditional hunting grounds of the Koiari people. The land which the Park lies on was originally owned by two clans (Nadeka and Ianari). The Ianari clan owns the northern portion of the Park, which was previously demarcated for protection, and the Nadeka clan possesses the entire southern part of the Park, which was the extension of the Park (pers.comm. Kisia Arua, VNP Ranger, 08.07.15).

The Park was originally reserved under the trusteeship of the District Commission, Director of Forest and Ruth Isobel Sefton on 17th February 1963. The Park was committed to the care and control of the National Parks Board (maybe equivalent to the National Conservation Council under the Policy on Protected Area (PPA)) on 18th December 1969 (PNG Gazettal Notice No.70). An additional land, where the main picnic area and the information center lie was once a coffee nursery established in 1950's. The same area was logged by two portable sawmill companies managed by Sandis and Burns Philip back then. Later a piggery and poultry farm were established on the same piece of land, which the land was acquired from Burns Philip (NG) Limited. The concrete foundations are the only remnants today. The Park was officially opened on 8th October 1973.

2.0 Legislative Status of the Park

The status of the Varirata National Park (VNP) is not very clear from the legislative and governance view point. VNP was declared by the GoPNG under the Ordinance Act in 1969 for the protection of the biodiversity and the unique scenic sites. The land was given to the State by the Koiari customary landowners (by the Omani, Ianari and Nadeka clans of Koiari) at that time as a gift. This should be verified from the CEPA regarding the gazettal status of the VNP so that immediate actions can be undertaken in order to pursue the biodiversity planning action plan for the expansion and rehabilitation of the Park by the current JICA-CEPA Biodiversity Project.

Official/legal documentation of the Park including the land boundary descriptions, national gazettal notice, management rules, etc should be readily available within CEPA. Unfortunately this is not the case therefore; proper demarcation and land boundary mapping of the Park should be undertaken immediately with direct consultation with the Koiari customary landowners (Nadeka and Ianari clans), Central Province Administration, Hiri LLG Administration, and other relevant stakeholders.

3.0 Boundary of the Park

The boundaries of the Park are not very clear to this stage. However, it was assumed that the State portion of the land where the Park lies on was given away by the Koiari landowners for the protection of the biodiversity many years ago (Figure 1). The extension of the Park was also not clear and this sits on the customary land, no data or information is available to date. Thus proper boundary survey to determine the land boundaries should be conducted to verify the land boundary and boundary descriptions of the Park. The genuine customary landowners and clans should be also identified in order for proper consultation by the JICA-CEPA Biodiversity Project to take place. Other key stakeholders within and outside the vicinity of the Park should also be consulted.

4.0 Management Enforcement

Currently, park's rules and regulations are not clear, and therefore, there is no clear sign to visitors on the rules and regulations for the use. It results poor intervention of park staff to visitors, and has been inducing many inappropriate use: make fire anyplace in the park, arson on the toilet facility, fire marks along tracks, vehicles are parked anywhere in the park, drunkards abusing other visitors, trash and beer cans and other rubbish are littered or loitered anywhere and so on. These incidents are tarnishing the park's environment because it is a public amenity, and people are not trusting CEPA's commitment. As people loose trust in CEPA, the number of visitors continuing will continue to decrease. Hence appropriate rules and regulations are essential for the park management, and are immediate measures and regulations are needed to be effected and reinforced in order to control the behavior of visitors immediately. Hence section 2.5 discusses the regulations and rules to be immediately enforced.

5.0 Sustainability and Revenue Generating Activities

The VNP has high potential for sustaining itself financially. Apart from gate fee collections, more revenue generating activities can be organized. The most promising and lucrative project is Bird watching. Over the years tour operators have been taking birdwatchers to VNP and benefiting from it while CEPA and landowners have been missing out on the benefits. There is no Memorandum of Understanding (MOU) between CEPA, TPA, PAU and Koiari LLG and landowners, hence CEPA and Koiari LLG and landowners have been missing out on Bird watching project spinoffs.

More money generating activities are needed for VNP to raise its own revenue in order to sustain itself.

6.0 Financial Management

The financial information of VNP from CEPA (then DEC) was not sufficient to generate an appropriate budget or financial plan. The following information was gathered from interviews to CEPA staff. This information shall provide indicative expenses of VNP for the last 15 years from 2000- 2015.

<In the period 2000 – 2006>

6.1 Services Provided for VNP

From the period 2000 – 2006, locals from Koiari were engaged to carry out general labour work at

the park were as follows;

1. General Cleaning (Grass Cutting, Rubbish removal, maintenance of the bush tracks)
2. Provide firewood for the picnic sites and the lodge
3. House Keeping for the lodge (laundry, cleaning, etc)
(The condition of the lodge at that time was better than how it is now and visitors frequently pay fees to use the accommodation at the lodge. There were proper beddings like mattresses, pillows, bed sheets, etc)
4. Provide securities for visitors visiting the park as well because the local labourers were always at the park vicinity
5. Maintain fire-break areas from bushfires in order to avoid fire spreading into the park

6.2 Work Arrangements and Labour Cost

Six (6) locals were engaged at a time each week. At times, 10 locals were engaged but often not more than 10. However, the engagement of the locals was on a rotational basis which for every week different locals were engaged to have turns to work and get paid. The local laborers are paid on flat rate at K280.00 fortnightly/person, whereby a time sheet was kept to keep track of the people doing work on daily basis.

6.3 Cessation of Local labourers to do work at VNP

The engagement of the locals from Koiari to carry out general labour work at the park ended at the end of 2006 due to the following issues below;

1. Long distance walk - The Labourers usually walk long distances from their village to the park and usually arrived at the park between 9am and 10am and usually stop work between 2:30 pm and 3pm resulting in less work being done.
2. Bad weather - During the days that it rains/showers, the local do not go to the park to do work which affect provision of securities for visitors and housekeeping for the lodge
3. Payment on time - The local labourers have an attitude where they expect to be paid on time. Hence, when their payments are delayed they turn to make threats to shut the toll-gate (main VNP gate) which may affect visitors that would happen to visit the park at that time.

<In the period from 2007 to now>

6.4 Services Provided for VNP

From 2007, general labour activities carried out during that period were as follows;

1. General Cleaning (Grass Cutting and Rubbish removal)
2. Maintenance of the bush tracks (locals are engaged to maintain the tracks)
3. Provide firewood for the picnic sites

6.5 Work Arrangements and Labour and Other Costs

Youths and known persons are engaged randomly annually. 6 people are engaged at one time because of the budget indicated below.

1. General Cleaning – K2, 000.00 monthly
2. Track cleaning and Maintenance – K6, 000.00 monthly (K1, 000.00 per track). The tracks are listed below; Monthly
 - Creek (Main Picnic Area) – Gares Lookout (Scarp Track)
 - Creek (Main Picnic Area) – Main Lookout (Self Guide Track)
 - Circus Track
 - Gares – Entrance
 - Main Lookout to Gares
 - Campsite – Lake (The track has not been used or maintained for a while so possibly it has not been maintained – plans to clean the track again for visitors' hiking/ tracking activities) (At times when the land movers, slasher/ grass cutter, chain saws for the park are not working or needs repairs, Manager in charge tend to hire such machineries at a rate of K250.00/ hour – is hire for a full day or couple of days depending on type of work...give some indication for budget purposes)

6.6 Use of Vehicle for VNP

The arrangement of the vehicle hire by CEPA is made with a private hire car company and the payments are made monthly. The vehicles are hired only on special occasions and payments were made monthly. Typically, two kinds of vehicles are hired depending on the type of work and these are on dry hires (fuel not provided). The following below are the types of vehicles hired and their respective costs:

- Hilux – K650 daily rate – roughly hire for over 1 month and can be 12 months depending on the nature of work and need for vehicle;
- 10 sweater Toyota Land Cruiser – K850 daily rate – similar to above;

- Both rates are for dry hires (fuel not provided);
- Fuel Rate; - payment made by cash through fuel voucher or cheque
- Within city limits – K50.00 daily; and
- Outside city limits – K150.00 daily.

6.7 Other Costing / Expenses

Locals are usually hired to construct the Koiari Tree house at a rate of K1, 500.00. The maintenance of the tree house is usually done after every 5 years at the same rate per maintenance.

7.0 Stakeholder Analysis - Key Partners and their roles and responsibilities

7.1 Conservation and Environment Protection Authority (CEPA)

The role and function of CEPA is:

- To regulate the utilization of the Park to ensure the management objectives and standards to be incorporated into the Park's Strategy and Management Plan are met;
- To facilitate funding for activities to improve the management of the Park and initially to fund development of the Park's Strategy and Management Plan;
- To provide advice and assistance to the Koiari LLG and Central Province in the implementation of the Park's Strategy and Management Plan; and
- To provide counterpart assistance (in terms of technical and administrative support) to the JICA Expert Team (JET) in regard to the development and implementation of Park Management Plan.

7.2 PNG National Planning and Monitoring

The role and function of the PNG National Planning and Monitoring Department is:

- To provide assistance for the JICA-CEPA Biodiversity Project with the planning and implementation; and
- To assist the Project whenever required.

7.3 PNG Department of Lands and Physical Planning

The role and function of the Department of Lands and Physical Planning is:

- To support the Project with relevant technical expertise and remote sensing technology

including GIS and land data when required; and

- To assist the Project for the land mediation and land boundary mapping of the Varirata National Park.

7.4 Provincial, District and Local-level Governments of Central Province

The role and function of the Provincial, District and Local Level Governments of Central province is:

- To facilitate landowner engagement and consultation;
- To develop the Park Management Plan (PMP) in collaboration with JET and CEPA counterpart team;
- To endorse the PMP and assist in the management of the Park; and
- To provide additional support required by the JET and CEPA counterpart team.

7.5 PNG Tourism Promotion Authority (TPA)

The PNG TPA is another important stakeholder in the operation of the CEPA-JICA project. This is because:

- The PNGTPA exists to market and promote PNG as an ideal tourist destination. PNGTPA also exists to enable tourism product development, provide tourism awareness and other tourism technical advice;
- PNGTPA has a keen interest in working with CEPA, provincial and local level governments to ensure activities to develop tourism can be implemented at all levels of Government below the national level. It has created a partnership with the CEPA to develop integrated tourism through cooperation in the area of environment protection and biodiversity conservation; and
- The partnership in establishing bird watching sites for tourists and Port Moresby residents including domestic visitors within PNG is significant.

PART II: Management Improvement Action Plan

1.0 Proposal on Strengthening the Park in Two Stages

Below are proposed objectives and activities the CEPA-JICA biodiversity project envisioned to undertake to develop VNP and address management issues to improve the Park.

1.1 Objectives of “Staged Approach”

The following objectives are expected to be achieved during the duration of the Project are:

- **Increase Park visitation by 2020:** CEPA aims to increase visitors numbers to the Park. In the early 2000’s, the number of visitors to the Park from Port Moresby as well as from overseas, has increased remarkably. This has greatly a major source of revenue for the Park. Until recently, the numbers of visitors is significantly decreasing because of various reasons. Hence this project aims to increase the number of visitors to the Park again.
- **Increase dialogue and communication with different stakeholders:** The CEPA-JICA Biodiversity Project will improve dialogue and communicate with its stakeholders. Since June 2015, CEPA-JICA Project Team had frequent visit to VNP, and is constantly having dialogues with various stakeholders, including staff of Koiari LLG government, to assess needs and expectations of those stakeholders regarding the management and improvement of the Park.
- **Conduct of Situation analysis:** The CEPA-JICA Project Team is to conducted situation analysis of the Park and identify existing gaps. Once this is done the Project will identify basic strategy for strengthening the park effectively and efficiently to respond to the needs and expectations.

The CEPA-JICA Project Team suggests adopting a “staged approach”, which divides activities into two groups; “Revival Stage” and “Progress Stage”.

- **Revival Stage** is a stage focus only limited scopes, to regain necessary minimum function, all of which once the Park was equipped. Revival Stage focuses only within the park’s boundary, to be carried out in a short period of time.
- **Progress Stage** is the stage to further strengthen park’s functions and roles, and the management scope extends to the outside of the park boundary. It assume the park as “Core” of biodiversity in Laloki/Sirinumu catchment ecosystem, and the management of “buffer” and “transition” will be within the scope to realize bio-regional management. Progress Stage emphasizes on the works to promote cooperation and collaboration among different institutions and governments, who work in Laloki/Sirinumu catchment areas. In anticipation of the future, Progress Stage is preparatory stage for UNESCO’s Biosphere Reserve (MAB-BR) application.

Table 1 indicates summary of different characteristics of each stage and Table 2 are issues to be addressed at each stage.

Table 1: Characteristics of Each Stage

Stage	Purpose	Target Area	Basic strategy	Target Period
Revival Stage	<ul style="list-style-type: none"> - To revive the minimum-necessary role and function of the park as a baseline for Progress Stage. - To regain the reputation of the park in 20 years ago. 	Within the park boundary	<ul style="list-style-type: none"> - Focus on the least required function as a national park. - Quickly revive the park management and regain good reputation from residents in POM in order to receive more visitors. 	Short-term (1-2yrs.)
Progress Stage	<ul style="list-style-type: none"> - To promote landscape level or bioregional level management in Laloki/Sirinumu catchment. - To manage VNP as a core to be integrated into buffer and transition management. - To promote active participation of local governments and communities for sustainability. 	Not only within the park boundary, but around the park (buffer and transition zones)	<ul style="list-style-type: none"> - Immediately after regaining the baseline in Revival Stage. - Work for the management of buffer and transition zones within the scope. - Promote bio-regional management (ecosystem management) in Laloki/Sirinumu catchment. - Active collaboration with provincial/district/LLG governments, TPA, PAU and other institutions. 	Mid-term (3-4yrs.) Long-term (5-10yrs.)

Table 2: Issue to be addressed in Each Stage

Target activities	Revival Stage	Progress Stage
1. related to the protection and preservation of wildlife habitats and biodiversity	Yes	In some extent
2. related to the enhancing and optimizing the use of the park by visitors 1 (recreation and leisure)	Yes	In some extent
3. related to the enhancing and optimizing the use of the park by visitors 2 (research and education)	In some extent	Yes
4. related to the bio-regional management of the landscape with participation of LLG	In some extent	Yes
5. related to the livelihood development and participation of local communities in the management of the park	No	Yes
6. related to the land use planning and development planning around the park	No	Yes

1.2 Proposal on Assessment and Planning in Each Stage

Below are the assessment and planning stages of the redevelopment and revitalization of VNP.

- The first activity is to carry out an initial evaluation of the Park using Management Effectiveness Tracking Tool (METT) developed by IUCN. In the Revival Stage of the Park, a "protection/ preservation function" and a "use function" approach will be undertaken and will be the priority functions to conduct the assessment separately. After the assessments, the preparation of a "management action plan" and "facility action plan" will be completed. The

Revival stage is equivalent to the short-term plan (one to two years) of METT.

- In the Progress Stage, the Project will utilize the concept of “ecosystem management”, to capture the watershed level ecosystem management of Laloki/Sirinumu ecosystems. All plans such as Conservation Plan (preservation plan), Development Plan (utilization plan), and Logistic Support Plan (organization control plan) are three priority plans that will be developed by the Project. Hence, the Progress Stage is equivalent to the medium-to-long term plan of METT (three to ten years).

Figure 1 below is the proposed Revival and Progress Stages for the Assessment and Planning of the rehabilitation of the Park.

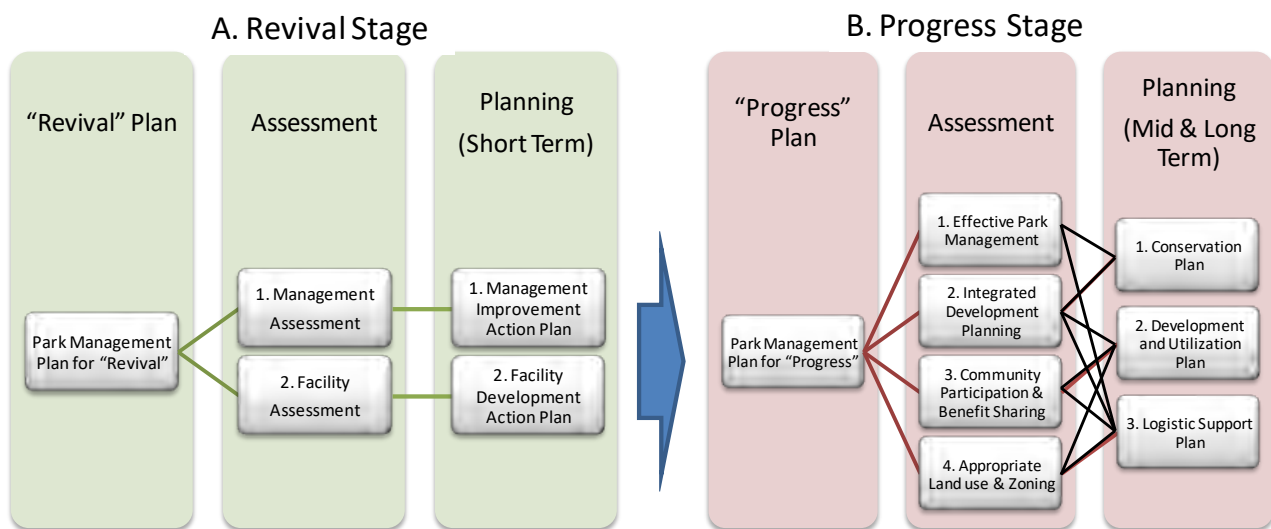


Figure 1 Assessment and Planning in Each Stage

1.3 Biosphere Reserve Application in Future

In case the Project decides to progress applying to the MAB-BR of UNESCO in the future, the Project will assist strengthen and improve the park management plans into a “Landscape/Regional Management Plan”, which will have more emphasis on landscape and regional level management, with more involvement of local governments and communities as required by MAB-BR. Table 3 indicates the process it will undertake to become MAB-BR ready.

Table3 Landscape/Regional Management Plan based on MAB-BR Requirement

Individual Plans		Key contents
(1) Basic policy/strategy of the plan based on MAB-BR requirements		As per the requirements for UNESCO MAB-BR, making preservation and use of a natural resource compatible in landscape level will be clearly shown.
(2) Park Management Plan	Preservation/conservation plan	The plan for strengthening the preservation/conservation function of the park

- for strengthening the function of VNP [the activity 2-2]	Utilization plan	The plan for use function and management function (research, education, use by training) of the park
	Logistic Support Plan	The plan for better control, management and administration of the park and surrounding areas. Financial source to maintenance of the park needs to be clarified.
(3) Landuse Plan – Optimization plan of landuse by appropriate zoning [the activity 2-3]		The zoning plan which classifies three areas; core, buffer and transitions zones.
(4) Regional Development Plan - Integration of a regional development plans in difference levels[the activity 2-4]		The plan to ensure the development projects in the area to have harmony with natural environment.
(5) Livelihood Development Plan – Promotion of livelihood development in relation the park and regional biodiversity [the activity 2-5]		The plan for livelihood development in the area to have harmonized with natural environment

1.4 Proposed Schedule

Both stages will consist of two tasks, 1) "assessment and planning" and 2) "implementation." Before the Revival Stage, an initial evaluation will be done to assess the baseline using METT. When finishing all actions of the Progress Stage, terminal evaluation comparing the achievement with the baseline will be conducted. Items such as activities in buffer and transition, activities with local governments and local communities, which are not covered with METT will be assessed separately.

Figure 2 below shows the proposed stages schedule over a five year period covering different stages of the Project.

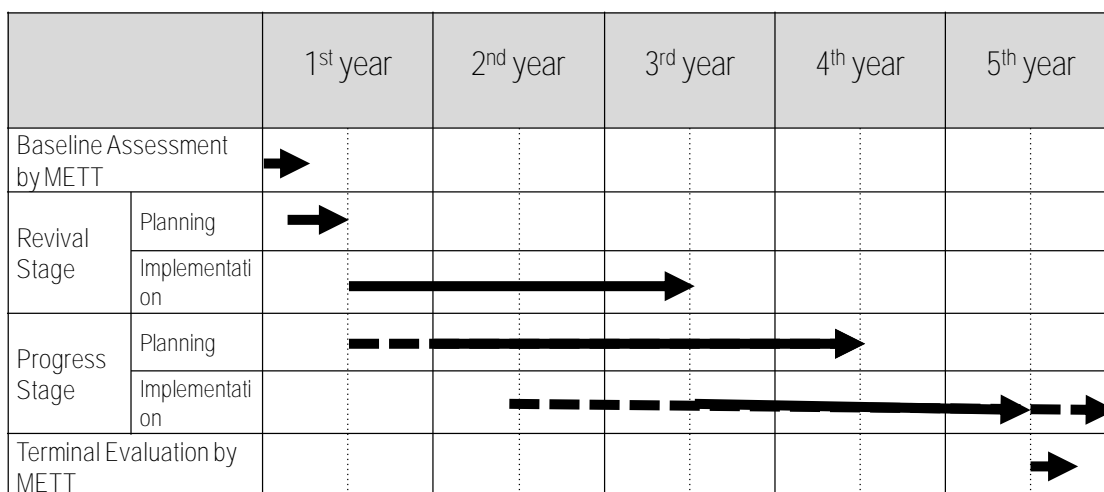


Figure 2 Proposed Work Schedules of Each Stage

2.0 Priority Actions in Revival Stage

Below are the priority actions or activities to be implemented in the Revival stage.

2.1 Renovation of Facilities and Infrastructures

The Park conditions seemed to be deteriorating because of poor facilities and infrastructure. The Information center and bridges have deteriorated, coupled with poor track and signage conditions and limited recreational attractions. Immediate actions are required for a Facility Assessment to be conducted. Based on the assessment result, a Facility Development Plan should be made. In the plan, priority facilities for immediate action need to be identified, and facility-wise renovation works should be implemented. All related actions will be made by direct involvement of CEPA staff with technical support by JICA Expert Team.

2.2 Information Collection and for Management with Appropriate Monitoring System

Appropriate management of the Park requires adequate information, and currently vital biological and socio-economic information are lacking. This requires a biological survey to be conducted and once the survey is done, basic information should be made available to the public, including the visitors and tourists. The biological information can be condensed and simplified for the purpose of educational awareness, for students/schools, for tourists and target audiences. Detailed social mapping (including the socio-economic survey and assessment) and biodiversity study should be undertaken in VNP and its surrounding areas.

Information on visitors, facility use, facility condition, fauna and flora are essential for the park management. In this regard, monitoring will become a key activity for park management. At the moment, there are no monitoring activities being undertaken. Thus, appropriate monitoring system for the park management needs to be established.

2.3 Appropriate Financial Management and Improvement of the Park Revenue System

The Park requires sustainable financing to become successful. Below are the proposed steps to be undertaken to improve the Park Financial Management.

2.3.1 Projection of necessary Funds

The information given in this section may provide some basis for the Project Team to develop a budget or financial plan for VNP. Table 4 provides an annual projection of the expenditure side for the VNP.

Table 4: Expected Budget for VNP

Expenditures	Unit	Unit Cost (PGK)	No. of Units	Total (PGK)
1. General cleaning (<i>Grass Cutting, Rubbish removal, maintenance of the bush tracks</i>)	monthly	2,000.00	12	24,000.00
2. Track cleaning & maintenance	monthly	6,000.00	12	72,000.00
3. Local Labour				
3.1 Firewood collection (picnic areas/lodge)	fortnightly	280	26	7,280.00
3.2 Housekeeping for lodge	fortnightly	280	26	7,280.00
3.3 Security for visitors	fortnightly	280	26	7,280.00
4. Fire-break maintenance	monthly	280	12	3,360.00
5. Equipment hire	hourly	250	8	2,000.00
6. Vehicle hire (Hilux)	daily	650	26	16,900.00
7. Vehicle hire (10 seater)	daily	850	26	22,100.00
8. Fuel (within POM)	daily	50	26	1,300.00
9. Fuel (outside POM)	daily	150	26	3,900.00
10. Construction & maintenance of Koiari Tree House	pa	280	26	7,280.00
			TOTAL(annual)	174,680.00
			TOTAL(monthly)	14,556.00

2.3.2 Revision of Park Entrance Fee

VNP does not have a consistent or proper coming funding from the National Government through the Public Investment Program (PIP) Funding, hence there is difficulty to project the revenue generated from VNP. The most important aspect of revenue management is the entrance fee system. The Park needs to be self-sustaining in order to achieve long-term sustainability.

CEPA-JICA is undertaking a review to determine various options of income generation activities for long-term management of VNP. It is also critical for CEPA to provide relevant support in order to alleviate financial constraints and embark on strategic approaches to lure and attract sufficient funding for the effective and sustainable management of VNP. One of such strategies is to review the current gate fees and increase it in order for it to be affordable and at the same time more competitive and comparable to other similar sites such as the Nature and Adventure Parks. Table 5 shows the Present and Proposed visitors entrance fees for individuals/groups fees as individuals or for a vehicle.

Table 5: Present and Proposed Entrance Fee Systems for VNP

Fees	Present		Proposed	
	Locals/Citizens	Non-Citizens	Locals/Citizens	Non-Citizens
<i>Individuals/groups</i>				
Adult	K2.00	K5.00	K5.00	K10.00
Student (with ID)	-		K4.00	K8.00
Children (≤ 12 yr)	-		K3.00	K6.00
Vehicle (1-8 pass)	-		K50.00	K100.00

Vehicle (9-15 pass)	K50.00		K70.00	K200.00
Vehicle (≥ 15 pass)	-		K100.00	K250.00
<i>Tour Operators</i>				
Vehicle (1-8 pass)	-	-	?	K200.00
Vehicle (9-15 pass)	-	-	?	K300.00
Vehicle (≥ 15 pass)	-	-	?	K500.00

Currently, there are two forms of fees being collected as specified as – paid at the VNP gate and at CEPA’s office in Waigani. There is also another proposal for an arrangement with the Gas Stations to sell tickets in Port Moresby. This is basically because most visitors go to nearby service stations to refill their vehicles prior to their trips to the VNP.

2.3.3 Projection of number of visitors

The revival of the VNP is expected to generate positive increase in the number of visitors and tourists visiting the park on the daily basis. This can be done when relevant security, logistic, utilization and management regimes are put in place and properly promoted by all stakeholders including the local landowners.

2.3.4 Projection of revenue

CEPA has established mutual relationships with various other entities and agencies who have vested interest for their benefits but at the same time should provide incentives for the management of the VNP. Such arrangements were made through lease-lease arrangements such as Rental fees from Digicel and Police surveillance Tower.

(1) Rental fees from Digicel (PNG) Ltd Tower

Recent construction and erection of the Digicel (PNG) Ltd Tower (30 x30 m) leased premises within the VNP. This will generate PGK15,000 per annum. From this rental fees, how much will be budgeted for the management of the VNP is unknown.

(2) Rental fees from Police Surveillance Tower

An agreement in the form of a MoU or MOA is yet to be accomplished. CEPA has begun the negotiation with the Department of Police at their headquarters in Konedobu. To-date there is no tangible outcome from those discussions. It is still in progress.

(3) NCDC and others

The National Capital District Commission (NCDC) has provided support to VNP in-kind over the years. It was evident that NCDC has provided water tanks and water pipes at the Main Picnic area in VNP. Currently, there is discussion with NCD and CEPA for the transfer of the management rights of VNP to NCDC. Through this arrangement the VNP might be fully funded and supported by NCDC for the development of its facilities and improvement to cater for visitors, tourists and Port Moresby residents who are visiting and exploring VNP in the near future. However, it was unclear whether the CEPA will still have the legal rights over the VNP.

2.4 Key Management Issues and Proposed Management Plans

Some important legislatives and appropriate regulations for the smooth management of the VNP are lacking. Three main issues were identified in Part 1 includes (i) Legislative status of the Park (ii) Boundary of the Park and (iii) Management enforcement. Table 6 outlines the proposed management plans for these issues that require immediate actions.

2.4.1 Appropriate Regulations

Appropriate rules and regulations are essential for the park management, that need to be re-defined and enforced to visitors immediately. According to the results of our assessment, policies on alcohol and parking should have priority. In addition, use of tracks should have another attention. Currently, all track are open to the public, however, boundary tracks should have restriction of use, since CEPA doesn't have enough capacity to maintain and conduct frequent patrols. Table 6 shows the issues and management and policies (the rules) for the Park.

Table 6: Issues identified and immediate management plans

Issues	Management and Policies	Comments
Alcohol	<ol style="list-style-type: none"> 1. Only allowed on permitted areas <ul style="list-style-type: none"> • Main Picnic site • Camping Sites • Lodge 2. Rangers must be strict on drunkard. <ul style="list-style-type: none"> • Drunkard causing disturbance must be asked to leave 	*** Second option is to have complete ban of alcohol beyond the park's main gate
Parking	<ol style="list-style-type: none"> 1. ALL vehicles are to park at designated areas 2. No vehicles are allowed at main lookout 3. Only people with disabilities and elderly people are allowed to drive to the main lookout 4. Travelling off designated areas and speeding past 30kmp is prohibited 	
Fire	<ol style="list-style-type: none"> 1. Fire is allowed only at the permitted areas <ul style="list-style-type: none"> • Picnic areas • Camping sites 2. No burning of grass and woods outside the designated areas. 3. All fires MUST be completely put off before vacating the area 	
Tracking	<ol style="list-style-type: none"> 1. Only tracks open to public are to be used <ul style="list-style-type: none"> • Tracks under constructions/maintenance will be closed temporarily • Boundary tracks are to be closed for public until further notice • Tracking off the designated route is prohibited 	
Vandalism	<ol style="list-style-type: none"> 1. No vandalism on VNP property or assets 2. No graffiti on signboards or property 3. No markings or cuttings on standing trees 	
Camping	<ol style="list-style-type: none"> 1. Camping is not allowed outside designated areas. 2. Spotlighting of wildlife is not allowed unless for scientific purposes 	
Smoking	<ol style="list-style-type: none"> 1. Smoking is prohibited on trails and near drier areas. There is no smoking in buildings or within 10 meters of building entrances. 	
Removal of plants and animals in an out of the Park	<ol style="list-style-type: none"> 1. No animal or plant specimens should be taken out of the park unless under the supervision of the park ranger or permission from CEPA for research purposes and for specific reasons 2. No exotic animals and plants should be introduced or taken into the park 3. No feral animals (including domesticated dogs and cats) are allowed in the park 4. Hunting and fishing or removing or possessing natural or cultural resources (such as wildflowers and eggs, bush fowl eggs and animals) is prohibited within the park and 1km inside the buffer zones. 	
Rubbish	Loitering and dumping of rubbish is NOT allowed in the Park	
Wildlife	<ol style="list-style-type: none"> 1. Willfully remaining near or approaching wildlife, including nesting birds, within any distance that disturbs or displaces the animal is prohibited. 2. Feeding and handling wildlife is prohibited unless for 	

	research purpose	
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2.4.2 Enforcement of Security

Security for the Park and its facilities, and public, including tourists, are of paramount concern. In addition to the safety of the facilities at the park, visitors must feel safe and have relaxing time with their families and enjoy the nature and the biodiversity at the Park. The management of the security issues of park are outlined in Table 7.

Table 7: Security issues and management plans

Specific Security Issue	Management and Policies	Comments
Facilities in the Park: (Lodge, Picnic site, Tree-House, Bird Watch site)	1. Facilities must not be damaged <ul style="list-style-type: none"> • Trained rangers will patrol the area, making sure all facilities are safe. 	Five rangers each day.
Safety of ALL visitors.	1. Safety of all visitors of the park requires holistic approach, which include multiple and fully integrated levels of authorities <ul style="list-style-type: none"> • CEPA and Park Rangers • NCD and Koiari Community police • Koiari LLG and landowners 2. Check Point <ul style="list-style-type: none"> • All vehicles going in to the park will be checked at the main gate 3. Will have two (2) check points <ul style="list-style-type: none"> • First Check point to be built just after going after the main Sogeri Rd • Upgrade the existing gate near the park • Rangers manning the two check points (gates) will be communicating via VHF radios. 	* CEPA, together with park rangers will work closely with NCD and Central Community Police and landowners *All visitors going in and out of the park will be checked *Two check points is more secure

2.5 Sustainability and Attraction Sites

The VNP must generate its own fund to sustain itself in the future. This can be achieved by attracting more visitors to the park. Some attractions needs to be developed are:

2.5.1 Development of Bird Watching Sites in VNP.

Bird watching is a lucrative project and VNP has great potential. CEPA-JICA will work closely with Tourism Promotion Authority (TPA) and establish bird watching sites within the park. Table 8 outlines the work plan to establish Bird Watching sites.

Table 8: Working plan for developing attraction sites – Bird Watching Sites

Main Task	Partners/ Produce by	Output
MoU	CEPA, TPA, Koiari LLG, PAU	MoU developed & signed
Establishing Bird watching sites	CEPA, PAU and UPNG	Sites identified and developed
Birds list of VNP	CEPA and Consultant	Production of field guide – Birds of VNP

There were two specific sites identified for bird watching in the VNP; along the Self Guide Track and the Raggiana Bird of Paradise display site. The CEPA/ JICA Project also have plans to develop Bird Manuals/ Birds Guide Books for the Varirata National Park (VNP). This manual or guide book when developed will be used by tourists and visitors visiting the park. PNGTPA and CEPA/JICA Biodiversity Project are keen to undertake educational awareness and train local guides/ research guides for bird watching in the VNP and neighbouring areas. This can be an opportunity to develop a profile for Bird Manual/ Guide for the VNP.

2.5.2 Establishment and Promotion of Eco-tourism in VNP and buffer areas

The Tourism Master Plan (10 years); 2007 – 2017 of TPA has identified several tourism products under their community-based eco-tourism project (CBEP). This plan can be shared with the implementing parties so that effective participation and implementation of the village huts, local village accommodation, cultural shows, including the birding project are enhanced.

These eco-tourism activities shall provide education and community awareness on different tourism products and their significance to the local people. It will in the long-term sustain their livelihoods in terms of improving their living standards from obtaining small cash from these eco-tourism activities or tour operators as local guides. Thus, these activities will encourage management of the VNP.

2.5.3 Cultural and Ecological exposure tour

CEPA-JICA Project is keen to support the creation of packaged cultural/ecological tours which can be centered on bird watching or other eco-tourism products such as, Koiari Tree-House, craft making, etc. The packaged tour might include the following contents such as serving lunch and/or cultural show like traditional dancing. In accordance with the packaged tour from the discussions with local community, training and workshop for capacity development will be

provided to local people. Support activities for making packaged tour will include identifying needs from relevant stakeholders, identifying potential resource assessment, forming social groups, workshop for making packaged tour with local people, training in packaged tours for local people and implementation of FAM tour.

The CEPA-JICA will identify the potential resource for cultural and ecological exposure tour and these resources can be properly packaged and utilized by visitors/tourists visiting the VNP and the Koiari area. Also, specific exposure tour options including eco-tourism and bird watching were identified by the local community and how this can be executed equitably for the local benefit and the management of the VNP.

Annex 1:

Signboard Notice and regulations at picnic area and main lookout

CEPA-JICA project can make signboards of notice of rules or regulations at the picnic area and the main lookout based on the “National Parks Regulation 1984”. The following regulations and rules that can protect the interest of the Park are indicated below.

(1) A person while in Varirata National Park must not—

- (a) deposit or leave any litter or rubbish or any noxious, offensive or polluting substance or any material which is likely to injure other persons or pollute the park; or
- (b) break any object, the fragments of which, if left on the ground, would most likely to endanger or injure another person using the Park; or
- (c) light, maintain or use a fire in any place other than a fireplace or location approved by the Director; or
- (d) fish or hunt, capture, snare, injure, kill or have in his possession any fish, birds, animals or reptiles, accept with a fishing or hunting permit or with the written consent of the Director; or
- (e) pollute the water in any rivers, streams, reservoirs, dams or tanks in the park; or
- (f) cut, fell, remove or have in his possession any tree, shrub, plant or flower, unless the consent of the Director is granted; or
- (g) damage, remove, deface or interfere with—
 - (i) any rockface or any natural objects or features; or
 - (ii) any property or infrastructure in the Park.
- (h) walk outside the demarcated tracks and roads, or drive outside recognized driveways, except with the consent of the Director; or
- (i) remove, damage, destroy, deface, and interfere with or have in possession (in whole or in part) any sign, building, outdoor furniture or other man-made structures, plant or equipment forming part of, or used in connection with, the park except with the consent of the Director; or
- (j) carry or use any firearms, airguns, spearguns, spears, bows and arrows or other lethal weapon except with the consent of the Director; or
- (k) carry or use any explosives except with the consent of the Director; or
- (l) carry or use any firework; or
- (m) carry or use any traps, nets, snares, lines, hooks, lures, poisons, baits, enticements, cages, and other articles capable of being used for luring, holding, taking or destroying animals, birds or reptiles, except with the consent of the Director; or
- (n) hunt, capture, snare, injure, kill or have in his possession any bird, animal or reptile except with the consent of the Director; or
- (o) destroy, remove or interfere with the eggs of birds or any birds nest except with the consent of

the Director; or

- (p) dig, cut, collect, remove or interfere with any sand, soil, clay, gravel, rock, mineral, shell, fossil, timber (whether or not living), humus or other natural substances or objects whether on or under water, except with the consent of the Director; or
- (q) subject to Section 9, erect, build or maintain any dam, fence, tent, building, or other structure except with the consent of the Director; or
- (r) except with the prior written consent of the Director or in accordance with a license—
 - (i) sell or hire, expose for sale or hire or solicit for sale or hire any article or service; or
 - (ii) conduct or assist the operation of an amusement, entertainment or performance; or
- (s) throw any missile or behave in a disorderly, abusive, drunken or offensive manner; or
- (t) obstruct an officer in the performance of his duties or the exercise of his powers under this Regulation; or
- (u) make any noise that may threaten or endanger the peace and quietness of the nature in the Park; or
- (v) enter the Park without paying entry fee at the gate or the designated person collecting the entry fee; or
- (w) vehicles moving in the Park must not speed past the 30kmp speed limit.

(2) A person must not bring, release (whether or not the release is intended to be temporary), lead, drive or allow to stray onto or in the park any animal except with the consent of the Director.

(3) A person, group of persons or organizations must not use the park for the purpose of holding meetings, private or public, except with the consent of the Director.

PENALTY.

A person who contravenes or fails to comply with a provision of the Regulation is guilty of an offence. A fine not exceeding K500.00.

添付資料 2.3.2 MOU of bird watching project



**Conservation and Environment
Protection Authority**



Koiari Local Level Government



PNG Tourism Promotion Authority



Pacific Adventist University

MEMORANDUM OF UNDERSTANDING

Between

PNG Tourism Promotion Authority (PNGTPA)

And

Pacific Adventist University (PAU)

And

Koiari Rural Local Level Government (KLLG)

And

Conservation & Environment Protection Authority (CEPA)

Relating to

Bird Watching Project in/around the Varirata National Park (VNP), Pacific Adventist University (PAU) and Sirinumu/Laloki Catchment

Parties

- Whereas:** PNG TOURISM PROMOTION AUTHORITY (hereinafter referred to as PNGTPA), P.O. BOX 1291, PORT MORESBY, NCD is the national agency in-charge of promoting and marketing tourism in Papua New Guinea;
- Whereas:** PACIFIC ADVENTIST UNIVERSITY (hereinafter referred to as PAU), Private Mail Bag , BORO KO 111, NCD, PAPUA NEW GUINEA is a Tertiary Institution providing education and support for students in PNG and the Pacific;
- Whereas:** KOIARI RURAL LOCAL LEVEL GOVERNMENT (hereinafter referred to as KLLG), P.O Box 6844, BORO KO 111, NCD, PAPUA NEW GUINEA is a local-level government agency providing service and support for the local people of Koiari LLG area; and
- Whereas:** CONSERVATION & ENVIRONMENT PROTECTION AUTHORITY (hereinafter referred to as CEPA), P.O BOX 6601, BORO KO, NCD, PAPUA NEW GUINEA is implementing a biodiversity conservation and sustainable livelihood development project in PNG.
- Recognising:** CEPA's mandate to ensure that PNG's environment is managed in an environmentally sustainable manner, in order to implement the Government's *sustainable development* policy agenda. This will also provide extensive experience in nature conservation and support for natural resources management by landowners and government and NGOs in the Central Province, Papua New Guinea.

Objectives of the Memorandum of Understanding (MOU)

The parties have the intention to maintain cooperation to enhance planning and information exchange to develop and promote the bird watching activities in the Varirata National Park (VNP), PAU campus and Sirinumu/Laloki Catchment areas in Central Province.

Scope of the MOU

The scope of the MOU is based on the mutual understanding and respect of each party's policies and procedures and availability of funding for the following purposes:

1. The execution of the project titled *Bird Watching Project in/around the Varirata National Park (VNP), Pacific Adventist University (PAU) and Sirinumu/Laloki Catchment* in Central Province.
2. The inventory of the birds and their habitats, including the eco-tourism potential. All parties to work on same.
3. An assessment of (2) above that will assist PNGTPA for the promotion of bird watching and its potential for eco-tourism towards realising the region's economic potential.

4. Ongoing logistics and technical support by PNGTPA for further tourism related training and information exchanges to assist the progress of the bird watching project.
5. Provision of input by PNGTPA, PAU, KLLG and CEPA including local government bodies about conservation options and policies as required.
6. The development and execution of such further activities as agreed by all parties (PNGTPA, PAU, KLLG and CEPA) through mutually accepted and possible means.
7. To create an environment for mutual understanding for research, training and capacity building for all parties, local resource owners and partner organisations in order for better planning to achieve the above.

I General

- a. The partnership described in this MOU is for the long-term collaborative working relationship between all parties for bird watching and natural resource planning and conservation for sustainable livelihood development in the Koiari and Hiri areas of Central Province.
- b. The Parties agree to commence the collaboration on the date of the signing of this MOU.
- c. The duration of the MOU will be 5 years, and may be extended by agreement of all parties.
- d. This MOU may be modified only by written amendment executed by all parties.
- e. Any party may terminate this MOU by giving two months notice in writing. Collaboration of the surviving parties is intended in the event just one party wishes to terminate their participation.
- f. The parties welcome external funding assistance from the National Government, NGO's, NCDC Tourism office, Central Tourism office, Central Provincial Government and the district services fund to assist with the project. However, any such financial support provided by the Government, NGO's, private sector, individuals or other relevant institutions will not be considered party to this project.
- g. All parties intend to work together to create and update a webpage to communicate and publish any progress on activities carried out during the course of this project.
- h. All parties will maintain confidentiality of all information that is not in the public domain. All information passing from one party to another including, technical advice, special skills and knowledge, copyright materials, designs, estimates, project secrets, budgets, proposals, know how, techniques, and agreements with other third parties to be treated confidential in line with normal professional confidentiality protocols.

II The responsibilities and contribution of the PNGTPA will be to:

- a. Provide funding according to the project planning agreements reached at the beginning of the bird watching project for at least the beginning of the project.
- b. Provide a member of staff to be involved in the execution of site identification and verification, facility design and promotion.
- c. Provide a senior member of staff to sit on the Technical Working Group of the *Bird Watching Project in/around the Varirata National Park (VNP), Pacific Adventist University (PAU) and Sirinumu/Laloki Catchment*.
- d. Actively promote the *Bird Watching Project in/around the Varirata National Park (VNP), Pacific Adventist University (PAU) and Sirinumu/Laloki Catchment* by making information readily available.
- e. Take ownership of the bird watching database and such other information as is produced by the *Bird Watching Project in/around the Varirata National Park (VNP), Pacific Adventist University (PAU) and Sirinumu/Laloki Catchment* for the use of PNGTPA work.

III The responsibilities and contribution of PAU will be to:

- a. Assist the *Bird Watching Project in/around the Varirata National Park (VNP), Pacific Adventist University, and Sirinumu/Laloki Catchment* by providing at least one staff and/or student as a guide on the PAU campus.
- b. Provide PNGTPA with semi-annual technical and financial reports on the *Bird Watching Project in/around the Varirata National Park (VNP) and Pacific Adventist University* and such other results as may be obtained.
- c. Provide a senior member of staff to sit on the Technical Working Group of the *Bird Watching Project in/around the Varirata National Park (VNP), Pacific Adventist University and Sirinumu/Laloki Catchment*.
- d. Provide technical support to PNGTPA, CEPA and KLLG including the local stakeholders, beyond the scope and duration of the *Bird Watching Project in/around the Varirata National Park (VNP), Pacific Adventist University (PAU) and Sirinumu/Laloki Catchment* in regards to information and advice on issues of the biodiversity (including birds) and natural resources conservation, environmental management and such related issues as arise or are required.

IV The responsibilities and contribution of KLLG will be to:

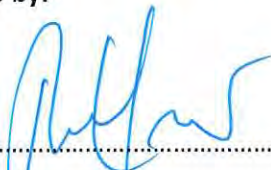
- a. Assist the *Bird Watching Project in/around the Varirata National Park (VNP), Pacific Adventist University and Sirinumu/Laloki Catchment* and provide at least a staff or community representative to participate in this project.
- b. Provide necessary support and coordination for the bird watching project amongst the local landowners.
- c. Provide logistical support and guide to all collaborating researchers, including PAU staff and students, in locations other than NCD or PAU campus.
- d. Act as a moderator and medium between different landowner/clan groups and social groups.
- e. Take initiative to strengthen participation and community involvement and benefit sharing amongst partners.
- f. Address cross cutting issues amongst landowners such as biodiversity conservation and tourism related activities in the Koiari LLG area.

V The responsibilities and contribution of CEPA will be to:

- a. Assist the *Bird Watching Project in/around the Varirata National Park (VNP), Pacific Adventist University (PAU) and Sirinumu/Laloki Catchment* by providing at least some staff as agreed at the outset of the project.
- b. Provide PNGTPA, PAU and KLLG with semi-annual technical and financial reports on the *Bird Watching Project in/around the Varirata National Park (VNP), Pacific Adventist University (PAU), and Sirinumu/Laloki Catchment* including other results as may be obtained.
- c. Accept students during practicum/vacation periods in support of the *Bird Watching Project in/around the Varirata National Park (VNP), Pacific Adventist University (PAU), and Sirinumu/Laloki Catchment* Project.
- d. Provide a senior member of staff to sit on the Technical Working Group of the *Bird Watching Project in/around the Varirata National Park (VNP), Pacific Adventist University (PAU) and Sirinumu/Laloki Catchment*.
- e. Provide camera traps and drone imagery including the GIS technology for the *Bird Watching Project in/around the Varirata National Park (VNP), Pacific Adventist University (PAU) and Sirinumu/Laloki Catchment*.


- f. Participate in training offered by PAU specifically related to the *Bird Watching Project in/around the Varirata National Park (VNP), Pacific Adventist University (PAU) and Sirinumu/Laloki Catchment*.
- g. Provide technical support to PNGTPA, PAU and KLLG including the local stakeholders, beyond the scope and duration of the *Bird Watching Project in/around the Varirata National Park (VNP), Pacific Adventist University (PAU) and Sirinumu/Laloki Catchment*, in regards to information and advice on issues of the biodiversity (including birds) and natural resources conservation, environmental management and such related issues as arise or are required.

Agreed to by:

Signed.....


Mr. Eric Mossman
Chief Executive Officer (Acting)
PNG Tourism Promotion Authority

Date.....
19/02/2016

Signed.....


Professor Ben Thomas
Vice-Chancellor
Pacific Adventist University

Date.....
19/2/16

Signed.....


Mr. Gunther Joku
Managing Director
Conservation & Environment Protection Authority

Date.....
19/02/2016

Signed.....


Mr. David Ogi
Council President – Koiari LLG

Date.....
19.2.16

Witness:

Signed.....
Mr. Koji Asano

Mr. Koji Asano
Chief Advisor - CEPA-JICA Project

Date.....
19 Feb 2016

Annex 1: Varirata National Park, Pacific Adventist University and Sirinumu/Laloki Catchment Bird Watching Enhancement Joint Project

Project Workplan

Project Title: Bird Watching Project in/around the Varirata National Park (VNP), Pacific Adventist University (PAU) and Sirinumu/Laloki Catchment

Submitted/Provided By: PNG Tourism Promotion Authority (PNG TPA), Pacific Adventist University (PAU), Koairi Rural Local Level Government (KLLG) and Conservation & Environment Protection Authority (CEPA) through the CEPA/JICA Project Technical Cooperation Team

Objective: The objective of the project is to identify key birding spots/areas at the Varirata National Park (VNP) and the catchment area (including PAU) by working in partnership with JICA/CEPA to develop the respective sites and to strengthen the VNP management function. The timeframe for this project is approximately five (5) years from 2016-2020.

Background:

Papua New Guinea is one of the last biodiversity frontiers in the world with over 80% of its population are in rural areas and still directly dependent on the natural environment with the rich biodiversity for their subsistence and livelihoods. PNG also has a remarkable cultural diversity with over 800 languages, associated with traditional beliefs, dances, customs and taboos, with 96% of its land still under a customary land tenure system. It is also home to over 18,894 described plant species, 760 birds, 271 mammals, 227 reptiles, 266 frogs, 341 freshwater fish species, 600 different coral species, and 3000 species of reef fish, with many more species yet to be discovered and documented scientifically.

It was documented by Coates (2014) that some 400 species of birds have been found in Port Moresby and outside of the city including the Varirata National Park (VNP), Laloki/Sirinumu Catchment and Pacific Adventist University (PAU). Most are resident birds, many of which are either endemic to PNG (e.g. Raggiana Bird of Paradise) or specifically to the island of New Guinea (e.g. Brown Oriole), and the migratory birds which visit annually from their breeding areas in Australia. These annual visitors include the migratory birds such as the Sacred Kingfisher and the Pacific Golden Plover which follows the East Asia-Australasian Flyway.

This birding project will also promote the mandate of CEPA to ensure that PNG's environment is managed in an environmentally sustainable manner, in order to implement the Government's *sustainable development* policy agenda. CEPA on behalf of the GoPNG is the signatory to the United Nations Convention on Biodiversity (CBD) has committed by 2020 to establish a comprehensive, effective managed and ecologically-representative national system of protected area, including the effective management of Varirata National Park in Koiari LLG, Central Province. Therefore, places like Varirata National Park (VNP) and the surrounding areas with unique biodiversity and cultural diversity need to be protected. This will also include the bird watching sites within the VNP and the surrounding areas of the Laloki and Sirinumu Catchment areas and PAU campus.

Project Partners:

The partners which will be implementing the bird watching project are comprised of PNG Tourism Promotion Authority (PNG TPA), Pacific Adventist University (PAU), Koiari Rural Local Level Government (KLLG) and Conservation & Environment Protection Authority (CEPA) through the CEPA-JICA Project.

Further, Tourism Promotion Authority (TPA) has keen interest to identify and establish bird watching sites in and around the VNP with the collaborative support from the CEPA-JICA project. TPA is also working closely with PAU to promote the bird watching sites in and around the PAU campus including the lakes and wetlands.

Project Locality:

The sites for bird watching will be identified and established within the Varirata National Park (VNP) and the surrounding areas of Sirinumu and Laloki Catchment including sites within the PAU campus. These sites are situated at an elevation of 50 – 800m on both the State (VNP/PAU) and the customary land with the consent from the local landowners of Koiari. The VNP and Sirinumu/Laloki Catchment areas have an average annual rainfall of 5080 mm. The general landform of the VNP and the Catchment areas consist of closely spaced narrow accordant ridges and spurs with a relief of 15-30 meters. Rocks found in the VNP consist of balastic lava, agglomerate, tuff and dyke origins.

The sites at PAU (including PAU campus at Koiari Park and marine area towards Bootless Bay) are mosaic of savannah grasslands and wetlands.

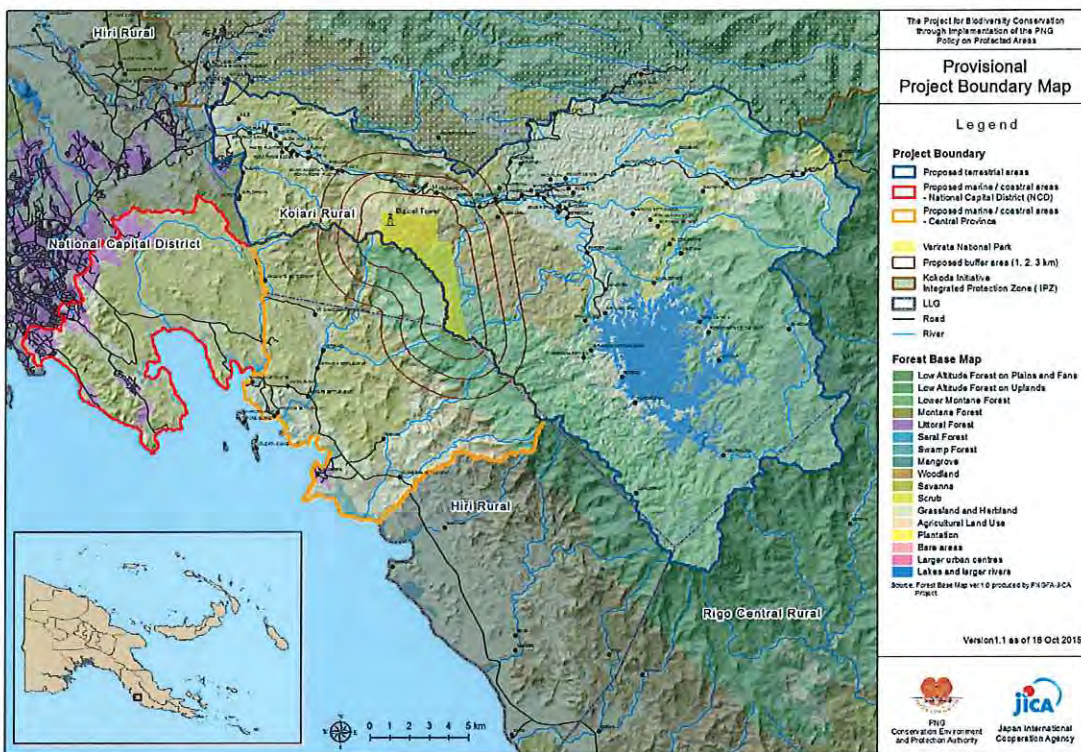


Fig.1. Map showing the VNP, Sirinumu/Laloki Catchment and PAU

Other Flora and fauna:

The vegetation types of the VNP, Sirinumu/Laloki Catchment areas and PAU consist of the rainforest, savannah, grassland, gallery forest, secondary regrowth and wetlands. Bird life is rich in those different environments, and in particular the Raggiana Bird of Paradise (BoP), the Rifle BoP, and the other different species of doves, lorries, pigeons, kites, cockatoos, kingfishers, fantails, and swallows are common in the VNP. The waterbirds including the Intermediate Egrets, sandpipers, water ducks and plovers are popular at PAU and the catchment areas of Laloki and Sirinumu Dam. Some of these species are local migrant utilizing the lakes and wetlands at Sirinumu/Laloki and PAU campus. Whilst others are migratory birds using the lakes and wetlands at PAU campus and Sirinumu/Laloki Catchment areas as stop-overs and follow the East Asia-Australasia Flyway to Australia for breeding.

The VNP and the Catchment areas (including PAU) also have common animals such as the migrant Rosa deer, forest wallabies, possums, cuscus, bandicoots, rodents, wild boas, frogs, odonates, butterflies, other terrestrial insects and different species of reptiles including pythons.

Project Workplan and Budget:

It is estimated that a total of **PGK 550,000** is budgeted for the implementation of the birding project by the four partners (TPA, PAU, KLLG and CEPA through the CEPA-JICA Project) over the period of the CEPA-JICA project.

Goal : Bird Watching Product Enhancement Project In/around the Varirata National Park (VNP)							
Activities (key action steps)	Inputs	Timeline	Expected result	Outputs	Person Responsible	Propose Budget	Actions
Step 1: Site Selection							
1. Site observation	<ul style="list-style-type: none"> TPA officers PAU staff KLLG staff CEPA/JICA staff 	Feb 2016	At least 6 appropriate bird watching site identified	<ul style="list-style-type: none"> Profile notes of candidate sites 	PAU (Peter)	NA	<ul style="list-style-type: none"> Series of meetings Profile form will be developed by PAU
			At least 2 in VNP	<ul style="list-style-type: none"> General site description 	CEPA/JICA	NA	
			At least 2 in PAU campus and/or Bootless bay	<ul style="list-style-type: none"> General site description 	PAU	NA	
2. Site verification	<ul style="list-style-type: none"> TPA officers 	Feb 2016-Mar 2016	At least 2 in Sirinum/Laloki catchment	<ul style="list-style-type: none"> General site description 	TPA, KLLG	K5,000 (KLLG)	<ul style="list-style-type: none"> Interview Bird expert(s) and Guide TPA/PAU/KLLG carry out site verification
			Candidate BW sites are assessed from bird watcher point of view	<ul style="list-style-type: none"> Assessment memo 	TPA (Nathan)	NA	
3. Biodiversity Survey(bird survey) in VNP	<ul style="list-style-type: none"> CEPA/JICA staff 	Feb 2016-Dec 2016	Bird list produced and habitat information collected in VNP	<ul style="list-style-type: none"> Bird guides Reports 	CEPA/JICA (Ted)	K140,000 (JICA)	<ul style="list-style-type: none"> Biodiversity survey including bird in VNP
4. Site selection for development and planning	<ul style="list-style-type: none"> TPA officers PAU staff KLLG staff CEPA/JICA staff 	Feb 2016-May 2016	At least a total of 3 bird watching sites identified.	<ul style="list-style-type: none"> Plan for next course of actions in each site 	TPA (Nathan)	NA	<ul style="list-style-type: none"> Series of meetings Variable type of site should be selected ex). Forest, Grassland River, Wetland, Mangrove, Sea, etc.

Step 2. Facility (such as bird hide) development							
1. Site rapid assessment for development	<ul style="list-style-type: none"> • TPA officers • PAU staff • KLLG staff • CEPA/JICA staff 	Feb 2016-May 2016	Facilities for bird watchers	List of proposed facilities to be installed in each site	TPA (Nathan)	NA	Series of meetings
2. Facilities planning	<ul style="list-style-type: none"> • TPA officers • PAU staff • KLLG staff • CEPA/JICA staff 	Mar 2016 – June 2016	Plan, Drawing, design	Plans and designs for actual installation	TPA (Nathan)	K10,000 (TPA)	Plan & design of facilities agreed
3. Facility construction	<ul style="list-style-type: none"> • TPA officers • PAU staff • KLLG staff • CEPA/JICA staff 	Jun 2016-Dec 2016	Signboards, facilities for bird watcher	Signboards etc	CEPA/JICA	K25,000 (JICA)	Ex) Sign boards within and around VNP, etc
		Jun 2016-Dec 2019	Signboards, facilities for bird watcher	Signboards etc	TPA/PAU	K150,000 (5 years) (TPA)	Ex) Bird hide, Sign board, wooden path, etc
Step 3. Promotion							
1. Preparation of Bird Guide Book	<ul style="list-style-type: none"> • TPA officers • PAU staff • KLLG staff • CEPA/JICA staff 	Oct 2016-Feb 2017	Bird Guidebook for VNP	Guide book developed, distributed	CEPA/JICA	K100,000 (JICA)	Engage expert to develop Bird Guide Book
			Bird Guidebook for PAU/ Sirinum/Laloki catchment	Guide book developed, distributed	TPA	K15,000 (TPA)	Develop Bird Guide Book
2. Research & compiling of visitor brochure & VNP bird information	<ul style="list-style-type: none"> • TPA Officers • PAU staff 	Oct 2016- Jan 2017	Research & brochure compiling and printing	Brochure developed, distributed to visitors	TPA	K10,000 (TPA)	Consultations & series of meeting
3. Road shows/ Bird fairs/ tourism expeditions	<ul style="list-style-type: none"> • TPA Officer/Marketing Division 	Jan 2017- May 2018	Events, advertisement	Recognized attraction of VNP, PAU & Sirinum/Laloki by bird watchers and tour agencies	TPA	K20,000 (TPA)	Identify & schedule timing for shows, etc

4. Creation of promotional video (using camera trapping and drone imagery)	<ul style="list-style-type: none"> • TPA Officers/Marketing Division • CEPAJICA staff 	Jan 2017- May 2018	Creation of promotional bird watching DVD	Recognized attraction of VNP, PAU & Sirinum/Laoki by bird watchers and tour agencies	TPA	K50,000 (TPA)	<ul style="list-style-type: none"> • Engage experts (bird expert, camera crews) & narrator
Step 4. Eco-tour development (to be discussed in later stage)							
1. Training and capacity building	<ul style="list-style-type: none"> • TPA officers • PAU staff 	Jun 2016-Dec 2017	Training modules design, participation list, organisations involved etc	Birding Knowledge development, Certificates issued to participants, etc	TPA,PAU	K10,000 (TPA)	<ul style="list-style-type: none"> • Identify training needs • Series of trainings
2. Development of eco-tourism with local communities	<ul style="list-style-type: none"> • CEPAJICA staff • KLLG staff 	Jun 2016-Dec 2019	BW tour package including livelihood activities	Regularity conducted BW tour as livelihood activity	CEPA/JICA, KLLG	K15,000 (KLLG) (JICA -Not yet fixed)	<ul style="list-style-type: none"> • Series of meetings

添付資料 2.3.3 Gazette new fee system in VNP



CONSERVATION AND ENVIRONMENT PROTECTION AUTHORITY

OFFICE OF THE MANAGING DIRECTOR

7TH Floor-Dynasty Tower II
Savannah Heights, Waigani
P O Box 6601
BOROKO, NCD
Papua New Guinea

Telephone: (675) 3014500/3014530
Facsimile: (675) 3250182
E-mail: officesec@dec.gov.pg
Website: www.dec.gov.pg

Mrs. Christine Lenturut
Government Printer
Government Printing Office
Department of Prime Minister & NEC
Muruk Haus, Kumul Avenue
P. O. Box 1280
PORT MORESBY
National Capital District

Date: 21st February 2019
File: vnp/fees
A/Officer: mal

Dear Mrs. Lenturut,

SUBJECT: GAZETTAL OF VARIRATA NATIONAL PARK NEW ENTRY FEE'S SYSTEM

The declaration and establishment of the Varirata National Park new entry fee's system has been approved and certified for gazettal.

Attached are pertaining declaration and gazettal instruments signed by the Minister for Environment, Conservation and Climate Change and forwarded to the Government Printing Officer for the gazettal.

Kindly accord the instruments for immediate gazettal.

Yours sincerely,


Gunther JOKU
Managing Director



Conservation and Environment Protection Authority Act 2014.

**DECLARATION AND ESTABLISHMENT OF NEW GATE FEE SYSTEM FOR
VARIRATA NATIONAL PARK.**

I, **JOHN PUNDARI**, Minister for Environment, Conservation and Climate Change, by virtue of the powers conferred by Section 50 of the *Conservation and Environment Protection Authority Act 2014* and all other powers me enabling, having consulted with the Conservation and Environment Protection Authority Administration, hereby -

- (a) state that pursuant to Section 50(1) of the *Conservation and Environment Protection Authority Act 2014*, the *National Parks Acts Act* (Chapter 157) is repealed; and
- (b) in Section (50(2), all subordinate enactments including the *National Parks Regulations* (Chapter 157) and all forms and instruments made, issued or approved under the *National Parks Act* (Chapter 157) (*Repealed*) continue in force as if made under this Act, so far as they are not inconsistent with this Act, until varied, repealed or replaced in accordance with this Act; and
- (c) commit to the care, control and management of Varirata National Park in accordance with *Conservation and Environment Protection Authority Act 2014*; and
- (d) in Section 31 of the *Conservation and Environment Protection Authority Act 2014*, state that Conservation and Environment Protection Authority shall comply with the *Public Finances (Management) Act 1995* and Section 32(1C) also stipulates that the funds of the Authority shall consists of monies received in respect of rents, fees, charges, bonds and other sum payable under this Act; and
- (e) approve the imposition of fees as specified in Schedule 1 for the Varirata National Park to be enforced immediately and collected as funds for Conservation and Environment Protection Authority.

SCHEDULE.

	New Fees	
	Locals/Citizens	Non-Citizens
(I) General Public.		
Adult (>15 years)	K5.00 / person	K10.00 / person
Students (with ID)	K4.00 / person	K8.00 / person
Children (3-14 years)	K3.00 / person	K6.00 / person
Vehicle (1-8 passengers inside)	K50.00 / vehicle	
Vehicle (9-15 passengers inside)	K70.00 / vehicle	
Vehicle (>15 passengers inside)	K100.00 / vehicle	
(II) Tour Operators.		
Group (1-8 people)	K300.00 / group	
Group (9-15 people)	K400.00 / group	
Group (>15 people)	K500.00 / group	
(III) Special Arrangements.		
Visiting Schools (any)	K250.00 / group	
Research Groups (any)	K500.00 / group	
Corporate (any)	K1,000.00 / group	
Others (including Churches, Government, Sports, Trekkers, etc.,)	K300.00 / group	

DATED this

20th

day of

February

, 2019.

**MINISTER FOR ENVIRONMENT,
CONSERVATION AND CLIMATE CHANGE.**



OFFICE OF LEGISLATIVE COUNSEL

DEPARTMENT OF PRIME MINISTER AND NATIONAL EXECUTIVE COUNCIL
6th FLOOR, SIR MANASUPE HAUS, SIR JOHN GUISE DRIVE, WAIGANI, PORT MORESBY

TELEPHONE: (675) 301 9277/301 9278/301 9284
EMAIL: olc.drafting@pnglaw.gov.pg

*These 4 do person
to relevant Director
do return
18/02/19.*

② Scan copy for my office.
P O BOX 639
WAIGANI
PAPUA NEW GUINEA

Mr. Gunther Joku,
Managing Director,
Conservation and Environment Protection
Authority,
P. O. Box 6601,
BOROKO,
National Capital District.

Date: 12th February, 2019.

Our Reference:
Action Officer
Designation:

Your Reference:
Date:



Dear Mr. Gunther

I acknowledge your letter of 29th January, 2019 and enclose the relevant Instruments for your further action.

Yours sincerely,


JOHNNY BOGOMBARI
First Legislative Counsel.

添付資料 2.3.4 Final reports of Biodiversity Survey



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

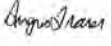
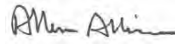
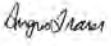
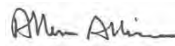
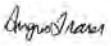
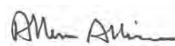


Japan International
Cooperation Agency

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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 km²) 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 (*Zonotrichia 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.

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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 5: Eucalypt savannah below the VNP Main Lookout

Photo credit: Allen Allison



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 6: Main Lookout, elevation 833 meters, VNP

Photo credit: Allen Allison



Figure 4: Lower Laloki Valley & Mt Lawes from the VNP Main Lookout

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 Lova 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, Nitty 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.

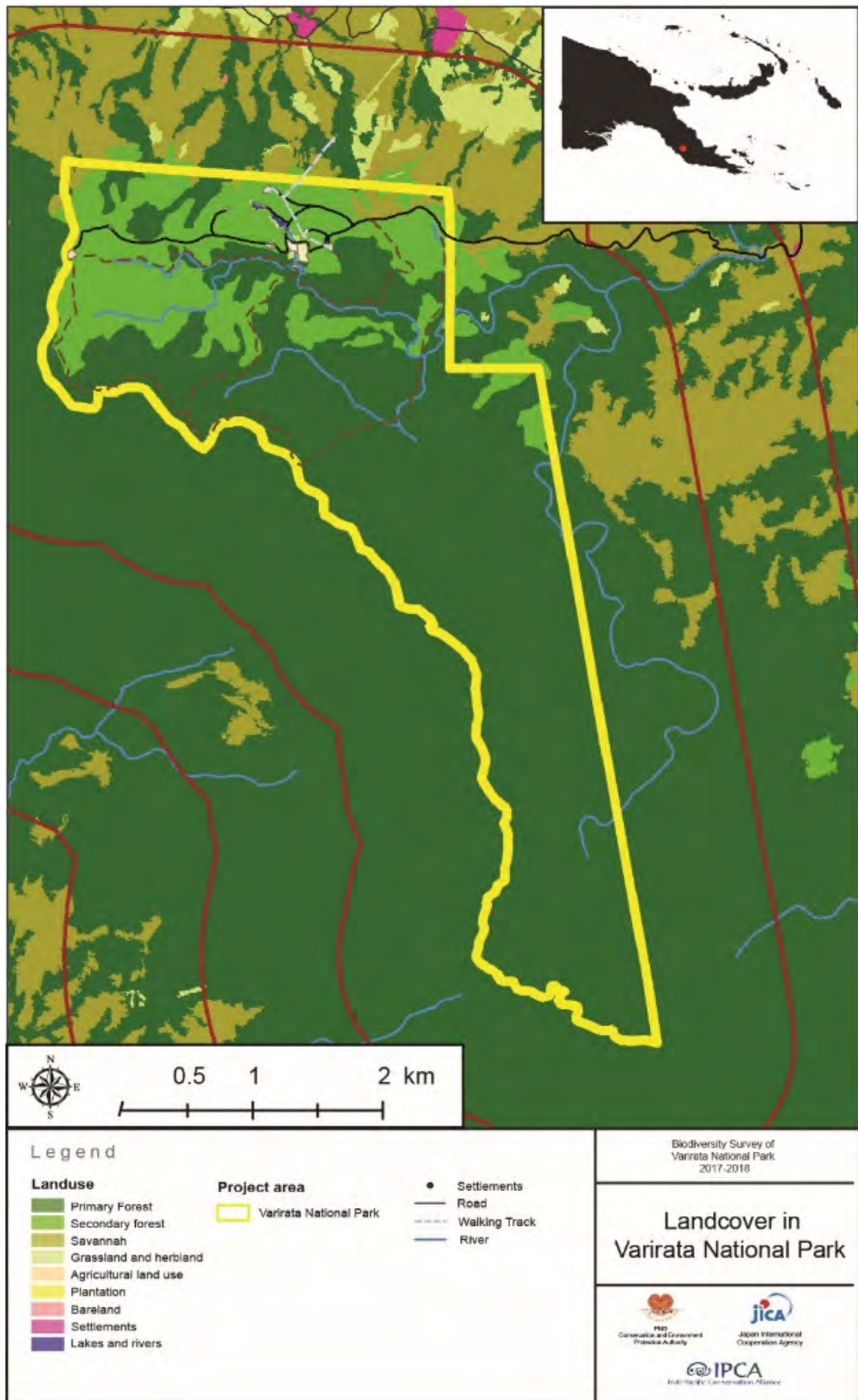


Figure 8: Land use in VNP and surrounding areas.

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 emphasize 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 30°C and rarely drop below 16°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.

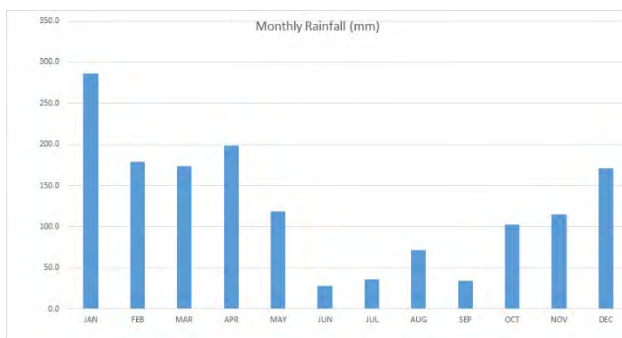


Figure 10: Monthly rainfall in VNP

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 (*Grevillia 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.

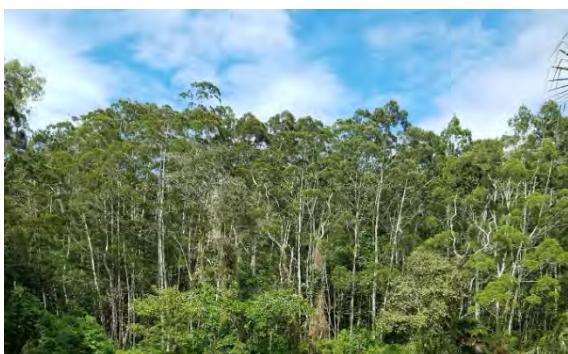


Figure 17: Secondary forest (*Gymnostoma papuana*) adjacent to Lake Lililikatabu

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: *Pandanus* 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.

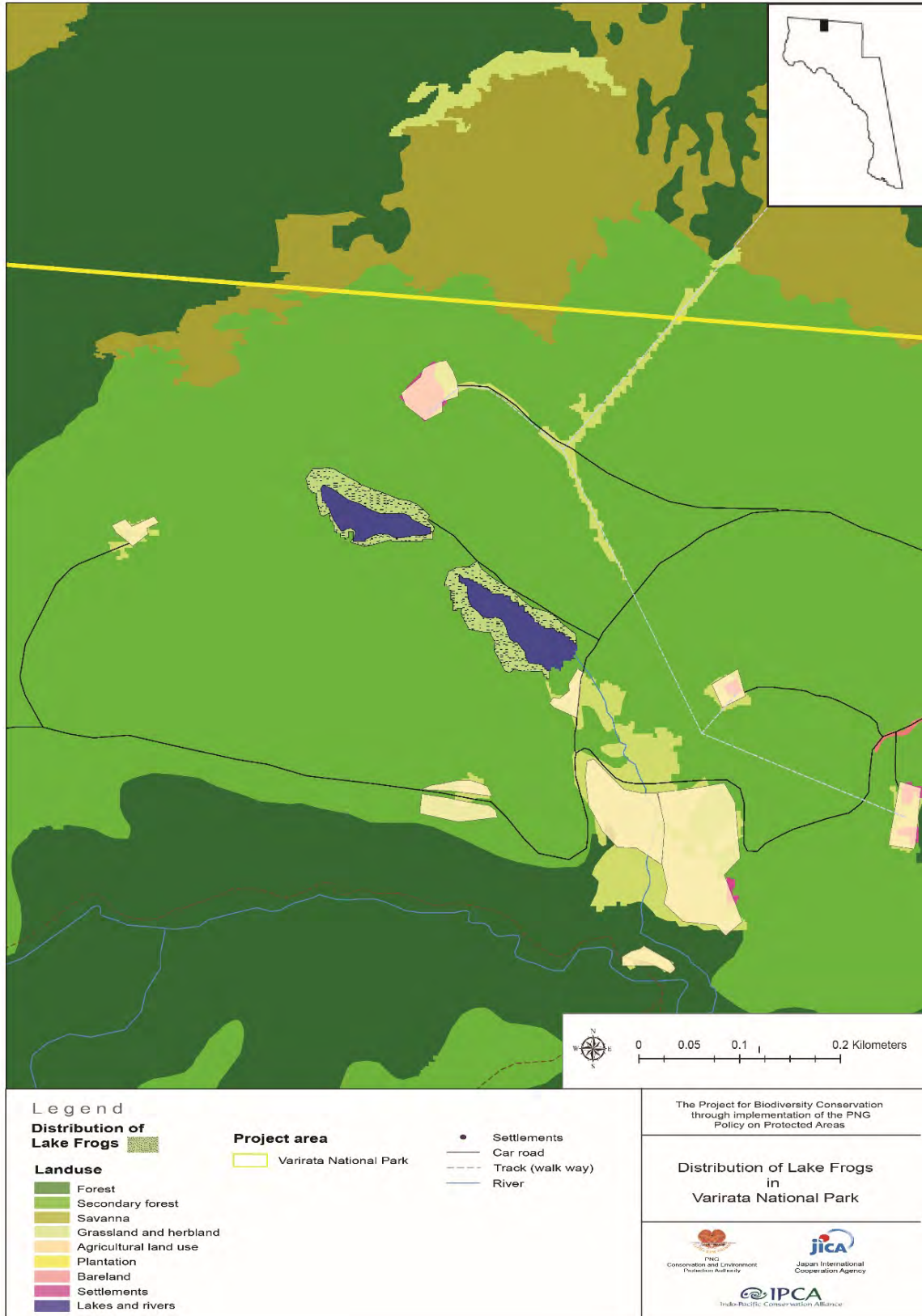


Figure 30: Map of frog habitat around the Lifilikatabu Lake complex in VNP.

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.

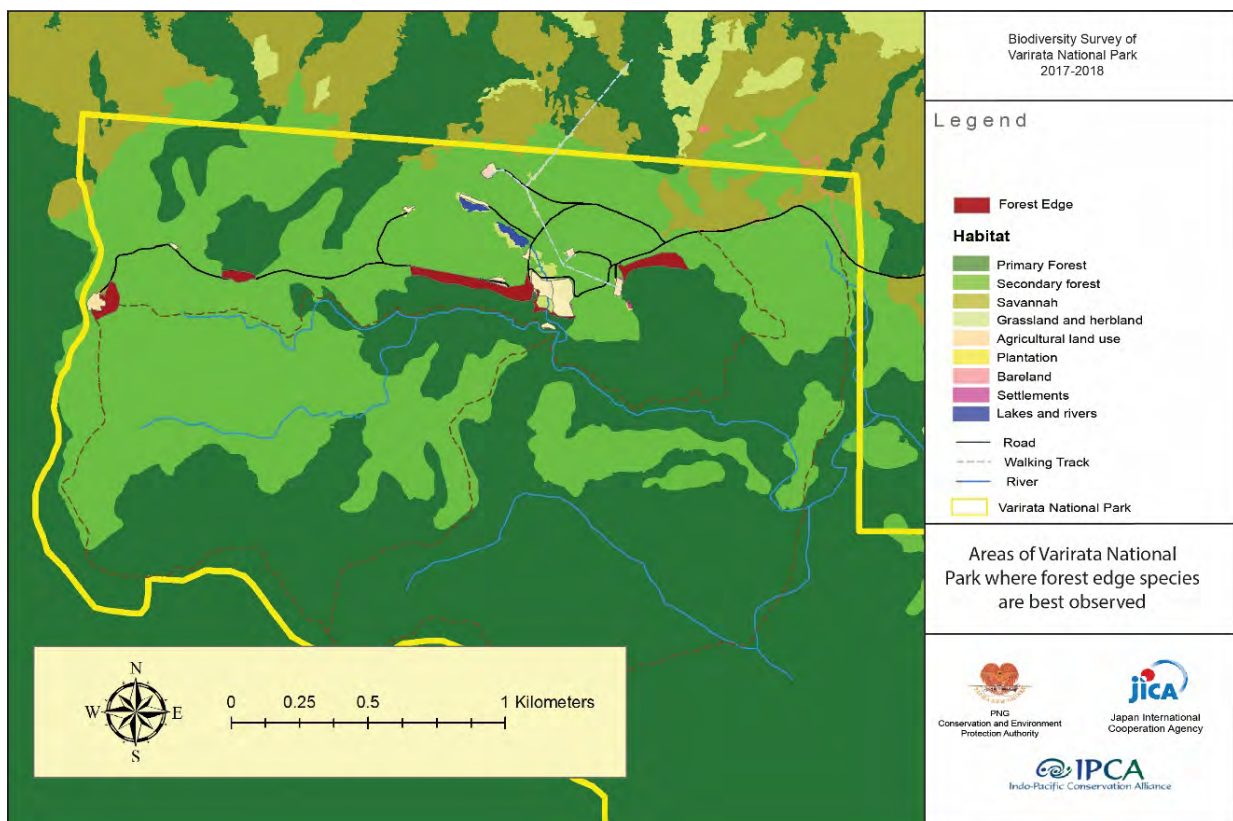


Figure 33: Map of forest edge communities where wildlife can be readily observed

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).

4.2.1. Annelida, Class Hirudinea: Leeches

Leeches belong to the Class Hirudinea 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

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).

4.2.2. 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 Lifikatabu 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*
- *Nihoavireti*

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).

Nihoavireti 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).

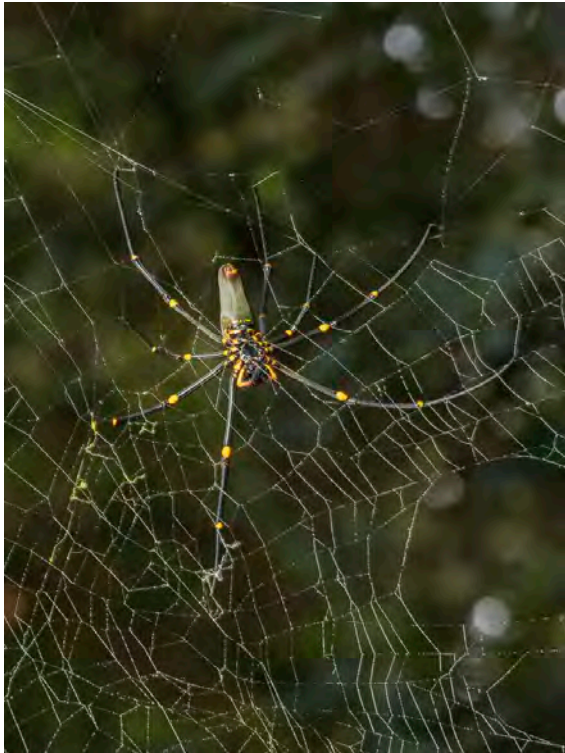


Figure 38: Golden Orb spider (*Nephila sp.*), VNP
 Photographed in primary forest along the Scarp Track.
 Photo credit: Angus Fraser



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 ulyssees*), 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

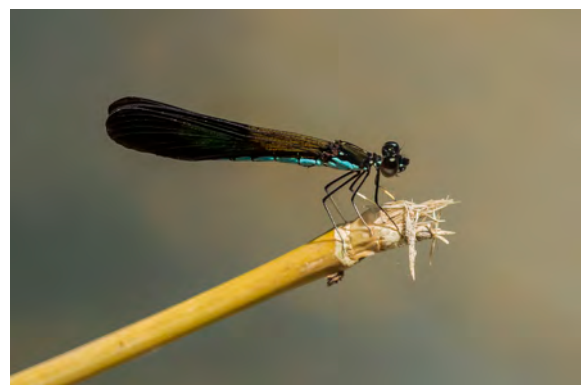


Figure 47: Damselfly (*Idiocnemis sp.*), VNP

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 its 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 Lifikatabu 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).

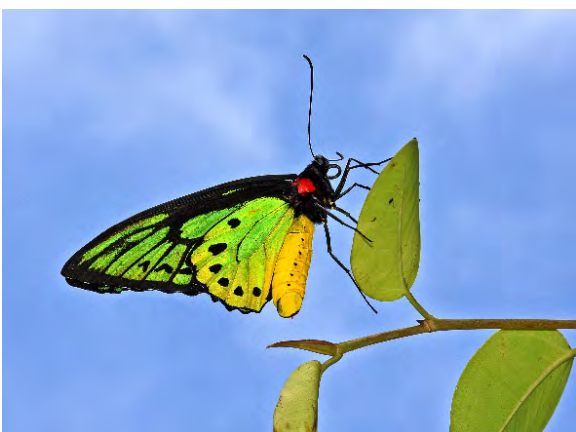


Figure 48: Common Birdwing Butterfly (*Ornithoptera priamus*)

Photo credit: Dan Polhemus



Figure 49: Red Lacewing (*Cethosia cydippe*), VNP

Photographed adjacent to the Lake Lifikatabu 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

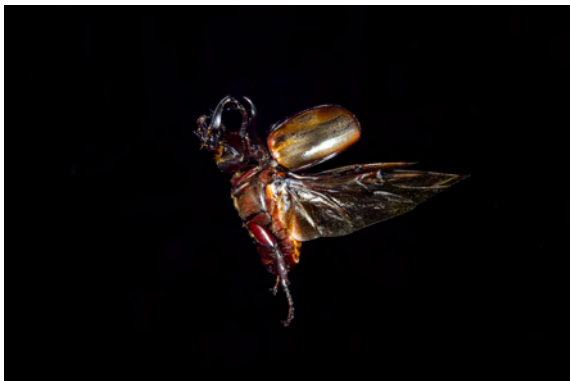


Figure 52: Rhinoceros Beetle (*Xylotrupes gideon*), VNP
Photographed in flight using a camera trap and light source configured specifically for this purpose enabling non-destructive sampling to be undertaken for insect taxa. Photo credit: Angus Fraser



Figure 53: Longhorn Beetle (*Agranome* 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.

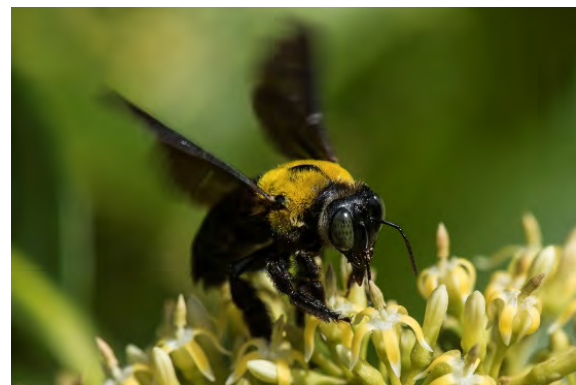


Figure 54: Bumble Bee (Order Hymenoptera) VNP
Photo credit: Angus Fraser

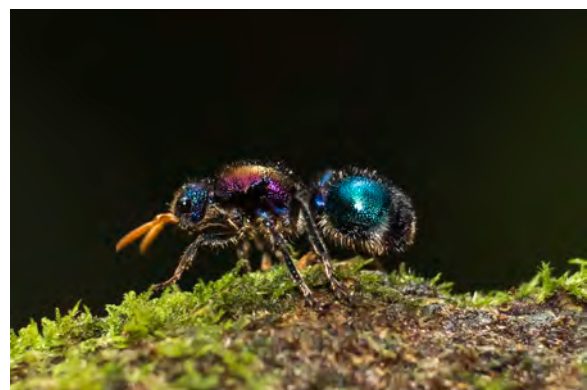


Figure 55: Rainbow Ant (Order Hymenoptera) VNP
This species was photographed in primary forest. Photo credit: Angus Fraser

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

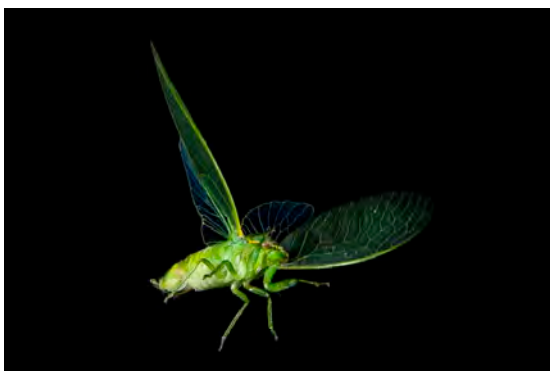


Figure 57: Nocturnal cicada sp (Order Hemiptera), VNP

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).

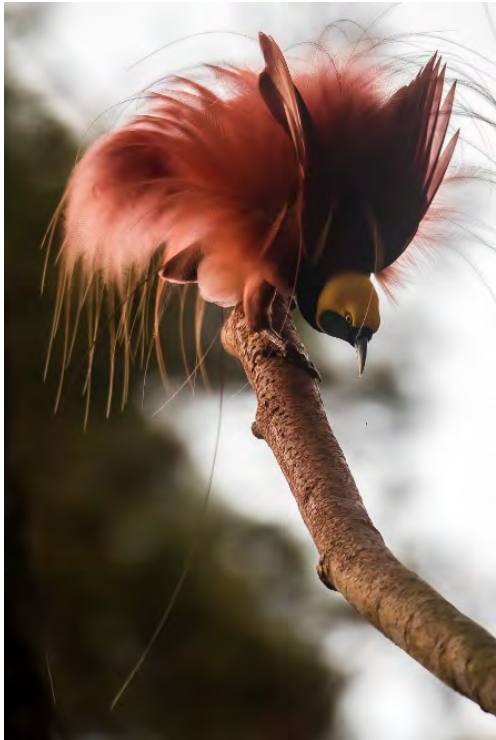


Figure 75: Raggiana Bird of Paradise (*Paradisaea Raggiana*), VNP

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.

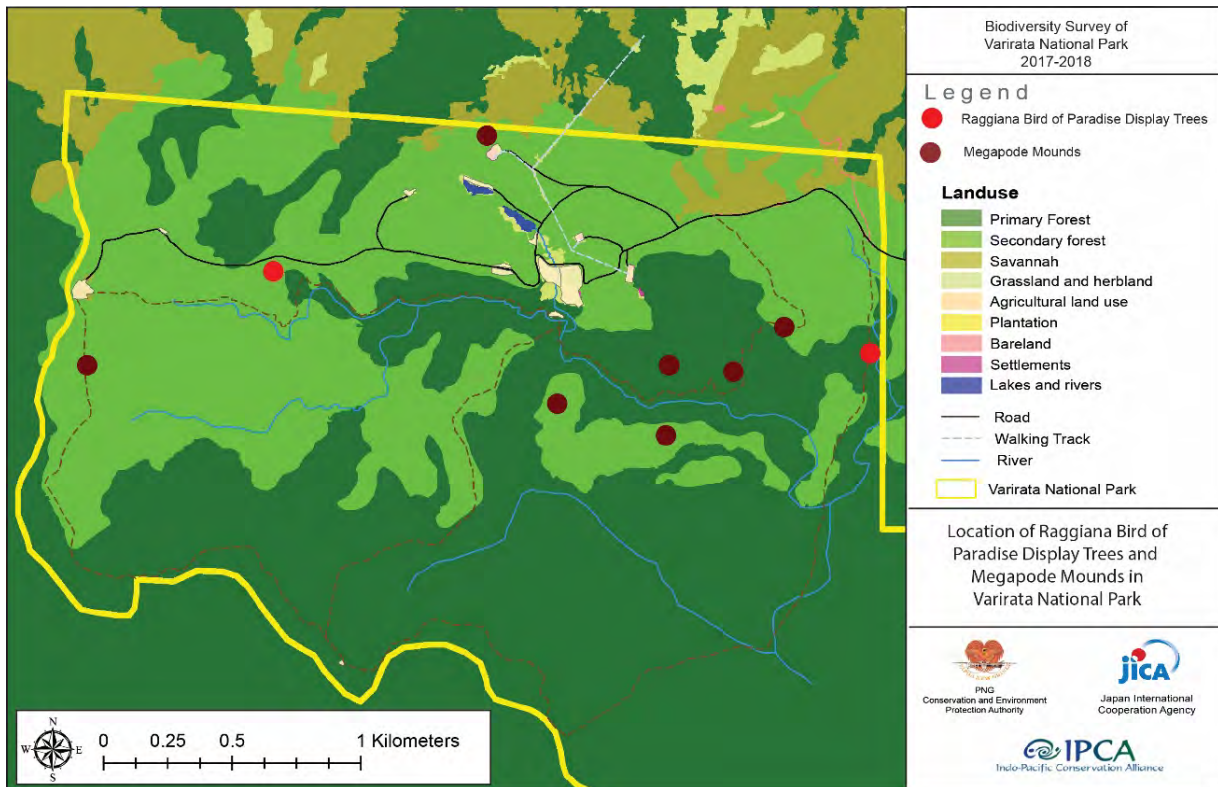


Figure 76: Map of Raggiana display leks and megapode mounds

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 Lifikatabu 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 JICA's 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

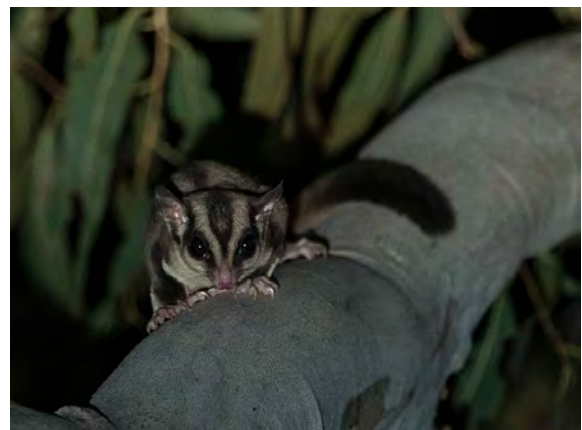


Figure 95: Sugar Glider (*Petaurus breviceps*), VNP

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 September 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*).

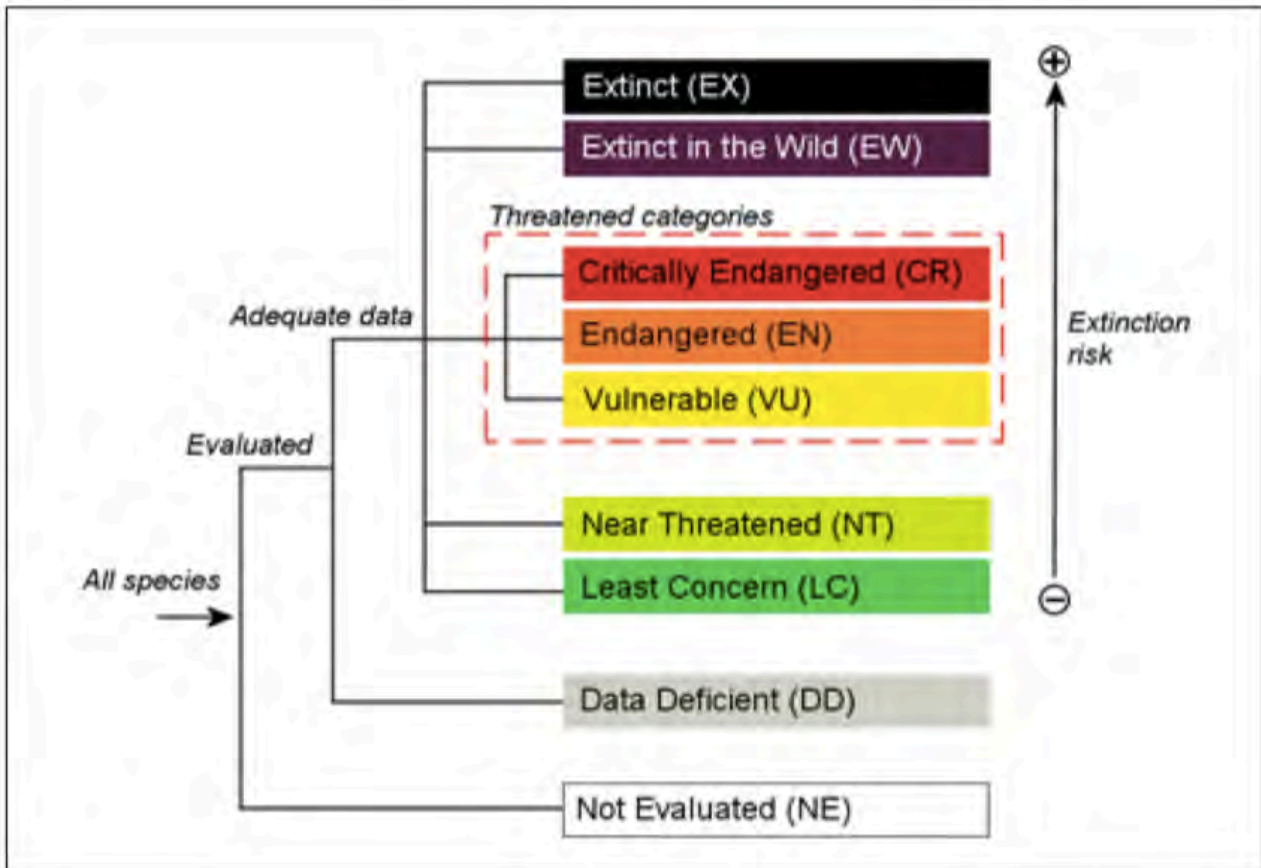


Figure 99: IUCN Red List Conservation Categories

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

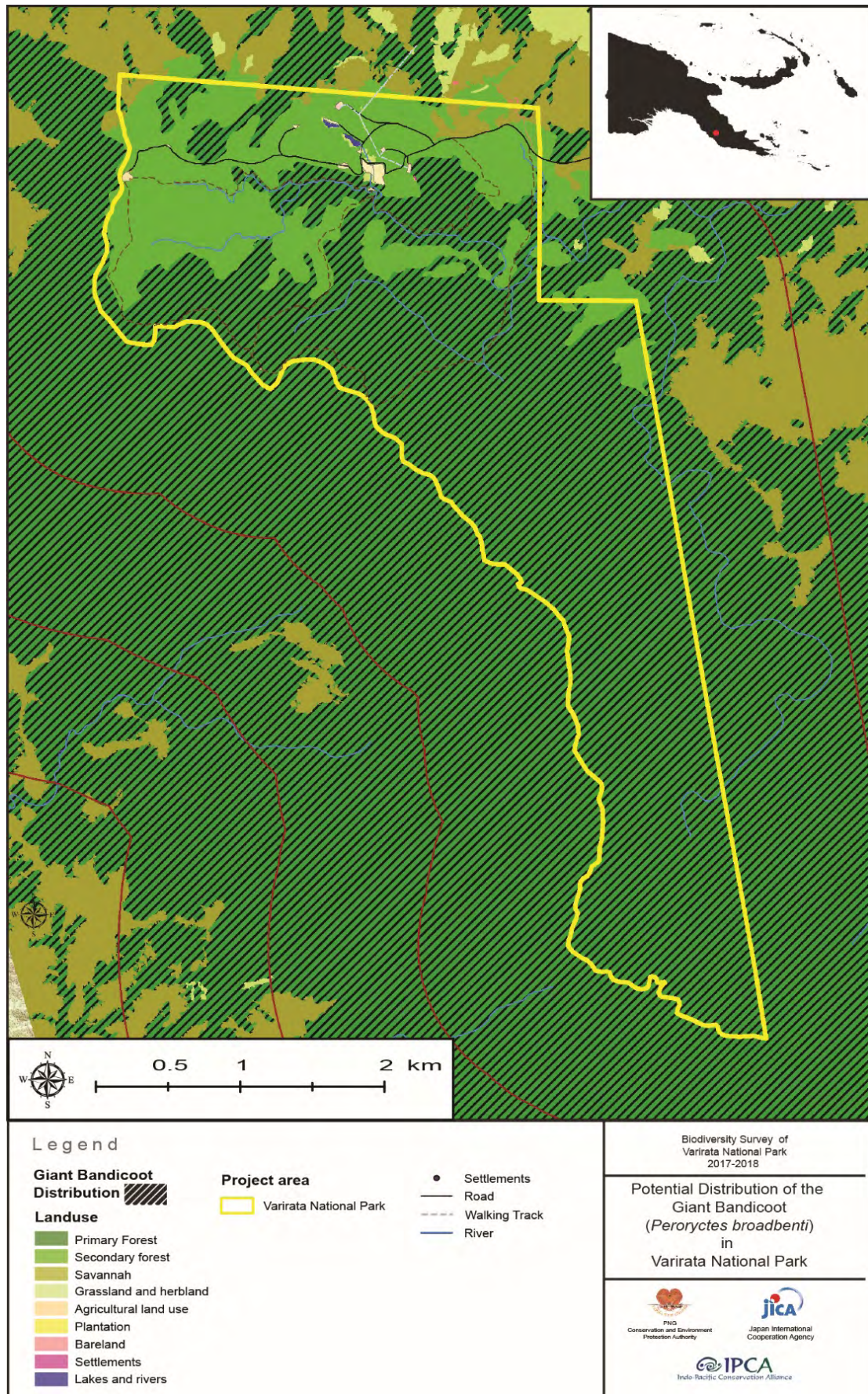


Figure 102: Distribution of Giant Bandicoot based on habitat preference

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	<i>Oreochromis mossambicus</i>	Fish
Guppy	<i>Poecilia reticulata</i>	Fish
Cane Toad	<i>Rhinella marina</i>	Amphibian
Black Rat	<i>Rattus rattus</i>	Mammal
Domestic Cat	<i>Felis catus</i>	Mammal
Domestic Dog	<i>Canis familiaris</i>	Mammal
Feral Pig	<i>Sus scrofa</i>	Mammal
Rusa Deer	<i>Cervus timorensis</i>	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 Lifikatabu complex during the dry season.

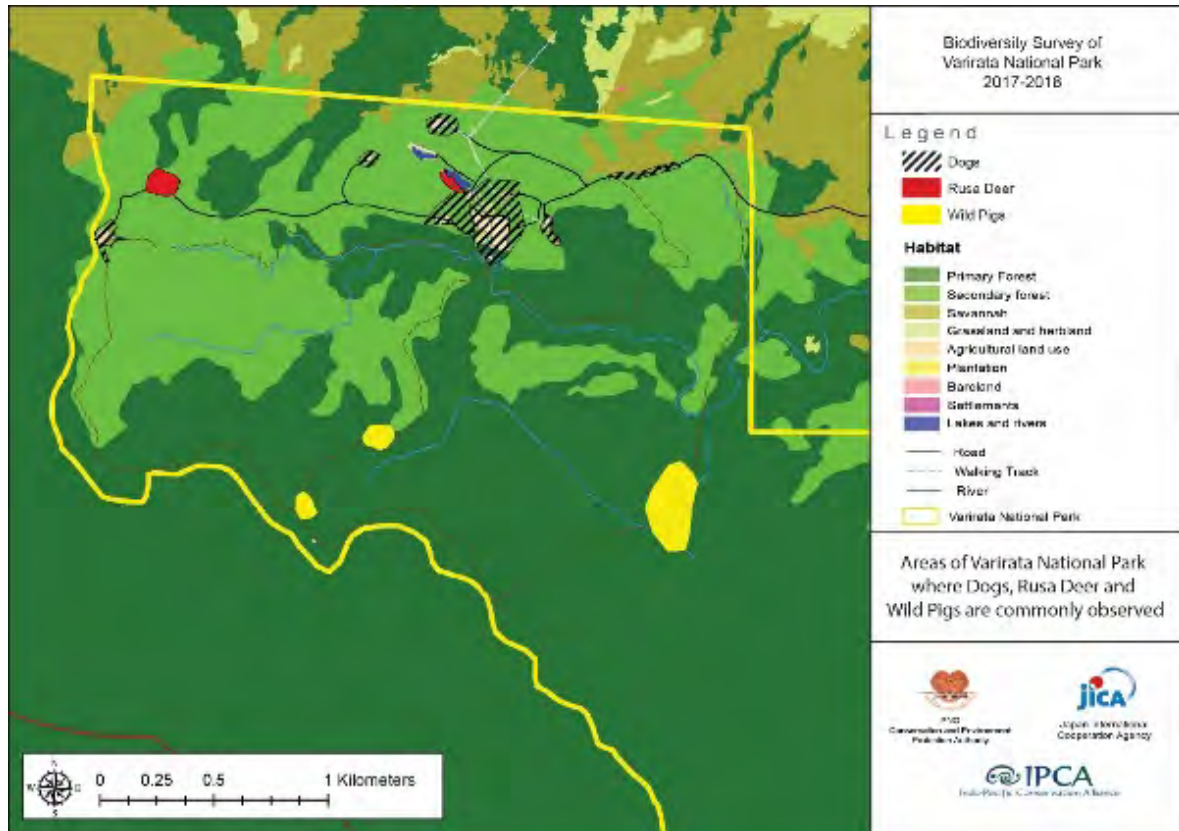


Figure 103: Locations of invasive vertebrate species observed during Field Survey

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 prize 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 preying 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 world's 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.

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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 be 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 or animal that is not native to an area and has been 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.

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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: <ul style="list-style-type: none"> a) Vertebrate taxa; <ul style="list-style-type: none"> (i) Freshwater fishes (ii) Amphibians; (iii) Reptiles; (iv) Birds; (v) Mammals b) Invertebrate taxa; <ul style="list-style-type: none"> Insects (visually appealing, iconic, or scientifically interesting species) Other invertebrates of interest 	Conduct field surveys targeting the following: <ul style="list-style-type: none"> (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 <ul style="list-style-type: none"> 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. <ul style="list-style-type: none"> ▪ Common Vascular Plants ▪ Vertebrate <ul style="list-style-type: none"> ○ Amphibians ○ Common reptiles ○ Common birds ○ Common mammals ▪ Common invertebrates

Section	Fauna	Flora
4.6	NA	<p>Biodiversity Seminar</p> <ul style="list-style-type: none"> 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

Argiolestes sp. 1

Neurothemis stigmatizans

Argiolestes sp. 2

Orthetrum villosovittatum

Idiocnemis sp.

Rhyothemis sp.

Order Lepidoptera (Butterflies and Moths)

Ornithoptera priamus

Pingasa sp.

Papilio Ulysses

Pygospila sp.

Taenaris sp.

Parotis sp.

Nyctemera sp.

Hyposidra sp.

Hydroclada 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 amethystina (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 mcdowellii (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 spilorrhoea (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

Chamosyna 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]

Eudynamis 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'Alberty, 1875 [Barred Owlet-nightjar] [S – se]

Aegotheles cristatus (Shaw, 1790) [Australian Owlet-nightjar]

HEMIPROCNIDAE - Treeswifts

Hemiprogne 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]

MEROPIIDAE - 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-Babblers and Quail Thrushes

Ptilorhoa 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'Alberty, 1875 [Black-backed Butcherbird] [F – s]

Cracticus cassicus (Boddaert, 1783) [Hooded Butcherbird] [C – fe]

ARTAMIDAE - Woodswallows

Artamus leucorhynchus (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]

ORIOOLIDAE - Orioles and Figbirds

Oriolus szalayii (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) [Frimled 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 griseiceps (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]

PHYLLOSCOPIIDAE - 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

Casuarus bennetti Gould, 1857 [Dwarf Cassowary] [S – f]

Casuarus casuarus (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 Crane] [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 nigrirostris Salvadori, 1876 [Black-billed Cuckoo-Dove] [S – f]
Gallucolumba 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 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]

Loriculus aurantiifrons Schlegel, 1871 [Orange-fronted Hanging Parrot] [R – f]

Alisterus chloropterus (Ramsay, EP, 1879) [Papuan King-Parrot] [F – f]

Eclectus roratus (Stadius 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]

Eudynamis 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-Babblers and Quail Thrushes

Ptilorhoa 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]

CRATICIDAE - 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 caeruleo-grisea (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]

ORIOOLIDAE - Orioles and Figbirds

Oriolus szalayii (Madarász, 1900) [Brown Oriole] [F – fe]

MONARCHIDAE - Monarchs

Arses telescopthalmus (Lesson & Garnot, 1827) [Frisled 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 griseiceps* (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

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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 spilorrhoea (Gray, GR, 1858) [Torresian Imperial Pigeon] [S – s]

PSITTACULIDAE - Australasian Parrots

Chamosyna placensis (Temminck, 1835) [Red-flanked Lorikeet] [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 leucorhynchus (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]

ORIOOLIDAE - Orioles and Figbirds

Oriolus szalayii (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

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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

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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 maggietaaylorae (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 (Reveillod, 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%
<p>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.</p> <p>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.</p> <p>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].</p> <p>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.</p>	<i>based on any of the following:</i>		<p>(a) direct observation [except A3]</p> <p>(b) an index of abundance appropriate to the taxon</p> <p>(c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality</p> <p>(d) actual or potential levels of exploitation</p> <p>(e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.</p>
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 km ²	< 5,000 km ²	< 20,000 km ²
B2. Area of occupancy (AOO)	< 10 km ²	< 500 km ²	< 2,000 km ²
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
(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 km ² 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.



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>

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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)

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

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.



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.

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.

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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>

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External Resources

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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 benignly: No
Subject to ex-situ conservation: No
In-Place Education

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

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

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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>

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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).

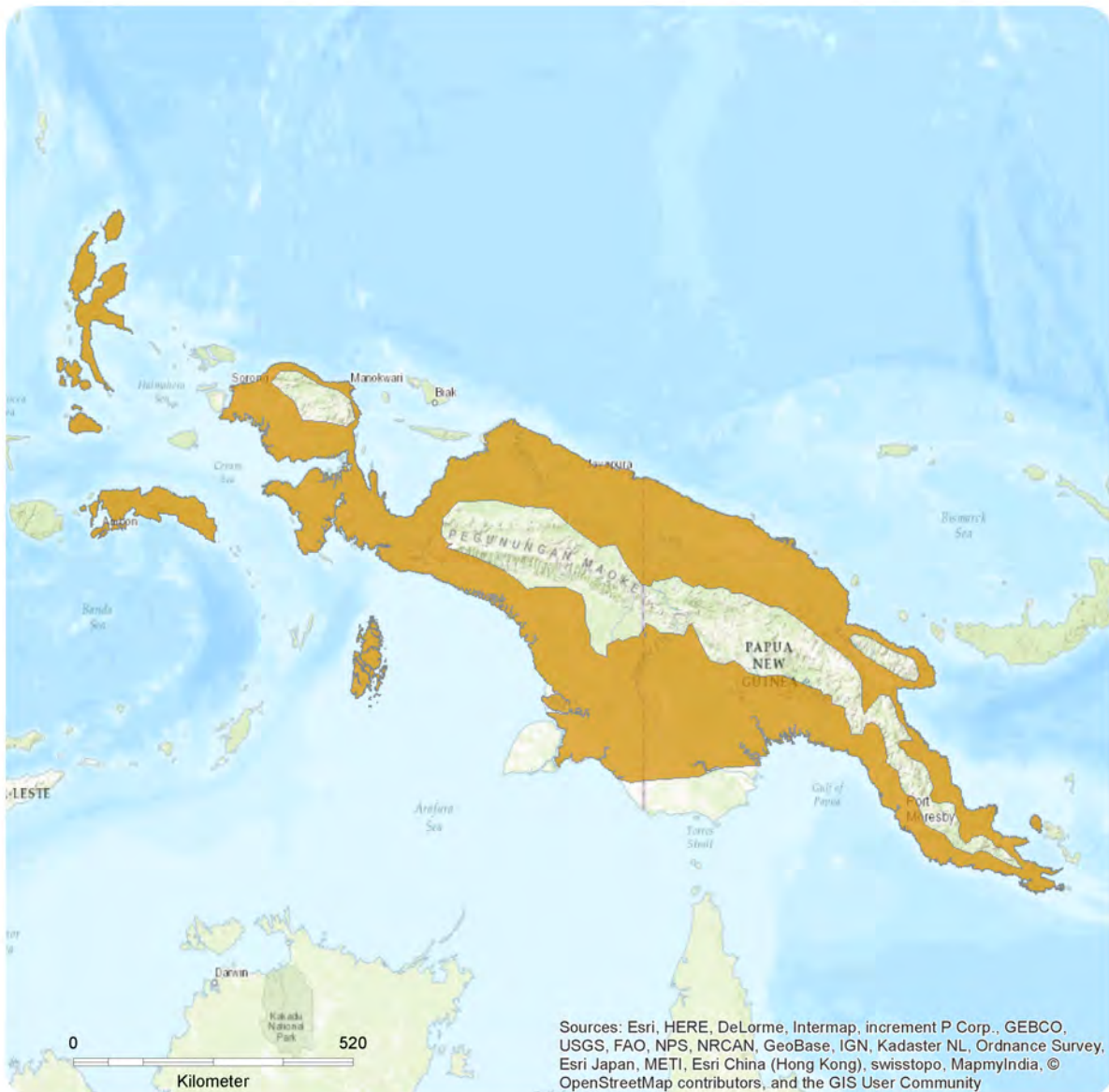
Country Occurrence:

Native: Indonesia; Papua New Guinea

Vagrant: Australia

Distribution Map

Aquila gurneyi

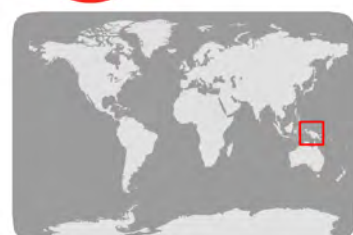


Range

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.



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.

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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>

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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 benignly: No
Subject to ex-situ conservation: No
In-Place Education
Subject to recent education and awareness programmes: No

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

Habitats and Ecology
Continuing decline in area, extent and/or quality of habitat: Yes
Generation Length (years): 16.8
Movement patterns: Not a Migrant

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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>

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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

Distribution Map

Dasyurus albopunctatus



Dasyurus albopunctatus

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.



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.

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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>

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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		

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

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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>

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If you see any errors or have any questions or suggestions on what is shown in this document, please provide us with [feedback](#) so that we can correct or extend the information provided.

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)



The boundaries and names shown and the designations used on this map do not imply any official endorsement, acceptance or opinion by IUCN.



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 typically omnivorous. 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.

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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>

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Habitats

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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

Research Needed
1. Research -> 1.5. Threats
1. Research -> 1.6. Actions

Additional Data Fields

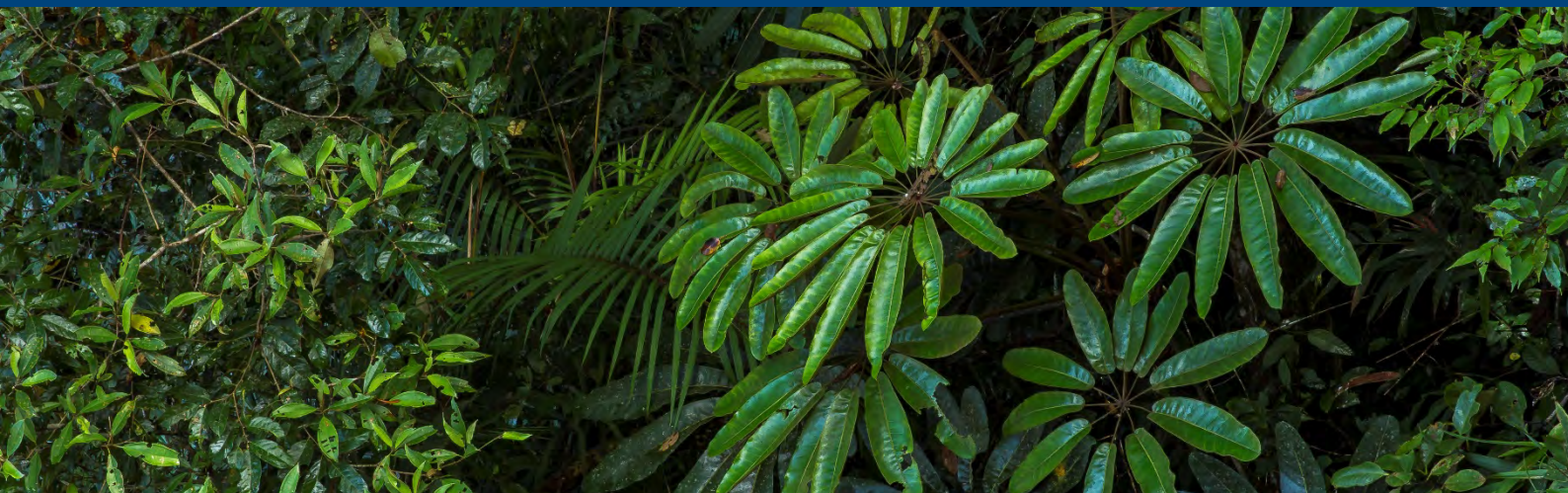
Distribution
Lower elevation limit (m): 0
Upper elevation limit (m): 1000
Population
Population severely fragmented: No
Habitats and Ecology
Generation Length (years): 4

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FINAL REPORT BIODIVERSITY (FLORA) 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

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REV 1: FINAL	A Fraser & A Allison	A Allison		A Allison		26 SEP 2018
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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 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 botanical survey (flora) component of scope. Reporting requirements for items (iv), (vi) and (vii) have been prepared as separate standalone documents (IPCA, 2018a; 2018c; 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

The Park contains three key vegetation associations comprising the following five key habitats:

- (i) Primary rainforest (medium-crowned lowland hill forest) including old re-growth forest (approximately 80% of the Park);
- (ii) Secondary forest dominated by Casuarina (*Gymnostoma papuana*) (approximately 18% of the Park);
- (iii) Eucalypt savannah (<2% of the Park);
- (iv) Aquatic habitats (streams and lakes); and
- (v) Disturbed habitats (landscaped gardens, roadside verges and other disturbed areas).

Medium-crowned lowland hill forest includes a rich diversity of tree species with oaks (*Fagaceae*), particularly *Castanopsis acuminatissima* and *Lithocarpus celibicus* often occurring along ridgelines. Forest structure is typically characterised by a closed canopy 25-30 m high, a dense understory of shrubs, small trees and lianas.

Secondary forest communities are dominated by Casuarina (*Gymnostoma papuana*) and the extent of these forests within the Park is remarkable. Through natural forest succession this habitat has expanded by more than 200 hectares in less than 50 years. Close proximity of a forest seed bank, an absence of fire and limited poaching of forest resources have largely facilitated the successful expansion of secondary forests within VNP.

At less than 2% of the Park's area, eucalypt savannah is poorly represented despite being a common habitat at low elevations in

Central Province. It is however, important ecologically as several species with a restricted range in PNG only occur in these habitats. They include Ghost Gum (*Corymbia papuana*), Grey Gum (*E. tereticornis*) White Gum (*E. alba*), Weeping Paperbark (*Melaleuca leucadendron*) and the cycad (*Cycas campestris*), which is a regional endemic. Increasing the Park's footprint to cover a greater area of eucalypt savannah would comprise a valuable conservation initiative.

The aquatic habitats within the Park comprise Nairogo Creek and its tributaries, and the Lake Lifilikatabu complex. Several species are restricted in their distribution throughout the Park given their dependence on aquatic habitats. These include a species of sedge (*Eleocharis* sp.) from the lake and *Neonauclea* sp a medium sized riparian shrub and a native species from the genus *Impatiens*, which are largely confined to watercourses within the park.

Disturbed habitats including landscaped gardens of the Park's picnic areas and roadside verges are dominated by weed species and naturalised grasses.

VNP's Botanical Diversity

PNG's tropical forests sit within the greater 'Papuasia Region' and are widely recognised as a major centre of plant diversity (Takeuchi, 2003b). Estimates of the New Guinea Island's plant diversity are significant and range from 11,000 (Collins et al. 1991) for PNG to 20,000-25,000 species for West Papua (Supriatna 1999).

Preparation of a species checklist for the known flora of PNG is currently in progress and comprises approximately 1,800 genera and 13,500 species of vascular plants (James, pers.comm). There is no doubt that these figures will rise given significant knowledge gaps associated with PNG's flora which remains poorly collected (Takeuchi, 2003b).

The first listing of vascular plant species from the Park is presented in this report and

currently contains 157 vascular plant families, 581 genera and 1,126 species. The checklist does include a number of taxa identified only to morpho-species. It is therefore likely that some of these are duplicates, however it is estimated that approximately 150 species of ferns, at least eight species of conifers, and between 700 and 900 species of flowering plants occur within VNP.

In broader context, the diversity of flora represented by species accounts from the Park to date is extraordinary. This survey has demonstrated that VNP, which currently only covers 1,063 ha and has negligible range in elevation (630 to 833 m) contains representatives from most of PNG's plant families, nearly a third of the vascular plant genera, and nearly 10% of PNG's vascular plant species. This represents a remarkable proportion of PNG's plant biodiversity. It is also expected that with further targeted field surveys, additional species records for flora will most certainly be added to the Park's checklists with the potential for describing species new to science considered to be very high.

Species with Scheduled Conservation Significance

Six species of plants scheduled with conservation significance under the IUCN Red List are included in the Checklist.

One species is classified as Critically Endangered (*Halfordia papuana*) while a second species; *Flindersia pimenteliana* is scheduled as Endangered. *Halfordia papuana* is a synonym for *H. kendack*, which is widely distributed throughout PNG occurring in Morobe, Western Highlands, Eastern Highlands, Southern Highlands, Western, Central and New Britain Provinces. The IUCN assessment for this species requires revision because this plant is not considered to be under threat.

Neither *H. kendack* or *F. pimenteliana* were collected from the Park during the current surveys, although *F. pimenteliana* was

previously confirmed by Hopkins & Hisao (1994) as occurring within the Park.

Similarly, the distribution of *F. pimenteliana* is also widespread throughout PNG as this tree species occurs with medium crowned hill forest. The listing of this species in the IUCN Red List is also considered questionable.

Of the remaining four species (*Cycas campestris*; *Hopea forbesii*; *Myristica globosa*; and *Helicia albiflora*) all are scheduled as Endangered.

H. albiflora is commonly associated with *Castanopsis* and *Nothofagus* forest communities and has a broad distribution across PNG. Little is known regarding the population status of *Myristica globosa* and both species are considered to be 'low risk' under the 'Near Threatened' category.

Cycas campestris is endemic to PNG with its range largely confined to low altitudes in the Central Province. Habitat loss and frequent fire regimes are the primary threats to this species. Given that VNP contains less than 2% of eucalypt savannah habitat increasing the Park's footprint to include a greater proportion of savannah would be a tangible measure in affording a greater level of protection to this regionally endemic species.

The Dipterocarps (Family Dipterocarpaceae) are highly sought after by the logging industry given their high value as timber species. *Hopea forbesii* is native to the island of New Guinea (including West Papua) and has a broad distribution within PNG from Milne Bay Province to the Sepik and Western Provinces. It has been subjected to an estimated 25% decline in population in the last three generations due to loss of habitat and logging. These impacts have been most severe in Central and Milne Bay Provinces. As such, the IUCN indicate that this species is borderline 'Vulnerable'.

Introduced Species

The introduced flora of VNP includes 51 species with six serious invasive species. The remaining 45 species of introduced plants within Park are common non-invasive weeds and include the species of grasses that comprise the lawns around the picnic and housing areas and as well as many of the common weeds found which also occur in road verges and currently pose little threat to the native biota of VNP.

The six species of ecological concern comprise: Lantana (*Lantana camara*), Spiderwort (*Tradescantia* spp.) the African Tulip Tree (*Spathodea campanulata*) and Hemp Vine (*Mikania micrantha*). The remaining two species *Clidemia* (*Miconia crenata*) and Spiked Pepper (*Piper aduncum*) are well established in the Park. *Clidemia* in particular is a dominant groundcover in secondary forests with potential to significantly impact floristic diversity and processes of forest succession. The Invasive Species Management Plan (IPCA, 2018d) and Environmental Monitoring Plan (IPCA, 2018a) detail further recommendations regarding the challenges associated with containing and managing these species in the Park.

At least four species of introduced and highly invasive plants also currently occur in areas surrounding the Park – on the Sogeri Plateau or in the Laloki Valley. These species include: Giant Sensitive Plant (*Mimosa pigra*), Sanchezia (*Sanchezia speciosa*), White Angel's Trumpet (*Brugmansia candida*) and the Mexican Sunflower (*Tithonia diversifolia*). All are characteristically aggressive and have the potential to cause significant ecological impacts to the native floristic assemblages of the Park. Preventing establishment of these species in VNP is a significantly preferable option ecologically and economically as opposed to attempting to manage infestations within the Park should they become established.

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 Botanical 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.

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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. Management Priorities for Varirata National Park

Investment and restoration of Varirata National Park and the surrounding Koiari area comprise key Conservation Management Priorities for the JICA-CEPA Project. The Project aims to re-establish the Park as a major recreational and educational resource for the people in Port Moresby City, National Capital District and Central Province (JICA, 2018).

Capacity building, institutional strengthening and implementation of practical science based resource management strategies for the Park and buffer zone (area surrounding the Park) have been flagged as critical strategies to drive the restoration program for VNP.

1.2. 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 botanical survey (flora) component of scope (Appendix 1). Reporting requirements for items (iv), the Field Guide Brochures have been prepared as separate standalone documents and are also presented as appendices to this report.

1.3. 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 hectares (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 areas together with more than 12 km of walking tracks.



Figure 1: Location of VNP, Papua New Guinea

Source: JICA, 2017



Figure 2: Satellite Image of VNP

Source: Phil Shearman, 2017

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.

1.3.1. Key Vegetation Associations

Three key vegetation associations characterise the park: medium-crowned lowland hill forest (primary rainforest); secondary forest dominated by *Gymnostoma papuana*; and eucalypt savannah. Within these floristically diverse communities are five key habitats. They comprise the three forest types in addition to aquatic habitat (found within and adjacent to streams and lakes) and disturbed habitat (including landscaped gardens, and roadside verges). Both aquatic and disturbed habitats occur in all three forest types.

Approximately 80% of VNP is covered in medium-crowned lowland hill forest, including old re-growth forest rich in diversity but dominated by oaks (Fagaceae), particularly *Castanopsis acuminatissima* and *Lithocarpus celibicus* at higher elevations (Paijmans, 1973; 1975).

The percentage cover of secondary rainforest forest within the Park is truly remarkable given that this vegetation association has

expanded markedly to reclaim more than 200 ha of grassland since 1973 through natural processes of forest succession, largely facilitated by an absence of fire. This is despite the Park's close proximity to Port Moresby and surrounding communities, which have concurrently undergone significant increases in population during the same period. VNP has avoided the ecological and social impacts associated with broad scale deforestation typical in areas adjacent to large metropolitan centres across the country.

1.3.2. 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. 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 6: Main Lookout, elevation 833 meters, VNP
 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

2. METHODOLOGY

The IPCA biodiversity surveys comprised a combination of detailed literature reviews and desktop studies in conjunction with field surveys conducted over a twelve month period commencing in mid-April 2017 and concluding 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 Monomu 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). The survey team included:

- Dabio Moi – Technical Officer (Doe Village)
- Bali Korohi (Omani Clan)
- Gideon Warite (Nadeka Clan)
- Monobe Kisea (Ianari Clan)
- 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. Botanical Survey Collections

In May 2017, Mr. Kore Maraia a qualified and well regarded botanist was mobilised from the University of Technology in Lae, to supervise construction of plant drying facilities and to train the field survey team on all aspects of plant collecting and specimen preparation. Written protocols were prepared and issued to the team for reference throughout the field survey program. Mr. Maraia has been trained by internationally renowned botanists working in New Guinea, including Ed de Vogel (Naturalis, Leiden) and Michael Sundue (University of Vermont, Burlington) during previous IPCA field survey campaigns.

The field team generally spent Monday to Friday of each week collecting plants and animal specimens and documenting key observations. By deploying the survey team on a nearly continuous basis over a twelve month period, IPCA were able to collect flowering plants as they came into season.

Flowering and fruiting cycles of tree species within VNP is irregular and does not occur in predictable seasonal cycles. Brown and Hopkins (1995) report that only 60% of individual trees flowered during their 26-month study period. This variation in flowering and fruiting cycles among species demonstrates that long-term, sustained monitoring effort is necessary to obtain biological data from PNG's tropical forests. The Hopkins study identified most specimens

collected to genus or morpho-species only. As such, further taxonomic effort is required to resolve the Hopkins collection to species level.

A total of 635 plant specimens were collected from various locations throughout the Park and Park buffer zone (Figure 8) during the course of the program. Specimens were pressed, dried and sorted in the field (Figure 9) and then sent to the UPNG Herbarium for identification by herbarium staff.

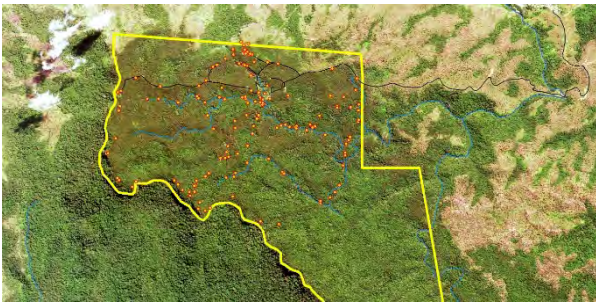


Figure 8: Plant collection sites for the botanical Biodiversity Survey.

Each point represents one or more collection points with multiple plants often collected from the same site.



Figure 9: Bali Korohi and Monobe Kisea sorting pressed botanical specimens

Photo credit: Dabio Moi

2.3. Land Cover

JICA has obtained Worldview satellite coverage of the Park and has used that to classify land cover into nine land use categories (Figure 10). IPCA confirmed this classification by ground truthing areas within the Park and believe that these categories are appropriate for defining the major land use units present in the Park. IPCA have

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 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 354 references. These are maintained in Endnote, the leading commercially available product for managing literature references and associated PDF files.

Given the lack of published lists of the vascular flora in VNP, specimen data was obtained from the University of PNG Herbarium and the PNG National Herbarium [Lae]. In addition, records were obtained from Cedric Carr's collections made from the Sogeri Plateau and surrounding area in 1935-36. These collections are housed in various international herbaria including the Singapore Botanical Garden, the Royal Kew Botanic Gardens, the Natural History Museum in London, the Naturalis Biodiversity Centre in Leiden, the Bishop Museum in Honolulu and other institutions. Data from these collections in combination with the UPNG data and data from our surveys comprised the basis of the composite database presented in Appendix 2 to Appendix 4.

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 field surveys.

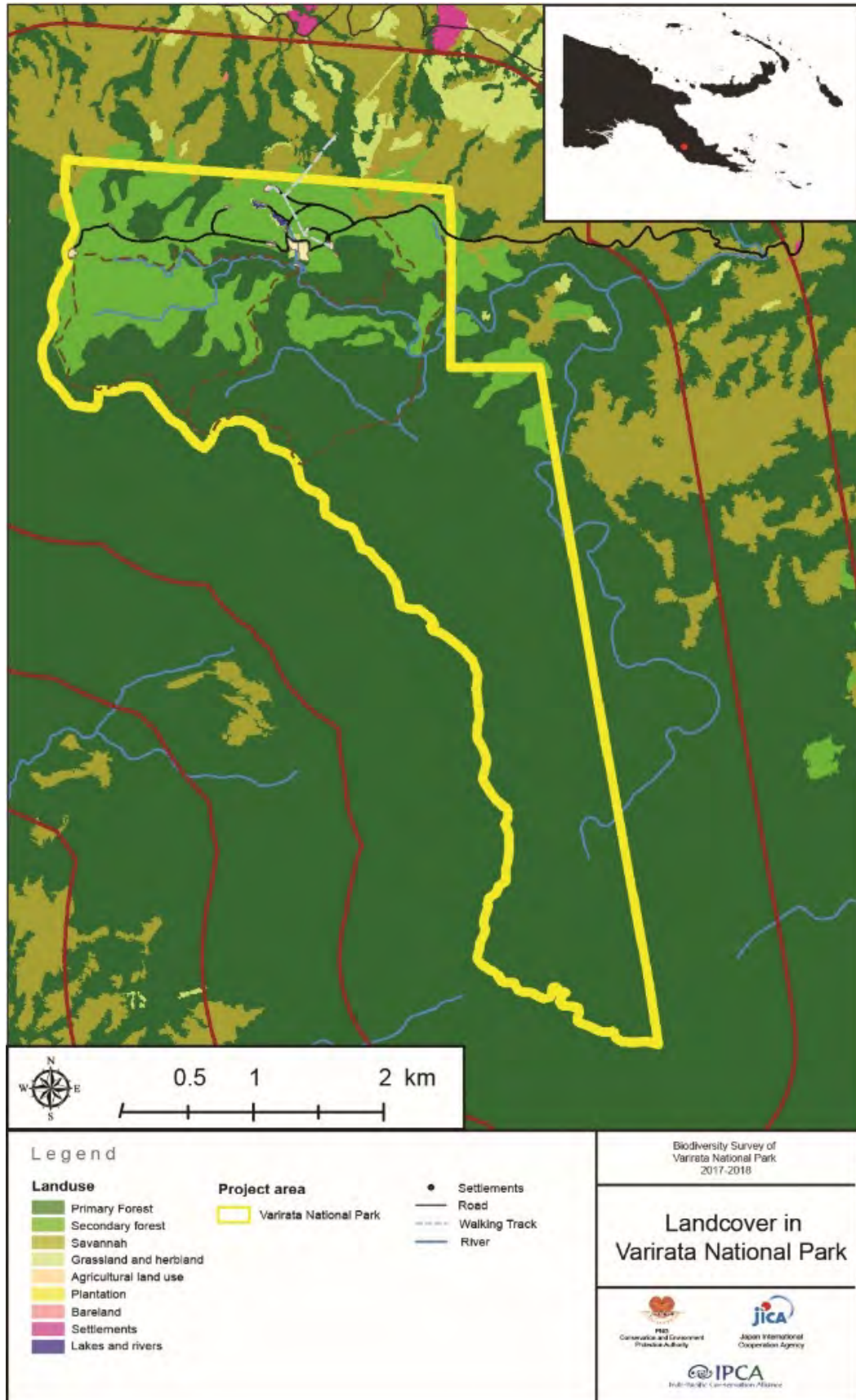


Figure 10: Land use in VNP and surrounding areas.

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. 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 emphasize PNG's extraordinary biodiversity and assist in promoting the benefits of community conservation practices (Appendix 5).

3. RESULTS

Sixteen hundred days of fieldwork were amassed by the IPCA Field Team during conduct of the botanical and zoological biodiversity field surveys. At the conclusion of the botanical survey 635 plant specimens were collected with the majority having five replicate specimens when sufficient flower or fruiting material enabled the collection of replicates. Plants collected included ground cover, shrubs, epiphytes, lianas and flowering trees. The survey team also catalogued several hundred photos of plants in flower. Combined with herbaria data the results of the field survey program have contributed to the first comprehensive listing of vascular plant species from VNP (Appendix 2 to Appendix 4).

The vascular plant checklist comprises 157 vascular plant families, 581 genera and 1,126 species. The checklist includes a number of taxa identified only to morpho-species and it is likely that some of these are duplicates. As such, IPCA estimates that the Varirata flora comprises approximately 150 species of ferns, at least eight species of conifers, and between 700 and 900 species of flowering plants.

Although the Park and surrounding area are relatively well collected, much of the material in the UPNG herbarium is sterile and can only be identified to genus. The results from this project have added significant value to the knowledge base of VNP's biota.

4. BOTANICAL 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 11). 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 30° C and rarely drop below 16° C at night, with little annual variation.

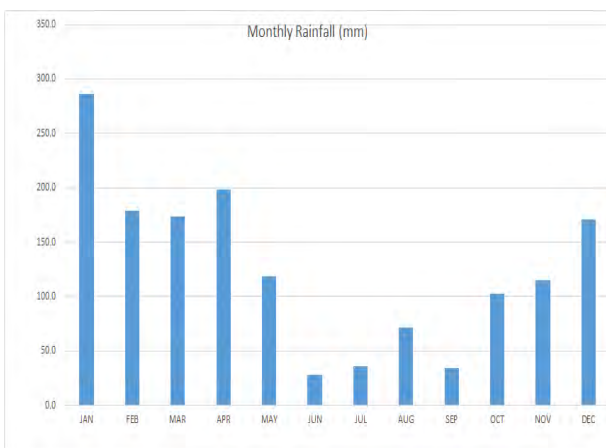


Figure 11: Monthly rainfall in VNP

Source: Hopkins and Hiaso, 1994

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.

4.1. Key Vegetation Associations

For the purposes of conducting the botanical survey, IPCA confirmed the presence of three separate vegetation associations. Each is

generally floristically unique (with some convergence at ecotones), however all three associations also contained both aquatic habitat and areas of disturbance. As such, five key habitats were identified and surveyed as follows:

1. Eucalypt Savannah comprising <2% of the Park
2. Secondary Forest dominated by *Casuarina (Gymnostoma papuana)* comprising approximately 18% of the Park ;
3. Medium-crowned Lowland Hill Forest (primary rainforest) comprising approximately 80% of the Park;
4. Aquatic Habitat* (streams & lakes); and
5. Disturbed Habitat* (landscaped areas including picnic grounds and roadside verges and other 'disturbed areas').

* Estimates for the size of these habitats are not calculated given that they typically occur as small patches or areas within each of the three key habitats.

4.2. Eucalypt Savannah

The northern border of the Park is covered in eucalypt savannah (Paijmans, 1973; 1975) (Figure 12 to Figure 14) dominated by four myrtaceous trees, Ghost Gum (*Corymbia papuana*) (Figure 15), Grey Gum (*E. tereticornis*) (Figure 16), White Gum (*E. alba*) (Figure 17) and Weeping Paperbark (*Melaleuca leucadendron*) (Figure 18), with an understory of grasses, particularly Kangaroo Grass (*Themeda triandra*) (Figure 19) and Cogon Grass (*Imperata cylindrica*) (Figure 20), together with scattered shrubs, including Grassland Sheoak (*Grevillea papuana*), Tropical Banksia (*Banksia dentata*) (Figure 21 and Figure 22), and a cycad (*Cycas campestris*) (Figure 23). Other aspect dominants include species of *Pandanus (Pandanus sp.)*.



Figure 12: 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 13: 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 14: Eucalypt Savannah with White Gum and Grey Gum, VNP
White Gum (*Eucalyptus alba*), Grey Gum (*E. tereticornis*) and dominant grass species is Kangaroo Grass (*Themeda australis*). Photo credit: Angus Fraser



Figure 15: *Corymbia papuana*, VNP
Photo credit: Angus Fraser



Figure 16: *Eucalyptus tereticornis* flower buds, VNP
Note the difference in operculum (flower bud) between *C. papuana* and *E. tereticornis*. Photo credit: Angus Fraser



Figure 17: *Eucalyptus alba* woodland, VNP
Foreground grass species is mainly Kangaroo Grass (*Themeda triandra*). Photo credit: Angus Fraser



Figure 18: Weeping Paperbark (*Melaleuca leucadendron*), VNP
 Photo credit: Angus Fraser



Figure 19: Kangaroo Grass (*Themeda triandra*), VNP
 Photo credit: Allen Allison



Figure 20: Cogon Grass (*Imperata cylindrica*), VNP
 Photo credit: Allen Allison



Figure 21: Tropical Banksia (*Banksia dentata*)
 This is the only species of *Banksia* found in New Guinea. The other 170 species occur in Australia. Tropical Banksia is widely distributed in PNG and is found in grasslands at mid-elevations. Photo credit: Allen Allison



Figure 22: *Banksia dentata* in inflorescence, VNP
 Photo credit: Angus Fraser



Figure 23: Cycad (*Cycas campestris*), VNP
 Taken along the roadside leading up to the entrance of the Park in the Park Buffer Zone at the beginning of the monsoon. Note the green grasses shooting after dry season grass fires. Photo credit: Angus Fraser

Hopkins and Hiaso (1994) mention populations of Pitcher Plants (*Nepenthes*) along some of the trails in the Park but these appear to have since disappeared. However, there is a sizable population of *Nepenthes mirabilis* in eucalypt savannah along the Varirata National Park entrance road at approximately a kilometre south of the junction with the Sogeri Road (9.4338S; 147.3969E) (Figure 16). Pitcher plants have modified leaves that form urn-shaped “pitchers” that trap and digest insects and other invertebrates (Figure 24).



Figure 24: Pitcher Plan (*Nepenthes mirabilis*), VNP

Photo credit: Allen Allison

Eucalypt savannah covers < 2% of the overall Park area but is the dominant vegetation around Port Moresby and along the road to Sogeri, reflecting the monsoonal climate of the area. Eucalypts are particularly critical for a variety of mammals and birds, particularly parrots, which rely on hollows produced by these trees for nesting sites.

Eucalypt savannah is highly susceptible to fire and large tracts are burnt each year during the dry season. Savannah plant associations have adapted to a fire ecology with grassland species generally recovering within a year or two if not burned repeatedly (Figure 25 and Figure 26).

Tree density is approximately 150 trees per ha in these habitats, which makes for a very open canopy (Heyligers, 1966). The composition of the Eucalyptus species in the forest clearly depends on slope, aspect and drainage, with specific species becoming dominant and forming nearly pure stands in some areas. The overall plant species richness in these forests is low and comprises less than 1% of the plant species known from the Park.



Figure 25: Large tracts of Eucalypt Savannah burnt during the dry season, VNP

Looking east towards the Sogeri Plateau from the VNP escarpment. Photo credit: Angus Fraser



Figure 26: Grass fires along the VNP escarpment

Fires are deliberately lit during the dry season in the Park Buffer Zone. Photo credit: Angus Fraser

4.3. Secondary Forest

Immediately south of the eucalypt savannah lies a band of mainly secondary forest dominated by *Gymnostoma* (*G. papuana*), a nitrogen fixing and pioneering tree species in the family Casuarinaceae (Figure 27 - Figure 28). Other common species include Ghost Gum (*C. papuana*), Grey Gum (*E. tereticornis*), sumac (*Rhus taitensis*) (Figure 29), *Macaranga*

spp., *Ficus* spp (Figure 30) and *Euodia* spp (Figure 31).



Figure 27: Gymnostoma (*Gymnostoma papuana*) foliage and seedpods, VNP

Photo credit: Angus Fraser



Figure 28: Secondary forest dominated by *Gymnostoma papuana*, Lake Lifilikatabu, VNP

Photo credit: Allen Allison



Figure 29: Sumac (*Rhus taitensis*) is prominent in mixed second growth forest, VNP

This tree was photographed in April 2017 near the Lodge. It was in flower throughout the Park and in the upper Laloki Valley. Photo credit: Allen Allison



Figure 30: Fig trees are a common element in secondary forest, VNP

This large fig tree is located in secondary forest along the Koiari Tree House Track near the Main Picnic Ground. Photo credit: Angus Fraser



Figure 31: *Euodia* sp secondary forest, VNP

Photographed in secondary forest along the VNP northern escarpment. Photo credit: Angus Fraser

The central areas of the Park were cleared beginning in 1897 by Burns Philp for an arabica coffee plantation (Lewis, 1996). This area was later expanded to include vegetable gardens. However, a few years later, the coffee became infested with *Hemileia vastatrix*, a fungal disease that causes coffee

rust, and the area was leased to Warirata Estate, which developed it into a piggery. When the Park was officially opened by the Government in 1973, the former plantation areas had reverted to savannah grassland, which covered 220.7 hectares. By 2017 most of this grassland has been replaced by secondary forest through a process called ecological succession. Only 12.8 ha of savannah grassland remains in the Park today (Figure 33).

Gymnostoma forms nearly pure stands in over much of the secondary forest (Figure 61). The boundary between the secondary forest and eucalypt savannah is typically characterised with some mixing of species. In particular Ghost Gum (*C. papuana*) and Grey Gum (*E. tereticornis*) 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 (*M. leucadendron*) within the secondary forest likely represents remnants of the former savannah grassland that covered the area in 1973.

Some evidence of forest resource poaching was documented during survey with illegal harvesting of *Gymnostoma* (both green timber and firewood) observed along the Park Boundary (Figure 32). Interestingly, the trees were harvested using a chainsaw and not a bush knife or axe. Paperbark, which occurs in low densities in the Park, was also observed to have been harvested for building materials from trees within the Park Buffer Zone.



Figure 32: Poaching of forest resources, VNP

Gymnostoma (Yar in Tok Pisin) is highly valued timber for firewood given its superior capacity to generate heat compared with other local timbers. This tree was cut with a chainsaw in secondary forest along the Park Boundary just south of the main entrance along an old bush track accessible by vehicle. On other occasions pickup trucks were observed collecting dead yar within the Park for domestic firewood consumption.

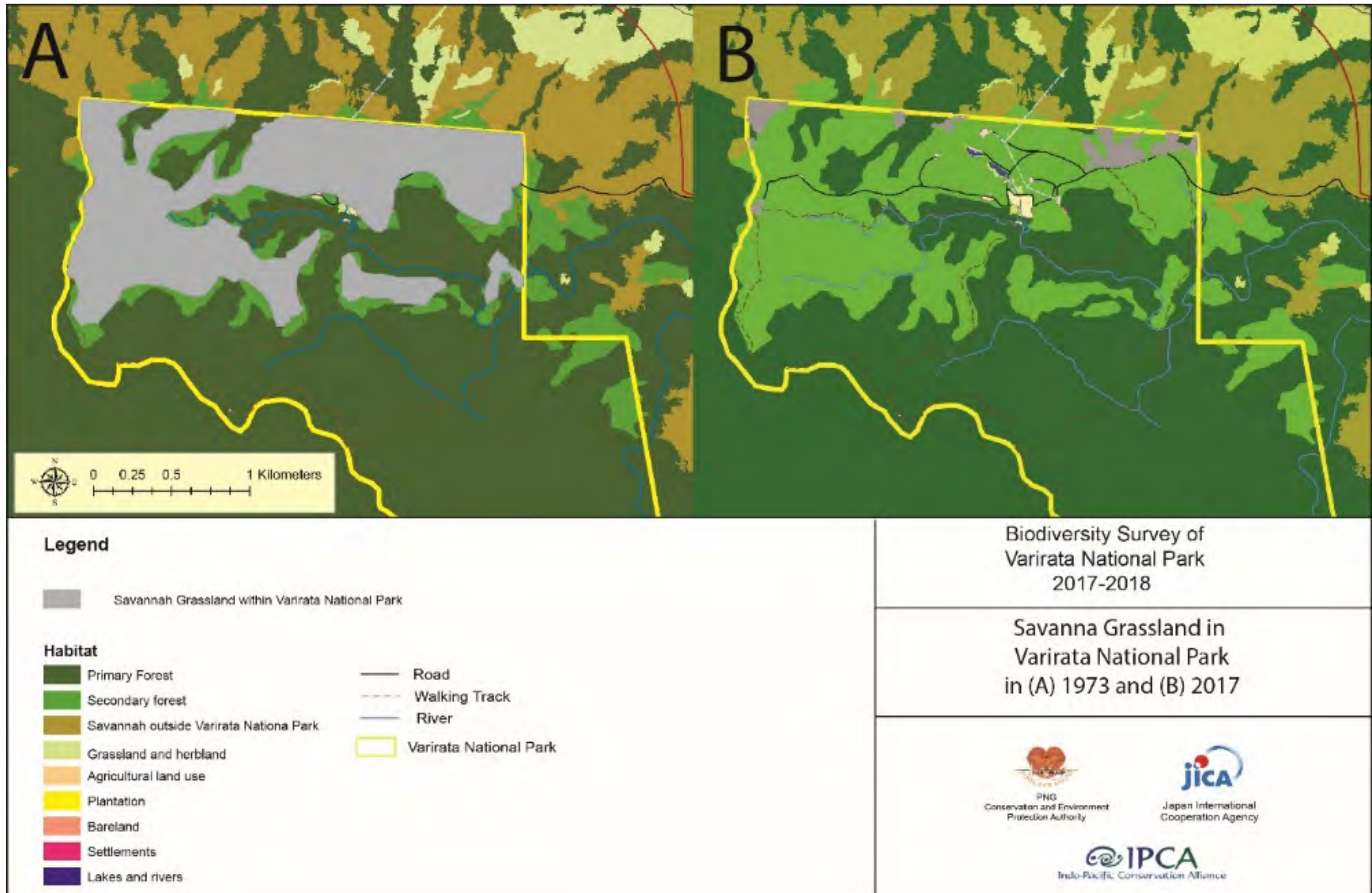


Figure 33: Comparison of savannah grasslands in 1973 and 2017

Sources: 1974 1:100,000 topographic sheet (8379 – Port Moresby) based on 1973 aerial photographs. 2017 WorldView Satellite Imagery (JICA, 2017).

In the absence of fire in areas with sufficient rainfall, a shield fern (*Sticherus* sp.) will tend to invade forest clearings. This fern (Figure 34), 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 35). The shade produced by the *Gymnostoma* canopy 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*.

Forest succession has also been quite evident along the access road near the Park's entrance as indicated by photographs taken in 1992 and 2017. This has resulted in secondary forests having a greater element of primary forest species (Figure 36 and Figure 37).



Figure 34: 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 35: Shield Fern (*Sticherus* sp) comprising a dominant ground cover, VNP

Photo credit: Allen Allison



Figure 36: Entrance to VNP in 1992

This photo was taken in 1992 at approximately the same location as the 2017 photograph below. A comparison between the two images shows that the secondary forest is now much more diverse and dense than it was 25 years ago. Photo credit: Allen Allison



Figure 37: Entrance to VNP, 2017

Photo credit: Angus Fraser

Clidemia (*Miconia crenata*), an aggressive invasive shrub from South America, apparently became established in VNP around 2005-2006 (Figure 38). This species is commonly known as *Clidemia* and was formerly classified as *Clidemia hirta*.

Subsequent taxonomic classification resulted in the plant being reclassified as *Miconia crenata* (Mabberley, 2017), however the plant is still referred to as Clidemia.

Clidemia is now well established in the Park and appears to be replacing *Sticherus* as the dominant ground plant in the secondary forest. Although pure stands of *Sticherus* remain (Figure 35), some patches now contain a mixture of *Sticherus* and Clidemia (Figure 39). In some areas Clidemia forms nearly pure stands (Figure 40). A native species of *Rubus* is often found in association with both species and also appears to be an early successional pioneering species (Figure 41).



Figure 38: Clidemia (*Miconia crenata*) in flower, VNP
Photo credit: Allen Allison



Figure 39: Shield Fern (*Sticherus* sp.) and Clidemia (*Miconia crenata*), VNP
Photo credit: Allen Allison



Figure 40: Clidemia (*Miconia crenata*) dominant in secondary forest, VNP

This image is taken between Lake Lifilikatabu and the Lodge. Photo credit: Allen Allison



Figure 41: Rubus (*Rubus* sp.) VNP

Rubus sp is common in the undergrowth of the secondary forest, occurring within stands of Clidemia and *Sticherus*. Photo credit: Allen Allison

In addition to Clidemia, another serious invasive shrub from Central and South America, Spiked Pepper (*Piper aduncum*) (

Figure 42), occurs throughout the secondary forest and in disturbed areas along roadsides and tracks. It has been in Papua New Guinea for decades and has spread throughout much of the country.



Figure 42: Spiked Pepper (*Piper aduncum*), VNP
Photo credit: Allen Allison.

4.4. Primary Forest (Medium crowned lowland hill 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 covered in primary forest, including old re-growth forest, which includes a rich diversity of tree species and a dense understory of shrubs, small trees and lianas (Figure 43). These forests are dominated by ten plant families (Table 1) and are part of an association termed medium-crowned lowland hill forest (Paijmans, 1973; 1975; Figure 45 to Figure 52). In addition, a conifer, Tulip (*Gnetum gnemon*) (Figure 49), is common throughout the forest, which is also rich in epiphytes, particularly ferns and orchids.



Figure 43: Aerial photograph of primary forest along VNP’s Western Escarpment

Image taken near Gare’s lookout. Several dozen tree genera are represented in the photo. Photo credit: JICA, 2017

Table 1: Dominant plant families by biomass in primary forests of Varirata National Park.

FAMILY	COMMON GENERA
Fagaceae	<i>Castanopsis, Lithocarpus</i>
Meliaceae	<i>Aglaia, Chisocheton, Dysoxylum, Toona</i>
Elaeocarpaceae	<i>Elaeocarpus, Sloanea</i>
Myrtaceae	<i>Syzygium</i>
Myristicaceae	<i>Myristica</i>
Annonaceae	<i>Popowia</i>
Lauraceae	<i>Cryptocarya, Litsea</i>
Moraceae	<i>Ficus</i>
Burseraceae	<i>Canarium</i>
Pandanaceae	<i>Pandanus</i>

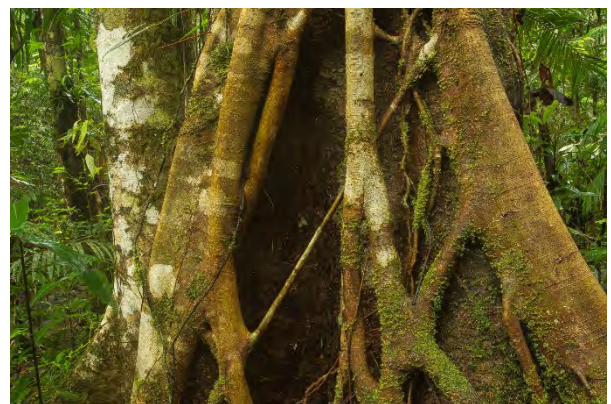


Figure 44: Strangling figs (*Ficus spp*) are a common element in primary forests, VNP

Photo credit: Angus Fraser

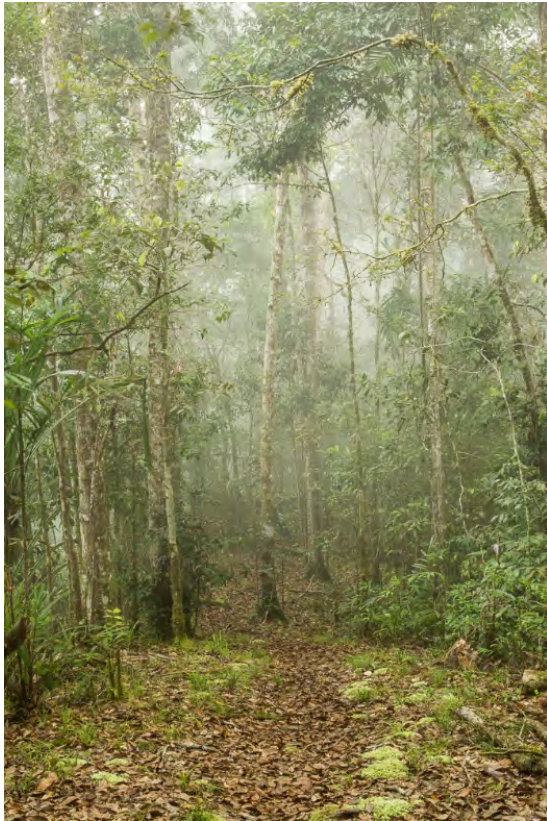


Figure 45: Re-growth primary forest along the Scarp Track, VNP

The dominant tree is PNG Oak (*Castanopsis acuminatissima*). Forest mist is a regular occurrence throughout the year providing moisture and relatively cool conditions that influence the Park’s micro-climate throughout the year compared with the seasonally hot dry conditions experienced in Port Moresby. Photo credit: Angus Fraser



Figure 46: Aerial photograph of primary forest at Gare’s Lookout, VNP

Gare’s Lookout is on the edge of the escarpment of the Astrolabe Range. The dominant trees are PNG Oak (*Castanopsis acuminatissima*) and Lithocarpus (*Lithocarpus celibicus*). Photo credit: JICA, 2017



Figure 47: Aerial photograph of primary and secondary forest ecotone, VNP

This image was taken near the Digicel Tower (9.430232°S, 147.351295°E) showing the sharp separation (ecotone) between secondary forest dominated by *Gymnostoma* (*Gymnostoma papuana*) (left) and primary forest (right). The secondary forest now probably comprises the areas that were cleared for coffee plantations in the late 1800s. Photo credit: JICA, 2017

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. 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 (Figure 52) is harvested by people throughout PNG for food and is also an important food source for many species of parrots. The distribution of *Castanopsis* forests within the Park is presented in Figure 53.



Figure 48: Orchids are abundant and diverse in VNP
Epiphytes such as orchids (*Bulbophyllum* sp.) and fern occur throughout medium crowned lowland hill forest. Photo credit: Angus Fraser



Figure 49: Tulip (*Gnetum gnemon*) a common gymnosperm in VNP
Tulip is a common component of the primary forest within VNP. It is easily recognised by its distinctive ringed trunk (left). Although it is a gymnosperm, closely related to conifers, it has expanded, paired leaves resembling those of flowering plants. The fruit and foliage are edible and the bark is used to make billum twine. The fruit is bright red when ripe and is eaten by people and is also favoured by many species of birds including fruit doves, hornbills, pigeons and birds of paradise. Photo credit: Angus Fraser



Figure 50: PNG Oak (*Castanopsis acuminatissima*), near Gare's Lookout, VNP
Photo credit: Allen Allison



Figure 51: A large PNG Oak (*Castanopsis acuminatissima*), Scarp Track, VNP
PNG Oak can be easily identified by its propensity to coppice (shoot multiple stems) from the base of the tree. Photo credit: Angus Fraser



Figure 52: PNG Oak (*Castanopsis acuminatissima*) in fruit
Photo credit: NSW State Herbarium

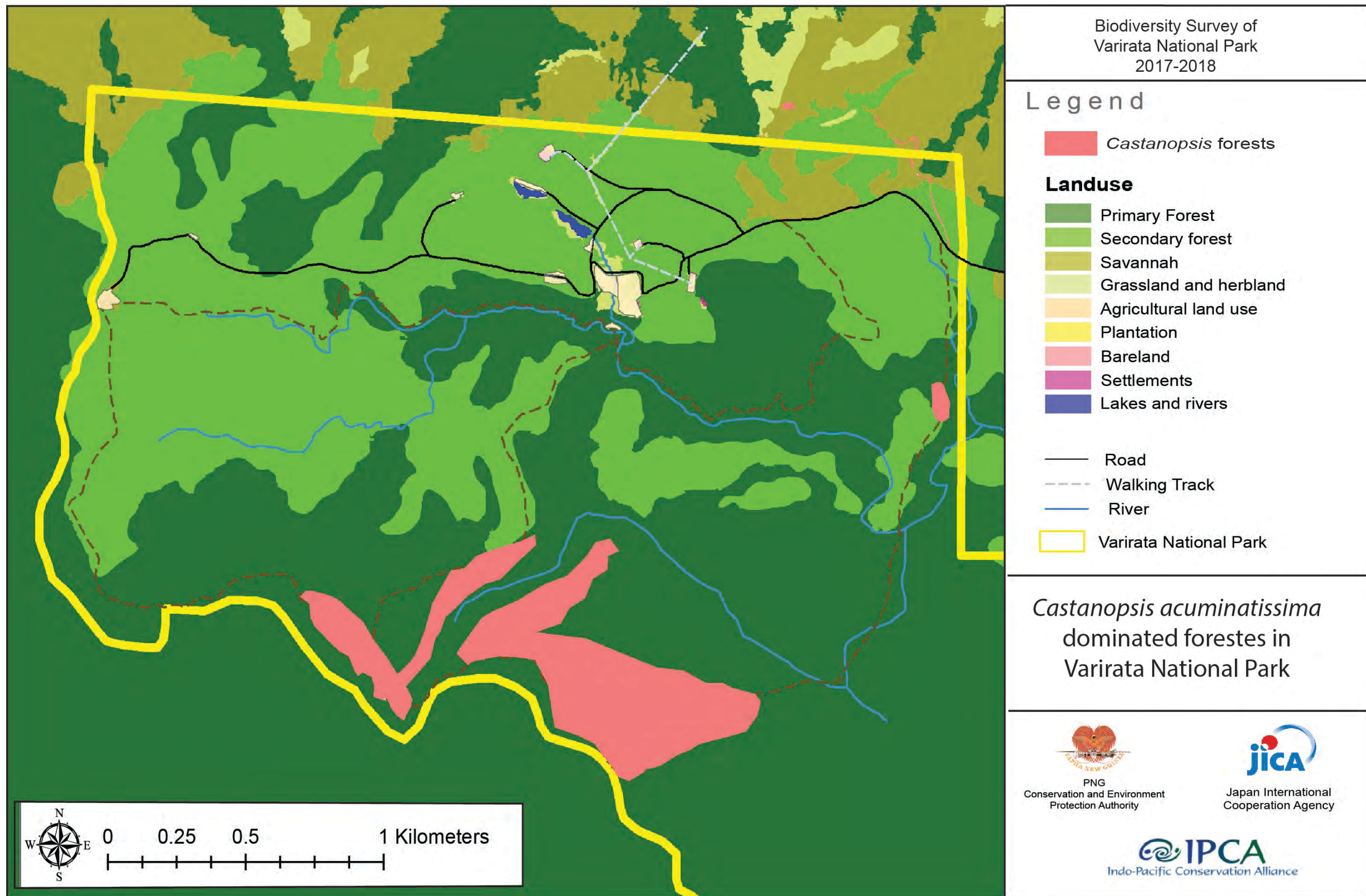


Figure 53: Distribution of *Castanoipsis*-dominated forests in VNP

4.5. Aquatic Habitat

Lotic habitat comprises Nairogo Creek, which is a small stream with several tributaries within the Park's catchment. The lentic habitat in the Park comprises two small lakes referred to as the Lake Lifilikatabu complex situated west of the Main Picnic Area.

4.5.1. Streams

The Park is drained by Nairogo Creek, which originates in the Park's west from two main branches that flow eastwards and join near the Park's eastern boundary after which it joins the Laloki River. Some plants such as *Neonauclea* sp. and *Impatiens* sp. are restricted to the stream channels and others comprise the riparian vegetation along the stream banks (Figure 54 to Figure 60).



Figure 54: Primary re-growth riparian vegetation along Nairogo Creek, VNP

Nairogo Creek along the Circuit Track. Photo credit: Angus Fraser

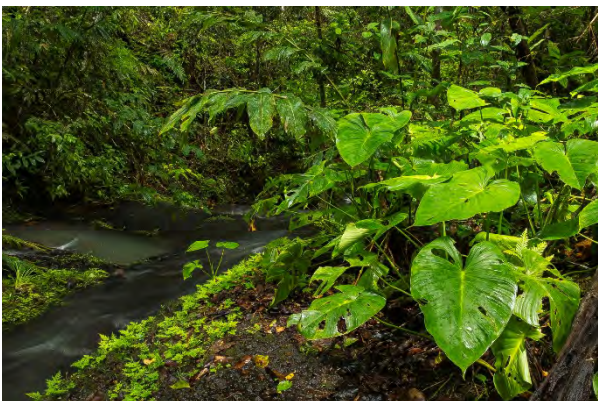


Figure 55: Alocasia sp. and Heliconia sp. adjacent to a tributary of Nairogo Creek, VNP

Primary forest. Photo credit: Angus Fraser



Figure 56: Nairogo Creek in secondary forest, VNP

This image is taken in the Park Buffer Zone Photo after the confluence of the two main branches. Photo credit: Angus Fraser



Figure 57: Neonauclea sp. in inflorescence, VNP

This common riparian shrub (Family Rubiaceae) occurs along the watercourses throughout VNP. Photo credit: Allen Allison



Figure 58: New Guinea Impatiens sp., VNP

New Guinea *Impatiens* sp is common along watercourses in primary and secondary forest. Photo credit: Angus Fraser



Figure 59: Nairogo Creek tributary in Primary Forest, VNP

Photo credit: Angus Fraser



Figure 60: Dense stands of Kanda (*Calamus* sp.) along a tributary of Nairogo Creek, VNP

Primary forest. Photo credit: Angus Fraser

4.5.2. Lakes

The Lake Lifilikatabu complex (Figure 61) is believed to have been built when the area supported a piggery (Hopkins & Hiaso, 1994). However, members of the Koiari Field Survey Team believe that the upper lake is natural and that the lower lake is artificial. Both are shallow and vary in size with rainfall. They are generally less than 0.5 ha in total area and have historically gone dry. The lower lake has a fine stand of Pandanus at the northern end (Figure 62 and Figure 63).



Figure 61: Aerial photo of the Lake Lifilikatabu complex and secondary forest, VNP

Lake Lifilikatabu is surrounded by almost pure stands of *Gymnostoma papuana* approximately 50 years old. Photo credit: JICA, 2017



Figure 62: Upper Lake Lifilikatabu in the dry season, VNP

Photo credit: Angus Fraser



Figure 63: Pandanus (*Pandanus* sp.) bordering upper Lake Lifilikatabu, VNP

Photo credit: Angus Fraser

There are a number of species of plants that in the Park are restricted to the lakes. These include a small aquatic fern, *Azola* (*Azola* sp.) and sedges (*Eleocharis* sp.) that line the water's edge (Figure 64). The lakeside

vegetation is otherwise unremarkable and consists mostly of introduced weeds.



Figure 64: Sedges (*Eleocharis* sp.) in upper Lake Lifilikatabu

This is prime habitat for a frog (*Litoria chloristona*), recorded from the lakes. Photo credit: Angus Fraser

4.6. Disturbed Habitat

Open grassy areas, such as the Main Picnic Area and grounds around Monomu Lodge, tend to be dominated by introduced (non-native) weeds generally restricted to landscaped garden areas and roadside verges (Figure 65 and Figure 66; Table 2). These species are discussed further in the Introduced Plants section of this Chapter (Section 4.10. Introduced Species) with a detailed account also provided in the Invasive Species Management Plan (IPCA, 2018d).



Figure 65: Landscaped gardens around the Main Picnic Area, VNP

Photo credit: Nitty Simard



Figure 66: Roadside verge of entrance road into the Park, VNP

Roadside verges characteristically have a high abundance of weed species. Photo credit: Angus Fraser

Table 2: Common weeds in VNP

FAMILY	COMMON GENERA
ASTERACEAE	<i>Ageratum conyzoides</i>
"	<i>Bidens pilosa</i>
"	<i>Crassophyllum crepidoides</i>
"	<i>Elephantopus mollis</i>
"	<i>Eleutherantra ruderalis</i>
"	<i>Erechtites valerianifolia</i>
"	<i>Mikania micrantha</i>
"	<i>Syndrella nodiflora</i>
CLEOMACEAE	<i>Clemone viscosa</i>
FABACEAE	<i>Mimosa pudica</i>
"	<i>Senna alata</i>
ONOGRACEAE	<i>Ludwigia octovalnis</i>
OXALIDACEAE	<i>Oxalis corniculata</i>
PASSIFLORACEAE	<i>Passiflora foetida</i>
POACEAE	<i>Eleusine indica</i>
"	<i>Paspalum conjugatum</i>
"	<i>Sporobolus sp.</i>
POLYGALACEAE	<i>Polygala paniculata</i>
RUBIACEAE	<i>Spermacoce laevis</i>

4.7. 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 67).

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.

4.7.1. Critically Endangered & Endangered

A species of tree *Halfordia papuana*, (Family Rutaceae) known from the Sogeri Plateau is scheduled as Critically Endangered under the IUCN Red List. *Halfordia papuana* is a synonym for *H. kendack*, which is widely distributed throughout PNG occurring in Morobe, Western, Eastern and Southern Highlands, and Western, Central and New Britain Provinces. The IUCN assessment for this species requires revision given that this plant is not considered to be under threat. It could be reasonably expected to occur within the Park, although this was not confirmed during the Biodiversity Survey (Figure 68).

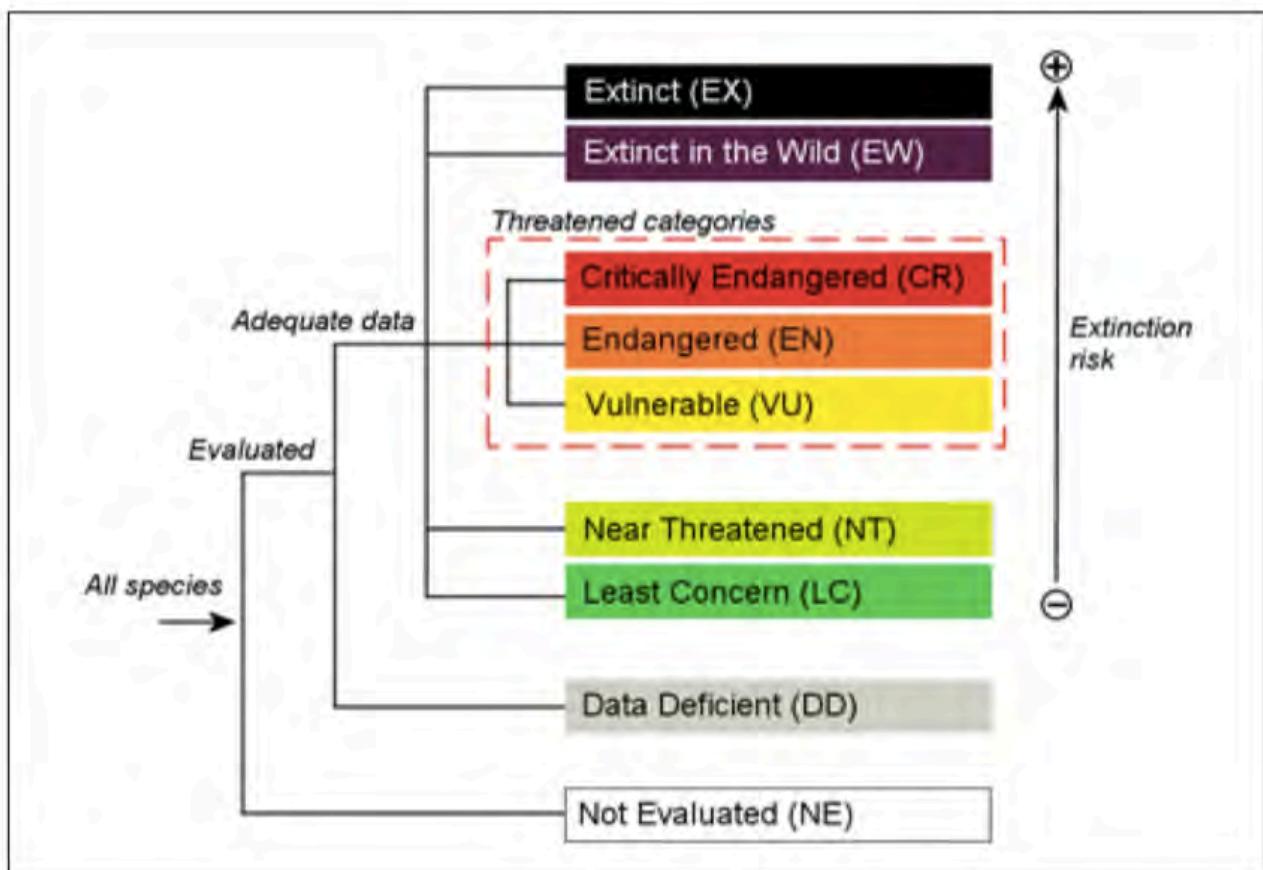


Figure 67: IUCN Red List Conservation Categories

Source: IUCN, 2018



Figure 68: *Halfordia papuana*, Critically Endangered under the IUCN Red List

Source: Botanic Illustrations.org

A widespread tree species *Flindersia pimenteliana* (Rutaceae) recorded from the Park by Hopkins and Hiaso (1994) is listed as ‘Endangered’ on the IUCN Red List (Figure 69). Hopkins and Hiaso provide a drawing of a mature *Flindersia pimenteliana* tree growing near Picnic Area 2 in 1991, however this tree could not be located during the Biodiversity (Flora) Survey. *F. pimenteliana* is widely distributed in hill forests throughout Papua New Guinea, Indonesian New Guinea and Australia.

Both *H. papuana* and *F. pimenteliana* are widely distributed in New Guinea and neither appears to be endangered throughout their range. They have both been scheduled on the IUCN Red List primarily because of over-exploitation in the Wau – Bulolo area of the Morobe Province. There is no compelling reason to treat these species as species of importance within the Park. It is strongly believed that the IUCN accounts for both species require revision.

Appendix 6 presents the IUCN Fact sheet for each species.



Figure 69: *Flindersia pimenteliana*, Endangered under the IUCN Red List

Source: Australian Tropical Rainforest Plants CSIRO, 2018

4.7.2. Near Threatened

Four species from the Park’s checklist (Appendix 2 and Appendix 6) are scheduled as Near Threatened. They comprise the locally common cycad (*Cycas campestris*) (Family Cycadaceae); a Dipterocarp, (*Hopea forbesii*) which is a lowland timber species; *Myristica globosa* (Family Myristicaceae) and *Helicia albiflora* (Family Proteaceae).

Cycas campestris is endemic to PNG with its range largely confined to low altitudes in the Central Province. Habitat loss through clearing and burning of savannah grasslands where it occurs are primary threats to this species.

The Dipterocarps (Family Dipterocarpaceae) are highly sought after by the logging industry throughout PNG and South East Asia given their high value as timber species. *Hopea forbesii* is native to the island of New Guinea (including West Papua) and has a broad distribution from Milne Bay Province to the Sepik and Western Provinces. It has been subjected to an estimated 25% decline in population in the last three generations due to loss of habitat and logging. These impacts have been most severe in Central

and Milne Bay Provinces. The IUCN indicate that this species is borderline 'Vulnerable' (Figure 67).

Myristica globosa is a large mid montane (up to 1,200 m) tree species to 30 m without commercial logging value. Very little data is available regarding its status and key threatening processes.

Helicia albiflora is widespread throughout PNG where it is typically associated with *Castanopsis* and *Nothofagus* dominant forests (PNGTrees, 2018). Little information is available regarding its status in the wild. Appendix 6 presents the IUCN Fact Sheets for each species.

4.8. Endemic Species

There are no species of plants endemic to Varirata National Park, however the locally common cycad *Cycas campestris* is restricted in distribution to the Central Province. Savannah comprises less than 2% of VNP and significant ecological value would be achieved by extending the Park's boundary to include a larger proportion of this habitat.

4.9. Important Species

Several important plant species occur throughout the Park, which comprise critical food sources for a variety of animals within the Park. A selection of these plants is discussed in the following sections.

4.9.1. Sogeri Velvet Bean (*Mucuna macropoda*)

Mucuna macropoda (Figure 70) is a leguminous vine that was collected in 1885 by Henry Forbes from the Sogeri Plateau and named in 1923 (Baker, 1923). It was known only from the holotype until it was re-discovered in 1988 by Helen and Michael Hopkins (Hopkins and Hopkins, 1993).

The genus *Mucuna* includes around 100 species that occur in both the Old World and New World tropics. It includes the familiar Flame of the Forest from New Guinea and

many species are pollinated by bats. Hopkins and Hopkins (1993) reported that *Mucuna macropoda* was pollinated by a small bat (*Syconycteris australis*) that occurs from the Moluccas, throughout New Guinea, including the Bismarck Archipelago, and along the east coast of Australia from Cape York south to the Sydney region. It is abundant throughout much of its range and is one of the most common species of bats found in the Park. *Mucuna macropoda* appears to be restricted, within Varirata National Park, to *Castanopsis* forests (Figure 53).



Figure 70: Common Blossom Bat (*Syconycteris australis*) feeding on *Mucuna macropoda*, VNP

Mucuna macropoda is a vine endemic to the Sogeri Plateau. Photo credit: M.J.G. Hopkins

4.9.1. Birthwort (*Aristolochia momandol*)

Aristolochia momandol is the only known food plant within the Park of the large iconic birdwing butterfly, *Ornithoptera priamus*. This plant is relatively common within primary and late secondary forest within the Park (Figure 71).



Figure 71: *Aristolochia momandol* in secondary forest, VNP

A. momandol is the primary host plant for the Birdwing Butterfly. Photo credit: Angus Fraser



Figure 72: Birdwing Butterfly (*Ornithoptera priamus*)

Photo credit: Dan Polhemus

4.9.2. Tulip (*Gnetum gnemon*)

Gnetum gnemon, a gymnosperm that occurs throughout New Guinea and much of Southeast Asia, is common in the primary forests of Varirata National Park. It is easily recognised by raised rings around the otherwise smooth trunk (Figure 49) and by its paired, expanded leaves, which has given it the Pidgin name of Tulip. The fruits and leaves are edible and the bark is used to produce billum string. Tulip is also an important food plant for many of the frugivorous birds that occur in VNP.

4.9.3. PNG Oak (*Castanopsis acuminatissima*)

The genus *Castanopsis*, a member of the oak family, Fagaceae, includes around 120 species of trees and shrubs concentrated in tropical and subtropical Asia but with a few

species occurring in Japan and close relatives in North America. There is a single species in New Guinea, *Castanopsis acuminatissima*, (Figure 50 - Figure 52) which occurs throughout the island, mostly in lower montane forest from elevations of 800 to 1,800 m, but it can range in some areas down to sea-level and up to around 2,200 m. The fruit, a spiny ovoid nut, is harvested by people in many areas and is an important source of food to many species of parrots. It is common at higher elevations in the Park, particularly in areas around Gare's lookout.

4.9.4. Fruiting Trees

There are at least 26 species of frugivorous birds occurring in Varirata National park (Frith et al., 1998), including, five species of birds of paradise, pigeons, berrypeckers and a diversity of other species. These birds are dependent on fruit produced by various species of primary rain forest trees. Two species of meliaceous trees, *Chisocheton lasiocarpus* and *Dysoxylum pettigrewianum* (Meliaceae) (Figure 73) and a species of *Myristica* (Myristicaceae) are visited almost exclusively by birds of paradise (Beehler and Dumbacher, 1996). Birds of paradise also feed heavily on the fruits from a fig, *Ficus* cf. *obliqua* and from a conifer, *Podocarpus nereifolius* (Podocarpaceae).



© W.T. Cooper

Figure 73: Fruit of *Dysoxylum pettigrewianum* (Family Meliaceae).

Source: Cooper and Cooper (1994)

There are, at least 42 species of *Ficus* found within the Park. One of these species, with small, bright orange fruits, is common at the forest edge. A tree, near the Lodge, was in fruit during November – December 2017 and was commonly visited by Raggiana Birds of Paradise, Brown Orioles, and several species of fruit doves and pigeons (Figure 74). Species of *Syzygium* (Figure 75) produce large, reddish fruit on the lower trunks of the trees; these are eaten by cassowary and other frugivorous birds and mammals.



Figure 74: *Ficus* sp., probably *Ficus rhizophoriphylla*, located near the Lodge, VNP

This species was frequently visited by a number of frugivorous birds, including the Pink-spotted Fruit Dove (*Ptilinopus perlatus*). Photo credit: Allen Allison



Figure 75: *Syzygium* sp., Primary forest, VNP

Photo credit: Angus Fraser

4.10. Introduced Species

IPCA have documented at least 51 species of introduced plants to occur within the Park (Appendix 4).

The introduced flora of VNP includes many of the same species, which occur along the Kokoda Track (Allison et al., 2015). These are mostly restricted to disturbed areas along roads and tracks and include many species of grasses together with a number of common herbaceous weeds such as Tobacco Weed (*Elephantophis mollis*) and Synedrella (*Synedrella nodiflora*). These and other weeds are common around the Main Picnic Area, the lakes, Monomu Lodge, roadside verges and other disturbed areas within VNP.

Of the introduced flora, six species have been recorded which warrant Park Management attention. These species comprise: African Tulip Tree (*Spathodea campanulata* Figure 76); lantana (*Lantana camara* Figure 77); Spiderwort (*Tradescantia* sp Figure 78) in addition to Hemp Vine (*Mikania micrantha* Figure 79) and two highly invasive and

problematic species: Spiked Pepper (*Piper aduncum*) and Clidemia (*Miconia crenata*). Both are widely established in secondary forests (Figure 40 and (Figure 42).



Figure 76: African Tulip Tree (*Spathodea campanulata*), VNP

Photo Credit: Allen Allison



Figure 77: Lantana (*Lantana camara*), VNP

Photo Credit: Angus Fraser



Figure 78: Spiderwort (*Tradescantia* sp.) surrounding Clidemia (*Miconia crenata*), VNP

Photo Credit: Angus Fraser



Figure 79: Hemp Vine (*Mikania micrantha*) in flower, VNP

Hemp Vine (*Mikania micrantha*) occurs around the shoreline of the Lake Lifikatabu complex. Photo credit: Angus Fraser

4.11. Potential Invasive Species

There are at least four species of introduced, highly invasive plants growing in the areas surrounding the Park – on the Sogeri Plateau or in the Laloki Valley. These species must be prevented from establishing in the Park, given their significant ecological risk to biodiversity. These species comprise Mexican Sunflower (*Tithonia diversifolia*), Giant Sensitive Plant (*Mimosa pigra*), Sanchezia (*Sanchezia speciosa*), and White Angel’s Trumpet (*Brugmansia candida*).

A detailed discussion on the ecology, potential environmental impacts and proposed management strategies are provided in the Invasive Species Management Plan (ISMP) prepared by IPCA (IPCA, 2018d).



Figure 80: Mexican Sunflower (*Tithonia diversifolia*)

Source: CABI Data Sheet, 2018



Figure 81: Giant Sensitive Plant (*Mimosa pigra*), lower Laloki Valley

The Giant Sensitive Plant does not currently occur in VNP. Image taken in the lower Laloki Valley. Nittyta Simard in frame. Photo credit: Allen Allison



Figure 82: Sanchezia (*Sanchezia speciosa*), Kokoda Track

Sanchezia is common in parts along the Kokoda Track. Photo credit: Allen Allison



Figure 83: White Angel's Trumpet (*Brugmansia candida*)

Photographed along Nairogo Creek, Sogeri Road outside VNP. Photo credit: Allen Allison.

4.12. Composition and Species Richness of Vascular Plant Flora

PNG's tropical forests sit within the greater 'Papuasias Region' including West Papua, the Bismarck Archipelago, and the Solomon Islands and are widely recognised as a major centre of plant diversity (Takeuchi, 2003b). Estimates of the New Guinea Island's plant diversity are significant and range from 11,000 (Collins et al. 1991) for PNG to 20,000-25,000 species for West Papua (Supriatna 1999).

Dr. Shelley James, formerly of Bishop Museum and now with the Royal Botanic Gardens, Sydney (NSW State Herbarium) is currently compiling a checklist for the flora of PNG. Although this work is still in progress there are approximately 1,800 genera and 13,500 species of vascular plants in PNG. There is no doubt that these figures will rise given there are significant knowledge gaps associated with PNG's flora, which remains poorly collected to date (Takeuchi, 2003b).

The 15 most speciose families occurring within the Park are listed in Table 3. IPCA's checklist of the vascular plants found in the Park includes 157 families, 581 genera and 1,126 species. The species total is considered conservative given previous botanical surveys have identified many taxa only to genus and morpho-species. Many of these likely represent the same taxon.

Based on IPCA's literature reviews and field surveys it is estimated that approximately 150 species of ferns, at least eight species of conifers, and between 700 and 900 species of flowering plants occur within VNP. These totals do not include the two species of *Araucaria* that were planted near the main lookout.

As such, the Park includes representatives from most PNG plant families, nearly a third of the vascular plant genera, and nearly 10% of PNG's vascular plant species. This is extraordinary diversity for a Park that is only

1,063 ha in total area and has negligible variation in elevation (630 to 833 m).

Table 3: Plant Families ranked according to species richness, VNP

NAME	NO.
Orchidaceae	71
Moraceae	55
Rubiaceae	48
Fabaceae	46
Lauraceae	41
Myrtaceae	30
Elaeocarpaceae	25
Poaceae	25
Apocynaceae	24
Phyllanthaceae	24
Euphorbiaceae	24
Malvaceae	23
Rutaceae	23
Sapindaceae	23
Meliaceae	22

PNG’s orchids have been a topic of great interest from botanists and collectors and have been the

focus of taxonomic interest for decades. PNG’s orchids are relatively well known compared with the majority of the country’s other plant taxa. This is reflected in their representation within literature and databases investigated by IPCA when compiling the check lists of plants for VNP.

Alwin Gentry of the Missouri Botanical Garden examined diversity in 226 temperate and tropical forests around the world. In 1989 he worked with Mike Hopkins of UPNG to examine diversity in VNP. Using a standardised protocol of identifying each species of tree with diameter at breast height (dbh) > 10 cm within ten plots of 100 m each, he determined that there were 209 species of trees and lianas within a hectare of primary forest in VNP. The Park was among the five richest forests surveyed worldwide by Gentry (Figure 84).

**Gentry Tropical Tree Plots (-22° to 22°)
Varirata National Park in Red**

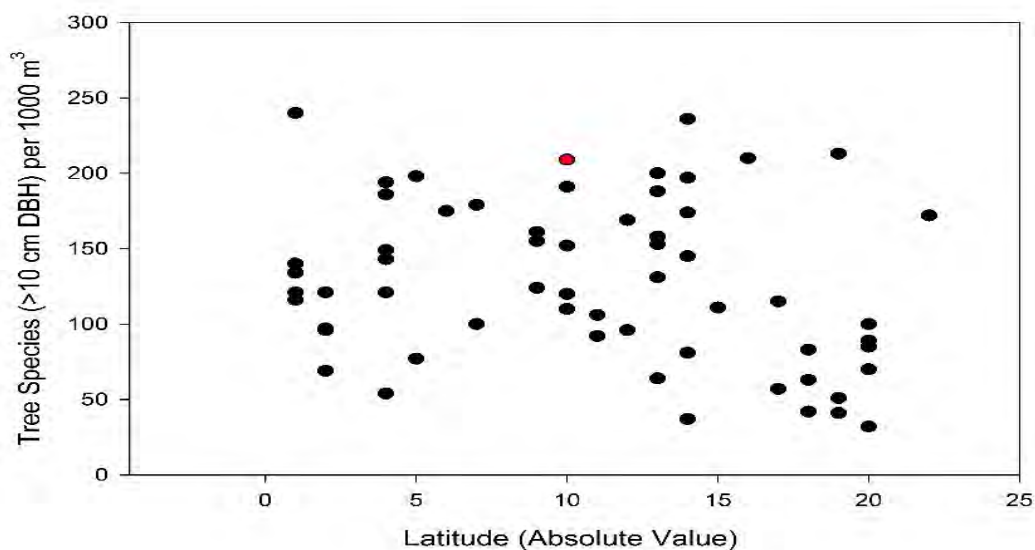


Figure 84: Tropical forest tree species diversity

Tree species diversity in 59 tropical forests of Africa, Indo-Pacific, Australia and the Americas. The result for Varirata National Park is indicated in red in the above figure, it is among the 5th most diverse forest system of those studied by Alwin Gentry (Phillips, O., and J.S. Miller, 2002).

4.12.1. Phenology

Brown and Hopkins (1995; 1996; 2002) established a 3 ha plot in primary forest near Gare’s Lookout in late 1990 and assessed tree flowering and fruiting phenology over 26 months. Their plot included 2,300 individual (permanently tagged) trees with a circumference of 20 cm (roughly a diameter at breast height of 7 cm) represented by 274 species. During their study a few species flowered continuously, some sporadically, some only once during a particularly intense wet season one year and many not at all. Overall, only 60% of the species produced flowers and fruit during the study period.

The proportion of the flora in the primary forest bearing fruit – a general indication of tree phenology – ranged from around 5% to approximately 16% with a peak during the dry season. At least some trees were bearing fruit

at any given time of the year and those with flowers ranged from 10% to 20% with a similar seasonal pattern to the fruiting trees.

These findings in conjunction with the results of IPCA’s field survey suggest that in primary forest flowers and fruit are readily available year-round, as are the nectivorous and frugivorous birds that are dependent on these resources. Although there is clearly a seasonal pattern (Figure 85) it is not particularly pronounced. As Brown and Hopkins (1995; 1996; 2002) demonstrate, unpredictable variation in annual rainfall has a pronounced effect on some plant species and on the nomadic species of birds that depend on them.

The eucalypts (Grey Gum, Ghost Gum and White Gum) that dominate the savannah vegetation generally flower during the dry season.

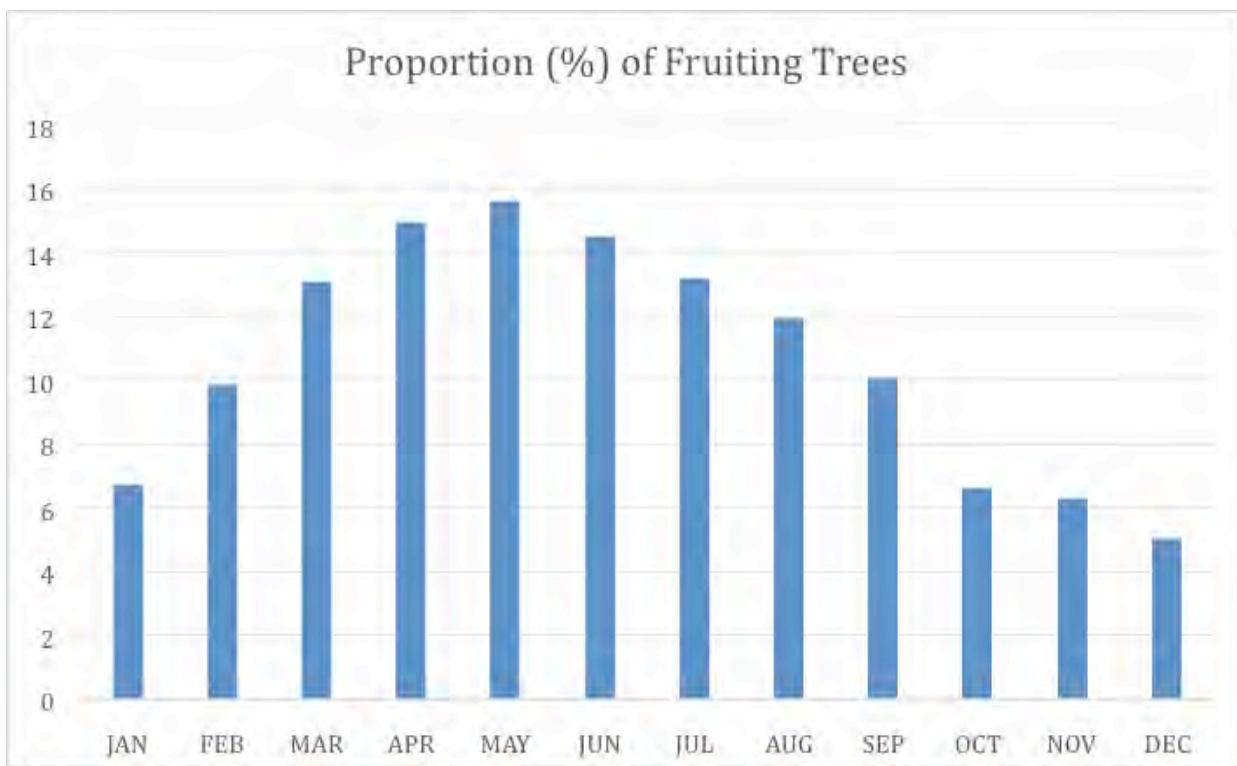


Figure 85: Percentage of trees in primary forest with fruit in VNP

Source: Hopkins & Hiaso, 1994.

4.13. Natural History 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 of a number of species 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 first Field Guide Brochure issued for Plants of VNP is presented in Appendix 7. The Field Guide Brochures for the fauna species are presented in IPCA's Biodiversity (Fauna) Survey Report (IPCA, 2018c).

5. CONCLUSIONS

PNG's tropical forests sit within the greater 'Papuasia Region' including West Papua, the Bismarck Archipelago, and the Solomon Islands and are widely recognised as a major centre of plant diversity (Takeuchi, 2003b). This places PNG in the centre a 'mega diversity hotspot' (UNEP, 2010). Plant diversity within PNG is significant with estimates ranging from 11,000 (Collins et al. 1991) for PNG to 20,000-25,000 which have been suggested for West Papua alone (Supriatna, 1999). Preparation of a species checklist for the flora of PNG is in progress and currently comprises approximately 1,800 genera and 13,500 species of vascular plants (James, pers.comm). There is no doubt that these figures will rise given there are significant knowledge gaps associated with PNG's flora, which remains poorly collected to date (Takeuchi, 2003b).

The highest diversity of flora is recorded from PNG's lowland forests, which decreases increasing elevation. The medium crowned lowland hill forests that comprise approximately 80% of VNP are species rich and generally poorly known (Takeuchi, 2003b). These forests throughout PNG are subject to a several threatening processes, which are primarily habitat loss and logging.

5.1. Key Vegetation Associations

The botanical survey of the Park confirms three key vegetation associations and five key habitats. Medium crowned lowland hill forest (primary forest), secondary Forest and eucalypt savannah comprise approximately 80%, 18% and <2% of the Park's total area respectively. Aquatic and Disturbed habitats occur in all three associations.

Medium-crowned lowland hill forest includes a rich diversity of tree species with oaks (*Fagaceae*), particularly *Castanopsis acuminatissima* and *Lithocarpus celibicus* often occurring along ridgelines. Forest structure is typically characterised by a closed canopy 25-30 m high, a dense understory of shrubs, small trees and lianas.

Secondary forest communities are dominated by *Casuarina* (*Gymnostoma papuana*) and the extent of these forests within the Park is remarkable. Through natural forest succession this habitat has expanded by more than 200 hectares in less than 50 years. Much of these forests now occupy areas of former grassland from when the Park was officially opened in 1973. Close proximity of a forest seed bank, an absence of fire and limited poaching of forest resources have largely facilitated the successful expansion of secondary forests within VNP. Similarly, since 1992 changes in old secondary forests such as those adjacent to the Main entrance are evident as they now contain a greater composition of primary forest species compared with the almost pure stands of *Gymnostoma* that occur around the Lake Lifikatabu complex in the Main Picnic Area.

At less than 2% of the Park's area, eucalypt savannah is poorly represented despite being a common habitat at low elevations in Central Province. It is however, important ecologically as several species with a restricted range in PNG only occur in these habitats. They include Ghost Gum (*Corymbia papuana*), Grey Gum (*E. tereticornis*) White Gum (*E. alba*), Weeping Paperbark (*Melaleuca leucadendron*) and the cycad (*Cycas campestris*), which is a regional endemic. Furthermore, the eucalypts are particularly critical for a variety of mammals and birds, particularly parrots, which rely on hollows produced by these trees for nesting sites. Increasing the Park's footprint to cover a greater area of eucalypt savannah would comprise a valuable conservation initiative.

The Aquatic habitats within the Park comprise Nairogo Creek and its tributaries, and the Lake Lifikatabu complex. Several species are restricted in their distribution throughout the Park given their dependence on aquatic habitats. These include a species of sedge (*Eleocharis* sp.) from the lake and *Neonauclea* sp a medium sized riparian shrub and native species from the genus *Impatiens*, which are largely confined to watercourses within the park.

Disturbed habitats including landscaped gardens of the Park's picnic areas and roadside verges are dominated by weed species and naturalised grasses.

5.2. Species Richness

IPCA's botanical surveys in conjunction with a detailed analysis of literature including records of past collections undertaken from the Park and the Sogeri Plateau confirm at least 1,126 plant species comprising 581 genera and 157 families. This is considered to be conservative given many of the collection specimens were not identified to species level given an absence of flower or fruit at the time of collection. Brown and Hopkins (1995) demonstrated that flowering and fruiting cycles of tree species within VNP is irregular and does not occur in predictable seasonal cycles reporting only 60% of individual trees flowered during their 26-month study. This variation in flowering and fruiting cycles among species demonstrates that long-term, sustained monitoring effort is necessary to obtain biological data from PNG's tropical forests.

The IPCA 2017-2018 study collected 635 plant specimens, including ground cover, shrubs, epiphytes, lianas and flowering trees. Both studies have contributed greatly to our current understanding of floristics within VNP. There are undoubtedly many new species records to be obtained for the Park with the potential for describing plant species new to science from the Park equally very high.

In broader context, the diversity of flora represented by species accounts from the Park to date is extraordinary. This survey has demonstrated that VNP, which currently only covers 1,063 ha and has negligible range in elevation (630 to 833 m) contains representatives from most of PNG's plant families, nearly a third of the vascular plant genera, and nearly 10% of PNG's vascular plant species. This represents a remarkable proportion of PNG's plant biodiversity. Furthermore, when compared with 59 other tropical forests, VNP ranked within the top 5 for the highest diversity of tree species in

tropical forest ecosystems (Phillips, O., and J.S. Miller. 2002).

It is expected that with further targeted field surveys, additional species records for flora will most certainly be added to the Park's checklists with the potential for describing species new to science considered to be very high.

5.3. Species with Conservation Significance

Six species of plants scheduled with conservation significance under the IUCN Red List are included in the first Checklist of Plants for VNP.

One species is classified as Critically Endangered (*Halfordia papuana*) while a second species, *Flindersia pimenteliana* is scheduled as Endangered. Neither species was collected from the Park during the current surveys, although *F. pimenteliana* was confirmed by Hopkins & Hisao (1994) as occurring within the Park. The distributions of both species co-occur with medium crowned hill forest, which is widely distributed across the country and it is expected that these species are also widely distributed. Their listing under the IUCN Red List is therefore considered questionable and it is believed that these IUCN records require revision.

Of the remaining four species (*Cycas campestris*; *Hopea forbesii*; *Myristica globosa*; and *Helicia albiflora*) all are scheduled as Endangered.

H. albiflora is commonly associated with *Castanopsis* and *Nothofagus* forest communities and has a broad distribution across PNG. Little is known regarding the population status of *Myristica globosa* and both species are considered to be 'low risk' under the 'Near Threatened' category.

The population status of *C. campestris* is comparatively better understood. *Cycas campestris* is endemic to PNG with its range largely confined to low altitudes in the Central Province. Habitat loss through clearing and frequent burning of savannah grasslands where it occurs are the primary threats to this species.

Given that VNP contains less than 2% of eucalypt savannah habitat increasing the Park's footprint to include a greater proportion of savannah would be a tangible measure in affording a greater level of protection to this regionally endemic species.

Hopea forbesii is native to the island of New Guinea (including West Papua) and has a broad distribution from Milne Bay Province to the Sepik and Western Provinces, it has been subjected to an estimated 25% decline in population in the last three generations due to loss of habitat and logging. These impacts have been most severe in Central and Milne Bay Provinces. The IUCN indicate that this species is borderline 'Vulnerable'.

5.4. Introduced Flora & Invasive Species

The introduced fauna of Varirata National Park includes 51 species of exotic plants, the majority (45 species) are common weeds generally associated with roadside verges, and landscaped gardens of the Park's picnic areas. Regular lawn maintenance ensures these species pose little ecological risk to the native plant assemblages in the Park.

The remaining six species are widely recognised as invasives with potential to cause serious ecological impact. Three of these are represented by small populations or individual specimens and can be quickly, and economically eradicated from the Park as strongly recommended. They comprise African Tulip Tree (*Spathodea campanulata*); Spiderwort (*Tradescantia* spp) and Lantana (*Lantana camara*).

The fourth species, Hemp Vine (*Mikania micrantha*) was documented from the foreshore of Lake Lifilikatabu. Further information is required regarding the extent of its distribution throughout the Park.

The remaining two species comprise Clidemia (*Miconia crenata*) and Spiked Pepper (*Piper aduncum*) and both are well established in the Park. Clidemia in particular is a dominant groundcover in secondary forests with

potential to significantly impact floristic diversity and processes of forest succession. The Invasive Species Management Plan (IPCA, 2018d) and Environmental Monitoring Plan (IPCA, 2018a) detail further recommendations regarding the challenges associated with containing and managing these species in the Park.

5.5. Ecological Value of Varirata National Park

The Biodiversity (Flora) Survey has provided 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.

The Park's incredible 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.

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7. 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 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 be 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 or animal that is not native to an area and has been 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.

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Appendix 1. Scope of Work

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. <ul style="list-style-type: none"> ▪ Common Vascular Plants ▪ Vertebrate <ul style="list-style-type: none"> ○ Amphibians ○ Common reptiles ○ Common birds ○ Common mammals ▪ Common invertebrates

Section	Fauna	Flora
4.6	NA	<p>Biodiversity Seminar</p> <ul style="list-style-type: none"> 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. Check List of Plant Species of VNP

Notes:

1. All non-native plants are indicated with an * in the checklist of vascular plants from the Park;
2. Species shaded in grey are native species listed under the IUCN Red List. Refer to Appendix 6 for further information on each species.

VASCULAR PLANT SPECIES OF VARIRATA NATIONAL PARK

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TOTAL NUMBER OF GENERA =	581
TOTAL NUMBER OF FAMILIES =	157
TOTAL NUMBER OF SPECIES =	1126
TOTAL NUMBER OF WEEDS =	51

FERNS**ASPLENIACEAE**

Asplenium bipinnatifidum
Asplenium kelelense
Asplenium lobatum
Asplenium ludens
Asplenium nidus
Asplenium pellucidum
Asplenium phyllitidis
Asplenium polyodon
Asplenium sancti-christofori
Asplenium spathulinum
Asplenium tenerum
Asplenium sp.
Diplora durvillaei

ATHYRIACEAE

Diplazium cordifolium
Diplazium crenato-serratum
Diplazium sorzogonense

BLECHNACEAE

Blechnum orientale

CYATHEACEAE

Cyathea contaminans

Cyathea fusca

Cyathea macrophylla

Cyathea rumphiana

Cyathea sp.

CYSTODIACEAE

Cystodium sorbifolium

DAVALLIACEAE

Davallia denticulata

Davallia parvula

Davallia pectinata

Davallia solida

DENNSTAEDTIACEAE

Dennstaedtia ampla

Dennstaedtia novoguineensis

Dennstaedtia scandens

DICKSONIACEAE

Calochlaena straminea

DRYOPTERIDACEAE

Dryopteris concolor

GLEICHENIACEAE

Dicranopteris linearis

Gleichenia sp.

Stichurus milnei

HYMENOPHYLLACEAE

Abrodictyum obscurum

Cephalomanes acrosorum

Cephalomanes atrovirens

Cephalomanes javanicum
Crepidomanes bilabiatum
Crepidomanes bipunctatum
Crepidomanes kurzii
Crepidomanes venulosum
Trichomanes bimarginatum
Trichomanes diffusum
Trichomanes saxifragoides
Vandenboschia maxima

LINDSAEACEAE

Bierhorstia chinensis
Lindsaea lucida
Lindsaea obtusa
Lindsaea repens
Sphenomeris sp.

LYCOPODIACEAE

Huperzia phlegmaria
Lycopodiella cernua
Lycopodium nummularifolium
Lycopodium squarrosum

LYGODIACEAE

Lygodium circinatum
Lygodium dimorphum
Lygodium microphyllum

MARATTIACEAE

Angiopteris evecta

NEPHROLEPIDACEAE

Nephrolepis biserrata
Nephrolepis hirsutula
Nephrolepis obliterated

OPHIOGLOSSACEAE

Ophioderma pendula

POLYPODIACEAE

Aglaomorpha parkinsonii
Calymmodon mnioides
Drynaria quercifolia
Goniophlebium verrucosum
Lemmaphyllum accedens
Loxogramme scolopendrioides
Microsorium membranifolium
Microsorium papuanum
Microsorium pteropus
Microsorium punctatum
Microsorium rampans
Microsorium sp.
Phymatosorus scolopendria
Pyrrosia lanceolata
Pyrrosia longifolia
Pyrrosia princeps
Schizaea dichotoma
Schizaea digitata

PSILOTACEAE

Psilotum nudum

PTERIDACEAE

Antrophyum callifolium
Cheilanthes distans
Monogramma dareicarpa
Pneumatopteris sogerensis
Pteris papuana
Syngamma quinata
Taenitis blechnoides
Taenitis mediosora
Vaginularia junghuhnii
Vittaria ledermannii

SELAGINELLACEAE

Selaginella hieronymi
Selaginella kaernbachii
Selaginella muelleri

Selaginella purpuripes

Selaginella velutina

Selaginella sp.

TECTARIACEAE

Arthropteris articulata

Tectaria bamleriana

Tectaria barclayi

Tectaria ferruginea

Tectaria pubescens

THELYPTERIDACEAE

Adiantum caudatum

Adiantum diaphanum

Adiantum neoguineense

Adiantum philippense

Ampelopteris prolifera

Macrothelypteris polypodioides

Plesioneuron tuberculatum

Pronephrium triphyllum

Sphaerostephanos arfakianus

Sphaerostephanos heterocarpus

CONIFERS

CYCADACEAE

Cycas campestris (EN)

GNETACEAE

Gnetum costatum

Gnetum gnemon

Gnetum latifolium

Gnetum sp.

PODOCARPACEAE

Decussocarpus sp.

Podocarpus neriifolius

Podocarpus sp.

FLOWERING PLANTS

ACANTHACEAE

Calophanoides sp.
Calycacanthus magnusianus
Dicliptera sp.
Graptophyllum pictum
Graptophyllum sp.
Hemigraphis sp.
Hygrophila sp.
Jadunia sp.
Justicia sp.
Lepidagathis sp.
Leptosiphonium versicolor
Phlogacanthus novoguineensis
Pseuderanthemum sp.
Ptyssiglottis pubisepala
Rungia diversiformis
Rungia sp.

ACHARIACEAE

Erythrospermum sp.
Pangium edule

ACTINIDIACEAE

Saurauia conferta
Saurauia dufaurii
Saurauia sp.

AMARANTHACEAE

Achyranthes bidentata
*Alternanthera sessilis**

ANACARDIACEAE

Buchanania amboinensis
Buchanania macrocarpa
Camptosperma montana
Dracontomelon brinco
Dracontomelon sp.

Euroschinus papuanus

Euroschinus sp.

*Mangifera minor**

Mangifera sp.

Rhus taitensis

Semecarpus cassuvium

Semecarpus magnificus

Semecarpus schlechteri

Semecarpus sp.

Spondias sp.

ANNONACEAE

Artabotrys sp.

Cyathocalyx petiolatus

Goniothalamus aruensis

Goniothalamus species 1

Goniothalamus sp.

Haplostichanthus longirostris

Maasia glauca

Meiogyne sp.

Mitrella sp.

Polyalthia forbesii

Polyalthia sclerophylla

Polyalthia species 1

Polyalthia sp.

Popowia sp

Popowia species 1

Popowia sp.

Pseuduvaria sp.

Uvaria rosenbergiana

Uvaria sp.

Xylopiia sp.

APIACEAE

*Centella asiatica**

Oenanthe javanica

APOCYNACEAE

Alstonia scholaris
Alstonia sp.
*Asclepias curassavica**
Dischidia major
Dischidia nummularia
Dischidia cf. papuana
Dischidia sp.
Ervatamia coronaria
Ervatamia sp.
Gymnanthera sp.
Gymnema sp.
Hoya nicholsoniae
Hoya sp.
Ichnocarpus frutescens
Melodinus australis
Melodinus forbesii
Ochrosia ficifolia
Ochrosia sp.
Papuechites aambe
Parsonsia buruensis
Parsonsia oligantha
Tabernaemontana aurantiaca
Tabernaemontana pandacaqui
Urceola javanica

APONOGETONACEAE

Aponogeton loriae

AQUIFOLIACEAE

Ilex sp.

ARACEAE

Amydrium magnificum
Cyrtosperma carrii
Epipremnum papuanum
Homalomena davidiana
Homalomena schlechteri
Lasia spinosa

Pothos hellwigii

Schismatoglottis potamophila

ARALIACEAE

Arthropodium macranthum

Boerlagiodendron novoguineense

Mackinlaya celebica

Osmoxylon species 1

Osmoxylon sp.

Polyscias ledermanii

Schefflera actinophylla

Schefflera bractescens

Schefflera elliptica

Schefflera stahlia

Schefflera thaumasiantha

Schefflera versteegii

Schefflera species 1

Schefflera sp.

ARECACEAE

Calamus aruensis

Calamus sp.

Calyptrocalyx forbesii

Calyptrocalyx sp.

Caryota rumphiana

Caryota sp.

Cyrtostachys loriae

Heterospathe sp.

Hydriastele cf. beccariana

Hydriastele sp.

Korthalsia brassii

Orania sp.

Paralinospadix sp.

Ptychosperma sp.

ARISTOLOCHIACEAE

Aristolochia momandul

ASPARAGACEAE

Cordyline fruticosa

Cordyline sp.

Dracaena angustifolia

Dracaena sp.

ASPHODELACEAE

Geitonoplesium cymosum

ASTERACEAE

Acmella grandiflora

*Ageratum conyzoides**

*Bidens pilosa**

Blumea riparia

Blumea saxatilis

*Crassocephalum crepidioides**

*Elephantopus mollis**

*Eleutheranthera ruderalis**

*Erechtites valerianifolia**

Gynura procumbens

Microglossa pyrifolia

Mikania cordata

*Mikania micrantha**

*Synedrella nodiflora**

*Tithonia diversifolia**

Vernonia lanceolata

*Wedelia spilanthoides**

BALSAMINACEAE

Impatiens hawkeri

BEGONIACEAE

Begonia sp.

BIGNONIACEAE

Deplanchea tetraphylla

Deplanchea sp.

Neosepicaea sp

Neosepicaea sp.

Pandorea sp.

*Spathodea campanulata**

Tecomanthe dendrophila

BIXACEAE

*Bixa orellana**

BURSERACEAE

Canarium acutifolium

Canarium asperum

Canarium cestracion

Canarium hirsutum

Canarium indicum

Canarium kaniense

Canarium maluense

Canarium cf. moluense

Canarium species 1

Canarium sp.

Garuga floribunda

Haplolobus furfuraceus

Haplolobus sp.

Protium macgregorii

Protium species 1

Protium sp.

Santiria sp.

CALOPHYLLACEAE

Calophyllum soulattri

Calophyllum trachycaule

Calophyllum sp.

CANNABACEAE

Aphananthe philippinensis

Trema orientalis

CARDIOPTERIDACEAE

Gonocaryum sp.

Pseudobotrys doraе

Pseudobotrys sp.

CARYOPHYLLACEAE

*Drymaria cordata**

CASUARINACEAE

Gymnostoma papuana

CELASTRACEAE

Bhesa archboldiana

Celastrus novoguineensis

Celastrus sp.

Salacia erythrocarpa

Salacia sp.

CHLORANTHACEAE

Chloranthus erectus

Chloranthus officinalis

CHRYSOBALANACEAE

Hunga papuana

CLEOMACEAE

*Cleome viscosa**

CLUSIACEAE

Garcinia assugu

Garcinia dulcis

Garcinia hollrungii

Garcinia sp

Garcinia subtilinervis

Garcinia sp.

COMBRETACEAE

Terminalia archboldiana

Terminalia kaernbachii

Terminalia species 1

Terminalia sp.

COMMELINACEAE

Commelina sp.

Dictyospermum sp.
Floscopa scandens
Polia secundiflora
*Tradescantia sp.**

CONNARACEAE

Rourea minor
Rourea cf. simnlans

CONVOLVULACEAE

Ipomoea eriocarpa
Ipomoea sp.
Lepistemon urceolatus
Merremia gemella
Merremia peltata
Merremia umbellata

CRYPTERONIACEAE

Crypteronia cumingii

CUCURBITACEAE

Nealsomitra pilosa
Papuasicyos papuana

CUNONIACEAE

Caldcluvia nymanii
Caldcluvia papuana
Caldcluvia sp.
Schizomeria floribunda
Schizomeria serrata
Schizomeria sp.

CYPERACEAE

Carex cryptostachys
Cyperus cf. brevifoli
Cyperus compressus
Cyperus digitatus
Cyperus halpan
Cyperus laxus

Cyperus meistostylus
Cyperus tenuiculmis
Eleocharis dulcis
*Fimbristylis dichotoma**
Fuirena umbellata
Hypolytrum nemorum
*Kyllinga brevifolia**
Mapania anomala
Mapania cuspidata
Paramapania parvibractea
Rhynchospora corymbosa
Rhynchospora rubra
Scleria lithosperma
Scleria polycarpa
Scleria scrobiculata

DICHAPETALACEAE

Dichapetalum papuanum
Dichapetalum sp.

DILLENiaceae

Tetracera nordtiana

DIOSCOREACEAE

Dioscorea nummularia
Dioscorea pentaphylla

DIPENTODONTACEAE

Perrottetia alpestris
Perrottetia species 1
Perrottetia sp.

DIPTEROCARPACEAE

Hopea forbesii (NT)
Hopea similis
Hopea sp.

EBENACEAE

Diospyros cordato-oblonga

Diospyros humilis

Diospyros novoguineensis

Diospyros sp.

ELAEAGNACEAE

Elaeagnus triflora

ELAEOCARPACEAE

Aceratium archboldianum

Aceratium muellerianum

Aceratium oppositifolium

Aceratium species 1

Aceratium species 2

Aceratium sp.

Elaecarpus sp

Elaeocarpus angustifolius

Elaeocarpus culminicola

Elaeocarpus dolichostylus

Elaeocarpus hartleyi

Elaeocarpus ledermannii

Elaeocarpus stenodactylus

Elaeocarpus womersleyi

Elaeocarpus species 1

Elaeocarpus species 2

Elaeocarpus species 4

Elaeocarpus sp.

Sloanea forbesii

Sloanea paradisearum

Sloanea sogerensis

Sloanea species 3

Sloanea species 4

Sloanea species 5

Sloanea sp.

ERYTHROXYLACEAE

Erythroxylum ecarinatum

Erythroxylum sp.

ESCALLONIACEAE

Polyosma forbesii

Polyosma sp.

EUPHORBIACEAE

Acalypha hellwigii

Alchornea rugosa

Aleurites moluccana

Claoxylon ledermannii

Claoxylon tenerifolium

Codiaeum variegatum

Croton choristadenius

*Croton hirtus**

Croton prunifolius

Endospermum medullosum

Endospermum myrmecophilum

Endospermum sp.

Euphorbia sp.

Homalanthus novoguineensis

Macaranga aleuritoides

Macaranga densiflora

Macaranga glaberrima

Macaranga punctata

Macaranga quadriglandulosa

Macaranga sp.

Mallotus floribundus

Mallotus sp.

Pimelodendron amboinicum

EUPOMATIACEAE

Eupomatia laurina

Eupomatia sp.

FABACEAE

Albizia papuensis

Archidendron lucyi

Archidendron sp.

Cajanus reticulatus

*Calopogonium mucunoides**

Canavalia papuana
*Cassia grandis**
Cassia javanica
*Castanospermum australe**
Castanospermum sp.
*Centrosema pubescens**
Crotalaria albida
Crotalaria chinensis
Crotalaria sessiliflora
Cynometra minutiflora
Derris rubrocalyx
Desmodium gyroides
Desmodium microphyllum
Desmodium pulchellum
Desmodium pullenii
Desmodium sequax
Desmodium velutinum
Dioclea hexandra
Erythrina merrilliana
Falcataria moluccana
*Flemingia macrophylla**
Indigofera linifolia
Macropsychanthus lauterbachii
Maniltoa cynometroides
Maniltoa psilogyne
Maniltoa sp.
*Mimosa pudica**
Mucuna stanleyi
Mucuna sp.
*Phaseolus lunatus**
Phylacium bracteosum
Phyllodium pulchellum
Pterocarpus sp.
Pueraria montana
Rhynchosia acuminatissima
*Senna alata**
Strongylodon lucidus
*Stylosanthes humilis**
Stylosanthes sp.

Tephrosia vestita

Zornia gibbosa

FAGACEAE

Castanopsis acuminatissima

Lithocarpus celebicus

Lithocarpus sp.

FLAGELLARIACEAE

Flagellaria indica

GENTIANACEAE

Fagraea berteriana

Fagraea ceilanica

Fagraea gracilipes

Fagraea racemosa

Fagraea sp.

Lisianthus sp.

GESNERIACEAE

Aeschynanthus hartleyi

Boea lawesii

Cyrtandra sp.

Rhynchotechum discolor

GOODENIACEAE

Scaevola oppositifolia

Searda sp

HIMANTANDRACEAE

Galbulimima belgraveana

Galbulimima sp.

HYDROCHARITACEAE

Blyxa aubertii

HYPOXIDACEAE

Curculigo capitulata

Curculigo orchioides

ICACINACEAE

Gomphandra papuana
Phytocrene interrupta
Platea excelsa
Platea latifolia
Platea sp.
Polyporandra scandens
Rhyticaryum longifolium

JUGLANDACEAE

Engelhardia rigida

LAMIACEAE

Callicarpa longifolia
Callicarpa pentandra
Clerodendrum buruanum
Clerodendrum costatum
Clerodendrum cf. tracyanum
Clerodendrum sp.
Faradaya splendida
Faradaya sp.
Gmelina sp.
Leucas flaccida
*Mesosphaerum suaveolens**
Plectranthus congestus
Plectranthus scutellarioides
Plectranthus sp.
Pogostemon stellatus
Premna regularis
Premna serratifolia
Premna sp.

LAURACEAE

Beilschmiedia sp
Beilschmiedia sp.
Cinnamomum grandiflorum
Cinnamomum massoia
Cinnamomum sp.

Cryptocarya alleniana
Cryptocarya apamifolia
Cryptocarya cf. apamifolia
Cryptocarya cagayanensis
Cryptocarya forbesii
Cryptocarya ledmannii
Cryptocarya masseyi
Cryptocarya cf. multinerva
Cryptocarya novo-guineensis
Cryptocarya papuana
Cryptocarya splendens
Cryptocarya sulcata
Cryptocarya species 1
Cryptocarya species 2
Cryptocarya species 3
Cryptocarya species 4
Cryptocarya species 5
Cryptocarya species 7
Cryptocarya species A
Cryptocarya sp.
Endiandra faceta
Endiandra ledermannii
Endiandra species 1
Endiandra sp.
Litsea communis
Litsea densiflora
Litsea elliptica
Litsea engleriana
Litsea firma
Litsea galorei
Litsea guppyi
Litsea timoriana
Litsea species 1
Litsea sp.
Neolitsea australiensis
Neolitsea sp.

LECYTHIDACEAE

Barringtonia calyptrocalyx

Barringtonia sp.
Planchonia papuana

LENTIBULARIACEAE

Utricularia striatula

LINACEAE

Hugonia jenkinsii

LOGANIACEAE

Fragraea ceilanica
Geniostoma rupestre
Neuburgia corynocarpa
Neuburgia sp.

LORANTHACEAE

Amyema cf. *friesiana*
Amyema rigidiflora
Amyema sp.
Decaisnina hollrungii
Decaisnina pedicellata
Dendrophthoe gjellerupii
Sogerianthe sogerensis

LYTHRACEAE

Lagerstroemia piriformis

MAGNOLIACEAE

Magnolia tsiampacca
Magnolia sp.

MALPIGHIACEAE

Stigmaphyllon timoriense

MALVACEAE

Abelmoschus manihot
Brachychiton carruthersii
Commersonia bartramia
Grewia sp.
*Melochia corchorifolia**

Melochia odorata
Melochia umbellata
Microcos sp.
Scaphium sp.
*Sida acuta**
*Sida cordifolia**
*Sida rhombifolia**
Sterculia schumanniana
Sterculia shillinglawii
Sterculia species 1
Sterculia species 2
Sterculia species 3
Sterculia sp.
Trichospermum burretii
Trichospermum pleiostigma
Trichospermum sp.
Triumfetta sp.
*Urena lobata**

MARANTACEAE

Donax canniformis
Phrynium sp.

MELASTOMATACEAE

Astronia brunneoaenea
Astronia sp.
Astronidium sp.
Creochiton novoguineensis
Medinilla forbesii
Medinilla sp.
Melastoma malabathricum
Melastoma polyanthum
*Miconia crenata**
Osbeckia chinensis

MELIACEAE

Aglaiia flavescens
Aglaiia leucoclada
Aglaiia mariannensis

Aglaiia sp.
Aphanamixis lauterbachii
Aphanamixis sp.
Chisocheton novoguineensis
Chisocheton species 1
Chisocheton sp.
Dysoxylum alliaceum
Dysoxylum excelsum
Dysoxylum gaudichaudianum
Dysoxylum kaniense
Dysoxylum parasiticum
Dysoxylum pettigrewianum
Dysoxylum species 1
Dysoxylum species 2
Dysoxylum species 3
Dysoxylum sp.
Toona sureni
Toona sp.
Vavaea sp.

MENISPERMACEAE

Arcangelisia tympanopoda
Macrococculus sp.

MONIMIACEAE

Kairoa suberosa
Kibara katikii
Kibara species 1
Kibara species 2
Kibara sp.
Levieria sp.
Palmeria gracilis
Palmeria sp.
Stegathera cf. salomonensis
Stegathera sp.

MORACEAE

*Artocarpus vriesianus**
Artocarpus sp.

Ficus adenosperma
Ficus albipila
Ficus archboldiana
Ficus baeuerlenii
Ficus benjamina
Ficus bernaysii
Ficus botryocarpa
Ficus caulocarpa
Ficus congesta
Ficus copiosa
Ficus crassiramea
Ficus disticha
Ficus distichoidea
Ficus drupacea
Ficus erythrosperma
Ficus glandulifera
Ficus gul
Ficus hesperidiiformis
Ficus hispidioides
Ficus itoana
Ficus mafuluensis
Ficus microcarpa
Ficus odoardii
Ficus opposita
Ficus pachyrrhachis
Ficus pantoniana
Ficus patellata
Ficus prasinicarpa
Ficus pungens
Ficus rhizophoriphylla
Ficus ribes
Ficus scratchleyana
Ficus semilanata
Ficus septica
Ficus subcordata
Ficus subtrinervia
Ficus subulata
Ficus tinctoria
Ficus trachypison

Ficus variegata
Ficus virens
Ficus virgata
Ficus xylosyca
Ficus species 1
Ficus species 2
Ficus species 3
Ficus species 4
Ficus sp.
Parartocarpus venenosus
Parartocarpus sp.
Prainea limpato
Streblus glaber
Trophis scandens

MYRISTICACEAE

Endocomia macrocoma
Gymnacranthera farquhariana
Horsfieldia hellwigii
Horsfieldia sinclairii
Horsfieldia spicata
Horsfieldia subtilis
Horsfieldia sp.
Myristica globosa (NT)
Myristica longipes
Myristica subalulata
Myristica undulatifolia
Myristica species 1
Myristica species 2
Myristica species 3
Myristica species 4
Myristica sp.

MYRTACEAE

Corymbia confertiflora
Corymbia papuana
Decaspermum bracteatum
Decaspermum parviflorum
Decaspermum sp.

Eucalyptus alba
Eucalyptus tereticornis
Eugenia sp.
Melaleuca dealbata
Melaleuca sp.
Octamyrtus sp.
Rhodamnia glauca
Rhodamnia latifolia
Rhodomyrtus elegans
Rhodomyrtus trineura
Rhodomyrtus sp.
Syzygium acuminatissimum
Syzygium furfuraceum
Syzygium gonatanthum
Syzygium jambos
Syzygium lagerstemioides
Syzygium longipes
Syzygium porphyrocarpum
Syzygium pyrocarpum
Syzygium roemeri
Syzygium species 1
Syzygium species 2
Syzygium species 3
Syzygium species 4
Syzygium sp.

NEPENTHACEAE

Nepenthes mirabilis
Nepenthes sp.

NYCTAGINACEAE

Pisonia longirostris
Pisonia umbellifera

NYSSACEAE

Mastixia kaniensis
Mastixia sp.

OCHNACEAE

Schuermansia henningsii

Schuermansia sp.

OLEACEAE

Chionanthus sp.

Jasminum elongatum

Jasminum papuasicum

Ligustrum glomeratum

ONAGRACEAE

*Ludwigia octovalvis**

ORCHIDACEAE

Acriopsis liliifolia

Agrostophyllum elongatum

Appendicula sp.

Bulbophyllum cimicinum

Bulbophyllum clandestinum

Bulbophyllum desmotrichoides

Bulbophyllum ebulbe

Bulbophyllum fractiflexum

Bulbophyllum gerlandianum

Bulbophyllum globiceps

Bulbophyllum hirudiniferum

Bulbophyllum infundibuliforme

Bulbophyllum manobulbum

Bulbophyllum sp.

Cadetia sp.

Calanthe sp.

Ceratostylis sp.

Cleisostoma firmulum

Coelogyne asperata

Coelogyne carinata

Crepidium brachycaulos

Dendrobium axillare

Dendrobium bracteosum

Dendrobium calceolum

Dendrobium capituliflorum

Dendrobium discolor
Dendrobium mirbelianum
Dendrobium smillieae
Dendrobium sp.
Dendrochilum longifolium
Didymoplexis sp.
Diplocaulobium sp.
Dipodium squamatum
Eria sp.
Eulophia bicallosa
Flickingeria comata
Flickingeria convexa
Geodorum sp.
Glossorhyncha sp.
Grammatophyllum sp.
Habenaria sp.
Hetaeria sp.
Hippeophyllum micranthum
Hippeophyllum sp.
Lecanorchis sp.
Liparis barbata
Luisia sp.
Malaxis zippelii
Micropera fasciculata
Oberonia sp.
Peristylus sp.
Pholidota imbricata
Phreatia micrantha
Phreatia paleata
Phreatia sp.
Plocoglottis moluccana
Podochilus scalpelliformis
Rhinerrhizopsis moorei
Sarcanthopsis nagarensis
Schoenorchis micrantha
Spathoglottis papuana
Spathoglottis parviflora
Taeniophyllum sp.
Thelasis sphaerocarpa

Thrixspermum sp.

Trichoglottis sp.

Trichotosia flexuosa

Trichotosia iodantha

Tropidia disticha

Tuberolabium sp.

Vanda hindsii

OROBANCHACEAE

Striga parviflora

OXALIDACEAE

*Oxalis barrelieri**

*Oxalis corniculata**

PANDACEAE

Galearia sp.

PANDANACEAE

Benstonea stenocarpa

Freycinetia lalokiensis

Freycinetia pseudoinsignis

Pandanus tectorius

Pandanus sp.

PASSIFLORACEAE

Hollrungia aurantioides

Passiflora aurantia

*Passiflora foetida**

PENTAPHYLACACEAE

Adinandra sp.

Eurya sp.

Ternstroemia merrilliana

Ternstroemia sp.

PHYLLANTHACEAE

Antidesma excavatum

Antidesma ghaesembilla

Antidesma polyanthum

Antidesma species 1

Antidesma species 2

Antidesma sp.

Aporosa brassii

Aporosa species 1

Aporosa sp.

Breynia cernua

Breynia sp.

Bridelia insulana

Bridelia tomentosa

Bridelia sp.

Cleistanthus inglorius

Glochidion benthamianum

Glochidion eucleoides

Glochidion cf. eucleoides

Glochidion fulvirameum

Glochidion ramiflorum

Glochidion sp.

Phyllanthus ciccooides

Phyllanthus reticulatus

Phyllanthus sp.

PINACEAE

Pinus kesiya

PIPERACEAE

Peperomia blanda

Peperomia gemella

Peperomia parvibacca

Peperomia sp

*Piper aduncum**

Piper caninum

Piper macropiper

Piper sp.

PITTOSPORACEAE

Pittosporum ferrugineum

Pittosporum ramiflorum

Pittosporum sinuatum

Pittosporum sp.

POACEAE

Bambusa sp.

Centotheca lappacea

Coix lacryma-jobi

Cyrtococcum accrescens

Cyrtococcum trigonum

*Eleusine indica**

Eriachne squarrosa

Eulalia irritans

Garnotia stricta

Isachne myosotis

Microstegium spectabile

Oplismenus compositus

Panicum sarmentosum

Panicum sp

*Paspalum conjugatum**

Paspalum sp.

Pogonatherum crinitum

Polytoca macrophylla

Pseudechinolaena polystachya

Sacciolepis myosuroides

Scrotochloa urceolata

Setaria palmifolia

*Sporobolus sp.**

Themeda triandra

Themeda villosa

PODOSTEMACEAE

Torrenticola queenslandica

POLYGALACEAE

Epirixanthes papuana

*Polygala paniculata**

Polygala persicariifolia

Polygala triflora

Securidaca sp.

Xanthophyllum papuanum

Xanthophyllum suberosum

PRIMULACEAE

Ardisia cf. tristanoides

Ardisia venusta

Ardisia sp.

Conandrium polyanthum

Embelia cotinoides

Maesa edulis

Myrsine acrosticta

Myrsine leucantha

Myrsine sp.

PROTEACEAE

Banksia dentata

Finschia carrii

Grevillea papuana

Grevillea pinnatifida

Helicia albiflora (NT)

Helicia sp.

PUTRANJIVACEAE

Drypetes longifolia

Drypetes neglecta

Drypetes sp.

RANUNCULACEAE

Clematis papuasica

RHAMNACEAE

Alphitonia excelsa

Alphitonia incana

Alphitonia macrocarpa

Alphitonia sp.

Gouania exilis

Gouania sp.

RHIZOPHORACEAE

Carallia brachiata

Carallia sp.

Gynotroches axillaris

ROSACEAE

Prunus dolichobotrys

Prunus turneriana

Prunus sp.

Rubus ledermannii

Rubus moluccanus

Rubus rosifolius

ROUSSEACEAE

Carpodetus sp.

RUBIACEAE

Amaracarpus attenuatus

Atractocarpus albituba

Canthium caudatum

Canthium megistocarpum

Canthium sp.

Coptosapelta carrii

Cyclophyllum barbatum

Gardenia species 1

Gardenia sp.

Geophila repens

Geophila zollingeriana

Hedyotis auricularia

Hydnophytum radicans

Ixora sp.

Lasianthus chlorocarpus

Lasianthus clementis

Morinda jasminoides

Morinda sp.

Mussaenda ferruginea

Mussaenda whitei

Mussaenda sp.

Mycetia javanica

Myrmecodia platytyrea
Myrmecodia tuberosa
Neonauclea acuminata
Neonauclea chalmersii
Oxyceros bispinosus
Porterandia macroptera
Psychotria micrococca
Psychotria papuana
Psychotria sp.
Randia ixoriflora
Randia pseudoixoraeflora
Randia sp
Randia sp.
Saprosma subrepandum
*Spermacoce laevis**
Tarenna buruensis
Tarenna sp.
Timonius pubistipulus
Timonius timon
Timonius sp.
Uncaria lanosa
Uncaria orientalis
Uncaria sp.
Wendlandia paniculata
Wendlandia sp.
Wrightia sp.

RUTACEAE

Clausena sp.
Euodia alata
Euodia elleryana
Euodia species 1
Euodia species 2
Euodia species 3
Euodia sp.
Evodiella muelleri
Flindersia pimenteliana (EN)
Flindersia species 1
Flindersia sp.

Glycosmis sp.

Halfordia papuana (CE)

Halfordia sp.

Lunasia amara

Melicope denhamii

Melicope cf. *muelleri*

Melicope xanthoxyloides

Melicope sp.

Murraya paniculata

Murraya sp.

Zanthoxylum ovalifolium

Zanthoxylum sp.

SABIACEAE

Meliosma sp.

Sabia pauciflora

SALICACEAE

Casearia carrii

Casearia sp.

Flacourtia zippelii

Flacourtia sp.

Xylosma papuanum

SANTALACEAE

Dendromyza ledermannii

Dendromyza reinwardtiana

Viscum ovalifolium

SAPINDACEAE

Alectryon ferrugineum

Alectryon species 1

Alectryon sp.

Allophylus sp.

Cupaniopsis curvidens

Cupaniopsis sp.

Dictyoneura obtusa

Elattostachys sp.

Ganophyllum sp.
Guioa comesperma
Guioa sp.
Harpullia carrii
Harpullia ramiflora
Harpullia species 1
Harpullia species 2
Harpullia sp.
Lepidopetalum species 1
Mischocarpus lachnocarpus
Mischocarpus sp.
Pometia pinnata
Pometia sp.
Toechima erythrocarpum
Toechima sp

SAPOTACEAE

Palaquium sp.
Planchonella obovoidea
Planchonella cf. sarcospermoides
Planchonella sp
Planchonella species 1
Planchonella species 2
Planchonella species 3
Planchonella sp.
Pouteria anteridifera
Pouteria suboppositifolia

SCROPHULARIACEAE

Vandellia anagallis

SIMAROUBACEAE

Picrasma sp.

SMILACACEAE

Smilax calophylla
Smilax sp.

SOLANACEAE

Solanum cf. anfractum
Solanum erianthum
Solanum lasiocarpum
Solanum torvoideum
*Solanum torvum**

STAPHYLEACEAE

Turpinia sp.

SYMPLOCACEAE

Symplocos pulvinata
Symplocos sp.

THEACEAE

Gordonia papuana
Gordonia sp.

THYMELAEACEAE

Phaleria macrocarpa
Phaleria sp.
Pimelea cornucopiae

URTICACEAE

Elatostema integrifolium
Elatostema rigidum
Elatostema sesquifolium
Leucosyke capitellata
Oreocnide sp.
Pipturus sp.
Poikilospermum inaequale
Poikilospermum sp.
Pouzolzia hirta
Procris frutescens
Procris sp.

VERBENACEAE

*Lantana camara**
Stachytarpheta mutabilis

VIOLACEAE

Rinorea horneri

VITACEAE

Cayratia japonica

Cissus conchigera

Cissus discolor

Cissus sp.

Leea indica

Leea sp

Leea sp.

Tetrastigma maluense

Tetrastigma pisicarpum

Tetrastigma schraderi-montis

Tetrastigma sp.

XANTHORRHOEACEAE

Dianella ensifolia

ZINGIBERACEAE

Alpinia sp.

Etlingera sp.

Hornstedtia sp.

Riedelia sp.

Appendix 3. Plant Family Species Richness, VNP

PLANT FAMILY SPECIES RICHNESS IN VARIRATA NATIONAL PARK

Plant Families of Varirata National Park with number of species per family. Listed in descending order by number of species per family.

FAMILY	No of Species
Orchidaceae	71
Moraceae	55
Rubiaceae	48
Fabaceae	46
Lauraceae	41
Myrtaceae	30
Elaeocarpaceae	25
Poaceae	25
Apocynaceae	24
Phyllanthaceae	24
Euphorbiaceae	23
Malvaceae	23
Rutaceae	23
Sapindaceae	23
Meliaceae	22
Cyperaceae	21
Annonaceae	20
Lamiaceae	18
Polypodiaceae	18
Asteraceae	17
Burseraceae	17
Acanthaceae	16
Myristicaceae	16
Anacardiaceae	15
Araliaceae	14
Arecaceae	14
Aspleniaceae	13
Hymenophyllaceae	12
Urticaceae	11
Vitaceae	11
Melastomataceae	10
Monimiaceae	10
Pteridaceae	10
Sapotaceae	10
Thelypteridaceae	10
Primulaceae	9
Araceae	8
Piperaceae	8

FAMILY	No of Species
Bignoniaceae	7
Icacinaceae	7
Loranthaceae	7
Polygalaceae	7
Clusiaceae	6
Convolvulaceae	6
Cunoniaceae	6
Gentianaceae	6
Proteaceae	6
Rhamnaceae	6
Rosaceae	6
Selaginellaceae	6
Celastraceae	5
Commelinaceae	5
Cyatheaceae	5
Lindsaeaceae	5
Pandanaceae	5
Salicaceae	5
Solanaceae	5
Tectariaceae	5
Asparagaceae	4
Combretaceae	4
Davalliaceae	4
Ebenaceae	4
Gesneriaceae	4
Gnetaceae	4
Loganiaceae	4
Lycopodiaceae	4
Oleaceae	4
Pentaphragmaceae	4
Pittosporaceae	4
Zingiberaceae	4
Actinidiaceae	3
Athyriaceae	3
Calophyllaceae	3
Cardiopteridaceae	3
Dennstaedtiaceae	3
Dipentodontaceae	3
Dipterocarpaceae	3
Fagaceae	3
Gleicheniaceae	3
Lecythidaceae	3

FAMILY	No of Species
Lygodiaceae	3
Nephrolepidacea	3
Passifloraceae	3
Podocarpaceae	3
Putranjivaceae	3
Rhizophoraceae	3
Santalaceae	3
Thymelaeaceae	3
Achariaceae	2
Amaranthaceae	2
Apiaceae	2
Cannabaceae	2
Chloranthaceae	2
Connaraceae	2
Cucurbitaceae	2
Dichapetalaceae	2
Dioscoreaceae	2
Erythroxylaceae	2
Escalloniaceae	2
Eupomatiaceae	2
Goodeniaceae	2
Himantandraceae	2
Hypoxidaceae	2
Magnoliaceae	2
Marantaceae	2
Menispermaceae	2
Nepenthaceae	2
Nyctaginaceae	2
Nyssaceae	2
Ochnaceae	2
Oxalidaceae	2
Sabiaceae	2
Smilacaceae	2
Symplocaceae	2
Theaceae	2
Verbenaceae	2
Aponogetonaceae	1
Aquifoliaceae	1
Aristolochiaceae	1
Asphodelaceae	1
Balsaminaceae	1
Begoniaceae	1

FAMILY	No of Species
Bixaceae	1
Blechnaceae	1
Caryophyllaceae	1
Casuarinaceae	1
Chrysobalanaceae	1
Cleomaceae	1
Crypteroniaceae	1
Cycadaceae	1
Cystodiaceae	1
Dicksoniaceae	1
Dilleniaceae	1
Dryopteridaceae	1
Elaeagnaceae	1
Flagellariaceae	1
Hydrocharitaceae	1
Juglandaceae	1
Lentibulariaceae	1
Linaceae	1
Lythraceae	1
Malpighiaceae	1
Marattiaceae	1
Onagraceae	1
Ophioglossaceae	1
Orobanchaceae	1
Pandaceae	1
Pinaceae	1
Podostemaceae	1
Psilotaceae	1
Ranunculaceae	1
Rousseaceae	1
Scrophulariaceae	1
Simaroubaceae	1
Staphyleaceae	1
Violaceae	1
Xanthorrhoeaceae	1

Appendix 4. Introduced Species, VNP

LIST OF INTRODUCED PLANTS RECORDED FROM VARIRATA NATIONAL PARK

AMARANTHACEAE

Alternanthera sessilis

ANACARDIACEAE

Mangifera minor

APIACEAE

Centella asiatica

APOCYNACEAE

Asclepias curassavica

ASTERACEAE

Ageratum conyzoides

Bidens pilosa

Crassophyllum crepidoides

Elephantopus mollis

Eleutheranthera ruderalis

Erechtites valerianifolia

Mikania micrantha

Syndrella nodiflora

Tithonia diversifolia

Wedelia spilanthoides

Spathodea campanulata

Bixa orellana

Drymaria cordata

Clemone viscosa

Tradescantia spp.

CYPERACEAE

Fimbristylis dichotoma

Kyllinga brevifolia

EUPHORBIACEAE

Croton hirtus

FABACEAE

Calopogonium mucunoides

Cassia grandis

Castanospermum australe

Centrosema pubescens

Flemingia macrophylla

Mimosa pudica

Phaseolus lunatus

Senna alata

Stylosanthes humilis

LAMIACEAE

Mesosphaerum suaveolens

MALVACEAE

Melochia corchorifolia

Sida acuta

Sida cordifolia

Sida rhombifolia

Urena lobata

MELASTOMATACEAE

Miconia crenata

MORACEAE

Artocarpus vriesianus

ONOGRACEAE

Ludwigia octovalnis

OXALIDACEAE

Oxalis barrelieri

Oxalis corniculata

PASSIFLORICACEAE

Passiflora foetida

PIPERACEAE

Piper aduncum

POACEAE

Eleusine indica

Paspalum conjugatum

Sporobolus sp.

POLYGALACEAE

Polygala paniculata

RUBIACEAE

Spermacoce laevis

SOLANACEAE

Solanum torvum

VERBENACEAE

Lantana camara

Appendix 5. IPCA Community Outreach Program

Outreach Program to Local Schools

Andrew McInnis and Christo Ferguson conducted an outreach program to local schools and villages from 1-8 November.

Given that local people and villages play an integral part in the Park's future success IPCA felt it important to engage with the community to share some key findings and images from the project. A presentation was created to share the scope and importance of the Park's biodiversity, the benefits of the Park's ecosystem goods and services, threats to the Park, future opportunities for Park collaboration, and potential livelihood activities from the Park's unique biodiversity. The program was implemented to achieve three main goals:

1. Community Engagement
2. Youth Environmental Education
3. Field Team Growth and Experience

Community Engagement

At the community level, a presentation was given to a local women's group affiliated with the United Church. A short introductory talk was also provided to a woman's group in Bisiatabu, affiliated with the Seventh Day Adventist Church. Both meetings were held in collaboration with SERACS.

Youth Environmental Education

A total of four schools participated in our youth outreach effort: Depo Elementary School, Sogeri Elementary School, Sogeri Primary School, and Iarowari Secondary School.

November 2nd, 2017

Presenters: Andrew McInnis, Christopher Ferguson and Noel Max.

At Depo Elementary IPCA completed an interactive presentation with a total of 40 students, grades included: Prep, Grade 1 and Grade 2.

At Iarowari Secondary IPCA completed two interactive presentations. One session included Grade 9 with a total of 50 students in attendance and the second session included Grade 11 with a total of 35 students in attendance.

November 3rd, 2017

Presenters: Andrew McInnis, Christopher Ferguson and Noel Max.

At Sogeri Elementary IPCA completed two interactive presentations. One session included Grade 1 with a total of 30 students in attendance; Second session included Prep and Grade 2 with a total of 50 students in attendance.

At Iarowari Secondary IPCA completed one interactive presentation with a total of 70 students, grades included: Grade 9 and Grade 11.

November 7th, 2017

Presenters: Andrew McInnis, Christopher Ferguson, and Monobe Kisea.

At Sogeri Primary School IPCA completed three interactive presentations. One session included Grade 7 with a total of 45 students in attendance the second session included

Grade 6 with a total of 60 students in attendance and the third session included Grade 5 with a total of 65 students in attendance.

November 8th, 2017

Presenters: Andrew McInnis, Christopher Ferguson and Bali Korohi.

At Sogeri Primary School IPCA completed two interactive presentations. One session included Grade 4 with a total of 40 students in attendance and the second session included Grade 3 with a total of 50 students in attendance.

All schools noted that they would be interested in participating in future events with the Park and CEPA, including school field trips to the Park, student projects, volunteering projects, and further environmental education presentations in the schools.

A total of **535** students received environmental education through IPCA's Community Outreach Program from the following schools:

Depo Elementary: 40 students

Sogeri Elementary: 80 students

Sogeri Primary: 260 students

Iarowari Secondary: 155 students

Two additional schools also expressed interest in receiving presentations and attending field trips to VNP, these comprised: Sogeri National High School and Seven Adventist School Bisiatabu. These schools should be included in future programs.

Field Team Growth & Experience

Five local Koiari field assistants were trained in Environmental Education concepts, activities and techniques. In addition, three local team members assisted and facilitated presentations with local youths at community schools. The presentation was created so team members and park rangers can continue to use the provided information for school and tourist groups in the future.

Contacts

School Contacts

1. Depo Elementary: Head Master Mr. Arue Uwea. No cell # at this time.
2. Sogeri Elementary: Head Teacher Mr. Womae Degini. Cell: 7212-3978
3. Sogeri Primary: Head Master Mr. Maima Iamuia. Cell: 7659-7714; 7908-4850
4. Iarowari Secondary: Head Master Mr. Andrew Moava. Cell: 7113-9016

Future Contacts

1. Sogeri National High School: Deputy Master Ms. Ellen Toti. Cell: 7255-3173; Direct: 325-1095; General: 325-1526
2. Seven Adventist School Bisiatabu: awaiting contact information, see Dr. Rodney Kameata.

Appendix 6. Species Scheduled With IUCN Red List 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

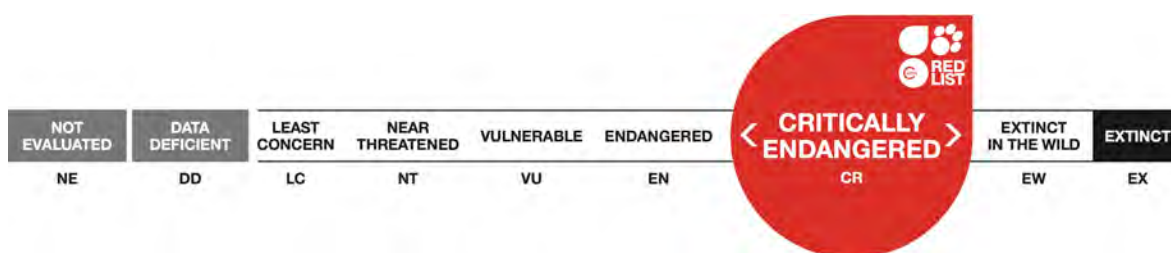
A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered	Endangered	Vulnerable
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3 & A4	≥ 80%	≥ 50%	≥ 30%
<p>A1 Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible AND understood AND have ceased.</p> <p>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.</p> <p>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].</p> <p>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.</p>	<i>based on any of the following:</i>		<p>(a) direct observation [except A3]</p> <p>(b) an index of abundance appropriate to the taxon</p> <p>(c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality</p> <p>(d) actual or potential levels of exploitation</p> <p>(e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.</p>
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 km ²	< 5,000 km ²	< 20,000 km ²
B2. Area of occupancy (AOO)	< 10 km ²	< 500 km ²	< 2,000 km ²
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
(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 km ² 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.



Halfordia papuana

Assessment by: Eddowes, P.J.



View on www.iucnredlist.org

Citation: Eddowes, P.J. 1998. *Halfordia papuana*. *The IUCN Red List of Threatened Species 1998*: e.T38151A10103085. <http://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T38151A10103085.en>

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Taxonomy

Kingdom	Phylum	Class	Order	Family
Plantae	Tracheophyta	Magnoliopsida	Sapindales	Rutaceae

Taxon Name: *Halfordia papuana* Laut.

Assessment Information

Red List Category & Criteria: Critically Endangered C2a [ver 2.3](#)

Year Published: 1998

Date Assessed: January 1, 1998

Annotations: Needs Updating

Geographic Range

Range Description:

Mostly confined to the Bulolo/Wau region in Morobe Province. It is not certain how many mature specimens remain but it is certainly less than 250.

Country Occurrence:

Native: Papua New Guinea

Habitat and Ecology

This tree is scattered in submontane and montane rainforest between 1,200 and 2,700 m.

Systems: Terrestrial

Threats (see Appendix for additional information)

The region has been heavily exploited, logged and converted into *Araucaria* plantations.

Credits

Assessor(s): Eddowes, P.J.

Bibliography

Eddowes, P.J. 1997. Completed data collection forms for New Guinea.

Oldfield, S., Lusty, C. and MacKinven, A. (compilers). 1998. *The World List of Threatened Trees*. World Conservation Press, Cambridge, UK.

Citation

Eddowes, P.J. 1998. *Halfordia papuana*. *The IUCN Red List of Threatened Species 1998*: e.T38151A10103085. <http://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T38151A10103085.en>

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External Resources

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Threats

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Threat	Timing	Scope	Severity	Impact Score
5. Biological resource use -> 5.3. Logging & wood harvesting -> 5.3.5. Motivation Unknown/Unrecorded	Ongoing	-	-	-
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation		

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Flindersia pimenteliana

Assessment by: Eddowes, P.J.



View on www.iucnredlist.org

Citation: Eddowes, P.J. 1998. *Flindersia pimenteliana*. *The IUCN Red List of Threatened Species 1998*: e.T38149A10102702. <http://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T38149A10102702.en>

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Taxonomy

Kingdom	Phylum	Class	Order	Family
Plantae	Tracheophyta	Magnoliopsida	Sapindales	Rutaceae

Taxon Name: *Flindersia pimenteliana* F. Muell

Assessment Information

Red List Category & Criteria: Endangered C2a [ver 2.3](#)

Year Published: 1998

Date Assessed: January 1, 1998

Annotations: Needs Updating

Geographic Range

Range Description:

In Papua New Guinea, the species is widespread but uncommon and sporadic. The population status in Australia is not taken into consideration in this evaluation.

Country Occurrence:

Native: Australia (Queensland); Indonesia (Papua); Papua New Guinea

Habitat and Ecology

A large tree found mainly in lower montane rainforest or in foothill rainforest.

Systems: Terrestrial

Threats (see Appendix for additional information)

It has been heavily exploited in the Bulolo/Wau region of Morobe Province. Populations on spurs and ridges of mountain ranges may be spared from future exploitation.

Credits

Assessor(s): Eddowes, P.J.

Bibliography

Eddowes, P.J. 1997. Completed data collection forms for New Guinea.

Oldfield, S., Lusty, C. and MacKinven, A. (compilers). 1998. *The World List of Threatened Trees*. World Conservation Press, Cambridge, UK.

Citation

Eddowes, P.J. 1998. *Flindersia pimenteliana*. *The IUCN Red List of Threatened Species 1998*: e.T38149A10102702. <http://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T38149A10102702.en>

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Threats

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Threat	Timing	Scope	Severity	Impact Score
5. Biological resource use -> 5.3. Logging & wood harvesting -> 5.3.5. Motivation Unknown/Unrecorded	Ongoing	-	-	-
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation		

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PNGTreesKey Flindersia pimenteliana F.Muell.

Barry Conn (NSW) & Kipiro Damas (LAE).

Guide to trees of Papua New Guinea

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Flindersia pimenteliana F.Muell.

Fragmenta Phytographiae Australiae Vol. 9: 132 (1875)

Other Literature: D.J. Boland *et al.*, *Forest Trees of Australia* 620-621 (1984) Fig. 621 (page).

Family: Rutaceae

Dicotyledon

Timber Group: Minor hardwood

Field Characters: Large canopy tree (up to 40 m high) or Small sub-canopy tree; Bole cylindrical (up to c. 100 cm diam.); straight (mostly bole up to 20 m long); buttresses absent; spines absent; aerial roots absent; stilt roots absent; Bark grey or brown, slightly rough, pustular or slightly cracked, lenticels elongated vertically; Subrhytidome (under-bark) sometimes green or dark red; less than 25 mm thick, (6.0-) 8.0-14.0; bark blaze consisting of one layer; strongly aromatic or faintly to non-aromatic; pleasant (fruity); outer blaze white, yellow (pale (straw-coloured), red, or pink, with stripes (white), fibrous; inner blaze pink, red, white, or yellow (pale (straw-coloured), with stripes (white), fibrous; bark exudate (sap) present, colourless, not readily flowing (spotty), colour not changing on exposure to air, not sticky; terminal buds not enclosed by leaves.

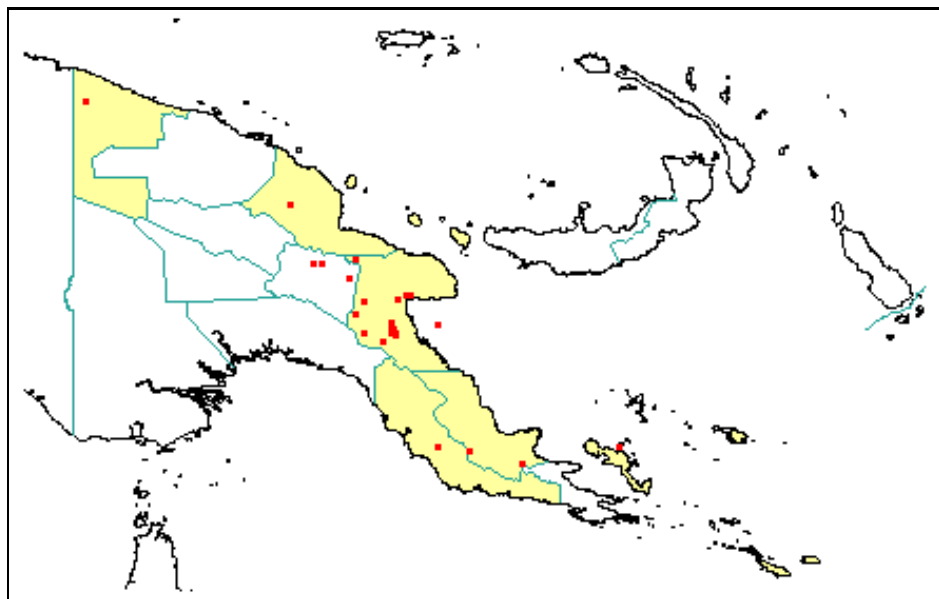
Indumentum: Complex hairs absent; stinging hairs absent; mature twig indumentum (hairs) absent.

Leaves: Leaves spaced along branches, opposite (in pairs, opposite one another on the branchlet) (to subopposite), compound (a leaf made up from two or more leaflets); petiole present, not winged, attached to base of leaf blade, not swollen; leaves pinnate (unbranched with more than three leaflets); petiolule not swollen; rachis present, absent; leaves with a terminal leaflet (the number of leaflets odd - imparipinnate), broadest below middle, 8.0-34.0 cm, 2.0-5.0 cm, leaflets opposite, symmetric (to slightly asymmetric), terminal developing leaflet buds straight; venation pinnate, secondary veins open, not prominent, but visible, intramarginal veins absent; leaves lower surface pale green or yellowish green, upper surface dark green, indumentum (hairs) absent; absent or present; domatia absent; stipules absent.

Flowers: Inflorescence terminal, flowers on a branched axis, cones absent; flowers bisexual, stalked, flowers with many planes of symmetry, 2.5-4.0 mm long, diameter small (up to 10 mm diam.) (c. 3 mm diam.); perianth present, with distinct sepals and petals whorls, inner perianth red (dark towards base) or white (on inner surface); 5, some or partly joined (shortly at base) or free; stamens 5, present, free of each other, free of the perianth; ovary superior, carpels joined (when more than one), locules 10 (2 per carpel); styles solitary, 1.

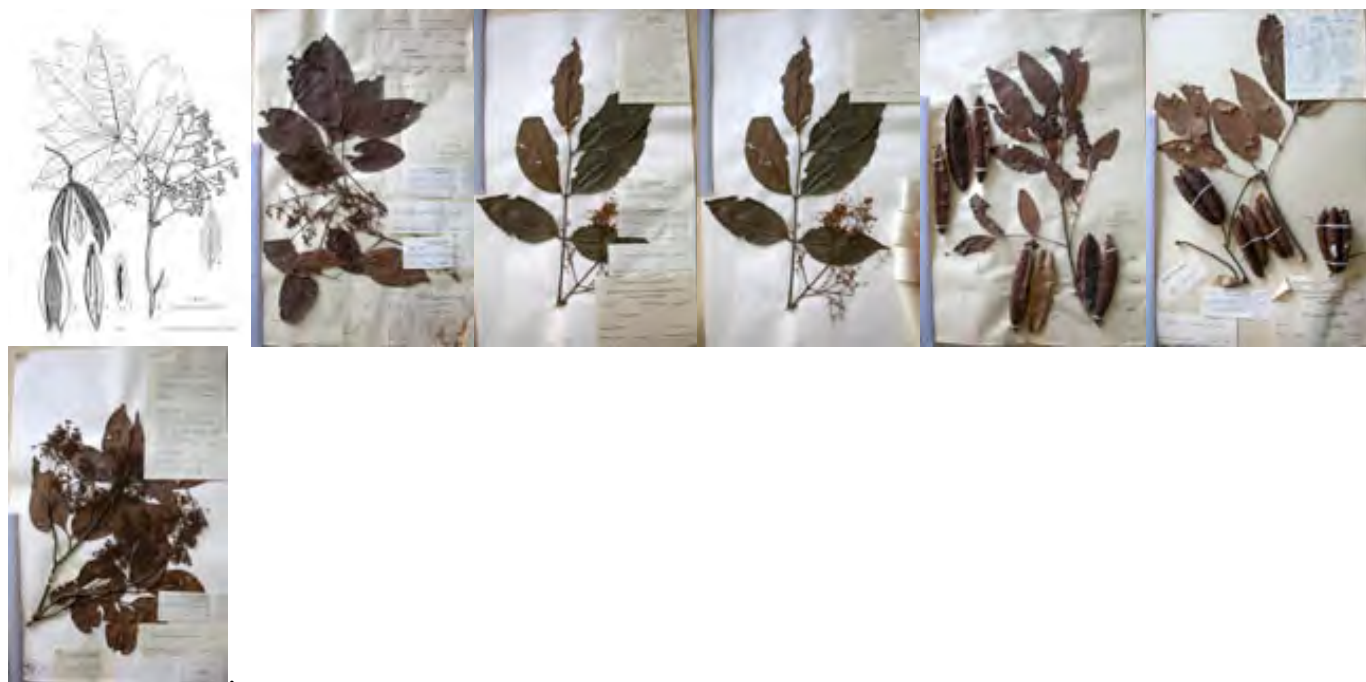
Fruits: Infructescence arranged on branched axis, fruit 50.0-120.0 mm long, 40.0-60.0 mm diam., brown, spiny (with blunt spines), non-fleshy, simple, dehiscent, capsule; seeds 30 (c.), much more than 10 mm long (40-60 mm long), winged (at both ends), narrow (longer than wide), seed 1-10 mm diam. (c. 10 mm diam.).

Distribution: West Sepik, Madang, Morobe, Central, Northern & Papuan Islands.



[Botanical records
in PNGplants database](#)

[Map details](#)





The IUCN Red List of Threatened Species™
ISSN 2307-8235 (online)
IUCN 2008: T42072A10618293

Cycas campestris

Assessment by: Hill, K.D.



View on www.iucnredlist.org

Citation: Hill, K.D. 2010. *Cycas campestris*. *The IUCN Red List of Threatened Species 2010*: e.T42072A10618293. <http://dx.doi.org/10.2305/IUCN.UK.2010-3.RLTS.T42072A10618293.en>

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Taxonomy

Kingdom	Phylum	Class	Order	Family
Plantae	Tracheophyta	Cycadopsida	Cycadales	Cycadaceae

Taxon Name: *Cycas campestris* K.D.Hill

Assessment Information

Red List Category & Criteria: Near Threatened [ver 3.1](#)

Year Published: 2010

Date Assessed: October 31, 2009

Justification:

Assessed as Near Threatened because of ongoing decline and the extent of occurrence being less than 20,000 km², but the population is not severely fragmented and is found at more than ten locations. Almost qualifies as threatened under criterion B1ab(iii,v).

Previously Published Red List Assessments

2003 – Near Threatened (NT)

Geographic Range

Range Description:

This species is endemic to Papua New Guinea, where it occurs in the Central Province, particularly around Port Moresby, extending from Kairuku to Abau.

Country Occurrence:

Native: Papua New Guinea (Papua New Guinea (main island group))

Population

The population size is not well known but is estimated to exceed 10,000 plants in the wild.

Current Population Trend: Decreasing

Habitat and Ecology (see Appendix for additional information)

This species is locally abundant but sporadic and it occurs in savanna woodland country. Plants are often in more open and grassy areas prone to frequent fire. Occurs only at low altitudes on the coastal plain.

Systems: Terrestrial

Threats (see Appendix for additional information)

This species may be subject to over-collecting for ornamental purposes. Fire may also be a problem as in other *Cycas* species, frequent fires have led to decline.

Conservation Actions (see Appendix for additional information)

This species is listed on Appendix II of the CITES Appendices.

Credits

Assessor(s): Hill, K.D.

Reviewer(s): Donaldson, J.S. & Bösenberg, J.D.

Bibliography

Donaldson, J.S. (ed.). 2003. *Cycads. Status Survey and Conservation Action Plan*. IUCN/SSC Cycad Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK.

Hill, K.D. and Stevenson, D.W. 1998-2006. The Cycad Pages. Available at: <http://plantnet.rbgsyd.gov.au/PlantNet/cycad/>.

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Citation

Hill, K.D. 2010. *Cycas campestris*. *The IUCN Red List of Threatened Species 2010*: e.T42072A10618293. <http://dx.doi.org/10.2305/IUCN.UK.2010-3.RLTS.T42072A10618293.en>

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Appendix

Habitats

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Habitat	Season	Suitability	Major Importance?
1. Forest -> 1.5. Forest - Subtropical/Tropical Dry	-	Suitable	-
2. Savanna -> 2.1. Savanna - Dry	-	Suitable	-
4. Grassland -> 4.5. Grassland - Subtropical/Tropical Dry	-	Suitable	-

Use and Trade

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

End Use	Local	National	International
Pets/display animals, horticulture	No	Yes	Yes

Threats

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Threat	Timing	Scope	Severity	Impact Score
5. Biological resource use -> 5.2. Gathering terrestrial plants -> 5.2.1. Intentional use (species is the target)	Ongoing	-	-	-
	Stresses:	2. Species Stresses -> 2.1. Species mortality		
7. Natural system modifications -> 7.1. Fire & fire suppression -> 7.1.1. Increase in fire frequency/intensity	Future	-	-	-
	Stresses:	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 Education
Included in international legislation: Yes
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 -> 1.1. Site/area protection

4. Education & awareness -> 4.3. Awareness & communications

Research Needed

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Research Needed

1. Research -> 1.3. Life history & ecology
--

1. Research -> 1.6. Actions

Additional Data Fields

Distribution

Estimated extent of occurrence (EOO) (km ²): 9250

Population

Number of mature individuals: 10000-12000

Population severely fragmented: No

Habitats and Ecology

Generation Length (years): 40

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Hopea forbesii, Giam

Assessment by: Barstow, M.



View on www.iucnredlist.org

Citation: Barstow, M. 2018. *Hopea forbesii*. The IUCN Red List of Threatened Species 2018: e.T36291A68070385. <http://dx.doi.org/10.2305/IUCN.UK.2018-1.RLTS.T36291A68070385.en>

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Taxonomy

Kingdom	Phylum	Class	Order	Family
Plantae	Tracheophyta	Magnoliopsida	Malvales	Dipterocarpaceae

Taxon Name: *Hopea forbesii* (Brandis) Slooten

Synonym(s):

- *Shorea forbesii* Brandis

Common Name(s):

- English: Giam

Assessment Information

Red List Category & Criteria: Near Threatened [ver 3.1](#)

Year Published: 2018

Date Assessed: May 23, 2017

Justification:

This species is a large tree native to the lowland evergreen forests of Papua New Guinea and east Irian Jaya. It has an estimated extent of occurrence (EOO) of 85,000 km². As well as confirmation of the species range, population size and volume of species harvested for timber also requires investigation. The species is suspected to be in decline due to the loss of lowland forest within its native range which is estimated to be at least 25% over the last three generations. The species is also exploited for its timber which is a growing threat particularly within Central and Milne bay provinces where harvest is greatest. Due to this, it is estimated that the species has experienced at least 25% population decline over the last three generations. The species is therefore globally assessed as Near Threatened as it almost meets the criteria for Vulnerable under criterion A2.

Geographic Range

Range Description:

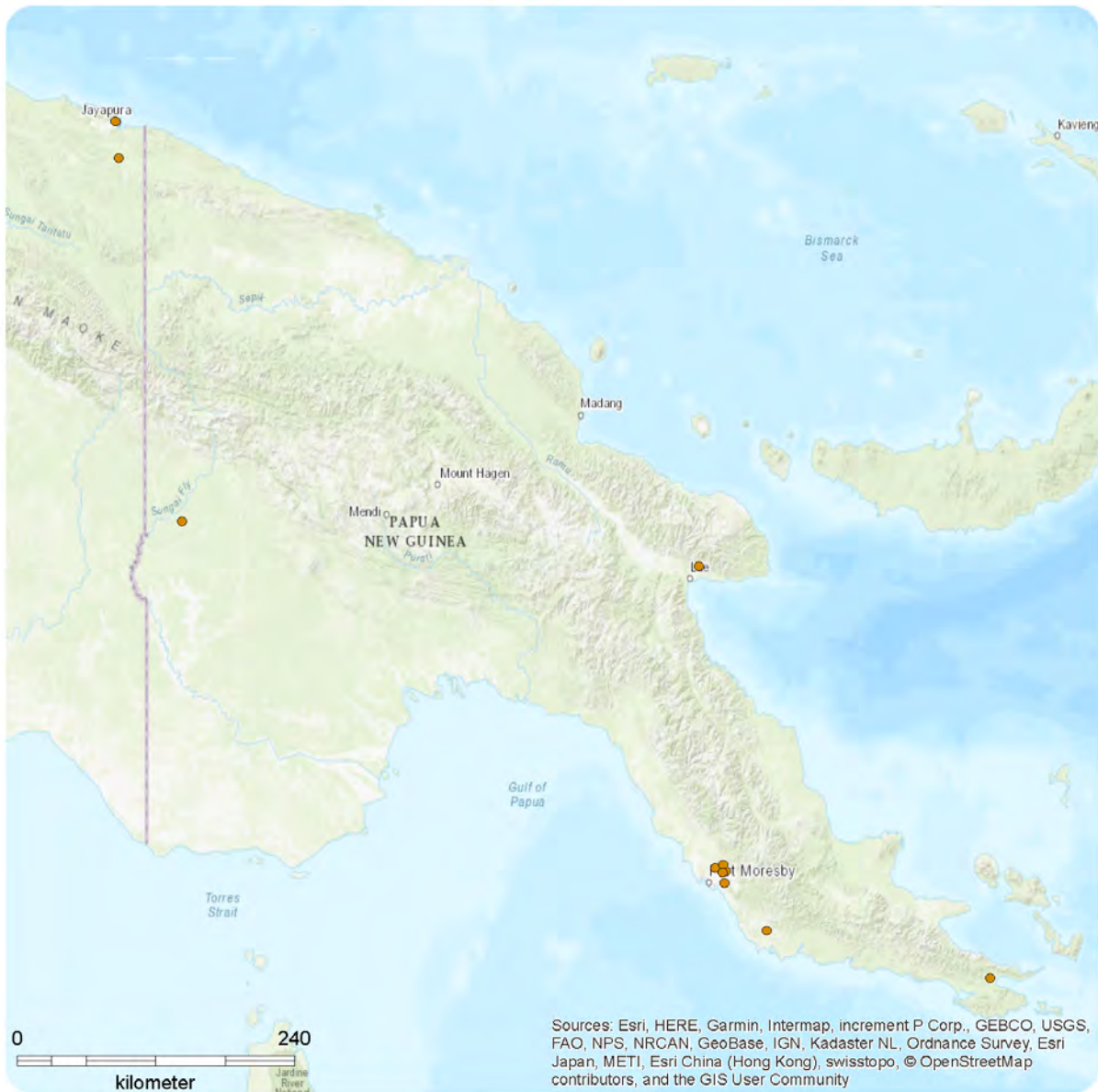
This species is native to Papua New Guinea (PNG) along the coast of the Papuan Islands, Milne Bay Province, and the inland and coastal forest of Central Province, Morobe Province and Western Province (T. Jimbo pers. comm. 2018). The species is also present within Irian Jaya. More sampling across New Guinea is required to confirm the species range. The species has an estimated extent of occurrence (EOO) of around 285,000 km².

Country Occurrence:

Native: Indonesia (Papua); Papua New Guinea (Papua New Guinea (main island group))

Distribution Map

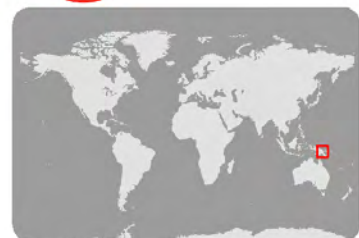
Hopea forbesii



Range

- Extant (resident)

Compiled by:
BGCI



The boundaries and names shown and the designations used on this map do not imply any official endorsement, acceptance or opinion by IUCN.



Population

The species is considered locally common in lowland rain forests (ITTO 2017). Shearman *et al.* (2009) estimated that between 1972 and 2002 the Milne Bay region experienced forest decline of 27.28% and in Central Province deforestation was slightly lower at 25.15%. Overall in Papua New Guinea, there was 15% forest decline from 1972 to 2002. The greatest amount of decline occurred in lowland areas and the greatest cause of forest loss was logging (Shearman *et al.* 2009). The highest rates of timber extraction in PNG are in Central and Milne provinces where this species is found (T. Jimbo pers. comm. 2018). As *Hopea forbesii* is used as a timber and is found in lowland forest it is likely that its population has been adversely affected by this decline. It is also predicted that 49% of remaining unlogged forests will be logged and subject to degradation in the future (Shearman *et al.* 2009). We therefore infer that population is currently in decline and may have declined by at least 25% in the last 300 years based on this information. Population decline may continue into the future due to commercial logging and due to growth of urban and agricultural areas.

Current Population Trend: Decreasing

Habitat and Ecology (see Appendix for additional information)

Hopea forbesii is a large tree species, growing up to 32 m in height and up to 100 cm in diameter (ITTO 2017). This species is found in lowland seasonal semi-evergreen forest. It is sometimes the dominant tree on ridges (ITTO 2017) and is an under canopy species (Ashton 1988). The species does not have a persistent seed bank instead many seedlings of the species persist in the undergrowth as they are shade tolerant. These then rapidly grow upon an opening in the canopy (Sist *et al.* 2003). Pollination is by insects and flowering most often occurs in a mast year. Seedling recruitment is greatest this year and is often local to the mother tree due to poor wind dispersal of winged fruits (Sist *et al.* 2003). The species habitat is declining in area due to the expansion of subsistence agriculture in the area as a consequence of a growing population (Shearman *et al.* 2009). Lowland forests are also subject to degradation due to the loss of canopy cover caused by logging and also destruction of the under-story vegetation due to the heavy machinery used for timber extraction.

Systems: Terrestrial

Use and Trade

Hopea forbesii is a commercially important timber species (Mark *et al.* 2014). The wood is used for making window frames, doors and marine constructions (ITTO 2017). In PNG, the species is traded under the name 'Light Hopea' alongside other species of *Hopea*, it may also be called 'Heavy Hopea'. From 1995 to 2017 SGS (PNG) shipment records found Milne Bay recorded a volume of 7,284 log pieces of 'Heavy Hopea' were logged and 15,348 log pieces of 'Light Hopea'. In Central Province 49,777 pieces of log were recorded as being felled (T. Jimbo pers. comm. 2018). If this rate of extraction continues population will continue to decline in the future.

Threats (see Appendix for additional information)

This species is threatened by habitat loss and degradation within the lowland forests of PNG. Deforestation is occurring as a consequence of the need to expand agricultural areas to cope with a growing population. This is a particular threat in Milne Bay and Central province for both large and small

scale agricultural expansion (T. Jimbo pers. comm. 2018). It is also caused by the increase in commercial logging within the country which began to grow in the nineties (Shearman *et al.* 2009). Logging may be a particular threat to the species as it is a desirable timber, but this has yet to be confirmed and the effect of the extraction on the population is not known. Also due to logging practice the regeneration of the species may be adversely affected as the machinery can destroy seedlings persisting in the under growth (Bryan *et al.* 2013). Forests are becoming more susceptible to forest fires due to the decline in canopy cover and due to the growing occurrence of extreme El Niño years which causes forests to become dry (Shearman *et al.* 2009).

Conservation Actions (see Appendix for additional information)

This species is not reported from any *ex situ* collections (BGCI 2017). Seed collections of this species should be made to ensure the genetic conservation of this species and to contribute to *ex situ* conservation efforts. More information on the population size and trend of this species is needed as well as the localities of individuals. The species should be identified within current protected areas and habitat protection should also be expanded. The harvest and trade of the species requires monitoring and sustainable management plans should be established to insure the current and future use of the species.

Credits

Assessor(s): Barstow, M.

Reviewer(s): Jimbo, T.

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Citation

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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	Unknown	Slow, significant declines	Unknown
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance		
5. Biological resource use -> 5.3. Logging & wood harvesting -> 5.3.5. Motivation Unknown/Unrecorded	Ongoing	Unknown	Unknown	Unknown
	Stresses:	2. Species Stresses -> 2.1. Species mortality		
7. Natural system modifications -> 7.1. Fire & fire suppression -> 7.1.1. Increase in fire frequency/intensity	Ongoing	Unknown	Very rapid declines	Unknown
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 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 Species Management
Subject to ex-situ conservation: No

Conservation Actions Needed

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Conservation Actions Needed
1. Land/water protection -> 1.1. Site/area protection
3. Species management -> 3.4. Ex-situ conservation -> 3.4.2. Genome resource bank

Research Needed

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Research Needed
1. Research -> 1.2. Population size, distribution & trends
3. Monitoring -> 3.1. Population trends
3. Monitoring -> 3.2. Harvest level trends
3. Monitoring -> 3.3. Trade trends
3. Monitoring -> 3.4. Habitat trends

Additional Data Fields

Distribution
Estimated extent of occurrence (EOO) (km ²): 285000
Upper elevation limit (m): 1000
Habitats and Ecology
Continuing decline in area, extent and/or quality of habitat: Yes
Generation Length (years): 100

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Myristica globosa

Assessment by: World Conservation Monitoring Centre



View on www.iucnredlist.org

Citation: World Conservation Monitoring Centre. 1998. *Myristica globosa*. *The IUCN Red List of Threatened Species 1998*: e.T37876A10077890.

<http://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T37876A10077890.en>

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Taxonomy

Kingdom	Phylum	Class	Order	Family
Plantae	Tracheophyta	Magnoliopsida	Magnoliales	Myristicaceae

Taxon Name: *Myristica globosa* Warb.

Assessment Information

Red List Category & Criteria: Lower Risk/near threatened [ver 2.3](#)

Year Published: 1998

Date Assessed: January 1, 1998

Annotations: Needs Updating

Geographic Range

Country Occurrence:

Native: Papua New Guinea (North Solomons); Solomon Islands

Habitat and Ecology

Confined to evergreen rainforest up to 1,200 m.

Systems: Terrestrial

Credits

Assessor(s): World Conservation Monitoring Centre

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Lemmens, R.H.M.J., Soerianegara, I. and Wong, W.C. (eds) 1995. *Timber Trees: Major Commercial Timbers (Plant Resources in South-East Asia, No. 5[2])*. Backhuys Publishers, Leiden.

Oldfield, S., Lusty, C. and MacKinven, A. (compilers). 1998. *The World List of Threatened Trees*. World Conservation Press, Cambridge, UK.

Citation

World Conservation Monitoring Centre. 1998. *Myristica globosa*. *The IUCN Red List of Threatened Species 1998*: e.T37876A10077890.

<http://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T37876A10077890.en>

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PNGTreesKey Myristica globosa Warb.

Barry Conn (NSW) & Kipiro Damas (LAE).

Guide to trees of Papua New Guinea

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Myristica globosa Warb.

Nova Acta Academiae Caesareae Leopoldino-Carolinae Germanicae Naturae Curiosorum. Abhandlungen der Kaiserlichen Leopoldinisch-Carolinischen Deutschen Akademie der Naturforscher Vol. 68: 540

Other Literature: W.J.J.O. De Wilde, *Flora Malesiana, Series 1* 480-483 (2000)

Family: Myristicaceae

Dicotyledon

Timber Group: Non-timber species

Field Characters: Large canopy tree (up to 30 m high) or Small sub-canopy tree; Bole cylindrical (mostly 40-70 cm diam.); straight (bole up to c. 5 m long); buttresses absent (sometimes slightly spurred near base); spines absent; aerial roots absent; stilt roots sometimes present or absent; Bark brownish grey or brown, rough or almost smooth, slightly scaly or flaky or fissured; Subrhytidome (under-bark) red or brown; less than 25 mm thick, 5.0-8.0; bark blaze consisting of one layer; faintly to non-aromatic; pleasant; outer blaze pale pink, red, or brown, markings absent, fibrous; inner blaze pale pink, red, or brown, markings absent, fibrous; bark exudate (sap) present, colourless (watery), flowing or not readily flowing (spotty), colour changing on exposure to air, to red, not sticky or sticky; terminal buds not enclosed by leaves.

Indumentum: Complex hairs absent; stinging hairs absent; mature twig indumentum (hairs) present when young or absent, hairs sparse.

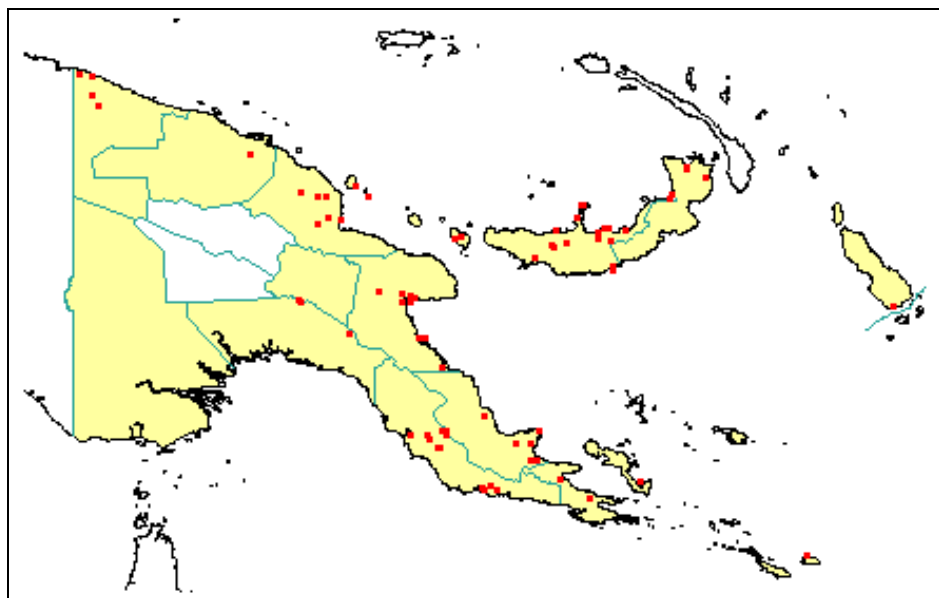
Leaves: Leaves spaced along branches, spiral (leaves occurring singly at a node and arranged spirally up the branchlet), simple (a leaf composed of a single blade); petiole present, not winged, attached to base of leaf blade, not swollen; leaves sometimes broadest below middle or equally broad throughout much of length, (6.0-) 7.0-16.0 (-21.0) cm, 2.0-7.0 (-8.0) cm; symmetric, entire, not dissected or lobed, acute or acuminate, venation pinnate, secondary veins open, prominent, intramarginal veins absent; leaves lower surface blue-green, pale green, or slightly grey, upper surface dark green (glossy) or slightly grey, indumentum (hairs) absent or present when young, indumentum (hairs) sparse; absent; domatia absent; stipules absent.

Flowers: Inflorescence axillary (and below leaves), flowers on a branched axis, cones absent; flowers unisexual, unisexual with male and female flowers on different plants, stalked, flowers with many planes of symmetry, 4.0-6.5 mm long, diameter small (up to 10 mm diam.) (c. 3 mm diam.); perianth present, with all sepals and/or petals (hence tepals) similar, inner perianth cream-coloured, pale yellow, or green; 2-3, some

or partly joined; stamens 10-?-16 (-20), absent, joined (to form a central staminal column), free of the perianth; ovary superior, carpels joined (when more than one), locules 1; styles absent.

Fruits: Infructescence arising from single point (usually (usually 1-3 fruits per infructescence), fruit 15.0-32.0 (-40.0) mm long, 20.0 (c.) mm diam., yellow, red, or brown (with nut meg aroma), not spiny, fleshy, simple, dehiscent, capsule; seeds 1, much more than 10 mm long (10-22 mm long), not winged, narrow (longer than wide), seed more than 10 mm diam. (10-20 mm diam.).

Distribution: West Sepik, East Sepik, Madang, Morobe, Eastern Highlands, Western, Gulf, Central, Northern, Milne Bay, Papuan Islands, New Britain & Bougainville.



[Botanical records
in PNGplants database](#)

[Map details](#)

Notes: Notes WJ.J.O de Wilde, 2000 (*Flora Malesiana*, Series 1, volume 14, pp. 482-483) recognises two subspecies, namely, subsp. *globosa* and subsp. *chalmersii*. The differences between these two subspecies appears to be slight with subsp. *globosa* having slightly larger fruit (at least 2.5 cm long), with pericarp 3-5 mm thick, whereas subsp. *chalmersii* has fruits up to 2.4 cm long and pericarp up to 3 mm thick.



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Helicia albiflora

Assessment by: Eddowes, P.J.



View on www.iucnredlist.org

Citation: Eddowes, P.J. 1998. *Helicia albiflora*. *The IUCN Red List of Threatened Species 1998*: e.T32940A9743886. <http://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T32940A9743886.en>

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Taxonomy

Kingdom	Phylum	Class	Order	Family
Plantae	Tracheophyta	Magnoliopsida	Proteales	Proteaceae

Taxon Name: *Helicia albiflora* Sleumer

Assessment Information

Red List Category & Criteria: Lower Risk/near threatened [ver 2.3](#)

Year Published: 1998

Date Assessed: January 1, 1998

Annotations: Needs Updating

Geographic Range

Range Description:

Known from the East and Western Highlands, Morobe, Northern and Central provinces of Papua New Guinea.

Country Occurrence:

Native: Papua New Guinea

Habitat and Ecology

A tree often found in *Castanopsis-Nothofagus* rainforest from 900 to 2,000 m.

Systems: Terrestrial

Threats (see Appendix for additional information)

Its conservation is dependent upon the conservation of its montane habitat.

Credits

Assessor(s): Eddowes, P.J.

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Conn, B.J. (ed.) 1995. *Handbooks of the Flora of Papua New Guinea*. Melbourne University Press.

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Citation

Eddowes, P.J. 1998. *Helicia albiflora*. *The IUCN Red List of Threatened Species 1998*: e.T32940A9743886. <http://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T32940A9743886.en>

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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 -> 2.1.4. Scale Unknown/Unrecorded	Ongoing	-	-	-
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation		
2. Agriculture & aquaculture -> 2.3. Livestock farming & ranching -> 2.3.4. Scale Unknown/Unrecorded	Ongoing	-	-	-
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation		
5. Biological resource use -> 5.3. Logging & wood harvesting -> 5.3.5. Motivation Unknown/Unrecorded	Ongoing	-	-	-
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation		

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添付資料 2.3.5 VNP Management Plan

Varirata National Park Management Plan

Progress Stage



CEPA-JICA Biodiversity Project
January 2019



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LIST OF ABBREVIATIONS

AusAID	Australian Aid
CBO	Community Based Organisations
CEPA	Conservation and Environment Protection Agency
CPDC	Central Province Business Development Corporation
CSIRO	Commonwealth Science and Industrial Research Organisation
DAL	Department of Agriculture and Livestock
DEC	Department of Environment and Conservation
DoP	Department of Police
GEF	Global Environment Fund
GoPNG	Government of Papua New Guinea
IC	Information Centre
ICC	Information Centre Complex
ILG	Incorporated Land Groups
IRA	Impact Risk Assessment
IUCN	International Union for the Conservation of Nature
JICA	Japan International Cooperation Agency
KLLG	Koiari Local Level Government
LLG	Local Level Government
METT	Management Effectiveness Tracking Tool
MoA	Memorandum of Agreement
MoU	Memorandum of Understanding
NAQIA	National Agriculture Quarantine and Inspection Authority
NARI	National Agriculture Research Institute
NCD	National Capital District
NCDC	National Capital District Commission
NFA	National Forest Authority
NGO	Non-Government Organisation
NSO	National Statistics Office
NTFP	Non-timber forest products
OJT	On-the-Job-Training
PA	Protected Area



PAU	Pacific Adventist University
PHQ	Provincial Headquarter
PIP	Public Investment Program
PNG	Papua New Guinea
PR	Public Relations
SDA	Seventh-Day Adventist Church
SME	Small and Medium Enterprise
SPC	South Pacific Commission
SPREP	South Pacific Regional Environment Program
TOR	Terms of Reference
TPA	Tourism Promotion Authority
UNDP	United Nations Development Programme
UPNG	University of Papua New Guinea
VNP	Varirata National Park
WWF	World Wildlife Fund

PART I. INTRODUCTION

CHAPTER 1: INTRODUCTION

1.1. Introduction

Varirata National Park (VNP) is the first national park in Papua New Guinea (PNG). It was declared on the 10th of December 1969 and officially opened on the 18th of October, 1973. It is situated on state land on the Sogeri Plateau on land which was the traditional hunting ground of the Koiari people who to this day continue to support the Park. With its scenic views and unique and rich biodiversity, VNP attracts not only domestic but also international visitors and researchers from throughout the world. Thus, VNP has its significance in both natural and cultural backgrounds, which should be conserved and integrated to secure its sustainability.

The PNG Policy on Protected Areas (GoPNG, 2014) under Pillar Three “Effective and Adaptive Biodiversity Management” stipulates for management planning to ensure maintaining of the protected area values to the highest possible extent. Protected area management plans are considered as key indicators of successful management and requires cooperation of many partners and full participation of customary landowners. This Management Plan is prepared to summarize the current status, to describe its threats and opportunities, and to propose its approaches and actions toward appropriate management of VNP.

On the other hand, this Management Plan has not actively involved such key stakeholders in its development process simply because there is no existing plan as yet for practical discussion. Therefore, we wish this plan to provide a foundation for discussion among stakeholders to improve the Park management.

1.2. Vision, Mission and Objectives of the Park Management

The vision and the mission of VNP management have already been known since 2016, when VNP received technical and financial assistance from JICA, which directs the Park to its goal.

The vision of VNP is;

- The Varirata National Park being a national icon of biodiversity conservation and integrity with local community in protected area management by ensuring its ecological and historical significance, scenic beauty and potential for sustainable income generation as a precious asset for present and future generations of the surrounding communities of the park.

The mission of VNP management is;

- To promote the value of VNP, its importance as an ecotourism destination, environmental and cultural education field for the people within and outside of the state, especially the residents of the National Capital District (NCD), by maintaining a showcase of biological and cultural diversity.
- To advance the integration of the park and its important actors; Local level Governments (LLGs), social groups, national institutions, research institutions, universities, NGOs, private sector, and so on through promoting appropriate role sharing and benefit sharing in biodiversity conservation and economic and social sustainable development.

This management plan is developed to make necessary steps in pursuit of the vision and the missions above over time. The objectives of the management plan are therefore as follows;

- To describe and analyse the current status of both natural and cultural backgrounds of VNP, its management system, threats and opportunities
- To provide concrete approaches and actions as potential countermeasures to address the issues
- To discuss integration of economic development and conservation to secure sustainability, and
- To improve management systems of VNP to support its functional logistics

1.3. Framework of the Park Management Plan

This plan consists of four parts. Each of which has distinctive objectives.

“Part I. Introduction” corresponds to Chapter 1 to 3, is composed of the chapters describing and analysing the current status of natural and cultural backgrounds of VNP, and its management system. These analyses figure out respective strength, weakness, opportunities and threats, which are the basis for discussion in the other Parts.

“Part II. Conservation Plan” corresponds to Chapter 4 to 7. It discusses conservation activities at species, gene and ecosystem levels. It also includes proposals of environmental monitoring and other research activities.

“Part III. Development and Utilization Plan” corresponds to Chapter 8 to 11. It highlights community issues such as agriculture, cultural/ customary practices, and conflict management. It also targets education activities to the public and tourism development.

“Part IV. Logistic Support Plan” corresponds to Chapter 12 to 17. It summarises current governance and management structure and community representation in it, management of human resources and finance in VNP, security issues, and facility development. This part is essential to support the activities recommended in “Part II. Conservation Plan” and “Part III. Development and Utilization Plan”.

CHAPTER 2: NATURAL BACKGROUND OF VARIRATA NATIONAL PARK

2.1. Location and Area

VNP is located on the Sogeri Plateau in Koiari LLG of Kairiku-Hiri District, Central Province. Its longitude is 147° 22' 08" E, and latitude is 9° 27' 05" S. The geographical coordinates of its northern, southern, eastern, and western edges are shown in Table 2.1.

Table 2.1. Geographical coordinates of VNP's cardinal points, under WGS 84

Cardinal points	Latitude	Longitude
Most central point	9° 27' 05" S	147° 22' 08" E
Northernmost point	9° 25' 47" S	147° 20' 52" E

Southernmost point	9° 29' 17" S	147° 23' 14" E
Easternmost point	9° 29' 17" S	147° 23' 14" E
Westernmost point	9° 26' 34" S	147° 20' 47" E

Location of VNP is shown in Figure 2.1. Total area size (ha): 1,063 ha. All areas are terrestrial and no marine area.

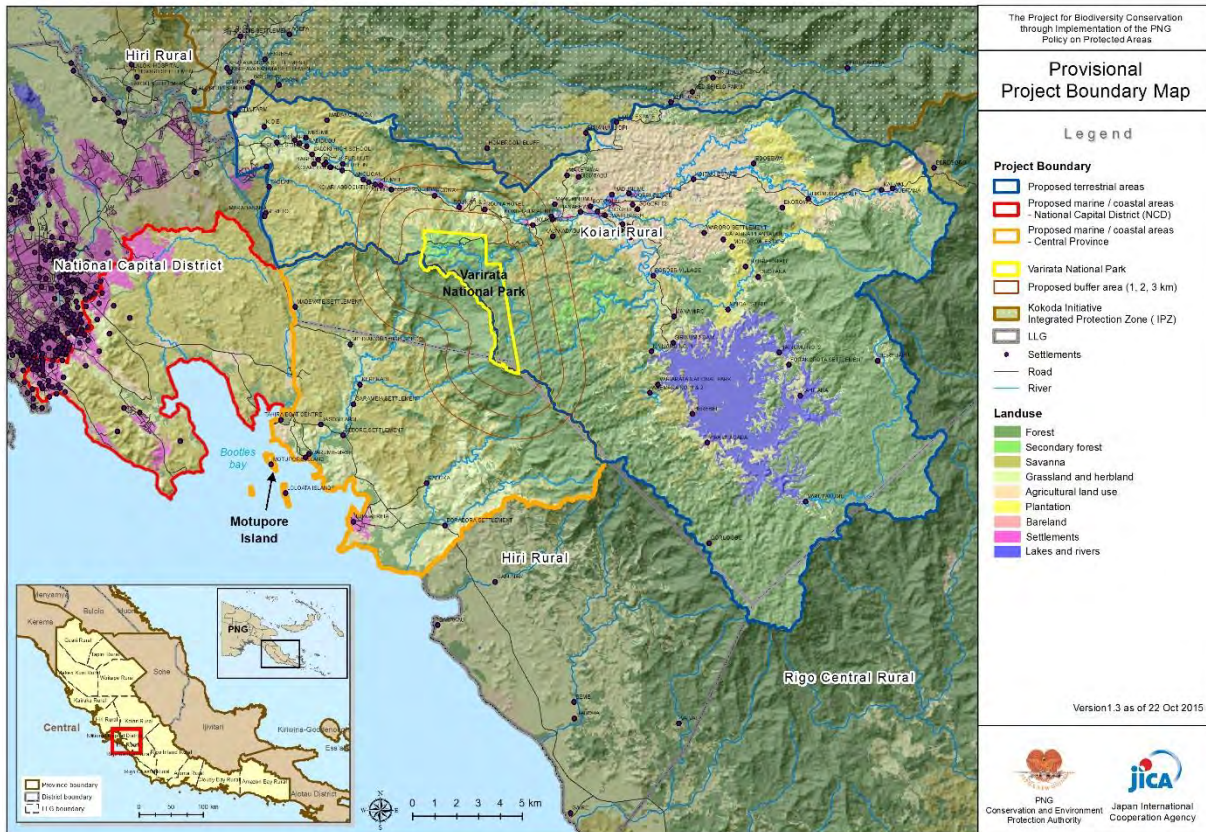


Figure 2.1. Location of Varirata National Park (yellow line)

2.2. Biogeographical Characteristics

2.2.1. Biogeographical Region

VNP lies in the Oceanian biogeographic region, Papuan province.

2.2.2. Topography

VNP is located at the edge of the Sogeri Plateau in the Astrolabe Range, within the Sirinumu catchment and on the edge of the Owen Stanley Ranges to the east. The Park occupies over undulating terrain on the Plateau. Its altitudinal range is between 630m at its lowest and 833m at its highest above sea level.

2.2.3. Climate

Despite the lack of long-term rainfall or temperature data published for the Park, Hopkins and Hisao (1994) monitored rainfall from October 1990 to March 1993 suggesting that the Park receives approximately 1,500 mm of rain per year. 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.

Under the Koppen regional climate classification, the climate of the area is categorized as Tropical Rainforest Climate.

Temperatures during the day commonly reach 30 °C and rarely drop below 16 °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.

Nearest meteorological station to the Park is situated at the Jacksons International Airport at Saraga, Port Moresby. On the other hand, Pacific Adventist University (PAU) at 14 mile has a meteorological station outside their campus, established about ten years ago. The PAU students are currently utilizing it as a part of their science and research projects. As soon as it is confirmed that the meteorological station at PAU meets the standard, this station will be the nearest station to the Park.

2.2.4. Geology

The landform of the Park consists of closely spaced narrow accordant ridges and spurs with a relief of 15-30 meters. This is the result of many millions of years of sedimentation and volcanic activity.

The surface rocks at the Park are agglomerates and consist of small to medium-sized stones embedded in a finer matrix. The volcanic activity about five million years ago caused many landslides, during which large amounts of mud and stones were mixed together producing a series of deposits called lahars. The agglomerates formed from these lahars combine big and small bits of rock in a basalt matrix to form the lumpy rocks exposed in many places. The Sogeri plateau itself is formed by the folding of a long series of lahar deposits during the past five million years. Each lahar was probably the result of a separate eruption, so the plateau as a whole has the appearance of a well-shuffled deck of cards due to the successive lahars and repeated folding. These agglomerate rocks are about 300 meters thick, and form a cap over the softer metamorphic and sedimentary rocks underneath. More recently, the whole plateau has been tilted so that the streams now flow back from the southeast edge of the plateau before they join the larger rivers which have cut down through the various rocks. This has also resulted in the formation of the steep cliffs to the southwest.

The soil at the Park is bright red. It is formed as a residual deposit after the erosion of the agglomerate rocks. It is red because of its high content of iron oxides (13-17%). The other major constituents are alumina (26-33%) and silica (29-34%). The soil is often very thick (up to 70 meters in places), but it usually shows very little layering.

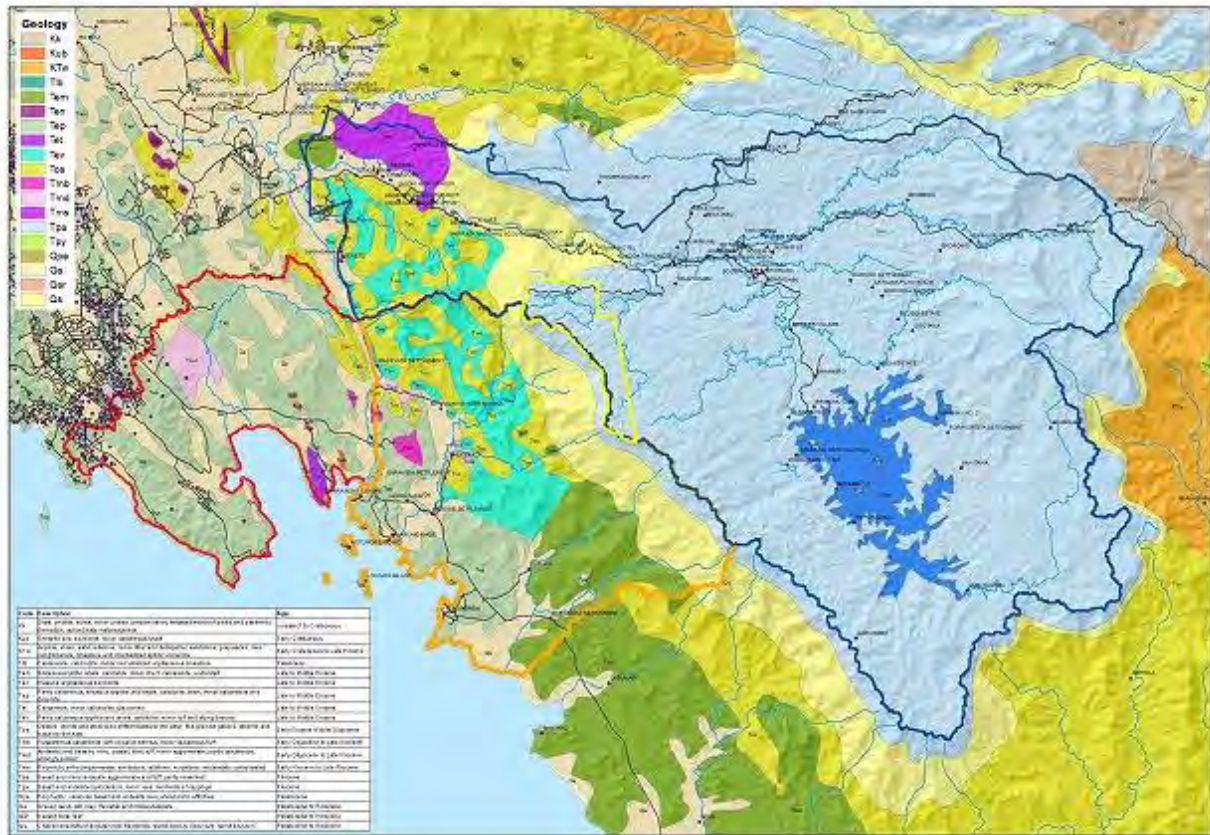


Figure 2.2. Geology of the area

2.3. Fauna and Flora

2.3.1. Flora

The Park contains three dominant vegetation associations that give rise to six key habitats:

- (i) Primary rainforest comprises medium-crowned lowland hill forest including old regrowth forest, occupying approximately 80% of the Park. Medium-crowned lowland hill forest includes a rich diversity of tree species with oaks (*Fagaceae*), particularly *Castanopsis acuminatissima* and *Lithocarpus celibicus* often occurring along ridgelines. Forest structure is typically characterised by a closed canopy 25-30 meters high, a dense understory of shrubs, small trees and lianas.
- (ii) Secondary forest communities are dominated by *Casuarina* (*Gymnostoma papuana*) and the extent of these forests are remarkable, occupying approximately 18% of the Park. Through natural forest succession this habitat has expanded by more than 200 hectares in less than 50 years. Close proximity of a forest seed bank, an absence of fire and limited poaching of forest resources have largely facilitated the successful expansion of secondary forests within the Park.
- (iii) Eucalypt savannah is poorly represented, less than 2% of the Park’s area, despite being a common habitat at low elevations in Central Province. It is however, important ecologically as several species with a restricted range in PNG only occur in these habitats. They include Ghost Gum



(*Corymbia papuana*), Grey Gum (*E. tereticornis*), White Gum (*E. alba*), Weeping Paperbark (*Melaleuca leucadendron*) and the cycad (*Cycas campestris*), which is a regional endemic species.

- (iv) Forest edge habitat comprises the convergence zones where two or more vegetation associations merge such as the interface between eucalypt savannah and secondary forest, secondary forest and primary forest and road side verges that essentially dissect a vegetation association.
- (v) The aquatic habitats within the Park comprise Nairogo Creek and its tributaries, and the Lake Lifilikatabu complex. Several species are restricted in their distribution throughout the Park given their dependence on aquatic habitats. These include a species of sedge (*Eleocharis sp.*) from the lake and *Neonauclea sp.* (a medium sized riparian shrub) and a native species from the genus *Impatiens*, all of which are largely confined to watercourses.
- (vi) Disturbed habitats including landscaped gardens of the Park's picnic areas and roadside verges are dominated by weed species and naturalised grasses.

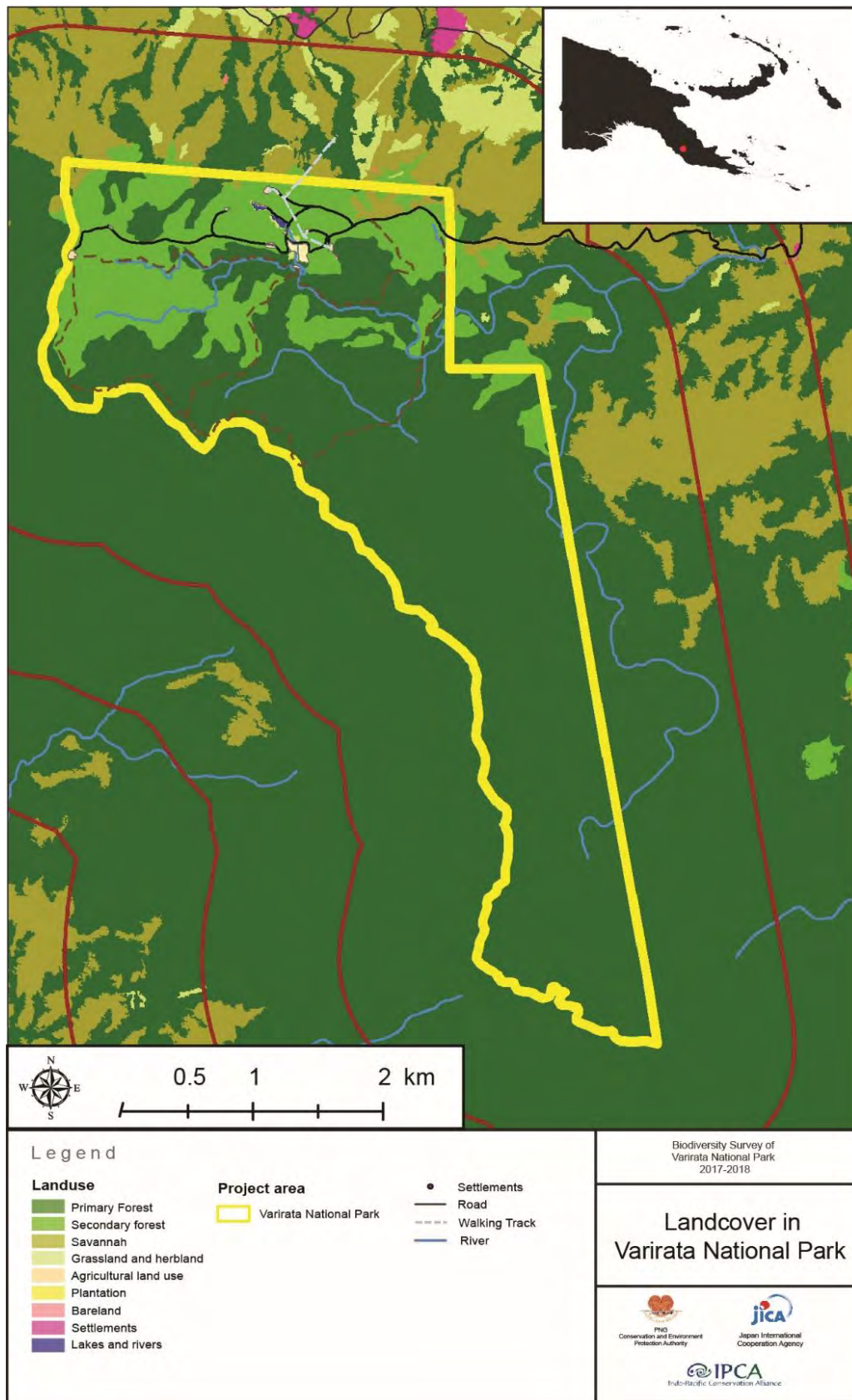


Figure 2.3. Vegetation map of Varirata National Park

2.3.2. Invertebrate Fauna

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 fact that the taxonomy of PNG's invertebrates is generally very poorly known.

The Park's invertebrate fauna include: land snails, leeches, millipedes and centipedes, spiders, freshwater crabs, and insects, among many others. PNG is internationally recognized for its astounding diversity of insects with estimates for the total number of insects in PNG ranging between 300,000 to 400,000 species. Generally poorly described, PNG's insects are characterized with high levels of endemism making them unique to the country.

2.3.3. Vertebrate Fauna

The Park provides habitat for 6% (24 species) of the country's frog fauna, 12% (26 species) of its described lizards, 15% (17 species) of PNG's snake fauna of which five species are highly venomous, and one species of freshwater turtle. The freshwater fish diversity in PNG is considered low and this is also reflected in the Park, where field surveys and literature reviews indicate four native species occur.

Approximately 28% (231 species) of PNG's avifauna (813 species) occur in the Park. Comparing VNP's forest bird species with the country's total for this group, the Park hosts almost 50% of PNG's forest bird taxa.

The mammals are similarly diverse within VNP with 33 species currently recorded. This represents 13% of PNG's terrestrial mammal taxa. The mammal groups include a monotreme (1 species), marsupials (14 species), rodents (8 species) and bats (7 species). Introduced mammals include Wild Pigs (*Sus scrofa*), Rusa Deer (*Cervus timorensis*) and the Black Rat (*Rattus rattus*).

Two mammal species cited in the literature, namely the New Guinea Quoll (*Dasyurus albopunctatus*) and the Short Beaked Echidna (*Tachyglossus aculeatus*), may now be locally extinct and no longer occur in the Park. However, literature reviews, historical collection records and professional ecological experience indicate that there is a very strong case to suspect at least 29 additional mammal species (16 bats, 8 rodents and 5 marsupials) will be added to the Park's checklist with further targeted field surveys. This would result in the Park containing approximately 24% of PNG's terrestrial mammalian fauna (263 species), which is extraordinary.

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 the high ecological value and international significance of the Park's biodiversity. It is expected that with further targeted field surveys, additional species records for frogs, reptiles and mammals will be added to the Park's checklists.

2.4. Ecosystem Services

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. This is also true for the wider Port Moresby populous, who benefit 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.

Including the above, the ecosystem services provided by the Park and the beneficiaries of these

services are identified as shown in Table 2.2.

Table 2.2. Types of ecosystem services and people’s benefits

Types of ecosystem services	Supply to human beings	Direct beneficiary	Indirect beneficiary
Terrestrial forest ecosystems			
Provisioning service	<ul style="list-style-type: none"> ● Supplying wood for house, infrastructure construction, and fuel ● Supplying non-timber forest products (NFTPs) ● Medicinal, healing plants, foods 	Local people	All people in the vicinity
Regulating service	<ul style="list-style-type: none"> ● Regulating water resources ● Reducing soil erosion, flood and sedimentation ● Absorbing CO₂, supplying O₂ 	Hydropower dam, local people	All people in the vicinity, including Port Moresby
Cultural service	<ul style="list-style-type: none"> ● Providing beautiful landscape ● Cultural and traditional festivals and spaces 	Local people, tour agencies	All people in the vicinity, tourists
Aquatic ecosystems (rivers, streams, lakes)			
Provisioning service	<ul style="list-style-type: none"> ● Supplying aquatic product ● Supplying water sources for drinking, housekeeping and agriculture ● Medicinal, healing plants, foods 	Local people	All people in the vicinity
Regulating service	<ul style="list-style-type: none"> ● Regulating water resources ● Limiting soil erosion, flood and landslides 	Hydropower dam, local people	All people in the vicinity, including Port Moresby
Cultural service	<ul style="list-style-type: none"> ● Providing beautiful landscape ● Cultural and traditional festivals and spaces 	Local people, tour agencies	All people in the vicinity, tourists

Indicators of ecosystem services are used to evaluate the three functions (conservation, development and logistic) of the Park, as presented in Table 2.3.

Table 2.3. Ecosystem services by three functions

Functions of the Park	Respective ecosystem service indicators
Biodiversity conservation	<ul style="list-style-type: none"> ● Area of the Park: 1,063hectares ● Number of ecosystems, landscapes, habitats: 6 ● Number of red list species in the Park at national and international level: 6 species of plants and 4 species of vertebrates in IUCN Red List. Many of the Park’s fauna are endemic. ● Number of threats, challenges, solutions
Environmental friendly economic development	<ul style="list-style-type: none"> ● Number of traditional economic activities, direct uses of natural resources, polluting activities, use of chemicals in agriculture ● Activities to exploit, grow medicinal plants in a sustainable way ● Number of tour agencies and services for community-based ecotourism ● Model for economic development and conservation
Supports to research and education	<ul style="list-style-type: none"> ● Number of foreign and domestic scientific researches implemented in the Park ● Number of training and education activities, number of students working in the Park

Biodiversity involved in the provision of ecosystem services in the Park are presented in Table 2.4. Evaluations on ecosystem services for the Park are used to develop this management plan.

Table 2.4. Biodiversity and ecosystem services in the Park

Biodiversity	Contributions to ecosystem services
Diversity of Ecosystems, landscapes and habitats	<ul style="list-style-type: none"> ● Provisioning service: forests, rivers, streams, and lakes supply foods ● Regulating service: forests, rivers, streams, and lakes contribute to climate regulation, water regulation, water supply for hydropower and agriculture, erosion and flood restriction, sedimentation, and underground water supply. ● Cultural service: Providing landscape for ecotourism development, cultural space based on landscape and ecosystem diversity.
Diversity of species, genetic, rare and precious species by national and international levels	<ul style="list-style-type: none"> ● Ethnic people use some types of plants as food, medicines, exploit some NTFPs: wild honey. ● Rare and precious species are concerned by foreign scientists:

2.5. Conservation Values and Issues

2.5.1. Conservation Values

VNP’s incredibly rich flora and fauna biodiversity is irrefutable and has internationally recognised conservation value. The Park benefits neighbouring communities and the broader Port Moresby populous while also offering infinite educational and tourism potential. All these attributes ensure that VNP represents an outstanding natural asset of high ecological value in PNG’s protected area portfolio.

The Park 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. The Park provides a network of trails, popular swimming holes, camping and picnic areas, and scenic lookouts that provide sweeping views of Port Moresby and the Astrolabe Escarpment.

The Park currently receives a modest number of visitors comprising local Koiari people, Port Moresby residents seeking recreational opportunities for picnics and camping, 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 demography to experience VNP’s biodiversity and appreciate the broader environmental values provided by the Park.

The Park contains three dominant vegetation associations as discussed in “2.3.1. Flora”, where rich biodiversity of flora and fauna is prominent. The surrounding area of the Park remains a traditional Koiari hunting ground with hunters targeting wallabies, deers, wild pigs and cassowaries. Koiari burial grounds, rock engravings and cave paintings located on the lower slopes of the Park buffer zone ensures that the areas surrounding the Park remain part of an important cultural landscape that warrants protection.

In addition to the Park’s established biodiversity and cultural values, the park’s relatively high forest

cover provides significant ecosystem services to the neighbouring communities and the wider Port Moresby populous, as discussed in “2.4. Ecosystem Services”.

At species level, six species of plants are scheduled with conservation significance under the IUCN Red List. One species *Halfordia papuana* is classified as “Critically Endangered”. Another species *Flindersia pimenteliana* is scheduled as “Endangered”. The remaining four species, *Cycas campestris*, *Hopea forbesii*, *Myristica globosa*, and *Helicia albiflora*, are scheduled as “Near Threatened”.

Other than the species of conservation significance, several species comprise critical food sources for a variety of animals within the Park. Details of such species are discussed in “5.1.1. Flora”, and conservation of such species is essential for ecosystem conservation.

As for fauna, three species of vertebrates are scheduled as “Near Threatened” status under IUCN, namely the Forest Bittern (*Zonerodius heliosylus*), Gurney’s Eagle (*Aquila gurneyi*) and the New Guinea Quoll (*Dasyurus albopunctatus*). The fourth species, the Giant Bandicoot (*Peroryctes bradibenti*) is scheduled as “Endangered”. All species have been subjected to similar pressures of habitat loss, with the Giant Bandicoot and New Guinea Quoll also suffering from hunting pressure.

2.5.2. Conservation Issues

Invasive species management is one of the key conservation issues that needs to be addressed urgently and continuously. The introduced flora of the Park includes 51 species of which six are considered to be serious invasive species. The remaining 45 species are common weeds and include grasses that comprise the lawns around the picnic and housing areas, currently posing little ecological threat to the native biota of the Park.

The six species of concern comprise: two species: Clidemia (*Miconia crenata*) and Spiked Pepper (*Piper aduncum*) both are well established in the Park, with the remaining isolated populations of four species: Lantana (*Lantana camara*), Spiderwort (*Tradescantia* sp.), the African Tulip tree (*Spathodea campanulata*) and Hemp Vine (*Mikania micrantha*). Clidemia in particular is a dominant groundcover in secondary forests with potential to significantly impact floristic diversity and natural processes of forest succession. Its presence in the Park is concerning.

At least four species of introduced and highly invasive plants also currently occur in areas surrounding the Park, on the Sogeri Plateau or in the Laloki Valley. These species include: Giant Sensitive Plant (*Mimosa pigra*), Sanchezia (*Sanchezia speciose*), White Angel’s Trumpet (*Brugmansia candida*) and the Mexican Sunflower (*Tithonia diversifolia*). All have the potential to cause significant ecological impacts to biodiversity within the Park. Establishment of these species in the Park therefore should be prevented.

The Park’s introduced fauna comprises six vertebrate species. Two widespread species of fish, Mozambique Tilapia (*Oreochromis mossambicus*), and the Common Guppy (*Poecilia reticulata*), are common. An amphibian, the Cane Toad (*Rhinella marina*), widely distributed throughout PNG also occurs throughout the Park and is most common in open disturbed areas.

Three species of introduced mammals also occur within the Park, namely: wild pigs (*Sus scrofa*), Rusa Deer (*Cervus timorensis*), and the Black Rat (*Rattus rattus*), which is largely associated with human habitation and dwellings.

Domesticated dogs and cats (*Canis familiaris* and *Felis catus*) are often recorded within the Park by camera traps. It is considered unlikely that feral populations of dogs and cats occur within or surrounding the Park. However those dogs have been recorded excavating bush fowl nests and are

used by hunters to hunt game adjacent to the Park and illegally within the Park.

Endangered species conservation is another significant conservation issue that requires sufficient attention and effort.

The Giant Bandicoot (*Peroryctes broadbenti*) is designated under the IUCN Red List as “Endangered”, and it requires to be an objective for further study in the Park. It is essential that the appropriate personnel are available to supervise this key study and it is likely to take time to identify these candidates.

Cycas campestris, listed as “Endangered” on the IUCN Red List, is endemic to PNG with its range largely confined to eucalypt savannah at low altitudes in the Central Province. Given that the Park contains less than 2% of eucalypt savannah increasing the Park’s footprint to include a greater proportion of this habitat would be a tangible measure in affording a greater level of protection to this regionally endemic threatened species.

Although the long-term success of the Park is encouraging, threatening processes (domesticated pets, poaching, fire, and unintentional introduction of invasive species) pose serious ecological risk to the integrity of the Park. Population increase in surrounding communities is likely to be a contributing factor to such threats to the Park management. Awareness raising among surrounding communities are therefore essential for the park management, taking into account the unique cultural landscape of the Park and its surrounding communities. In order to harmonize conservation and sustainable livelihood of the neighbouring communities, development of a support framework for employment and ecotourism opportunities should also be pursued.

CHAPTER 3: CULTURAL BACKGROUND OF VARIRATA NATIONAL PARK

3.1. Overview of the Neighbouring Communities

The Varirata National Park is in the Koiari Rural LLG, within the Kairuku-Hiri District of the Central Province, covering an area of 1,063 square kilometres and situated on an alienated land currently owned by the state to the North East of Port Moresby. Located to the North West is Guari, Tapini, Woitape and in the South East area is Efogi, Dorobisoro, Mari and Keria areas. The Kairuku-Hiri District surrounds Port Moresby and is administered from two locations from Bereina for the Kairuku area and for Hiri from Konedobu. The inland area of the district includes the Owen Stanley ranges including the Sogeri plateau and the areas surrounding the Kokoda Track.

The geographical area covered by the Koiari rural LLG is quite big with 22 wards spread from areas sharing boundary with Hiri LLG at Bautama and particularly Wards of Vaiagai and Osawei all the way north to Kagi, Efogi and Manari, and then going east to Sirinumu Dam area. There are also two urban wards in the Koiari Rural LLG that includes Sogeri Urban and Goldie Urban.

Figure 3.1 shows the areas of VNP shaded in yellow, and the 3 km buffer is shown by the rings after the shaded yellow area. These areas are inhabited by Sogeri Koiari and Grass land Koiari cultural groups who comprise ward 4 and 5. The main areas of ward 4 and 5 are accessible by road connecting Port Moresby and the Sogeri area.



Figure 3.1. Map of the neighboring communities of VNP

Ward 4 area covers the census units of Furimuti, CPA compound, Koiari LLG compound, Kipalan block, Raho Piggery, Hugo Canning, 15 Mile station, Sidco, Riverside, Bluff Inn Motel, Hebou Compound, Franciscan Friary, Mount Koiari block, Ted Diro, 17 mile, Gagibevai Scout camp, Rouna 4, Rouna 1&3, and Rouna Works. Only Gagibevai is a traditional village in Ward 4 and falls within the 3 km buffer of the Park. The former scout camp currently has families from Gagibevai also residing there. The other sites are under the state lease from the Government. Rouna 4 and Rouna 1&3 are residential areas for PNG Power staff and their families. Rouna Works is the site of former National Department of Works site, and former Rouna Hotel.

Ward 5 of Depo covers the villages and hamlets of Depo (Kalakadabu), Rouna 2, Varirata National Park, Sogeri Lodge, Kokoda Motel, Chamber, Anglican Church, Manurinumu, Magere, Bisiatabu SDA mission, Gogosenumu, Bisianumu DPI, and Ianabevai. Ward 5 of Depo consists mostly of traditional Koiari villages and past the entrance of the VNP. It borders with Ward 4 at Rouna 4 and ends at Depo creek along the Sogeri highway towards Sogeri Urban (Ward 21).

The preliminary data of the populations of the target areas within the vicinity of VNP (encompassing the council ward areas 4 and 5) are shown in Tables 3.1 and 3.2 based on the National Census 2011.

Table 3.1 Population of areas within Ward 4 (Furimuti)

Census Unit	Census Name	Unit	Total Households	Female	Male	Total Persons	Clans Present
425	Varirata Scout Camp	Scout	15	36	30	66	Nadeka
523	Rouna 4		14	57	59	116	Nadeka, Omani, Taburi
	Total		29	93	89	182	

Source: NSO, 2011 final figures

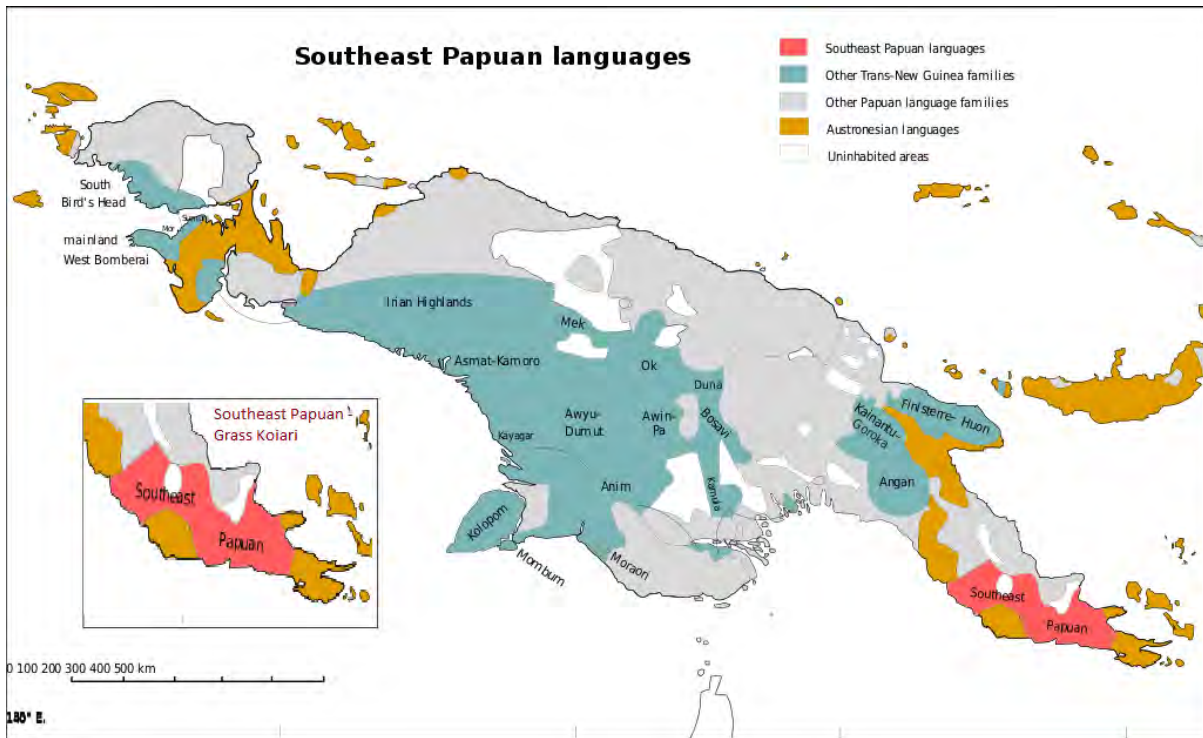
Table 3.2 Population of areas within Ward 5 (Depo)

Census Unit	Census Unit Name	Total Household	Female	Male	Total Persons	Clans Present
010	Ianabewai	7	17	15	32	Ianari, Nadeka
012	Kalakadabu	38	114	134	248	Narime (Taburi) Ianari, Omani, Dauri
013	Manurinumu	20	46	48	94	Omani
026	Bisiatabu	12	45	37	82	Dauri
415	Anglican Church	4	7	12	19	Dauri
424	Varirata National Park	12	35	37	72	Taburi, Ianari
507	Hombroom Bluff	3	12	6	18	Omani, Nadeka
513	Kokoda Trail Motel	2	0	5	5	Formal Estab
522	Rouna No.2	43	134	139	273	Formal Estab
530	Bahai Center	7	18	23	41	Sogeri Lodge
542	Maketawai	16	40	43	83	Omani
	Total	164	468	499	967	

Source: NSO, 2011 final figures

Ward 4 and 5 areas mainly comprise of 4 different clans known as; Nadeka, Ianari, Narime and Omani. The Ianari clan is believed to have originated from Manari on the Kokoda track in the north of their current area in Sogeri and they settled at Uberi which is between Manari and Sogeri. Then they lived at the area overlooking Rouna waterfall at Boanumu. The Omani clan is believed to have originated from Karakanumu Mountain which is located at the north easterly direction from present Sogeri National High School. The Narime or Taburi clan believes that they originated from the Mount Brown area, and their ancestor came from the Oro Province.

These communities are part of the Trans New Guinea, Southeast Papuan language known as Grass Koiaris as shown in the map in Figure 3.2.

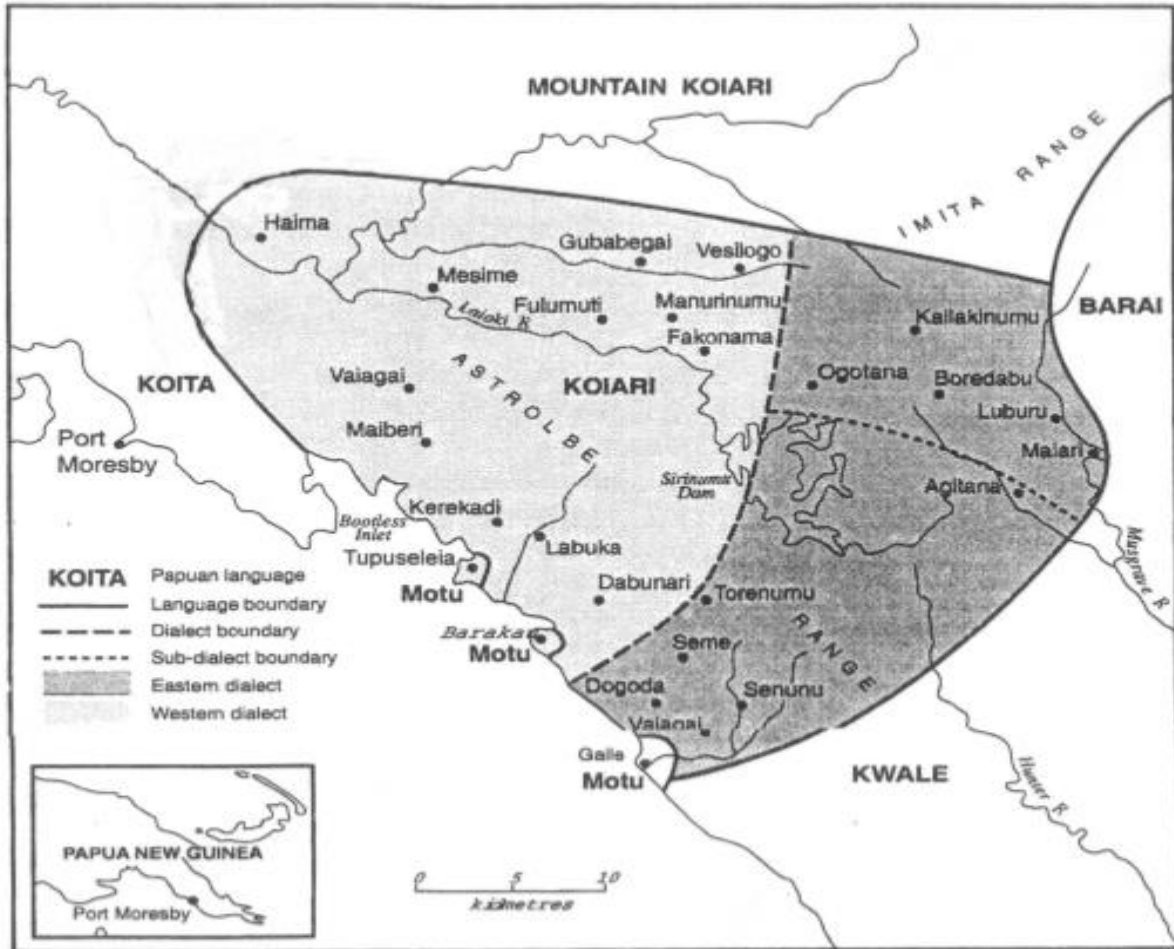


Source: https://en.wikipedia.org/wiki/Southeast_Papuan_languages

Figure 3.2 Map of Southeast Papuan language

Koiari is a small Papuan language spoken inland of Port Moresby, Papua New Guinea. When first surveyed by Tom Dutton in 1966 there were estimated to be approximately 1,800 speakers, although there are now likely to be much fewer than this as the younger generations have learned and use English and/or Tok Pisin as socially more useful languages in an urban context. In Dutton (1969:37-45), he described the Koiari language as consisting of two dialects; an Eastern and a Western one, with the Eastern one further divisible into North-Eastern (centred on Kailakinumu) and South-Eastern (including the villages of Agitana, Dagoda, Senunu and Futinumu), as in Figure 3.3.

The area near VNP comes under the Grassland Koiari speakers, while areas in the north fall under the Mountain Koiari speakers. The Grassland Koiari can also be further referred to as Sogeri Koiari, including those around 17 mile and areas in south, south east around Mountain Diamond, Kerekadi, Seme and Dabunari.



Source: Tom Dutton (1910) Koiari dialects revisited.

Figure 3.3: Dialects and sub-dialects of Koiari

Since the area has been known for agricultural plantation activities by early settlers, the main economic activity in the area is the sale of fresh vegetables from the garden such as; pineapples, sweet bananas, pawpaws, lettuce, cabbages, tomatoes, watermelons, capsicums and greens. Many are transported to be sold at the main Port Moresby markets. A few families sell daily necessity goods for their income coupled with garden food along the roadsides.

There are also potential economic activities that can be further explored such as tourism activities related to the park; traditional dancing, cooking, guide to bird watching and some not related to the park; floriculture and stock feed productions. These activities will be further discussed in Chapter 3 of the Development and Utilization Plan.

3.2. Historical Land Use and Resource Use

There is no infringement into the Park by the local communities. The local communities continue using their present resource base within the Laloki river areas for gardening and resource utilization, as in Table 3.3. There are hamlets near the Park area.

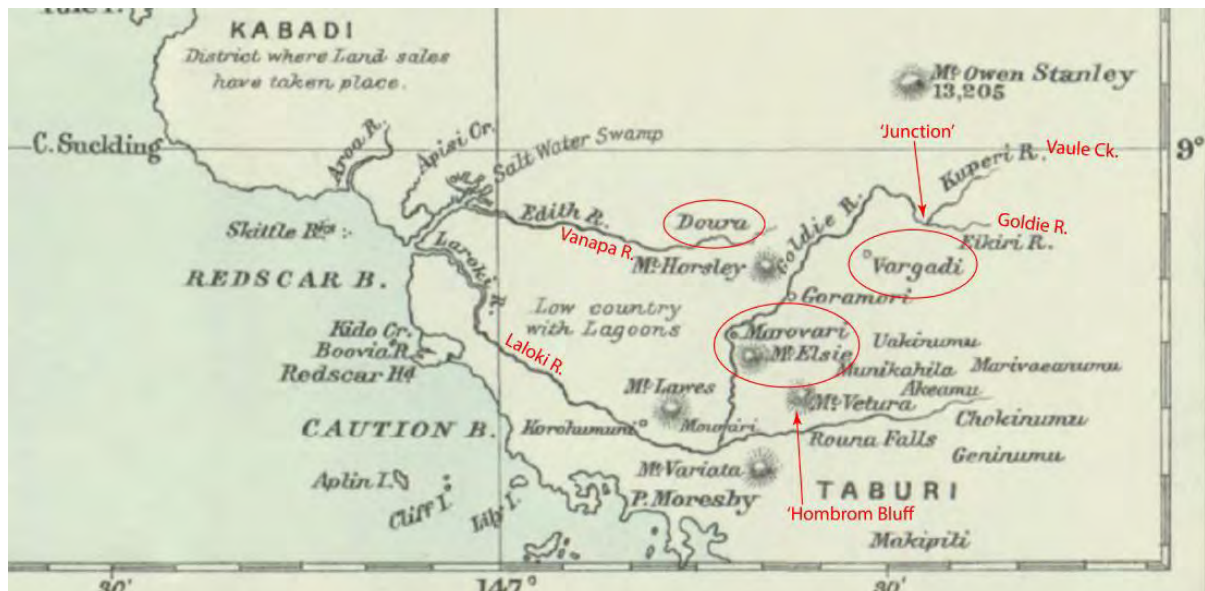
Table 3.3. Utilization of natural resources by local communities

Places/Location	Clans/Communities	Utilization
a) Access road to the park	Ianari & Taburi	Gardening (subsistence agriculture)
b) Rouna works area		Gardening (Lettuce, tomatoes and cabbages)
c) Scout camp area (17 Mile)	Ward 4 (hamlets of Gagibevei)	Hunting (Park's side), Gardening at banks of Laloki River

Subsistence agriculture for those both in ward 4 and 5 takes place along the banks of the Laloki River. Most families generate income through the sale of vegetables and daily necessity goods along the road sides. JICA/CEPA through its various activities such as traditional cooking and dancing does provide certain income to the ward 4 and 5 communities. Availability of freshwater for drinking and washing is a problem so most families use the Laloki River. Regular income generation for the communities is a priority and JICA/CEPA is assisting the communities to encourage sustainable community-based initiatives such as ecotourism so that the communities can continue to sustain themselves. Another potential option is to identify markets for them in Port Moresby so that they can supply their vegetables.

As mentioned above, the community mainly generates income from agricultural crops and relies on natural resources. The role of women is centred on caring for their family in providing food and taking care of the household since early times. Although women do not directly come out and speak in public or during discussion compared to men, there are no differences to access natural resources between men and women.

The Park is located on the traditional hunting ground of the Koiari people. The land which the Park lies on was originally owned by two clans (Nadeka and Ianari). The Ianari clan owns the northern portion of the Park, which was previously demarcated for protection, while the Nadeka clan possesses the entire southern part of the Park, which was the extension of the Park (pers.comm. Kisia Arua, VNP Ranger, 08.07.15).



Source: Lawes .1884. Map showing Varirata, Rouna Falls, Hombrom Bluff, and Taburi

Figure 3.4: Map Showing Varirata, Rouna Falls, Hombrom Bluff and Taburi

Immigration and movement of the local community had an impact on historical land use. Table 3.4 highlights the migration, movement and land acquisition dynamics of the area that includes Varirata National Park and the 3km buffer.

Table 3.4. Migration, movement and land acquisition dynamics of the areas in and around VNP

Period	Movements & Acquisitions	Communities/Clans	Impacts
	Movement during traditional days	Nadeka clan migrated from Manari, Omani from Karakanumu. Taburi & Ianari seems to be the original settlers on the land in these areas.	Omani & Nadeka clans have moved into the area and have taken over some of the land that was originally under Taburi & Ianari.
1800's	Migration during colonial patrol era and missionary influences (colonial administration)		Establishment of some of the present villages at Gagibevai, Manurinumu, Hombroom Bluff, Magere, Kalakadabu and Ianabewai. Establishment of Kalakadabu United Church.
1894 (23rd Oct.)	Land situated at the western end of the Astrolabe range and is known as Wodobonumu was transferred to the colonial government of the British New Guinea, on behalf of the queen.	Signed by William McGregor under the Land Ordinance of 1962. 19 that land acquired from are as follows: (1) Iwana Doana (2) Madohana (3) Toina (4) Saroa (5) Uguni (6) Iaba Davaia (7) Udia (8) Osiwa (9) Kidu (10) Nariki (11) Iohia (12) Kunuku (13) Toana (14) Mariori (15) Babaoiri (16) Mokuta (17) Nido Davera (18) Dawa Enauba (19) Moio Kosiva.	Purchased by; (a) Eighteen half axes (b) Eighteen tomahawks (c) Eighteen large knives (d) Eighteen small knives (e) Thirty-six yards of turkey red calico (f) Eighteen led's (g) Four & half pound's weight of beads.
1902-1909	Missionaries established first plantations in the Sogeri areas and the surrounding area.	Sogeri, Keregadi, central areas. The local Koiari were paid \$12 for their year's work, but the locals immediately exchanged that for axes, knives, lanterns, blankets, belts, singlets, loin cloths, towels and cooking utensils.	More than 12,000 acres of land at Varirata & Sogeri were cultivated with coffee, tea, pineapples, cinnamon & passion fruit
1903 (Dec.)	Charles Grant Garrioch (Central Court Register).	Sogeri areas	Planted Arabica Coffee & rubber
1908	Fairfax Harbour Sisal estate was established. This became the foundation of Itikum estates of British New Guinea Development company in 1910.		Plant sisal at Tavai, Gaire.
1913-1926	SDA missionary's concentration took place. 1924 First Excursion & Second Excursion in 1926.	Efogi, Manari, Kagi Bola, Fabila and Seragina and further onto Mount Victoria. Kokoda, Oivi, Ilimo, Kumusi river.	Years of stagnation until 1918 just one baptism took place. Finally, a church was built in Efogi village.
1929	Increasing land application for the establishment of rubber	The owners of the land was V.C. Waiaki of Itinum and Odua who	



	plantations around Sogeri.	was employed as shooting man by Eilogo plantation.	
1932	Patrol officers Jack Hides reached Kerikadi south of the Varirata National Park, owned land as far as Barakau.	Information gather through Patrol from Dabunari to Kerikadi. The present-day village of Kerikadi is at the Mount Diamond area.	The people of Waiwai garden on the slopes of Varirata had no shortage of food in the area.
1943 (20th Sep. - 5th Oct.)	World War 2, invaded by Japanese	Koiari's (inland esp)	Many damages to their homes & gardens. They did receive war compensation from the colonial administration.
1946/1947	States that the Nadeka Clan have left their site at Hombrum Bluff & moved down to Gagibevai. The patrol covered Dagoda, Seme, Daburika, Wameruku, Mokonumu, Berebi, Togonumu, Berebi, Wadinumu and Sirinumu. The patrol also passed through Nandinumu, Mariane, Kailakunumu and to Subitana plantation	The patrol refers to Village constable Varite Koare, who comes from the village located on the edge of the Hombrom Bluff near Karakanumu. A village constable willing to work & supporter of the SDA Mission. Varite Koare is based at a small hamlet on the north west of Hombrom Bluff.	67 natives of 8 different clans of the grassland Koiari are all claiming ownership of the portion of the Karakanumu – Karakadabu quarry site.
1950	Coffee nursery established.		
1963 (17th Feb.)	The Park originally reserved under the trusteeship (District Commission, Director of Forest & Ruth Isobel)		
1967 (2nd Nov.)	The Warirata (Varirata) Access road near Warirata Estate was purchased (under section 85 of the land ordinance of 1962)	Signed by: (1) Yohia Garugaru of Yanabewai village, Ianari Clan (2) Kaeka Manaka of Vaeagai village, Omani clan (3) Warite Koare of Manurinumumu village, Nadeka clan.	6ha (Agency agreement between members of the 3 clans & their agents. A total of \$113 was used to pay for this land area of 18.8 acres of land).
1969 (18th Dec.)	Park committed to the care & control of the National Parks Board		
1973 (08th Oct.)	The Park was officially opened		

Trends shows that groups in traditional days moved around together, and where deaths took place, they placed the death corpses on stone caves and rock shelters. The bones from corpses that were placed under those rock shelters does not necessary mean that relatives own those sites.

3.3. Cultural Significance

The Park has a long historical connection with the local Koiari people. There are some burials caves found within the Park and locals still use the forest for food, medicine and other traditional uses. There

are several archaeological sites in the area of the VNP. These sites have been documented by F.E. Williams (1926). They are also registered as archaeological monuments with the National Museum and Art Gallery, though the National Museum still plans to do detailed visits to this site for detailed documentations. In the broader Sogeri area there are 17 sites that have been recorded. Within the Park and the buffer zone, there are 5 sites. F.E Williams (1926) documented the following sites:

(1) Wagava:

On central one of the three bluffs, about half a mile distant from the left bank of the Laloki river, Aghoberi District (Aghoberi district – refers to areas around Hombrom Bluff, Manurinumu (old village site).

(2) Yoiworo I:

On hill side, right of the road approaching Rouna, and about 2m below what was then Rouna Rest House.

(3) Yoiworo II:

Close to above.

(4) Rouna:

Just behind what was then the Rouna rest house.

(5) Wureva Yani

Located on the right bank of the Laloki River, almost half a mile below Rouna falls – The site can be approached from Manurinumu village.

The National Museum and Art Gallery has further done some work in the area and has given site codes and grid references to these locations. These are in Table 3.5:

Table 3.5. Site codes and grid references by the National Museum and Art Gallery

Site code	Name	Description	Grid reference
ADW ALA	Oma Yaniwa (Rouna Falls)	Paintings on rock boulder shelter, half a mile from old Rouna Hotel.	EK404583
ADX	Rouna (Rouna Falls)	Rock shelter with paintings located three quarter of a mile below Rouna falls, about half a mile from the river at the foot of a huge conglomerate. Reference: Pretty G. 1966:7	
ALK AED	Ramadordo Hombrom Bluff Sogeri	Engravings and paintings located straight below the Hombrom Bluff, overlooking Vesirogo creek, about one hours walk from Hombrom bluff look out. References: White and White 1964, White 1967b Vol II-i-ii, Pretty G. 1966:10	EK471552
AEE	Manurinumu	Engravings and paintings, a rock shelter located half way between Rouna and Manurinumu village, Upper rapids B. Reference: Pretty.G. 1966:11, Leask 1943:120	EK442584
AEF	Manurinumu	Engravings and paintings, a rock shelter located half way between Rouna and Manurinumu village, Upper rapids A. Reference: Pretty.G. 1966:11, Leask 1943:120	EK442584
AEI	Wureva Yani	Engravings, painting and pottery on high scarp on right bank of Laloki half a mile below Rouna falls, approach from deserted Manurinumu	EK358604



	Manurinumu village Rouna	village site. Reference: Pretty.G.1966:15	
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The above listed archaeological sites fall within the 3 km buffer of the VNP and are part of the cultural resources that continue to remain in the area. This requires additional work and the rock painting work needs to be also incorporated into a tourism product so that villagers also benefit from this cultural resource that exists in the area. The documentation of this area will be in accordance with the draft Protected Areas Bill which states the following under section 9 – Traditional sacred sites, ples masalai, Tambu areas.

Subject to parts III and IV of the National Cultural Property (Protection) Act

- (1) Land that custom designates as traditional sacred site, ples masalai or traditional tambu area in a protected area or otherwise, is protected by this Act, whether it is registered as a protected area under this Act.
- (2) The boundaries and designation of such land may be determined by a customary owner or a village court magistrate.
- (3) The regulations may provide for the notification of the sacred sites to the public.

The cultural knowledge of Ward 4 and 5 on the herbs or medicinal plants is important. Although, there are several plants that the locals use in the area as medicines for their herbal properties, there is a lack of documentation on traditional medicinal plants.

3.4. Development Values and Issues

3.4.1. Development Values

Currently, the most lucrative project at VNP is the Bird Watching project in collaboration with PAU and CEPA. Over the years, tour operators have been taking birdwatchers to the Park and benefiting from it while CEPA and the landowners have been missing out on bird watching project spin offs. More money-generating activities are needed for the Park to raise its own revenue in order to sustain itself. It is also important that more ecotourism activities are identified and tour packages for the visitors and tourists to enjoy tourism services, is developed.

Gate fee collections at the park is crucial as there are many visitors to the Park during the weekends. Collection and management of the fees and reporting is important to improve management of the Park. Fees collected during the weekdays and weekends should be recorded and reported consistently for the management of the Park. Currently, fees collected during the weekdays are not reported effectively, except for weekends only. There is a high potential of generating more revenue from the gate fee collection if managed well with full time-based staff at the park.

Selling of garden food or fresh produce to the local or main markets in Port Moresby is another opportunity for local communities. Many locals make gardens and produce vegetables; bananas, pineapples, greens, pawpaw and cassava. Locals travel to Port Moresby main markets to sell their products to sustain themselves. Local communities around the Park have a high potential to market their products to the main central markets in Port Moresby through well-established networks and

partnerships with business houses and shops in Port Moresby. This potential needs to be developed further to support the livelihood of the people.

Three workshops have been held in Koiari for the purpose of identifying needs of livelihood development from relevant players including local communities. In these workshops, discussion sessions with the local community were conducted to gauge their views on how to improve their understanding of project activities and identifying the needs of livelihood development. They were very keen to participate in the tourism industry and engaging with local tour operators and PNG Tourism Promotion Authority (TPA). They have a high expectation that many people including women and children would be involved in livelihood activities.

3.4.2. Development Issues

For the local communities at Varirata and surrounding to benefit from the project, it is important for the local community groups to be mobilised and organised to provide quality tourism services to the visitors. Therefore, formation and establishment of small community-based groups is very crucial for the communities to develop as a community and not as individuals. Registration of community-based groups and identifying their roles, functions and systems at the Park is beneficial for the local communities.

Capacity building for the local community groups is vital in areas such as; cooking, tour guides, marketing of products, tourism training, and cultural exposure tours to help them know about what tourism is all about. The issue of false marketing in tourism is a hindrance to tourism development in PNG and this can be addressed through more capacity building trainings and workshops.

Gate entry fee collection at Varirata has never been gazetted since the establishment of the Park. It is anticipated that the gazettal of the Park's new entry fees will assist to generate revenues that will help manage the park in terms of cleaning, security, and maintenance of the Park's facilities. Basic training on book keeping will be conducted to build their knowledge and management of cash generating from the Park's spin offs because they lack the cash management skills.

Since there is no park management plan, it is a threat to the long-term management of the Park. For instance, local communities are not restricted to how their land surrounding the park is utilised. It is also an issue that will be addressed in the overall management plan. This will guide the local communities and the management team to ensure effective and good use of the park and its facilities.

Formation of a park management team to implement the park management plan is of paramount importance in the long term of the Park. The management board will consist of various key stakeholders of the Park to ensure effective decision-making in the best interest of the Park. The development and formation of the Park's management board is underway.

PART II. CONSERVATION PLAN

CHAPTER 4: CONSERVATION AT SPECIES LEVEL

This Chapter discusses conservation at species level: particularly conservation of endangered species and invasive species management.

4.1. Endangered Species Conservation

4.1.1. Flora

Six species of plants are scheduled with conservation significance under the IUCN Red List. One species *Halfordia papuana* (Figure X) is classified as “Critically Endangered”, while a second species *Flindersia pimenteliana* (Figure X) is scheduled as “Endangered”. Neither species was collected from the Park during the conduct of the biodiversity surveys in 2017-18, although *F. pimenteliana* was previously confirmed by Hopkins & Hisao (1994) as occurring within the Park. The distributions of both these trees co-occur with medium crowned hill forests, which is widely distributed across the country. As such, the listing of these two species on the IUCN Red List is considered questionable.

Of the remaining four species, *Cycas campestris*, *Hopea forbesii*, *Myristica globose*, and *Helicia albiflora*, all are scheduled as “Near Threatened” under the IUCN.



Figure 4.1. *Halfordia papuana*, Critically Endangered under the IUCN Red List

(Source: Botanic Illustrations.org)

H. albiflora is commonly associated with *Castanopsis* and *Nothofagus* forest communities and has a broad distribution across PNG. Little is known regarding the population status of *Myristica globosa* and both species are considered to be “low risk” under the “Near Threatened” category.

Cycas campestris is endemic to PNG with its range largely confined to low altitudes in the Central Province. Habitat loss and frequent fire regimes are the primary threats to this species. Given that the Park contains less than 2% of eucalypt savannah habitat increasing the Park’s footprint to include a greater proportion of savannah would be a tangible measure in affording a greater level of protection to this regionally endemic species.

The Dipterocarps (Family Dipterocarpaceae) are highly sought after by the logging industry given their high value as timber species. *Hopea forbesii* is native to the island of New Guinea (including West Papua) and has a broad distribution within PNG. It has been subjected to an estimated 25% decline in population due to loss of habitat and logging and as such, the IUCN indicates that this species is borderline “Vulnerable”.



Figure 4.2. *Flindersia pimenteliana*,
Endangered under the IUCN Red List

(Source: Australian Tropical Rainforest Plants
CSIRO, 2018)

Other than the species of conservation significance, several important species occur throughout the Park, which comprise of critical food sources for a variety of animals within the Park. Conservation of such species is an integral part of the ecosystems in the Park.

Sogeri Velvet Bean (*Mucuna macropoda*) is a leguminous vine. It is reported that Sogeri Velvet Bean is pollinated by a small bat (*Syconycteris australis*) that is one of the most common species of bats found in the Park. Sogeri Velvet Bean appears to be restricted to *Castanopsis* forests within the Park.

Birthwort (*Aristolochia momandol*) is the only known food plant within the Park of the large iconic birdwing butterfly, *Ornithoptera priamus*. This plant is relatively common within the primary and the late secondary forest within the Park.

Tulip (*Gnetum gnemon*), a gymnosperm that occurs throughout New Guinea and much of Southeast Asia, is common in the primary forests of the Park. It is easily recognized by raised rings around the otherwise smooth trunk and by its paired, expanded leaves, which has given it the Pidgin name of Tulip. The fruits and leaves are edible and the bark is used to produce billum string. Tulip is also an important food plant for many of the frugivorous birds that occur in the Park.

PNG Oak (*Castanopsis acuminatissima*) is a single species in New Guinea, although the genus *Castanopsis* includes around 120 species of trees and shrubs mainly in tropical and subtropical Asia. This species occurs throughout the island, mostly in lower montane forest from elevations of 800 to 1,800 m, but it can range in some areas down to sea-level and up to around 2,200 m. The fruit, a spiny ovoid nut, is harvested by people in many areas and is an important source of food to many species of parrots. It is common at higher elevations in the Park, particularly in areas around Gare’s lookout.

There are at least 26 species of frugivorous birds occurring in the Park, including five species of birds of paradise, pigeons, berrypeckers and a diversity of other species. These birds are dependent on fruit produced by various species of primary rainforest trees, *Chisocheton lasiocarpus* and *Dysoxylum perrigrewianum* (Meliaceae) and a species of *Myristica* (Myristicaceae) are visited almost exclusively by birds of paradise. Birds of paradise also feed heavily on the fruits from a fig, *Ficus cr. obliqua* and from a conifer, *Podocarpus nereifolius* (Podocarpaceae).

There are, at least 42 species of *Ficus* found within the Park. One of these species, with small, bright orange fruits, is common at the forest edge. A tree, near the Lodge, was in fruit during November – December 2017 and was commonly visited by the Raggiana Bird of Paradise, Brown Orioles, and several species of fruit pigeons. Species of *Syzygium* produce large, reddish fruit on the lower trunks of the trees; these are eaten by cassowary and other frugivorous birds and mammals.

4.1.2. Fauna

Three species of vertebrates are scheduled as “Near Threatened” status under IUCN, namely the Forest Bittern (*Zonerodius heliosylus*), Gurney’s Eagle (*Aquila gurneyi*) and the New Guinea Quoll (*Dasyurus albopunctatus*). The fourth species, the Giant Bandicoot (*Peroryctes broadbenti*) (Figure X) is scheduled as “Endangered”.

Forest Bittern 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.

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. Its status in the Park has not been confirmed since 1994.



Figure 4.3. Giant Bandicoot (*Peroryctes broadbenti*)
(Photo credit: Roy Mackay)

Giant Bandicoot is endemic to the south-eastern peninsula of Papua New Guinea and is thought to mainly be a lowland species, but is known from localities up to 1,000 m elevation. 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 and over-hunting. Giant Bandicoot is the largest bandicoot in the world at nearly 5 kg and would fetch a high price in the bush meat trade.

Hopkins and Hisao reported in 1994 that it has been seen in the Park and its presence has subsequently been confirmed through camera trap survey. 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 survey suggests that it also utilises secondary forest.

No species of vertebrates is endemic to the Park.

All species have been subjected to similar pressures of habitat loss, with the Giant Bandicoot and New Guinea Quoll also suffering from hunting pressure.

4.1.3. Action Plan

In order to facilitate conservation of not only species of conservation significance but also important species, two approaches are proposed; monitoring programs of forest succession, botany, Giant Bandicoot and mammals; and community outreach program.

PNG's tropical forests are widely recognised as a major centre of plant diversity, and estimates of the New Guinea Island's plant diversity are significant and range from 11,000 for PNG to 20,000-25,000 species for West Papua. However, PNG's flora remains poorly collected and there is a significant knowledge gaps. Botanical monitoring provides opportunities for the collection of herbarium materials, which is the only reliable mechanism of obtaining positive identification of flora within the Park. The priority is high.

The Park also offers a unique opportunity to monitor natural processes driving changes in vegetation communities. Data collected by Brown and Hopkins on forest dynamics provides an invaluable opportunity to utilise that study as a baseline to establish changes in community composition of primary forests over time. Some species are associated with a certain forest community, and understanding of its dynamics is crucial to conserve target species. The priority is high.

Given the lack of understanding of Giant Bandicoot, the flagship species within the Park and PNG, a biological monitoring program is proposed specifically to study this animal's ecology. The priority is medium – low.

Other mammals are also poorly known in the Park, compared with other vertebrate groups. Biodiversity survey conducted in 2017-18 produced a checklist of species including 30 native taxa and three introduced species, with a very strong indication that an additional 29 species occur in the Park. Implementing a targeted monitoring program specifically for bats and Dasyurids will further elucidate the occurrence of rare and cryptic species in the Park. The priority is medium – low.

Animals are often hunted for its meat and fur. Hunting animals can be recognised as a part of the local culture and tradition of the neighbouring communities, however increasing hunting pressure may lead to the extinction of some species. Sustainable management of the Park requires cooperation with neighbouring communities, and outreach program is considered as one of the effective activities to strengthen the relationship between the communities and the park management. The priority is high.

Taking into account of all the above, proposed actions and its timings are summarized in Table 4.1.

Table 4.1. Action Plan for the Endangered Species Conservation

Action		Priority	2019				2020	
			Q1	Q2	Q3	Q4	Q1	Q2
Monitoring Programs for:	Forest Succession	High		X	X	X	X	X
	Botanical	High		X	X	X	X	X
	Giant Bandicoot	Medium - Low					X	X
	Mammal Census	Medium – Low			X	X	X	X
Community Outreach Program		High		X	X	X	X	X

4.2. Invasive Species Management

The Park's biodiversity is impressively high, with nearly 10% (1,126) of the vascular plants species known from mainland Papua New Guinea and approximately 16% (338) of the country's terrestrial vertebrates. In contrast, the number of introduced species found in the Park is fortunately quite low: 51 species of plants and six species of vertebrates.

4.2.1. Invasive Plant Species

The introduced flora of the Park includes 51 species, of which six are considered to be serious invasive species. The remaining 45 species are common weeds and include grasses that comprise the lawns around the picnic and residential areas and as well as many of the common weeds found which also occur along road side verges. These plants currently pose little ecological threat to the native biota of the Park.

The six species of concern comprise: isolated populations of four species: Lantana (*Lantana camara*), Spiderwort (*Tradescantia* sp.), the African Tulip Tree (*Spathodea campanulata*) and Hemp Vine (*Mikania micrantha*), and the remaining two species: Clidemia (*Miconia crenata*) and Spiked Pepper (*Piper aduncum*) both are well established in the Park. Clidemia in particular is a dominant groundcover in secondary forests with potential to significantly impact floristic diversity and natural processes of forest succession. Its presence in the Park is of great concern.

At least four species of introduced and highly invasive plants also currently occur in areas surrounding the Park, on the Sogeri Plateau or in the Laloki Valley. These species include: Giant Sensitive Plant (*Mimosa pigra*), Sanchezia (*Sanchezia speciosa*), White Angel's Trumpet (*Brugmansia candida*) and the Mexican Sunflower (*Tithonia diversifolia*). All are characteristically aggressive and have the potential to cause significant ecological impacts to biodiversity within the Park. Preventing establishment of these species in the Park is a significantly preferable option both ecologically and economically as opposed to attempting to eradicate and manage infestations should they become established.

Separate Species Management Programs have been recommended for management of the six highly invasive plants that occur within the Park and for the three out of the four species that occur in close vicinity of the Park, as shown in Table X.

Immediate eradication of three species from the Park, namely Lantana, Spiderwort and the African



Figure 4.4. Clidemia (*Miconia crenata*) in flower (Photo credit: Allen Allison)



Figure 4.5. Spiked Pepper (*Piper aduncum*) (Photo credit: Allen Allison)

TulipTree is an urgent priority. More information is required on the distribution and extent of infestation within the Park of Hemp Vine, which was recorded from the shoreline of Lake Lililikatabu and around the lodge prior to formulating population control measures for the species.

Spiked pepper and Clidemia pose serious ecological risk and Species Management Programs for both species focus on implementing containment and targeted eradication strategies. Preliminary trials were conducted to estimate the potential costs of physically eradicating Clidemia from secondary and primary forests. Cost estimates range from K160 per ha (in primary forest) to K1, 050 per ha (in secondary forest where it is a dominant groundcover in many places). Total costs estimates for clearing infestations range from K44, 000 (294 ha in primary forest) to K223, 650 (213 ha in secondary forest). Ongoing costs would be incurred in the continued management of this species in the Park.

Table 4.2. Species Management Programs for six invasive species of plants

Target Species	Key Management Actions*	Priority
Clidemia	Containment: Primary and Secondary Forest (1) Prepare standalone management plan document (2) Conduct detailed literature review (3) Employ and train park rangers (4) Establish trial and control eradication plots (5) Implement monitoring program Community Outreach Plan: (1) Develop fire management strategy for the Park (2) Develop and implement citizen science program	High
Spiked Pepper	Asset Based: Secondary and Eucalypt Savannah (1) Prepare standalone management plan document (2) Conduct detailed literature review (3) Employ and train park rangers (4) Establish trial and control eradication plots (5) Implement monitoring program (6) Dovetail Fire Management Strategy (FMS) with VNP FMS Community Outreach Plan: (1) Develop FMS for VNP	Medium
Lantana Spiderwort African Tulip Tree	Eradication: Secondary Forest (1) Employ and train park rangers (2) Eradicate isolated populations (3) Implement monitoring program	High
Hemp Vine	Prevention: All habitats (1) Employ and train park rangers (2) Map and determine extent of establishment	High

	(3) Eradicate isolated populations (4) Implement a monitoring program or develop a standalone management plan if required	
Giant Sensitive Plant Sanchezia White Angel's Trumpet	Prevention: All habitats (1) Employ and train park rangers (2) Eradicate all populations within the Park (3) Implement monitoring program	High

* Community outreach plan, such as invasive species awareness workshops and invasive species fact sheets, are common key management actions for all target species, in addition to the above.

4.2.2. Invasive Vertebrate Species

The Park's introduced fauna comprises six vertebrate species. Two widespread species of fish, Mozambique Tilapia (*Oreochromis mossambicus*), and the Common Guppy (*Poecilia reticulata*), are common. An amphibian, the Cane Toad (*Rhinella marina*), widely distributed throughout PNG also occurs throughout the Park and is most common in open disturbed areas.

Three species of introduced mammals also occur within the Park, namely: Wild Pigs (*Sus scrofa*) (Figure 4.6), Rusa Deer (*Cervus timorensis*) (Figure 4.7) and the Black Rat (*Rattus rattus*), which is largely associated with human habitation and dwellings.

Domesticated dogs and cats (*Canis familiaris* and *Felis catus*) are often recorded within the Park by camera trap program, which frequently documents both itinerant dogs and those accompanying villagers transiting through the Park. It is considered unlikely that feral populations of dogs occur within the Park or surrounding the Park. However, they have been recorded excavating bush fowl nests and are used by hunters to hunt game adjacent to the Park and illegally within the Park.

The status of feral cats in the Park is less than certain as they have been recorded in close vicinity of staff quarters and are likely to be domesticated pets. The potential ecological impact of feral cats on tropical fauna is well documented and their establishment would have significant implications for the Park's mammal fauna.

Species Management Programs are recommended for all six species of vertebrates, as shown in Table



Figure 4.6. Wild Pig (*Sus scrofa*) in primary forest, VNP (Photo credit: Camera Trap Program, 7/Apr/2016)



Figure 4.7. Rusa Deer (*Cervus timorensis*) watering at Lake Lifikatabu, VNP (Photo credit: Angus Fraser)

X. Of high priority is to expand the existing camera trap program to monitor populations of pigs and deer within the Park given their potential for widespread ecological damage. This will provide relevant information necessary to subsequently determine effective population control measures.

Species Management Programs for domesticated cats and dogs will require establishment of formal Park Policy strictly regulating their presence in the Park. Unrestrained dogs and cats must be banned from the Park and staff living within the Park must be prohibited from keeping these animals as pets.

Table 4.3. Species Management Programs for six invasive species of vertebrates

Target Species	Key Management Actions*	Priority
Common Guppy Mozambique Tilapia	Asset Based: Disturbed habitats (1) Employ and train park rangers (2) Implement monitoring program at Nairogo Creek (3) Develop management plan based on monitoring results	Medium
Cane Toad	Asset Based: Disturbed habitats (1) No action required	Low
Wild Pig	Asset Based: All habitats (1) Employ and train park rangers (2) Expand existing camera trap monitoring program	High
Rusa Deer	Containment: Secondary and Eucalypt Savannah (1) Employ and train park rangers (2) Expand existing camera trap monitoring program Community Outreach Plan: (1) Fire Management Strategy	High
Black Rat	Asset Based: Disturbed habitats (1) No action required	Low
Domesticated Cats Domesticated Dogs	Prevention: All habitats (1) Employ and train park rangers (2) Continue and expand camera surveillance of bush fowl nests (3) Conduct a seasonal cat trapping program (4) Prepare a Park Policy for cats and dogs	High

* Community outreach plan, such as invasive species awareness workshops and invasive species fact sheets, are common key management actions for all target species, in addition to the above.

4.2.3. Action Plan

Implementation of the proposed Species Management Programs for invasive plants and animals is considered a high priority. In particular, prompt actions for the programs with high priority are needed and its timing is proposed as in Table 4.4.

Recognizing that adjacent communities are integral to the Park's future success, awareness raising

through community outreach activities is considered to be an important initiative. Organizing invasive species awareness workshops and production of invasive species factsheet/field guide brochures would promote public awareness around these species given that many invasive species in PNG, particularly plants, are commonly introduced as ornaments.

Table 4.4. Action Plan for the Invasive Species Management Programs with high priorities

Action	2019				2020	
	Q1	Q2	Q3	Q4	Q1	Q2
Containment and targeted eradication of Clidemia and Spiked Pepper	X	X	X	X	X	X
Immediate eradication of Spiderwort, Lantana and African Tulip Tree	X	X	X	X	X	X
Study on population status of Hemp Vine, and formulation of eradication/containment strategies					X	X
Monitoring of populations of Rusa Deer and Wild Pigs, to establish and implement effective control measures	X	X	X	X	X	X
Policy development to strictly regulate domesticated pets, particularly cats and dogs, in the Park		X	X	X	X	X
Community Outreach Plan to raise awareness on invasive species, and production of factsheet/brochures		X	X	X	X	X

CHAPTER 5: CONSERVATION AT ECOSYSTEM AND GENE LEVELS

5.1. Ecosystem Conservation

The Park contains three dominant vegetation associations: primary rainforest (medium-crowned lowland hill forest) covering approximately 80% of the Park; secondary forest dominated by Casuarina (*Gymnostoma papuana*) covering approximately 18% of the Park; and Eucalypt Savannah covering less than 2% of the Park.

The expansion of secondary and primary forests within the Park over the last 50 years has been extraordinary with the Park having largely avoided the negative ecological and social impacts associated with broad scale deforestation, and frequent fire regimes typical in areas adjacent to large metropolitan centres across the country. This has ensured that the Park's ecological integrity has been largely maintained since its official opening in 1973.

Although the long-term success of the Park is encouraging, threatening process, such as poaching, fire and invasive species, posing serious ecological risk to the integrity of the Park must be proactively managed, and community support is essential. Forests elsewhere on the Sogeri Plateau continue to be lost or degraded, and Protected Areas in other parts of PNG that return no discernible benefits to the community have fared poorly. It is particularly important to prevent the establishment of invasive species in the Park as these can significantly alter Park ecosystems.

Environmental monitoring programs on forest succession and botanical are expected to provide the latest information on the current status and dynamics of the ecosystems. Community outreach program would help develop local community attitudes towards conservation of the ecosystems.

5.2. Genetic Resources Conservation

No genetic resources conservation initiatives, including genetic surveys, has been recognized as of February 2019.

Six species of plants are scheduled with conservation significance under the IUCN Red List. One species *Halfordia papuana* is classified as “Critically Endangered”. Another species *Flindersia pimenteliana* is scheduled as “Endangered”. The remaining four species, *Cycas campestris*, *Hopea forbesii*, *Myristica globosa*, and *Helicia albiflora*, are scheduled as “Near Threatened”.

One species of vertebrates, the Giant Bandicoot (*Peroryctes bradibenti*) is scheduled as “Endangered”. Three species are scheduled as “Near Threatened” status under IUCN, namely the Forest Bittern (*Zonerodius heliosylus*), Gurney’s Eagle (*Aquila gurneyi*) and the New Guinea Quoll (*Dasyurus albopunctatus*).

Habitat loss through clearing, burning of savannah grasslands and logging are primary threats to *Cycas campestris* and *Hopea forbesii*. Habitat loss is also a major threats to all fauna species of conservation significance, and hunting pressure is another threat to Giant Bandicoot and New Guinea Quoll.

Environmental monitoring programs on forest succession, botanical, Giant Bandicoot and other fauna will be used to monitor their status and dynamics.

CHAPTER 6: ENVIRONMENTAL MONITORING

Camera trap monitoring has been conducted since September 2015, which provided very valuable information not only for biodiversity but also park utilization. This monitoring program is expected to continue as one of the key research/management activities of the Park.

In addition to that, some environmental monitoring programs have been developed to target existing knowledge gaps concerning the natural history and ecology of the Park. The identified knowledge gaps include: a lack of long-term meteorological data; an absence of long-term water quality data; a lack of biological data pertaining to ecological processes and key species; and a rudimentary understanding of Park patronage.

6.1. Camera Trap Monitoring

6.1.1. Review of the Camera Trap Survey at the Revival Stage

The survey for biodiversity monitoring has been implemented for more than 40 months and still ongoing. A total of 25 species of animals have been captured so far, including species of 11 mammals, 8 birds, 2 reptiles and 1 amphibian. Among them, 5 introduced species and 20 endemic species were recorded. Our former local expert, Mr. Biatus Bito, summarized some sets of data for Yellow-legged Brushturkey (*Talegalla fuscirostris*) to analyze their behavior, and his research was presented at the Biodiversity Seminar from 16th to 19th October 2018 in Port Moresby. The other successful outputs from the survey include confirmation of presence of Giant Bandicoot (*Peroryctes broadbenti*), an ‘Endangered’ species under the IUCN Red List criteria.

The survey for park utilization monitoring has been implemented to count the number of vehicles since 18 November 2016. Within 3 months from November 2016 to January 2017, 631 vehicles were recorded, among which 57% were in weekends and 43% were in weekdays. The number of Group A

vehicles (sedan, 4WD, pickup truck, and station wagon) occupied 88%.

Park utilization monitoring survey has another objective, which is to monitor the unexpected people entering the Park since 6 September 2016. The cameras were installed at the bush tracks along the VNP boundary, which are considered to be used by the local landowners for traditional hunting purposes. Within a month from 6 September to 4 October 2016, 2 males were observed utilizing the track between Main lookout and Picnic site 4, and 4 males and 2 females were recorded using the track near the Toll gate to go into/out of the Park.

6.1.2. Current Status of the Sensor Cameras

Following the “Draft Proposal of the Camera Trap Survey at the Progress Stage” (29/Mar/2018), five new cameras were procured in September 2018 in Japan and brought into PNG in October. The five cameras include; two Type A cameras (BMC SG565F-14mHD) to replace those at 1A and 5A, and three Type C cameras (HykeCam SP2) to monitor park utilization at the main entrance (toll gate), junction at the Main Picnic Area and behind the Lodge area.

Additional two Type C cameras (HykeCam SP2) were procured in December 2018 in Japan and brought into PNG in January 2019. These cameras await to be installed to replace seemingly faulty cameras in the Park at the earliest opportunity.

History of all cameras are summarized in Table X. Nine cameras are in operation mainly for biodiversity monitoring (green colored cells), and four cameras mainly for park utilization monitoring (orange colored cells). The numbers of working cameras in the field are 13 (5 Type A, 5 Type B, and 3 Type C). Seven cameras have become out of order (4 Type A and 3 Type B cameras) and two stolen (1 each for Type A and B). One Type B camera is damaged (sensor cover is broken) but still able to work, being kept in the office (white colored cell).

Table 6.1. History of the Sensor Cameras for Camera Trap Survey

Camera No.	22/Sep/2015	10/Nov/2017	07/Feb/2019 (40 months period)	
	Initial Location	Then Location	Current Location	Status
1A	Scarp track	Circuit track	Circuit track	Replaced with a new camera
2A	Scarp track	Scarp track	Scarp track	Ok
3A	Main lookout track	-	-	Out of order
4A	Main lookout track	Self-guide track	Self-guide track	Ok
5A	Main lookout track	Gare’s lookout track	Junction at Gare’s lookout track and Circuit track	Replaced with a new camera
6A	Circuit track	-	-	Out of order
7A	Tree house track	-	-	Stolen in late 2015
8A	Lakeside	-	-	Out of order
9A	Ranger house	Tree house track	Tree house track	Ok
10A	Boundary track	-	-	Out of order
1B	Scarp track	Scarp track	Scarp track	Ok

2B	Scarp track	Main lookout (entrance)	-	Stolen in May/June 2017
3B	Main lookout track	Self-guide track	Self-guide track	Ok
4B	Main lookout track	Main entrance	Main lookout (parking)	Faulty, needs to be replaced with new one
5B	Main lookout track	Self-guide track	Self-guide track	Ok
6B	Circuit track	Main lookout (parking)	-	Out of order
7B	Tree house track	-	-	Out of order
8B	Lakeside	Main entrance	-	Kept in the office
9B	Ranger house	-	-	Out of order
10B	Boundary track	Boundary track	Boundary track	Need to be relocated
8C	-	-	Main entrance	Replacing 4B camera with a new camera
11C	-	-	Junction at Main picnic area	Newly installed
12C	-	-	Behind Lodge area	Newly installed
C				Newly procured
C				Newly procured

*Color patterns: (Green) Biodiversity Monitoring, (Orange) Park Utilization Monitoring, (Grey) Out of order/stolen, (White) Good condition and kept in the office

6.1.3. Camera Trap Monitoring Plan for the Progress Stage

(A) Installation Plan

Objectives of the camera trap survey included biodiversity monitoring and park utilization monitoring at the Revival Stage. It is worth expanding the objectives at the Progress Stage to involve and support stakeholders' voluntary-based activities for VNP management.

(1) Biodiversity monitoring (10 cameras)

The survey has provided invaluable data on biodiversity in VNP, by recording not only endangered species (e.g. Giant Bandicoot) but also flagship species (e.g. Yellow-legged Brushturkey), invasive species (e.g. Rusa Deer, Wild Pig) and other popular species among others. This practice should continue to collect data on species in the Park, their sighting frequencies, locations and other information. Considering the importance of long-term monitoring of wildlife, cameras should stay at the same locations unless there is a strong and reasonable justification for relocation. Setting angle of the cameras can be adjusted to record wildlife properly. Locations of cameras are suggested to cover strategic areas for monitoring purposes.

(2) Park utilization monitoring (5 cameras)

The survey was effective in counting the number of vehicles entering the Park and the type of cars. Such information is required to evaluate the current status and to plan ahead for the appropriate financial management of the Park. It also proved that unexpected people seemed to use the Park regularly, which may pose threats to the park visitors. Driving patterns of vehicles also needs to be

monitored to effectively manage their behaviour. Security concerns need to be addressed and information from such camera traps is valuable in elaborating the countermeasures.

(3) Involvement and support for stakeholders’ voluntary-based activities for VNP (5 cameras)

There are wide varieties of stakeholders who are interested in and willing to participate in VNP management, such as NGOs, universities, local groups, youth groups, etc. Collaboration with such stakeholders is important for effective park management, and introduction of rental service of the sensor cameras are expected to encourage them to contribute to the management with their unique interest. That would be also advantageous for VNP by attaining wider perspectives and support in the management.

Considering the above, installation of 15 cameras is planned, 10 for biodiversity monitoring and 5 for park utilization monitoring. 5 for stakeholders’ use depends on their ideas and proposals, and further discussion is necessary how to manage such rental sensor cameras. A plan of camera installation is summarized in Table 7.2, and an installation map is shown in Figure 6.1.

In order to effectively manage the camera trap survey, some spare SD cards need to be prepared at all times to replace faulty cards without delay.

Table6.2. Plan of camera installation

Camera No.	Characteristics / Justification	
Biodiversity	1A	Good history of monitoring, for biodiversity and trail users both
	2A	Good history of monitoring, for biodiversity and trail users both
	4A	Good history of monitoring, for biodiversity and trail users both
	5A	Good history of monitoring, for biodiversity and trail users both, slightly relocated
	9A	Good history of monitoring for biodiversity
	1B	Good history of monitoring, particularly to monitor Brushturkey’s nest
	3B	Good history of monitoring, for biodiversity and trail users both
	5B	Good history of monitoring, particularly to monitor Brushturkey’s nest
	10B	Good history of monitoring, for biodiversity
	*	Proposed to install at ☆, as this side of the Circuit track has no cameras now.
Park Utilization	4B	Good history of monitoring, particularly for users of parking area at Main lookout
	8C	Good history of monitoring, particularly to monitor vehicles in/out of the Park
	11C	Newly installed to monitor vehicles to/from Main lookout road
	12C	Newly installed to monitor unexpected users of the Park behind the lodge area
	*	Proposed to install at X, Y and Z, considering suspected entry points of unexpected users. Experimental installation at these points will help determine the location.

* Cameras are yet to be installed and some locations are proposed to achieve respective objectives.

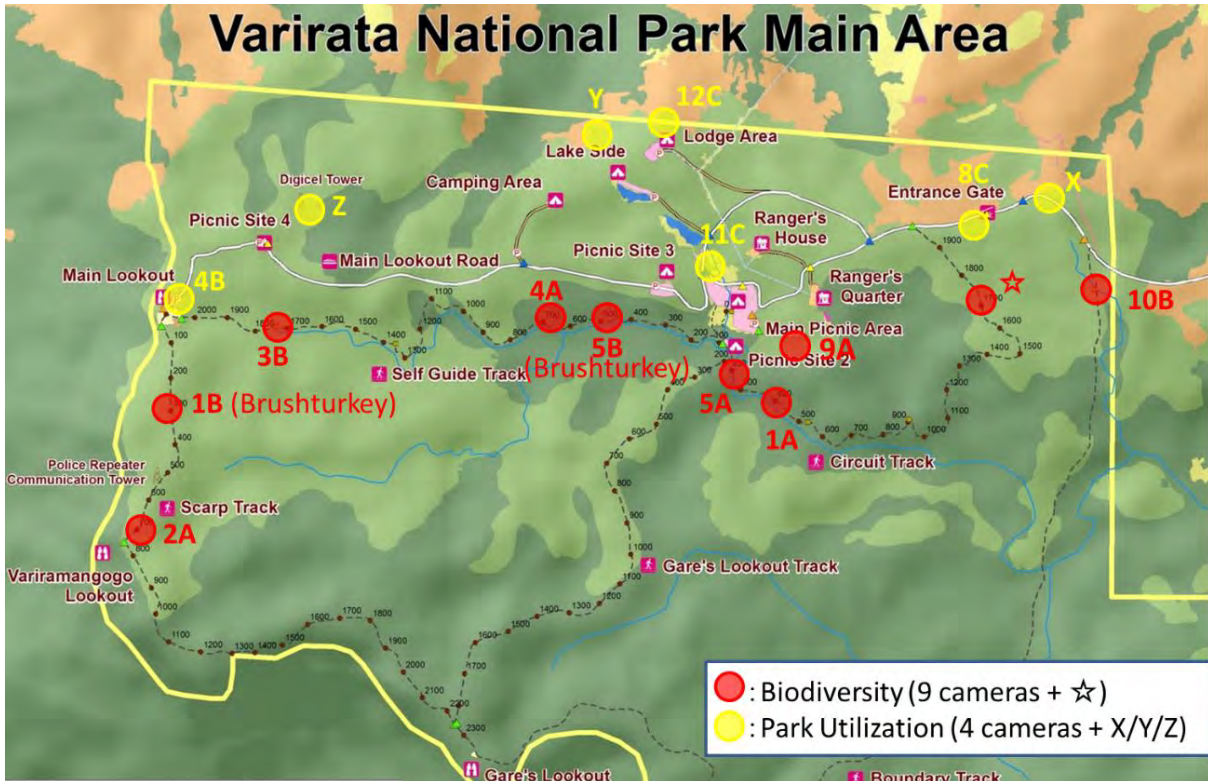


Figure 6.1. Installation Map of Camera Traps with Proposed Locations

(B) Procurement Plan

Implementing the rental service of five cameras requires good and practical management system, human resources, and a guideline for the service. These would secure effective and efficient provision of rental service. In other words, these practical management system, human resources and a guideline should be developed first before preparing the five cameras. Support and close monitoring of such development should be pursued, and procurement of such cameras would be considered before the end of the Project in June 2020.

(C) Capacity Development Plan

In order to secure sustainability of the camera trap monitoring, capacity development of CEPA officers is required to conduct the monitoring independently, effectively and efficiently. This capacity development includes deployment of the officers for the monitoring, On-the-Job-Training (OJT) for the deployed officers with the local experts of the Project for field data collection, data analysis and reporting. The monitoring has been done on a monthly basis, and similar frequency would be appropriate as an interval. At least two officers are needed for efficient activities in the field, and at least a year is required for OJT.

Considering all of the above, required actions and its timings are summarized in Table 6.3.

Table 6.3. Action Plan for the Camera Trap Monitoring

Action	2019				2020	
	Q1	Q2	Q3	Q4	Q1	Q2
Installation of sensor cameras	X					
Procurement of sensor cameras for rental service				X?	X?	X?
Deployment of officers for the monitoring training	X	X				
OJT for field data collection		X	X	X	X	X
OJT for data analysis & reporting			X	X	X	X

6.2. Other Proposed Environmental Monitoring Programs

Additional four environmental monitoring programs are proposed. Technical merit for each monitoring program have been developed based on professional environmental management experience, local knowledge and a detailed understanding of the Park's current ecological condition. Resource limitations have been taken into account, and low-cost-high-value solutions have been proposed without compromising the overarching objective to advance conservation priorities in the Park. A brief explanation and justification is summarized in Table 6.4.

Table 6.4. Proposed Environmental Monitoring Programs

Monitoring Program	Justification
Meteorological Data Monitoring Program	Appraisal of long term meteorological data is essential to determine if cyclical variation recorded from biological monitoring programs is natural or potentially climate change induced. This assessment cannot be undertaken without long term meteorological data.
Water Quality Monitoring Program	Physicochemical water quality (dissolved oxygen, conductivity, temperature, pH, turbidity) are critical drivers of ecological condition in aquatic ecosystems. Seasonal differences in water quality within the Park are clear, however a monitoring program is necessary to quantify changes in water quality over time. This program will dovetail with the Meteorological Monitoring Program and the Amphibian Monitoring Program.
Amphibian Monitoring Program	Utilizing frogs as bio-indicators of environmental condition will serve several key objectives. These include providing an early warning alert to possible disease outbreaks (such as chytrid disease not currently present in PNG); correlate changes in frog populations to water quality and long term meteorological data; enable an examination of frog tolerances to changes in water quality and further enhance knowledge of frog assemblages in the Park.
Park Patronage Monitoring Program	Little effort will be required to obtain demographic data (nationality, age (child or adult), origin, and reasons for visiting) from Park visitors. This will enable strategies to be implemented that cater to visitor needs and enhance visitor experiences in the Park.

CHAPTER 7: OTHER SUPPORTING INITIATIVES, RESEARCHES AND STUDIES

7.1. Other Supporting Initiatives

7.1.1. Initiative for Biological Control of Clidemia, in cooperation with NAQIA

Clidemia (*Micronia crenata*) is an aggressive invasive species and is already well established in the Park. The same Clidemia was a big problem in Fiji, but was eradicated through the eradication program with introduction of the biological control agent, with support of South Pacific Commission (SPC) and Fiji Ministry of Agriculture in the 1970's. The agent was an insect in the group of Thrips, *Liothrips urichi*. These insects eat the tender growing parts of the plant including the leaves, which then suppresses the growth of the plant leading to its death.

Mr. Warea Orapa, Acting General Manager of National Agriculture Quarantine Inspection Authority (NAQIA), used to work for SPC and was one of the lead persons working with other experts to successfully eradicate Clidemia in Fiji. Discussion was held with Mr. Orapa and Ms. Marilyn Apa, PNG Regional Plant Protection Officer at NAQIA, to identify below;

- NAQIA recommended that a host-specific biological control agent, *Liothrips urichi*, is the best option to effectively control Clidemia at the Park.
- NAQIA confirmed to assist with the Impact Risk Assessment (IRA) of the biological control agent and the preparation of the specific project planning. The IRA shall be prepared prior to bringing the bio-agent from Fiji into PNG. The relatives of Clidemia in PNG should also be determined. The assessment and documentation should take at least 6 months. Then the import permit to bring the bio-agent for culturing in the controlled environment (laboratory) at Kilakila in Port Moresby will be arranged. The cost estimates for the eradication of Clidemia at the Park for the first 3 years would be about PGK500, 000, from the experience of Mr. Orapa. These costs will cover wide range of activities, such as specific site selection in the Park for eradication prior to introduction of the bio-agent, baseline study of spread of the Clidemia on nearby areas and PNG, first generation rearing and trial at laboratory, introduction of bio-agent at selected sites in the Park, bi-annual monitoring over the 3 years period to determine the effectiveness of the bio-agent.
- NAQIA confirmed to support with setting up a temporary biological control agent culture facility at the Park to closely and effectively achieve the goal.
- If CEPA agrees to facilitate this process, a biological study on the specific host species is required including its relevant species within the Park and its surrounding areas.
- Monitoring can be done bi-annually either by CEPA or UNPG research students who wish to undertake this study further.
- This initiative will be implemented together with the Fiji Ministry of Agriculture, NAQIA, CEPA and PNG National Agriculture Research Institute (NARI).

On the other hand, scientific review of efforts to control Clidemia with phytophagous insects in Hawai'i

revealed that *Liothrips urichi* was effective in preventing the spread of Clidemia into open pastures and cultivated lands, however it did not prove to be effective in shaded areas (Nakahara et al, 1992).

Introduction of biological control agent to eradicate invasive species has many cases that resulted in unexpected irreversible impacts on native species, the agent attacks native species instead of the target invasive species to the edge of extinction for example. PNG has a very rich and unique biodiversity and its invertebrate taxa is not well documented so far. Introduction of bio-agent should be examined with extra care, and its precautionary measures to avoid unexpected impacts on native species must be developed with wide varieties of expertise.

The issue of Clidemia should be addressed swiftly, however it should be avoided to complicate the issue with another introduced species. Further discussion among the stakeholders is required.

7.1.2. CEPA and UNDP Diversity Conservation and Management Project by PAU

Pacific Adventist University (PAU) is embarking on the partnership as a part of a research project to be implemented in the Park, funding proposal for which has already been submitted to UNDP Global Environment Fund (GEF) 5. The development of the work plan is however currently in progress, and the updated information on biodiversity in the Park has been shared to avoid duplication and to facilitate work planning based on the latest data.

The proposal has four objectives;

(1) Ranger Training:

A ranger training program will be established at PAU and rangers will be trained. A ranger training manual will also be developed by PAU for long term training and education for the local rangers.

(2) Establishment of a Permanent Research Quadrat:

A research quadrat covering at least 5 ha of forest will be identified and established within the Park for long-term researches. This quadrat will be used by students for research purposes and also data generated will be shared with CEPA and other interested stakeholders. There will also be collaboration with UPNG.

(3) Culture of Native Plant Species:

A nursery will be constructed at PAU to culture native plant species collected in the Park, in order to maintain their gene pool. These plants can be replanted in the Park or on degraded areas of Sogeri Plateau for restoration purposes.

(4) Ethnobotanical Documentation:

The traditional usage of some plants in the Park will be documented through interviews to local communities, with identifying those plants in local, English and scientific names.

Other than the above, with knowledge of updated information from CEPA-JICA Biodiversity Project, PAU extends their interest in a baseline study of invasive plant species, establishment of a meteorological station at the Park, and further collaboration with other stakeholders such as

academics, scientists, CEPA, National Forest Authority (NFA), UPNG, TPA and JICA. Discussions and consultations will be continued to develop work plans.

7.1.3. Ideas of Initiatives to Promote Effective Park Management

In addition to the species management and environmental monitoring programs, the following key initiatives are considered necessary to promote effective management of the Park and achieve better conservation outcomes.

(1) Human Resource Development:

Full time national park rangers in the Park is necessary to effectively and efficiently manage the Park. Identification, employment and appropriate training for suitable candidate is required, as well as a planning of human resource development for the Park.

(2) Community Outreach Program

An integrated community outreach program should be developed as a strategic document. This document should outline a variety of programs designed to engage, educate and promote the Park to community stakeholders to share the Park's current and future success.

The document should include:

- Education programs for students (primary, secondary and tertiary);
- Citizen science and corporate sponsorship programs;
- General public conservation awareness initiatives (invasive species, unique ecological value of the Park); and
- Neighboring community engagement programs (documentation of oral cultural heritage from elders; development of strategies for fire management, anti-poaching, and eco-tourism development; and awareness raising on invasive species management).

These aspects are key components of an integrated community outreach program, and must take into account the unique cultural landscape of the Park's surrounding communities.

(3) Fire Management Plan

Park authorities are required to develop a fire management plan to articulate proactive management strategies specific for key habitats. Secondary forests are highly sensitive to fire, while Eucalypt Savannah ecosystem has a mechanism using fire to refresh, recruit and disperse many species in its ecosystem.

Specific consideration must be made to protect populations of the regional endemic and endangered Cycad which primarily occurs in Eucalypt Savannah. A proactive approach to fire regimes will require markedly different strategies for management of key habitats in the Park.

It will also require an active community engagement strategy. It is envisioned that the fire management plan would dovetail with community outreach program, the invasive species management plan, and

the environmental monitoring plan.

(4) Code of Practice (Policy Development)

Policy for appropriate park utilization should be developed to provide guidelines to visitor behavior, including regulations on domesticated pets in the Park. The policy should be translated into a plain language and organized as a Code of Practice.

A Code of Practice and associated brochure/signboard are required for distribution to visitors at the Park entrance, picnic areas and on CEPA's website. The purpose of the brochure/signboard is to outline the standard of behavior expected from Park patrons within the Park.

(5) Scientific Research Station

Monomu Lodge and the associated infrastructure should be converted into a dedicated Scientific Research Station to promote national and international research programs. This would provide significant value to conservation biology initiatives in the Park, and would provide an opportunity to generate revenue as a self-funding enterprise if managed effectively as a business model.

7.2. Other Researches and Studies

In spite of the richness of the biodiversity and relatively easy access from the capital city, not much researches and studies have been conducted in the Park. Biodiversity survey in 2017-18 thoroughly and comprehensively searched literature references, which returned 354 references for flora and 542 for fauna.

Specimen data of the vascular flora in the Park is available at the University of PNG Herbarium and the PNG National Herbarium in Lae. In addition, Cedric Carr's collections made from the Sogeri Plateau and surrounding area in 1935-36 are housed in various international herbaria including the Singapore Botanical Garden, the Royal Kew Botanic Gardens, the Natural History Museum in London, the Naturalis Biodiversity Centre in Leiden, the Bishop Museum in Honolulu and other institutions.

Key texts for fauna survey include varieties of field guides for respective taxa as below:

- 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.)

PART III. DEVELOPMENT AND UTILIZATION PLAN

CHAPTER 8: TOWARDS SUSTAINABLE DEVELOPMENT

8.1 Potential for Fostering Economic and Human Development

VNP is located in near Port Moresby and is great potential for tourism destination. Currently, the most lucrative project at VNP is the Bird Watching project in collaboration with PAU, TPA, Koiari LLG and CEPA. Over the years, tour operators have been taking birdwatchers to Varirata National Park and benefiting from it while CEPA and landowners have been missing out on Bird watching project spin offs. More money generating activities are needed for VNP to raise its own revenue in order to sustain itself. It's also important that more eco-tourism or cultural tourism activities are identified and develop tour packages for the visitors and tourists to enjoy the tourism services near VNP.

Gate fee collections at the park are crucial as there are many visitors to the park. Collection and management of the fees and reporting is important to improve management of the park. Fees collected during the weekdays and weekends should be recorded and reported consistently and used for the park maintenance and improvement. Simple book keeping training will be exercised with the park managers through appropriate revenue management process through CEPA and their revenue officers.

Agriculture is the lifeline of the people and seen as the most important source of income and employment for the rural population in the Koiari area. Selling of garden food or fresh produce to the local or main markets in Port Moresby has been a great revenue generating activity for the Koiari people. Many locals make gardens and produce vegetables; banana, pineapples, greens, pawpaw and cassava. The locals travel to Port Moresby main markets to sell their produce to sustain themselves. Local communities around the vicinity of the park has a high potential to market their produce to the main central markets in Port Moresby through well-established networks and partnerships with the business houses and shops in Port Moresby. Capacity development for making high-value-added product also made by processing of agricultural products. This contributes improvement of livelihood especially woman group. Since population in Koiari and Port Moresby has increasing, it is also a critical issue to improve agricultural production.

Poultry development will also impact the local economy and improve livelihood of Koiari area. The Ilimo farm which will produce poultry products (eggs and meat) is going to impact all the Central Province people. Based on the out-grower model, the main production facility will be located at 14 Mile whilst the out-grower units will be located in the four district towns; Kupiano (Abau), Kwikila (Rigo), Bereina (Kairuku) and Tapini (Goilala). The DAL at PHQ and the districts will assist the Central Province Business Development Co-operation (CPDC) in carrying out extension support in improved technical services to the farmers in all the districts. The Ilimo farm has been projected to generate internal revenue of between K200-400 million each year and is aimed at involving all the Central Province people. Feed grain products will also be grown by the people and sold back to the Feed Mill at 14 Mile.

Enhancement of all the above activities have the potential to succeed with proper capacity building training for the locals utilising the appropriate stakeholders and techniques in achieving a sustainable development. CEPA-JICA project is assisting the local Koiari communities to establish a formal community-based group or initiative (Kae Association Inc) who can play the roles of the taking the lead in implementing all the above income generating activities to support livelihood of the local communities from Koiari.

CHAPTER 9: COMMUNITY AFFAIRS AND LIVELIHOOD DEVELOPMENT

9.1 Agriculture

Subsistence agriculture for those in ward 4 particularly hamlets of Gagibevai takes place on the banks of the Laloki River. The flat river bed areas are often used for making gardens. The areas are dry so the water from the Laloki River is used to water crops grown. This is mostly done manually using watering jerry cans. Income generation continues to be a problem in the area, and sale of vegetables and road side market is the only option for the villagers. The alluvial flat river beds do have agriculture potential but there is lack of skills in agriculture so that such can be done at a commercial level for income generation.

Subsistence agriculture for those in ward 5 takes place on the banks of the Laloki River and on the North side of the river near creeks and streams. There is not much threats in land use in the area, as there is ample land for families to utilize for agriculture. Selling of fresh produce during the weekend is the main source of income generation for the villagers. There is also sale of trade store goods at the road site markets that provides income for the households. The availability of fresh water supply to the village is a major need especially for drinking and cooking.

The Census units of ward 5 are located within the 3km buffer area, and do not pose any threat to the Varirata National Park. There is no encroaching on the park areas for hunting, gardening and collecting of bush materials for building houses. The villagers within the ward have enough resources elsewhere within their environments that they continue to utilize. Income generation is a priority for the villagers, but it also needs to be addressed with other issues of availability of water supply, and a foot bridge across the Laloki River so that villagers have access to the eastern side of the river whereby the villagers regularly make gardens.

Currently in both wards the resources that the community utilizes for its subsistence is located away from the Varirata National Park. Ward 4 does use the area within the 3km buffer area for hunting and gathering. Those on the access road to Varirata do use the 3km buffer area for their gardening and resource utilization. These are potential risk areas that need to be managed so they do not extend their area of resource utilization into the 1km buffer. This could pose a potential threat to the protection of the Varirata National Park.

The Laloki River, nearby creeks and streams that flow into the Laloki River provides a resource base for the local communities to utilize. This areas and sites are located away from the Varirata National Park 3km buffer. As part of the process towards improvement of agriculture potential in the area, focus must be on use of legumes for rotational cropping patterns. This will ensure that people will continue to use the same area of land, but the use of legumes will enhance better soil fertility and the increase in yields of crops. This will have to be developed as part of the sustainable livelihood program for the villages.

There are several livelihood and income generations options that are either directly related to Varirata National Park, or those that the locals themselves could get engaged in. Those that the local people themselves can do are as follows:

(1) Sale of Fresh produce into Port Moresby

The environmental conditions at Sogeri within the villages of wards 4 and 5 are conducive to the production of fresh produce such as cabbages, tomatoes, pawpaw, water melons, capsicum, and sweet banana. There needs to be a proper supply chain developed within established markets in Port Moresby either at the Supermarkets or through the hotels in the city. The construction phase for the

second LNG project (oil and gas project) is also due to commence, and such is a potential market source for fresh produce from the area. This can be independently developed from the activities related to the Varirata National Park, but in the long run can also provide fresh produce and vegetables to the lodge at the park or provide a potential market for fruits to those that do day trips to the park.

(2) Floriculture

This has potential and needs to be developed, as locals themselves can do. There are possibilities of linking this to sites at the park, whereby only flowers can be grown and later sold to markets in Port Moresby. Currently those doing flower arrangements in the city are going up to Kalakadabu to buy flowers of which they later arrange and sell in the city. This can be direct cash benefit stream for the local people.

(3) Production of local stock feed

This has potential in the area, but training needs to be provided to the locals so that they can go into production of local stock feed that can be used for feeding chickens and fish. The number of fish farmers at Sirinumu Dam has increased so as the demand for fish feed. There are number sources of raw materials that can be used to produce this using hand-held machines such as grinder for milling cassava, and mincer for actual production of the stock feed. Local ingredients from the area such as cassava, beans, pawpaw and fish meal can be used to produce such. There are several poultry farmers in the area, who continue to come to Port Moresby for their stock feed. Production and selling of this stock feed at the local level can assist reduce the cost of stock feed.

Koiari LLG also plans to implement the following support for sustainable development of agriculture section in Koiari area.

Table 9.1. Support for sustainable development of agriculture section in Koiari areas.

Agriculture Priority Project Proposals	Performance Indicator
1. Upgrade and construct stalls for various markets	Sogeri market Seats, stalls improved, Rabidudu, Kona area, Kinakon & Sirinumu Dam Markets
2. Multi-purpose tractor with implements for Koiari LLG	Farmers assisted to improve soil cultivation
3. Establish 10 Cooperative Societies. 3 Vegetables, 3 Rice, 2 Vanilla and 2 Coffee	3 for Sogeri lowlands 4 for Sogeri valley 2 for Sirinumu area 1 for Suria warde area
4. Enhancement of small livestock/Poultry developments	For various SME Poultry and others
5. Market research for high added value	Producing something that is saleable/selling well.
6. Enhancement of Sustainable livelihood Agriculture development	Sustainable livelihood development, Food security, Cash crop, Livestock

7. Capacity Building, Educational Awareness, Training,	Train Schools, Local farmers and management up skill trainings,
8. Set up food storage depot	Facility for local food storages

Source: Koiari LLG 5 Year Development Plan 2017-2021

9.2. Cultural and Customary Practices

While the history of settlement of Port Moresby as the capital of Papua New Guinea (PNG) started in the 1950s, the Koiari people whose ancestors were fierce warriors occupied the Sogeri plateau around the head waters of the Laloki River, Hunter and Musgrave Rivers. Some lived in the spurs of Astrolabe Range and on the hilly hinterland behind the motuan villages of Tubuserea and Barakau while others behind along the Laloki River. These people were referred to as the Grassland Koiari's or the Grasslanders which is one of the native classification term as 'isu-bia'. Some are forest men or 'idutubia' distinct from 'mavota' or mountain men.

The Koiari's are believed to have a mixed reputation but mostly feared by the coastal motuans due to their very strong sense of sorcery practices. They usually lived in small families of not more than eight individuals and perched on ridge tops. Each village had a tree house as a form of protection against surprise enemy raids. They were organized in groups not more than a clan, linked to locally originate from mountains or hills. Different groups of people could come together to live in one larger village and thus, their social organization is difficult to relate to as 'clans'.

The language known as 'Koiarian' is central to this large non-Austronesia grouping. The Koiarian language family consists of six Non-Austronesia languages— Koita, Koiari, Mountain Koiari, Barai, Managalasi and Aomie, whose speakers number over 15,000. It stretches across Papua from the coast around Port Moresby almost to the sea on the north coast at the eastern end of the Hydrographers' Ranges. It is surrounded by other distantly related families of the Goilalan in the west, Binanderean in the north, Yareban, Manubaran, and Kwalean to the east. Over 50-60% of the Papuan Coastline villages speak the Koiarian language. Further studies shows that the Koiarian Language Family consists of two sub-families: (a) Koiaric (Koita, Koiari, Mountain Koiari); and (b) Baraic (Barai, Managalasi and Aomie).

The Koiari language is further subdivided into Western and Eastern. The Eastern speakers refer to those around the eastern end of the Sogeri plateau which consists of over 600 speakers and the Western dialect is the largest of the two which more than 1,100 speakers inhabiting the central and western part of the Sogeri Plateau around the Sirinumu dam and along the main courses of the Laloki River, on the lowlands (grasslands) along the middle ridges of the Laloki and on the coastal plains between the Astrolabe range and the south coast (T.E. Dutton, 1969).

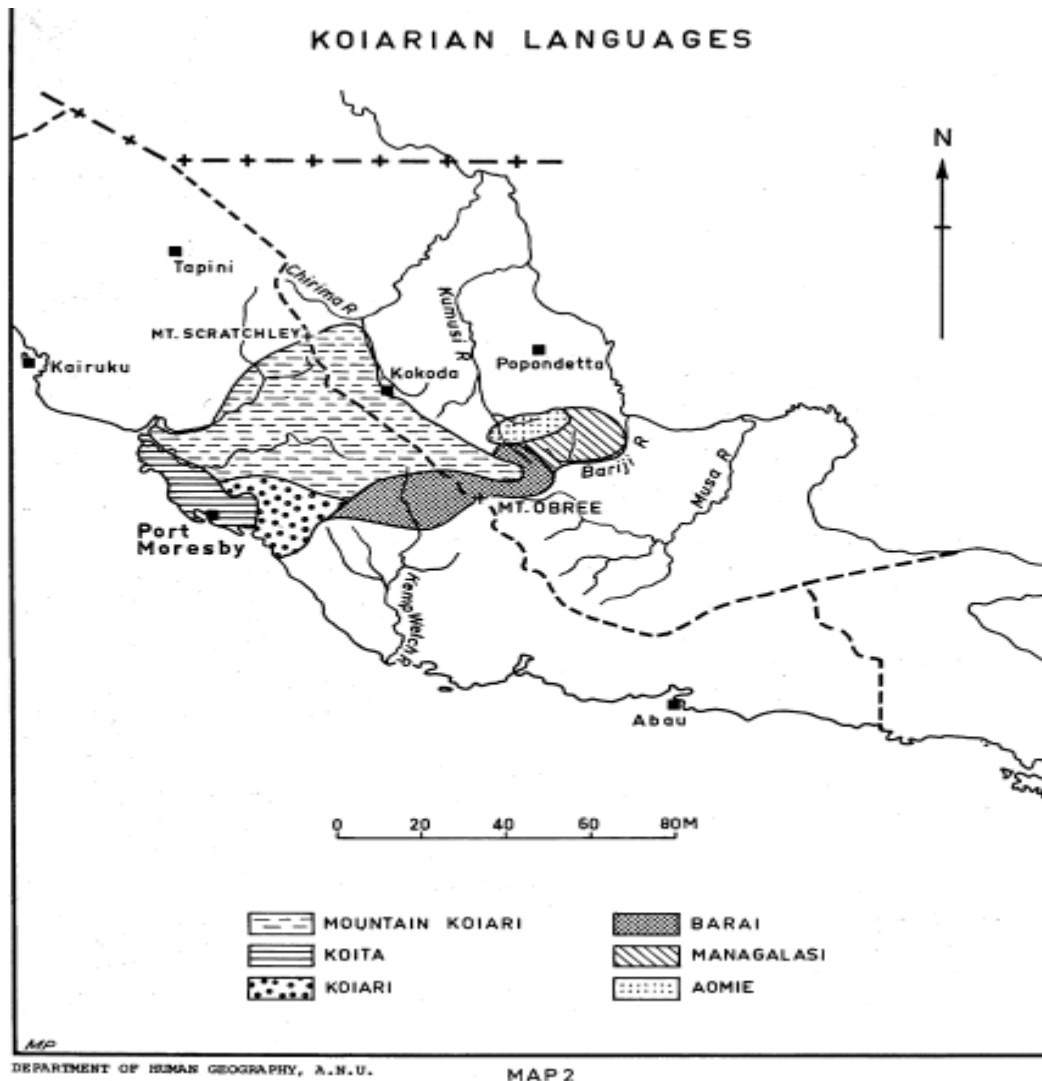


Figure 9.1: Source; Thomas Edward Dutton, February 1969

The centre of traditional identify here is the kinship and belonging to one place just like every other societies in PNG. One being existence with the forces of the nature was seen as a superior to rule and claimed to be passed down from generations to generations. This sense of belonging to a place, culture and family was part of the custom and obligation to a family. Thus, maintenance of such behaviours was well respected and honoured. The practice of sorcery has been a hindrance to further development of and progress of one's success in villages within and around the Koiari speakers as claimed by many people. Due to their sorcery practices and isolation, motuans settled away from the Koiari people and this is how the Koiari's took advantage over most of their land around Port Moresby.

There are several archaeological sites in the area of the Varirata National Park. The sites below have been documented by F.E.Williams (1926) and are also registered as archaeological monuments with the National Museum and Art Gallery. In the broader Sogeru area there are 17 sites that have been recorded. Within the Varirata National Park and the buffer zone, there are 6 sites documented by F.E Williams (1926).

The National Museum and Art Gallery has further done some work in the area and have given site codes and Grid references to these locations. These are as follows:

Table 9.2: Site codes and grid references to archaeological sites.

Site code	Name	Description	Grid reference
ADW ALA	Oma Yaniwa (Rouna Falls).	Paintings on rock boulder shelter, half a mile from old Rouna Hotel.	EK404583
ADX	Rouna (Rouna Falls)	Rock shelter with paintings located three quarter of a mile below Rouna falls, about half a mile from the river at the foot of a huge conglomerate. Reference: Pretty G. 1966:7	
ALK AED	Ramadordo Hombrom Bluff Sogeri	Engravings and paintings located straight below the Hombrom Bluff, overlooking Vesirogo creek, about one hours walk from Hombrum bluff look out. References: White and White 1964, White 1967b Vol II-i-ii Pretty G. 1966:10	EK471552
AEE	Manurinumu	Engravings and paintings, a rock shelter located half way between Rouna and Manurinumu village, Upper rapids B. Reference: Pretty. 1966:11 Leask 1943:120	EK442584
AEF	Manurinumu	Engravings and paintings, a rock shelter located half way between Rouna and Manurinumu village, Upper rapids A. Reference: Pretty. 1966:11 Leask 1943:120	EK442584
AEI	WurevaYani Manurinumu village Rouna	Engravings, painting and pottery on high scarp on right bank of Laloki half a mile below Rouna falls, approach from deserted Manurinumu village site. Reference: Pretty.G.1966:15	EK358604

The above listed archaeological sites are part of the cultural resources that continue to remain in the area within the 3km buffer of the Varirata National Park. There are burial sites and the rock painting that need to be documented well and incorporated into a tourism product so that villagers also benefit from this cultural resource that exist in the area are in accordance with the draft Protected areas bill which states the following under section 9 – Traditional sacred sites, ples masalai, Tambu areas

“Subject to parts III and IV of the National Cultural Property (Protection) Act

- (1) Land that custom designates as traditional sacred site, ples masalai or traditional tambu area in a protected area or otherwise, is protected by this act, whether it is registered as a protected area under this act.

-
- (2) The boundaries and designation of such land may be determined by a customary owner or a village court magistrate
 - (3) The regulations may provide for the notification of the sacred sites to the public “

Although these cultural and customary practice should be preserved, traditional culture has been declined because of proximity of Port Moresby. Hence, any traditional culture activities such as dancing and cooking should be linked to ecotourism and cultural tourism for providing learning opportunity of spiritual and cultural values and customary practices for strengthen community’s solidarity and inheriting tradition. Cultural performances (sing sing) and traditional cooking is still practiced today for visitors and during special occasions. Identification by clan land boundaries and incorporated land groups is important for the identification of the local people. Mapping of the land boundaries will help to find out how much of the land is owned by which clan or group of people. This will help to zone their areas to develop resource use management plans.

9.3. Other Activities

There are other activities that also positively or negatively contribute to the sustainable development of the area and these are such as;

- (1) Overhunting of key wildlife species as food sources in the area causes pressure to the natural habitats around and within the Varirata National Park.
- (2) The management of the Laloki River Catchment is critically important in the management of the Varirata National Park beyond the value of the Biosphere Nature Reserve is concerned. The management of the Laloki River is critical in building the conservation constituency due to the emerging pressures of the broader Sogeri plateau.
- (3) It is critical to preserve water supply and the regulations and provisioning services vital for the National Capital District and also to sustain livelihoods of the local land owners.
- (4) Fisheries is not encouraged and promoted in the Koiari Local Level Government area, however subsistence farming of; Tilapia, Supa Talapia, Barramundi, Trouts, Common Carp and Saratoga is done on a small scale, where people catch fish for human consumption and sell the surplus at the local markets for cash to meet their essential needs. Unlike coastal communities, Koiaris are inland people and relied on inland fish resources for protein supplement and in other situations as food security. Aquaculture for inland/hinter land communities must be looked into as there is interest shown by families and individuals to go into inland fish farming.

The Koiari LLG area has easy access to established fish processing, storage facilities and market availability in Port Moresby. Also, due to increase in settlements by outsiders along major rivers from Goldie and Laloki, fish species are depleting, there needs to be regulations to monitor and safeguard local inhabitants. The people’s desire for cash income is highly recognized and should be given priority to assist in this industry.

Currently, there are at least few areas that have been involved in inland fish farming in the Koiari area. Most recently and recognized fish project at the Sirinumu Dam is owned by Mr. John Oga. There are also other fish farms established in Mount Koiari area. National Fisheries Authority (NFA) has assisted

these projects, a total of 10 - 15 farmers have been trained but yet to start their projects due to funding constraints. Generally, the level of interest and potential for fish farming is high.

Currently, the main concerns existing are; lack of awareness by fisheries officers in promoting the program, lack of training, lack of financial capitals, poor road and market infrastructures and lack of scientific knowledge (ecology, biology, farming techniques, handling, feeding), market viability and storage facilities.

These issues can be addressed through establishing contacts with relevant stakeholders to provide assistance where necessary to build their capacity. Awareness and education in terms of training and establishing cooperative societies and identifying markets for their produce would help them most.

9.4. Summary of Economic Activities

Most promising economic activity around VNP would be a tourism sector. Several picnic and swimming spots have been used and normally charge K50 per vehicle to use their facilities that are on the banks of the Laloki River. The locals around the Varirata National Park and its surroundings now have the opportunity directly benefit from the utilisation of the parks through eco-tourism and cultural tourism activities. The local community through Kae Association Inc. can now benefit from performing activities such as; men and women performing traditional dances, women and girls provide cooking, selling of bilums, arts or crafts and men and boys can sell arts and crafts which can directly or indirectly link to other income generating opportunities. Monitoring and evaluation plan of these revenue generating activities will show the success of these activities around the park.

Sustainable development of agriculture and animal industry is also important around VNP. As the population increases, the demand for food is expected to increase. Sustainable development of food production is vital for proper management of VNP because most local community rely on natural resources around VNP.

9.5. Conflict Management

The accessibility and use of the parks resources is a concern. There is very little disturbance and pressures into harvesting the Varirata National Park's natural resources by the local communities. The local communities continue to use their present resources base within the Laloki river areas for gardening and resource utilization. Despite the small hamlets near the access roads that lead to the park, the local communities have not been harvesting and utilizing much of the parks natural resource. They mostly concentrate and continue to utilize their land outside of the park for gardening. Most of these land areas are within the 3km buffer of the park. Though there is still risk of them moving into the 1km of the park, especially for things such as cutting trees for building houses, bamboo for bamboo blind of houses. There has also been bush burning within the area that needs to be managed. This can easily spread into the park land areas and destroy the habitats of animals in there. These human activities need to be monitored and coupled with effective awareness on the park's resource management to the local communities to minimize invasion of the park's resources.

There have never been any clear community participation and clear benefits from the Varirata National Park to the local resource owners despite the establishment of this park in the 1960s. Communities have never been clearly participating effectively in the management of the park. Communities have formed small community-based organisation and groups are now able to participate in the park management as in cleaning, maintenance of tracks, cooking, dancing and promoting eco-tourism

within the park's vicinity. CEPA is planning to hire local communities for these works. Since they can get benefits from the VNP, this participation would help them to understand important of conservation for VNP.

Lack of collaboration amongst women and men in the community could imply lack of understanding and agreements for developing the park. This could also imply the lack of equal participation for men and women to change the mind-sets of people for the good use of the park's resources. Women within the Koiari society are undermined by their male counter parts and this prevents them from participating in development projects. However, community workshops in gender issues can improve equal participation from both genders. Currently, women are now participating in cooking, dancing, selling or tourism products to the outside markets which help to generate income for the management of their families. Women are now part of the community-based groups such as *Kae Association Inc* who is part of decision making body for the functions of the groups to benefit from the park's activities.

CHAPTER 10: ENVIRONMENTAL EDUCATION AND PUBLIC AWARENESS

10.1. Education Activities

The utilization of the park's information center complex (ICC) and the nature trails will be of great value in terms of the environmental education of the areas and people including its biodiversity's significances.

ICC become the main venue for dissemination of environmental education and awareness. At the ICC and the Park, knowledge and experiences can be exchanged on the ecological value of the area and PNG. Emphasis on protection and conservation of VNP land and forest and the surrounding areas will be promoted. The Park and ICC focus primarily on environmental education showcasing the unique flora and fauna of PNG and VNP to visitors, especially students, tourist and local residents of Port Moresby and PNG. The information shared and disseminated would enhance knowledge of people and learning students to further their studies and education on the park and its surroundings. Awareness brochures, stickers, maps, flyers, posters and reports are published and made available for public use and awareness.

Nature trails in the park provide the function of interest for observation, strolling, sightseeing, tourism, bird watching, research and educational purposes. These trails are mainly used by tourists for strolling or bird watching. Signboards located near the track or on the road sides and Lookouts provide much needed information on birds, rules and regulations, map of the Park and location, name of tracks, name of features such as lodge, ranger's quarter, and main entrance etc. Researchers and students can also use these tracks for regularly monitoring of animals or plants. All nature tracks are well maintained, having distance pickets numbered every 100m inserted onto stumps with signboards indicating each location, except the Boundary Track which does not have distance pickets.

10.2. Public Relations & Visitor Management

There will be more interactions, communications and networking with all forms of media channels such as newspapers, radio programs, awareness material designers and producers, journalists to ensure that information on conservation education is brought to all levels of audiences and partners. Special publications and social events will be managed through consultation with media experts to ensure effective and strong public relations are maintained.

Social media such as Facebook page will be used for public relation to introduce park activities. News and stories will be developed by CEPA staff and posted to the Facebook page. Events information will be printed on the daily newspapers (The National and Post Courier) when required. CEPA staff produces newsletters of the park regularly and disseminated to the public for awareness purpose.

Guidebooks for visitors were already produced, such as bird guide books and guide maps of the park. These materials are displayed in the ICC and distributed to the visitors. Contents of the guidebooks will be updated regularly and will be disseminated for the public.

The ICC covers daily assistance to visitors by providing general information of the park. Information such as nature trail guide maps, species information and nature interpretation in the park is provided in the gallery area of New IC. A guide book and brochure of VNP will also provide general information on the flora and fauna found in the Park. These contain photographs of mainly shown and eye-catching animals. Some other guide books specifically target species such as Birds, Amphibians and Reptiles. Visitors to the Park have access to the books in the ICC.

The ICC is an ideal location for the visitors to rest while visiting the park. Tourists can use benches or chairs placed on the wood decking. A big signboard or totem poles placed in ICC would be a good photo spot for tourists. In addition, old renovated IC can be used for evacuation space for sudden crack of thunder or a rain. New IC can be a place to take refuge during emergency accidents, and other incidents that may occur to visitors in the Park.

The auditorium in the old renovated IC will be used for events space, meetings and trainings hosted by CEPA or private companies. As some companies hold company events such as trail walk in VNP, this ICC will be also used for a gathering spot.

CHAPTER 11: TOURISM

11. 1 Tourism

Koiari land has various historic sites and great potential to venture into Tourism yet remains underdeveloped. CEPA-JICA has partnered with PAU and PNG TPA to support bird watching projects at Varirata and PAU jointly. The bird watching project will attract bird watchers and tourists from all over the world travelling into PNG through Port Moresby. This project is also developing tour packages for different types of tourists visiting the park including PAU for the bird watchers. Other services provided will be bush trekking, cooking, dancing, arts/crafts, theatre performances, security accommodation and hospitality and water rafting. The Park's Management Team will directly work with local community groups, tour operators and organizations such as PNG TPA, to develop tourism activities for visitors visiting the Park.

Four clan living near VNP formed a local community group for providing park management activities and tourism activities. All operations of the groups will be governed by its own by-laws and constitution. Through nominated representatives of this group, these officers will be responsible for all management, business and planning of activities emanating from VNP. Figure X shows the basic structure of the community-based group and its functions. It is responsible for providing temporary and periodic services on request by the Park Management Team and CEPA. It will also be responsible for doing other business activities such as tourism and other spin-off activities for the locals.

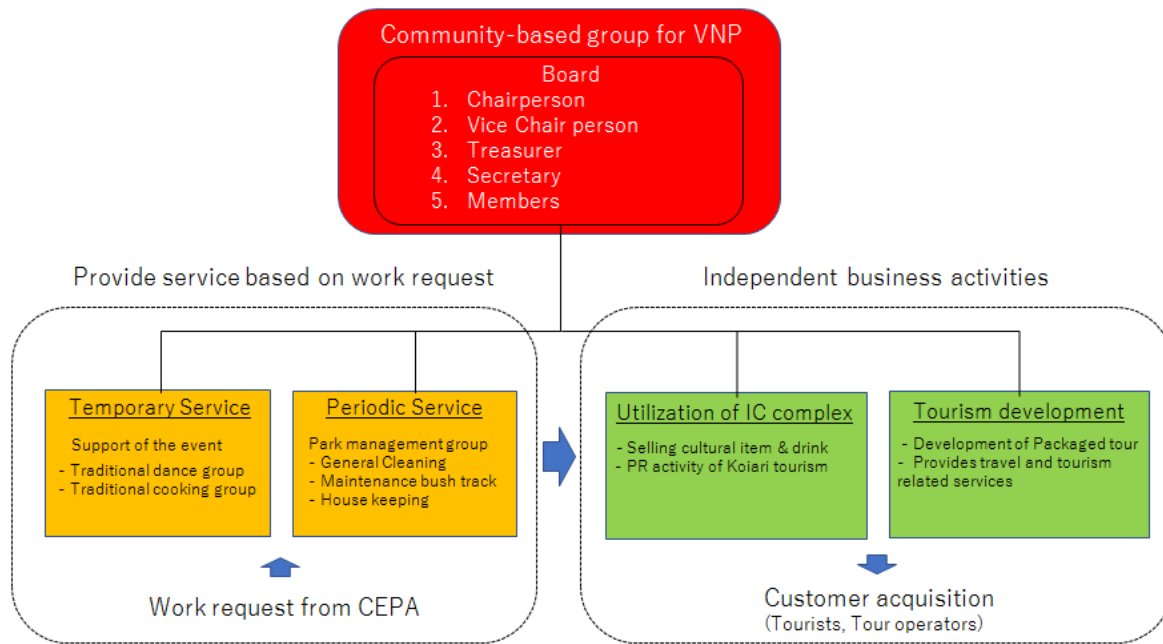


Figure 11.1: Community Based Organisation structures and functions

Since the CEPA-JICA project is working with Koiari LLG and the local communities in the last two and a half years, it has identified several potential tourism resources around Varirata National Park. This provides the opportunity for the Park Management to work closely with local community group to mobilize them to participate in any events or activities to complement bird watching ventures. The participation of local group will be to provide:

- Bird watching for tourists;
- Guide and cultural events or activities to for company’s events such as trail walking;
- Eco-tour and cultural tour including combination of bird watching; and
- Provide security and guide services.

Several tourism activities such as traditional dancing and traditional cooking will be provided at auditorium in the old renovated IC.

11.2. Visitor Management

The park rangers will be placed at the park to manage the visitors to the park. The park ranger stationed at the toll gate will be responsible for collecting gate fees and issuing tickets for the visitors. Vehicles and people entering and exiting the park will be checked and monitored by the rangers. The ranger responsible for the Information Centre Complex will ensure to inform the public about the usefulness and information about the information centre.



Environmental awareness materials will be distributed by the ranger for more information and guidance's on how to use the parks resources while touring the park. There are also signboards where necessary to inform the visitors of their safety, health, and precautions while at the park. These signs and rules are to be respected by all visitors and if bridged, penalties will be applied. These penalties will be enforced by the park rangers on site during the visits. Increasing awareness of the tourists would help to reduce impact of tourists to the park.

The parks coordinator will be overseeing the park at various times of their visitors stay at the park to ensure security and compliances to the parks rules and regulations. When any security issue happens in the park, park coordinator will make an incident report and report to Sogeri police station and CEPA.

Park management staff hired from local community will also contribute to manage park visitors. They will be hired including general cleaning of rubbish and debris from the park, doing grass cutting and mowing, collecting firewood for the barbecue and picnic areas, providing security, doing maintenance of facilities, performing park ranger tasks, doing road maintenance, doing housekeeping work for the lodge, and maintaining or establishing fire breaks.

PART IV. LOGISTIC SUPPORT PLAN

CHAPTER 12: HUMAN RESOURCE AND CAPACITY DEVELOPMENT

This chapter focuses on human resource and capacity development for the Park, forming core components of this Management Plan. The strategy is elaborated below.

12.1 Operational Structure, Human Resource Management and Capacity Development

12.1.1 Rationale and Approaches

Inadequacy of human resources and suitable skills to propel sustainable economic development and management of Protected Areas in PNG is a huge challenge. A Recent METT study and analysis by the CEPA-JICA Biodiversity Project (for VNP) and United Nations Development Program (UNDP)/ South Pacific Regional Environment Program (SPREP) (for all PAs in PNG) confirmed that human resource and capacity issues are major problems for better management of PAs.

Moreover, it is widely acknowledged that learning and skill development is a fundamental process for enhancing the capacities across institutions. Any existing capacity gaps are a hindrance to the effective implementation of any institution including VNP because that may affect delivering expected outputs on the individual roles and responsibilities. Hence, any skill gaps that need to be filled must be captured in the trainings once a training need analysis has been compiled to identify the needs.

Subsequently, this Plan provides policies that would help CEPA and local communities develop capacities and human resources in the management of VNP. Some of the approaches that this plan must address are discussed below.

(1) Recruitment

To enable the Park to function effectively, key management staff will be recruited in strategic positions to provide services in the management and running of the Park. These key management staff will form the core of the Management Team and will be supported by casual staff. Hence, CEPA will look into:

- Developing a full-scale organisational structure to meet the needs and set priorities to fill the vacant positions based on its short-, medium-, and long-term plans; and
- Developing a recruitment plan with appropriate and clear Terms of References (TORs) for respective positions to secure the budget funds that will cater for those positions.

(2) Trainings

Training is an integral part of the management of the Park in terms of capacity development and provision of appropriate skills for staff members and/or contractors to execute their roles and responsibilities. These trainings are important for the effective and efficient management and operation of the Park and can be implemented on short-, medium-, or long-term basis. Thus CEPA must:

- Provide training for CEPA staff and the key management staff for the overall management of the Park. Training include conservation, development and utilization, financial and logistics management, law enforcement (rules and regulations), monitoring and evaluation, Geographic Information Systems (GIS), and others suitable for the overall management of the Park;

- Provide trainings for casual staff, such as securities and tour guides. Some of the training includes customer care, security and safety, rules and regulations, interpretation and education, and basic knowledge of fauna and flora in the Park; and
- Provide training to local LLGs, ILGs or SMEs and community groups for livelihood improvement, tourism and other trainings where appropriate.

(3) Collaboration

It is the role of CEPA and the Management Team to build collaboration with its partners and stakeholders in the management and operation of the Park. Thus CEPA and the Management Team will:

- Work in collaboration with universities (e.g. UPNG and PAU), relevant government agencies (e.g. PNGTPA and KLLG), and other development partners (e.g. UNDP and AusAID) to provide biodiversity conservation and environment trainings to local people and the general public where appropriate;
- Work with local community groups through their ILGs, SMEs and CBOs to manage and maintain the Park; and
- Work with local community groups through their ILGs, SMEs and CBOs to provide services such as security, ranger services, tour guides and eco-tourism activities.

12.1.2. Proposed Organisational Structure

Figure 12.1 is proposed organogram of the Management Organisations of the Park and its operation on behalf of CEPA, which shows the roles and responsibilities of the key personnel and casual staff. A holistic approach is undertaken so that key recruitment can be done to effectively manage the park based on respective TOR. Also local communities are included to assist in the management of the Park.



Figure 12.1: The Organogram or organisation structure of the Park Management Team (structure and respective titles are proposed and subject to change accordingly to future discussions)

The overall management and supervision of staff, finance, activities or operation of the Park will be managed by the Park Manager. The Park manager also works directly with stakeholders, in meetings,

signing of MOUs etc. The Park Manager is answerable to CEPA (Sustainable Environment Program Director).

The Park Manager is directly and closely supported by the Finance Officer, who manages the financial issues of the Park. The Finance Officer also works closely with the Head of Administration

Under the Park Manager, three key strategic positions will be filled. Each personnel will head the Administration, Conservation and Utilisation, and Visitor, Community, ILG, SME, CBO and Public Relations divisions respectively. These Heads will also work collaboratively in areas where there are cross-cutting issues or matters and will report directly to the Park Manager.

The casual staff are people from the surrounding communities affiliated to the LLGs, SMEs or CBOs. They will report directly to their respective managers. Under the leadership of the Head of Administration, he/she is responsible for facility management, fee collection and security. The Head of Conservation and Utilisation will be responsible for conservation and research, and monitoring of activities of the Park. Finally, the Head of visitor, Community, ILG, SME, CBO, and PR is the focal of all Public relations work and is responsible for visitors and community (ILG, SME and CBO) affairs and wellbeing. The casual workers will be employed from the community.

Table 12.1: Roles and Responsibility of key management staff and casual staff in the management and operation of VNP

Designation	Roles and Responsibilities	Qualification	Expected salary range per month (K)
1. Overall Park Management and Supervision			
Park Manager	Overall management of the Park and its operation, including building partnerships with major partners and all stakeholders	Degree in Environmental Science with over 8 years experiences in Park or Protected Area Management	need to refer to the Fee Table of CEPA
Park Coordinator	Management of the Park and its operation, including building partnerships with major partners and all stakeholders	Degree in Environmental Science with over 8 years experiences in Park or Protected Area Management	need to refer to the Fee Table of CEPA
2. Key Management Staff			
2.1 Head of Administration (x 1)	Looks after the Park's facilities, maintenance and repair, fee collection and security to ensure the Park functions effectively. He/she is responsible for all administrative functions of the Park. He/she must work in collaboration with the other two heads.	Diploma in Accounting, Commerce or Business studies with more than 5 years experiences	need to refer to the Fee Table of CEPA
2.2 Finance Officer (x	Responsible for all financial operation of the Park. He/she reports to the Park Manager, works	Diploma in Accounting with	need to refer to the

1)		closely with the Park Manager and the Head of Administration and the other Heads where necessary, prepares financial statement, does financial focus, procurement, and other activities as instructed by the Park Manager.	more than 8 years experiences	Fee Table of CEPA
2.3 Accountant (x 1)		Responsible for daily management of cash, particularly from the gate fees. Accountant reports to the Finance Officer, and works closely with and supervise fee collection staff in the field operation.	Diploma in Accounting with more than 5 years experiences	need to refer to the Fee Table of CEPA
2.4 Head of Conservation and Utilisation (x 1)		Looks after all conservation and research activities plus monitoring of Park's activities including the Management Plan. He/she is also responsible for development of education activities and tourism of the Park. He/she must work in collaboration with the other two Heads.	Degree in Environmental Science (e.g. Forestry, Natural Resource Management) with more than 5 years experiences	need to refer to the Fee Table of CEPA
2.5 Head of Visitor, Community, ILG, SME, CBO, and Public Relations (x 1)		Deals with the publicity of the Park, do public relation work with local communities, SMEs and CBOs. He/she deals with all activities pertaining to eco-tourism and works closely with the other two Heads.	Degree in Community Development and Social Science with more than 5 years experiences	need to refer to the Fee Table of CEPA
3. Casual staff				Expected salary range per day (K)
Conserv Administration	3.1 Facility Maintenance and Repair worker (x 1)	Maintaining, cleaning and doing repairing the ICC, toilets, lodge, trails, do grass cutting and firewood collection for picnic areas. Do other duties as directed by the Head of Administration	Minimum of Grade 10. Experience in working as a handy man in carpentry, electrical, gardening and housekeeping, and mechanical fields is a plus	Need to refer to the Fee Table of CEPA
	3.2 Fee Collection worker (x 2)	Stationed at the toll gate and collect the gate fees, issue receipts and return the cash to the Head of Administration. Do other duties as directed by the Finance Officer and the Head of Administration	Minimum of Grade 10 education with basic knowledge of financial management and of good standing in the community	need to refer to the Fee Table of CEPA
	3.3 Security officer (x 4)	Provide security to visitors to the Park. The security personnel is responsible for manning the gate, do spot and periodic checks manning the facilities in the Park and patrols in the Park. Do other duties as directed by the Head of Administration	Minimum of Grade 10 education with good standing in the community	need to refer to the Fee Table of CEPA
	3.4 Conservation and Research	Responsible to work with any research and conservation personnel, students, researchers, etc., and provides guide to those people. Do other	Minimum of Grade 10 education with	need to refer to the Fee Table of CEPA

	officer (x 1)	duties as directed by the Head of Conservation and Utilisation	good standing in the community. Experience in biodiversity surveys is a bonus	
	3.5 Monitoring officer (x 1)	Work under the Head of Conservation and Utilisation to monitor all activities of the Park, including, research, education, conservation efforts like invasive species management, etc. Do other duties as directed by the Head of Conservation and Utilisation	Minimum of Grade 10 education with good standing in the community. Experience in biodiversity surveys is a bonus	need to refer to the Fee Table of CEPA
Visitor, Community and ILG / PR	3.6 Visitor Care officer (x 1)	Work under the Head of Visitor, Community, ILG, SME, CBO and Public Relations to ensure all visitors' needs and queries are addressed. Work to maximise the visitors' experience in the Park by providing information from the ICC and ecotourism activities, etc. Do other duties as directed by the Head of Visitor, Community, ILG, SME, CBO and Public Relations	Minimum of Grade 10 education with good standing in the community. Experience in visitor service and ecotourism is a bonus	need to refer to the Fee Table of CEPA
	3.7 Community and ILG Affairs officer (x 1)	Work under the Head of Visitor, Community, ILG, SME, CBO and Public Relations to ensure all the needs and queries of communities, LLG, SME and CBO are addressed. Do other duties as directed by the Head of Visitor, Community, ILG, SME, CBO and Public Relations	Minimum of Grade 10 education with good standing in the community. Experience in working with community is a bonus	need to refer to the Fee Table of CEPA

12.1.3 Issues

The biggest issue faced by the Park is that there has been no vital personnel working in then DEC and now CEPA. The Chief Ranger works as a lone Ranger over the last 30 years to do all work such as fee collection, management and maintenance of the Park. The problem is also long-standing and complicated due to lack of finance, human resources and capacity to effectively and sustainably manage the Park. This issue of human resources needs to be addressed most urgently. The recruitment of key personnel and the development of a functional organization structure will help revive the Park to become one of the most functional in the country.

The recruitment and assignment of the Park Manager, the Head of Administration, the Finance Officer, and casual workers for fee collection, security and facility maintenance and repair must be realised immediately in the first year of operation of this Management Plan.

The Head of Conservation and Utilisation and casual officers for conservation and research and monitoring will be the next target for recruitment, as well as the Head of visitor, Community and ILG, SME, CBO and Public Relations plus the casual staff for visitor care and community and ILG affairs. These two groups will be recruited after a year, to allow the transition phase of the new Park management and operation to become fully functional.

Currently there are two houses that accommodate the rangers but these structures need urgent renovation, including installation of proper water supply and flushable toilets. The same applies to the Lodge. These issues need to be addressed in the park facility development, which is however necessary

to secure good human resources in the Park.

12.1.4 Key actions for improved human resource management

Table 12.2 lists up actions to be taken and their priorities for development of operational structure and improved human resource management, while Table 28 shows the Action Plan.

Table 12.2: A list of actions and their priorities for improved human resource management

Actions	Priority
Preparation of Terms of Reference and contracts for key personnel and casual staff	High
Secure funding and prepare budget for key personnel and casual staff, including activities	High
Advertisement of positions for Park Manager, Finance officer, Accountant, Head of Administration and Admin support staff	High
Recruitment of key personnel to manage the park	High
Employment of casual workers for Admin support	High
Development of the Terms of Reference of the other key personnel and casual staff	Medium
Secure funding and prepare budget for the other key personnel and casual staff, including activities	Medium
Advertisement of positions for Head of Conservation and Utilization, Head of Visitor, Community, ILG, SME, CBO and PR, and their support staff	Medium
Recruitment of Head of Conservation and Utilization and Head of Visitor, Community, ILG, SME, CBO and PR	Medium
Employment of casual workers for support other than Admin	Medium

Table 12.3: Action Plan

Action	2018	2019	2020	2021	2022
Preparation of Terms of Reference and contracts for key personnel and casual staff	X				
Secure funding and prepare budget for Key Personnel and casual staff, including activities	X				
Advertisement of positions for Park Manager, Finance officer, Head of Administration and Admin support staff	X				
Recruitment of Park Manager	X				
Recruitment of Finance officer	X				
Recruitment of Accountant	X				
Recruitment of Head of Administration	X				
Employment of Casual workers for Admin support	X	X			
Development of the Terms of Reference of the other key personnel and casual staff	X	X			
Secure funding and prepare budget for the other key personnel and casual staff, including activities	X	X	X		
Advertisement of positions for Head of Conservation and Utilization and Head of Visitor, Community, ILG, SME, CBO and PR	X	X	X		

Recruitment of Head of Conservation and Utilization and Head of Visitor, Community, ILG, SME, CBO and PR	X	X	X					
Employment of casual workers for support other than Admin	X	X	X					

CHAPTER 13: FINANCIAL MANAGEMENT AND FEE COLLECTION

To date after the establishment of VNP in 1975, the Park does not have a financial or business plan. A recent assessment in 2017 by the CEPA-JICA Biodiversity Project using Management Effectiveness Tracking Tool (METT) developed by WWF found there is also no Management Plan for the Park. The report states that there are lack of financial management, capacity, resource and sustainability of the Park.

The current status of the Park's financial management is summarized below, based on which proposed financial management system is discussed.

13.1. Analysis of Current Situation, Issues and Objectives of Financial Management

13.1.1. Current Situation in Income Generation

The gate fees collected from tourists/visitors is a major source of income for the Park. The gate fees are normally paid at the CEPA office, where the Revenue Officer (Mr. Kevau) collects the money, or at the toll gate of the Park, where the Park Ranger (Mr. Kisea Tiube) collects the fees. All these fees are deposited in the account of the Department of Treasury. There are some records of the collected gate fees stored in the CEPA archives, however there are no appropriate financial account records in CEPA.

Table 13.1. The current park fee system is as below.

Category	Fee (PGK)
Adults (locals/citizens)	K2.00
Adults (non-citizens)	K5.00
Vehicles (9-15 passengers)	K50.00

A recent study by CEPA-JICA Biodiversity Project found out that, over a 10-month period from January to October 2015, a total of 2,594 people visited the Park, among which 2,223 were citizens and 371 were non-citizens, and K6, 266 was collected from the gate fees alone. Therefore, K7, 645 is estimated as a yearly income from the gate fees Including November and December.

CEPA-JICA Biodiversity Project conducted a study in 2016 on entrance fees of similar leisure parks in/around Port Moresby and its results are as below.

Table 13.2. List of Entrance Fees of Three Major Parks (as of November 2016)

1) Nature Park

Category		Fee (PGK)	Unit
Residents	Adults	7	/person



	Students (with ID)	4	
	Kids (3-12 years)	3	
Tourists	Adults	13	
	Students (with ID)	7	
	Kids (3-12 years)	4	
Guided Park Tours	1-5 people	50	
	6+ people	+10	/person

2) Adventure Park

Category	Fee (PGK)	Unit
Bird Sanctuary & National Orchard Garden	5	/person
Children under 10 years	Free	
Waterslides	20	
Paddle Boat	10	
Ferris Wheel/Merry Go Round	5	
Fishing Rod Hire	30	/day

3) Cristal Rapid

Category	Fee (PGK)	Unit	
Visitors	Group Picnic	600	/group
	Group Camp	400	/night
	Adults Walking	2	/person
	Students	1	/person
	Motorbike	15	/vehicle
	TV, Advertising, filming	300	/hour
	Trekking	30	/person
Vehicles	Cars	40	/vehicle
	Utes	40	
	Station Wagon	40	
	15-Seater Bus	50	
	20-30 Seater Bus	80	
	2-3 Ton Truck	80	

Gate fees of VNP is significantly lower than those parks, and no special rate is applied for the use of commercial entity at VNP. There is therefore a potential for the Park to generate more revenues by raising the gate fees to a competitive level with other parks, and by having a new fee category for the use of commercial entities.

13.1.2. Issues and Objectives in Income Generation

The study also revealed some of the current issues in the fee collection practices as below;

- Fee collection at the gate takes place in weekends only due to lack of labor force.
- The timing of fee collection is restricted to around 7-9am and 3-5pm.
- Fees for vehicles are not applied for collection.
- There is no special rate for the use of commercial activities such as bird watching tours.
- There is no transparent and efficient fee collection procedure.

In addition to the gate fee collections, the VNP has high potential to generate more revenue through activities such as collection of rental fees from communication towers in the park, fees for commercial tours and lodging fees for researchers that has never been effectively charged or considered by the Park Management.

The most promising and lucrative project is Bird watching. Over the years, tour operators have been taking birdwatchers to VNP and benefiting from it while CEPA and landowners missing out on the spin-off benefits. There is no MOU signed between the bird watching operators and CEPA, TPA, PAU and Koiari LLG and landowners. Consequently, CEPA, Koiari LLG and landowners have been missing out on the benefits of the Bird watching ventures.

Therefore, the Park needs more revenue generating activities to be developed in order for VNP to raise its own revenue so that it can sustain itself.

13.1.3. Current Situation in Expenditure

Since VNP management and financial status was poor in the last decade, the information regarding its financial status and expenditure is insufficient to develop budget or financial plan to meet the management needs. The scanty and scattered information was gathered from formal/informal interviews to CEPA staff, which is summarized as follows.

From 2000 to 2006, CEPA engaged some local people from Koiari to carry out some maintenance services in the Park, such as general cleaning (grass cutting, rubbish removal, bush track maintenance, etc.), provision of firewood for the picnic sites and the lodges, housekeeping for the lodge (laundry, cleaning, etc.), provision of securities, and maintenance of fire-break areas to avoid fire spreading into the Park.

Six Koiari people were engaged at a time on a rotational basis every week, and not more than 10 people in total. This arrangement made the economic benefit evenly distributed among them. The amount of wage was a flat rate of K280.00 fortnightly per person. A work timesheet was signed on a daily basis to monitor their actual work time.

The engagement of Koiari people to provide services, however, came to an end towards the end of 2006 due to the following reasons;

- (1) Short working hours due to long distance walk – the workers usually walked long distances from their village to report to the Park, arriving between 9-10am and leaving for home between 2:30-3pm. This resulted in less work being done.
- (2) Absence without permission, for bad weather – in rainy/shower days the workers rarely reported to work, affecting their daily tasks such as provision of securities for visitors and housekeeping services for the lodge.
- (3) Coercing demand for on-time payment – the workers had an attitude that they were determined to receive their wages on time. When their payments were delayed, they threatened to shut the

toll gate (main gate of VNP). Such threats had no good impacts on the visitors.

From 2007, types of maintenance services by casual workers have been restricted to general cleaning (grass cutting and rubbish removal), bush track maintenance, and provision of firewood for the picnic sites. Local youth and persons who were known to the Park management had opportunities for random engagement, regardless of land ownership and clan groups of their affiliation. At least six people are often engaged at any one time.

13.1.4. Issues and Objectives in Expenditure

Costs for the Park maintenance and management are summarized as below;

- General cleaning – K2,000 monthly
- Track cleaning and maintenance – K6, 000 per month for 6 tracks (K1, 000 per track). Those 6 tracks include; Creek (main picnic area)-Gares Lookout (Scarp Track), Creek (main picnic area)-Main Lookout (Self Guide Track), Circus Track, Gares-Entrance, Main Lookout-Gares, and Campsite-Lake.
- Firewood collection, housekeeping for lodge, and security for visitors by local labors.
- Fire-break maintenance.
- Equipment hire – Park machineries and equipment such as lawn-movers, slashers/grass cutters, and chain saws can be hired from local landowners at a rate of K250 per hour.
- Car hire – CEPA hires vehicles on special occasions from a private rental car company. Typical two types of vehicles for hire are Hilux (twin cab) and 10-seater Landcruiser, whose rate is on dry hire basis (without fuel). Hilux (twin cab) is charged at K650 per day, while Landcruiser at K850 per day.
- Fuel – within Port Moresby (POM) city limits K50 daily, while outside the city limits K150 daily.
- Construction and maintenance of Koiari tree house – local people are hired to construct the Koiari tree house at a rate of K1, 500, and the same rate applies to the maintenance every 5 years.

13.1.5. Analysis of Financial Management System

As discussed in the previous sub-sections, there is no Management Plan, Financial Plan nor Business Plan for the Park. Financial account records are insufficient, and the gate fees, collected by CEPA's Revenue Officer and the Park Ranger, are deposited in the account of the Department of Treasury. This means that no money generated from the gate fees is held back by CEPA for the VNP management.

VNP does not receive appropriate funding from the National Government through the Public Investment Program (PIP), unlike in the previous budgetary requirement of the Department of Environment and Conservation (DEC now CEPA) about 16 years ago. It seems that the fund allocation from the National Government to CEPA every year does not directly encompass the costs for the management of the VNP. The lack of funds affects the operation, management and planning of the Park, which makes it difficult to project revenues generated in VNP.

It has been recognized that the most important income earner is the gate fee. It implies that the Park has its own source of income and a potential to sustain itself if there is an effective financial management system.

13.2. Proposed Financial Management System

13.2.1. Balancing Expenditure and Revenue

In order to develop an effective financial management system, annual expenditure for VNP needs to be estimated and increase in income generation to cover the expenditure should be pursued. Annual expenditure is projected as below, based on the information in the previous section “7.2.1 Analysis of current situation, issues and objectives of financial management (4) Issues and objectives in Expenditure”.

Table 13.3. Projected Annual Expenditure for VNP

Expenditures		Unit	Unit Cost (PGK)	No. of Units	Total Cost (PGK)
1	Maintenance of Information Centre Complex and Koiari Tree House	Monthly	300	12	3,600
2	Other maintenance including cleaning (grass cutting, rubbish removal), bush track maintenance, and fire-break maintenance	Monthly	6,000	12	72,000
3	Personnel				
	3.1 Housekeeping of facilities, firewood collection etc.	Fortnightly/person (one person)	280	26	7,280
	3.2 Fee collection	Fortnightly/person (two person)	280	52	14,560
	3.3 Security	Fortnightly/person (four person)	280	104	29,120
4	Equipment hire	Hourly	250	8	2,000
5	Vehicle hire	Daily	650	26	16,900
6	Fuel				
	6.1 Fuel (within POM)	Daily	50	26	1,300
	6.2 Fuel (outside POM)	Daily	150	26	3,900
Total (annual)					150,660
Total (monthly)					12,555

In order to secure the Park’s financial sustainability, at least the revenue must exceed the annual expenditure as expected above. On the other hand, a total of K7, 645 is estimated as a current annual income from the gate fees, which consists of merely 5% of the expected annual expenditure. To fill the giant gap, the possibilities of revising the gate fee system and increasing the target numbers of visitors need to be explored to increase the gate fee revenue to a great degree, in addition to addressing the current issues in the fee collection practices (e.g. fee collection in weekends only, no fee collection from vehicles, etc.).

CEPA-JICA Biodiversity Project has been assisting the review of the current fee system and introduction of the new fee system, in order to evaluate the Park's potential to increase the revenue to a self-sustaining level. These review includes visitor survey in 2015 as explained in the previous section "7.2.1 Analysis of current situation, issues and objectives of financial management (1) Current situation in income generation", and the comparative study on entrance fees of similar leisure parks in/around Port Moresby.

Based on the review, the new gate fee system for VNP is proposed as below, to be competitive with those of other parks. The new fee system involves the introduction of new categories such as fees for tour operators.

Table 13.4. Current and Proposed New Gate Fee System for VNP

Category		Current Fees (PGK)		Proposed Fees (PGK)	
		Citizens	Non-Citizens	Citizens	Non-Citizens
Visitors	Adults	2.00	5.00	5.00	10.00
	Students (with ID)	-		4.00	8.00
	Children (≤ 12 y.o.)	-		3.00	6.00
Vehicles	1-8 passengers	-		50.00	100.00
	9-15 passengers	50.00		70.00	200.00
	> 15 passengers	-		100.00	250.00
Tour Operators (Special Arrangements)	Vehicle (1-8 pass)			200.00	
	Vehicle (9-15 pass)			300.00	
	Vehicle (> 15 pass)			500.00	

Meanwhile, the 2015 visitor survey revealed the numbers of visitors of both adults and children, the number of vehicles, and the estimated amount of gate fee collection in 2015 as below.

Table 13.5. Estimated numbers of visitors, vehicles and collected gate fees in 2015

Item	Estimated figures in 2015
The number of adult visitors	2,733 (person/year)
The number of child visitors	658 (person/year)
The number of vehicles	920 (cars/year)
Collected gate fees	7,645 (PGK/year)

In order to cover the necessary expenditure for VNP, estimated amount of PGK175, 000 annually, target numbers of visitors and vehicles are set at 84% increase from the current figures. The target numbers of visitors and vehicles, and target income as gate fees are as follows:

Table 13.6 Current and target numbers of visitors and vehicles, and target income as gate fees

Category		Current				Target				Income (PGK)
		Citizens		Non-Citizens		Citizens		Non-Citizens		
		Fees (PGK)	Numbers	Fees (PGK)	Numbers	Fees (PGK)	Numbers	Fees (PGK)	Numbers	
Visitors	Adults	2	2,268	5	465	5	4,763	10	960	33,415
	Students (with ID)	-	188	-	10	4	407	8	20	1,788
	Children (≤ 12 y.o.)	-	188	-	10	3	407	6	20	1,341
Vehicles	1-8 passengers	-	566	-	235	50	1,188	100	485	107,900
	9-15 passengers	50	57	-	24	70	121	200	53	19,070
	> 15 passengers	-	27	-	11	100	59	250	24	11,900
Tour Operators (Special Arrangements)	Vehicle (1-8 pass)					200		200		
	Vehicle (9-15 pass)					300		300		
	Vehicle (> 15 pass)					500		500		
Total		(estimated income in 2015) 7,645								175,414

Income from the new category, fees for tour operators, is yet to be known, and is not calculated in the table above. It is however expected to raise some good amount of revenue. Prior coordination with tour operators concerning the new gate fee system needs to be implemented for smooth operation.

13.2.2. Other Opportunities of Income Generation

In addition to the gate fees, there are other forms of income generation opportunities.

CEPA has established relationships with various entities and agencies vesting their own interest in the Park. CEPA has been making some arrangements with them that they provide incentives to VNP to take advantage of the Park. The arrangements include:

(a) Lease of premises to Digicel (PNG) Ltd

Digicel (PNG) Ltd constructed and erected a tower (30x30m) recently on a leased premises in VNP. Lease agreement will generate PGK15, 000 per annum, however it is not clear how much percentage of this lease fee will be budgeted for the VNP management.

(b) Lease of premises for Police Surveillance Tower

CEPA have been negotiating with the Department of Police (DoP) about a lease agreement on the Park premises for Police Surveillance Tower, in the form of MoU/MoA, which is yet to be accomplished. There is no tangible outcomes from the discussions and still in progress.

(c) Coordination with tour operators

Over the years, tour operators have been taking birdwatchers to VNP and benefiting from it while CEPA and landowners have been missing out on the spin-off benefits. Bird watching Project has been undertaken with MoU between CEPA, PNG Tourism Promotion Authority (TPA), Pacific Adventist University (PAU) and Koiari Local Level Government (KLLG), however bird watching tour operators have not been involved yet. Consequently, all parties except tour operators have not fully utilized the

opportunities of the bird watching ventures in the Park. Coordination with tour operators needs to be sought.

13.2.3. Proposed Financial Management System

As discussed in “7.1.2 Proposed Organizational Structure”, Finance Officer is needed to be responsible for managing financial issues of the Park. The proposed organizational structure and the roles and responsibility of the Finance Officer is repeated below.

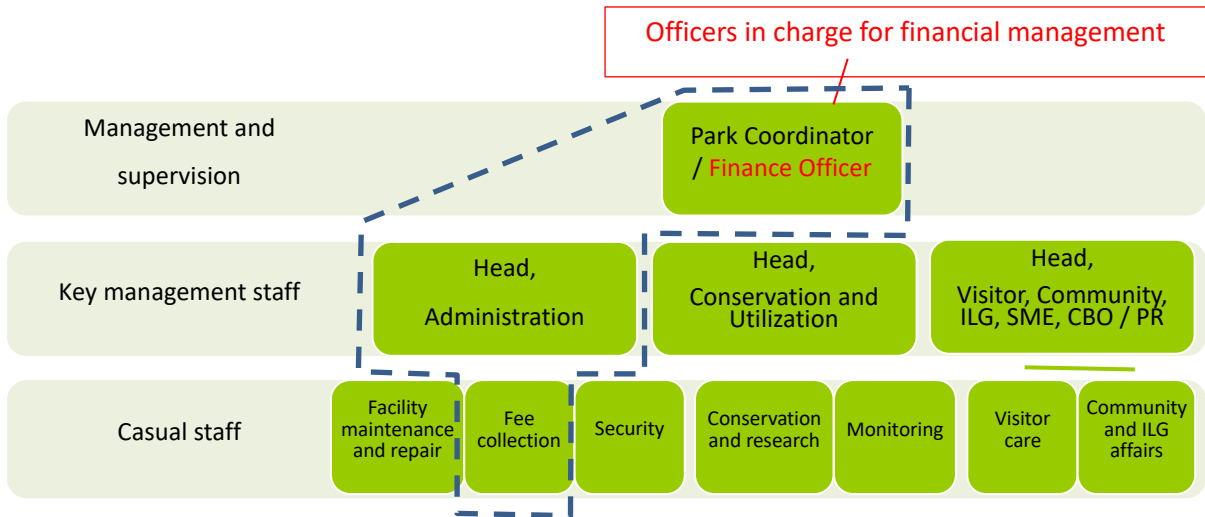


Figure 13.1: Proposed Financial Management Team.

Finance Officer: Responsible for all financial operations of the Park. He/she reports to the Park Manager, works closely with the Park Manager, the Head of Administration and the other Heads where necessary, prepares financial statements, and does financial focus, procurement, and other activities as instructed by the Park Manager.

The Finance Officer is a managerial position, which requires support staff such as an Accountant and a Fee collection staff. The Finance Officer pay will attention to the financial sustainability and balancing of revenue and expenditure in a certain period such as a quarter, a year and five years, while the Accountant will manage revenue and expenditure on a daily basis. Therefore, cash from the gate fees is managed by the Accountant, who keeps an account book and reports regularly to the Finance Officer.

Managing cash on a daily basis requires security, accountability and transparency. Considering the current status of CEPA and the Park, two options are suggested below.

(Option 1) CEPA’s corporate account is opened at a bank, and an independent Accountant will be hired to manage the money. The Finance Officer is responsible for the management of Income and expenditure, and the money flow is disclosed every year with a help from the Accountant. This option is reasonable for CEPA as an autonomous agency to manage its own money, but the coordination with the Department of Treasury needs to be secured, and it may take some time.

(Option 2) CEPA-JICA Biodiversity Project assists the management by providing a safe to store cash

generated from gate fees and other income while CEPA hires an independent Accountant to manage the money. This would be just a temporary measure until CEPA develops a certain level of the financial management system, including human resources development and account management. Transparency and capacity building would be the keys to the effective financial management.

13.3. Proposed Field Operations of Fee Collection

Fee collection is a part of the visitor services to provide them with an experience in VNP, as well as a part of management activities to raise revenue for the Park. The gate fee collection therefore requires systematic, accountable and transparent operations to fulfill its role.

The gate fees are collected either at the CEPA office or the toll gate of the Park. A Fee collection system (cash management system) for respective locations is proposed below.

13.3.1. Fee Collection and Cash Management at the CEPA Office

Currently, the Revenue Officer collects the money, and those money is deposited in the account of the Department of Treasury. There are no appropriate financial account records in CEPA.

A proposal includes; (1) cash collection and issuance of tickets as receipt, (2) keeping an account book for the gate fees, and (3) depositing these fees to a safe in CEPA until coordination with the Department of Treasury is achieved on the issue of revenue management for the Park. The cash flow is illustrated as below.

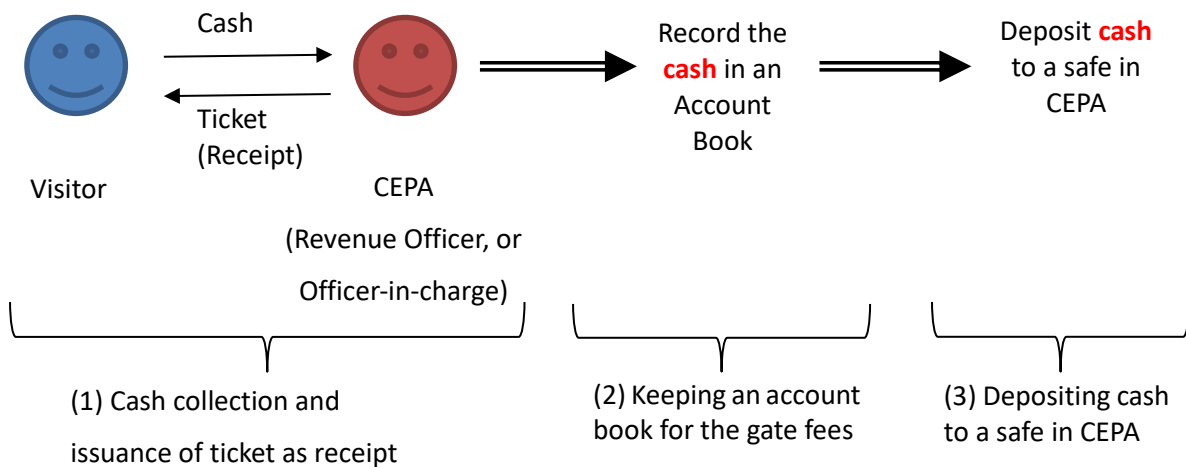


Figure 15.2. Proposed cash flow at CEPA office

Fee collection at CEPA office is possible only during the working hours of CEPA; Monday to Friday, 8:00 to 16:00.

The Account Book is monitored on a regular basis by senior staff such as the Finance Officer, and the cash in a safe and the Account Book is examined every month, which should be approved by the Finance Officer. The Revenue Officer submits monthly report of the gate fees to the Park Manager/Finance Officer, with the number of visitors, the amount of the gate fees, etc. The Finance Officer summarises the revenue from the gate fees and other statistics quarterly and annually, and submits reports to the Park Manager.

In order to put this proposal into practice, several issues need to be addressed as below.

- Confirmation of TOR of the Revenue Officer to collect cash, and assignment of other officers to play this role as an officer-in-charge when the Revenue Officer is not available.
- Training of the Revenue Officer and other officers-in-charge to familiarise themselves with this proposed fee collection system (cash management system).
- Preparation of tickets (receipt book) with a series of numbers to record in an account book and help cash management. (The Preparation includes design of tickets for respective categories, printing and keeping some stock at the CEPA office.)
- Preparation of an Account book to record cash-in, issuance of tickets (receipts), category of visitors, the number of visitors/cars, nationalities and gender (to monitor the visitor affiliation, which may be useful for marketing and promotion purposes), etc.
- Preparation of signboards to show the gate fee table, stamps, leaflets, and other items necessary for the gate fee collection at CEPA office.
- Provision of a safe at CEPA office to deposit cash.
- Coordination with the Park Manager, the Finance Officer, the Head of Administration and other relevant officers for the smooth operation of the fee collection system.

13.3.2. Fee Collection and Cash Management at the Gate of VNP

Currently, the Park Ranger collects the money, this money is deposited in the account of the Department of Treasury. There are no appropriate financial account records in CEPA.

A proposal includes; (1) cash collection and issuance of tickets as receipt, (2) keeping an account book for the gate fees, and (3) depositing these fees in a safe in the Park and later to a safe in CEPA until coordination with the Department of Treasury is achieved on the issue of revenue management for the Park. The cash flow is illustrated as below.

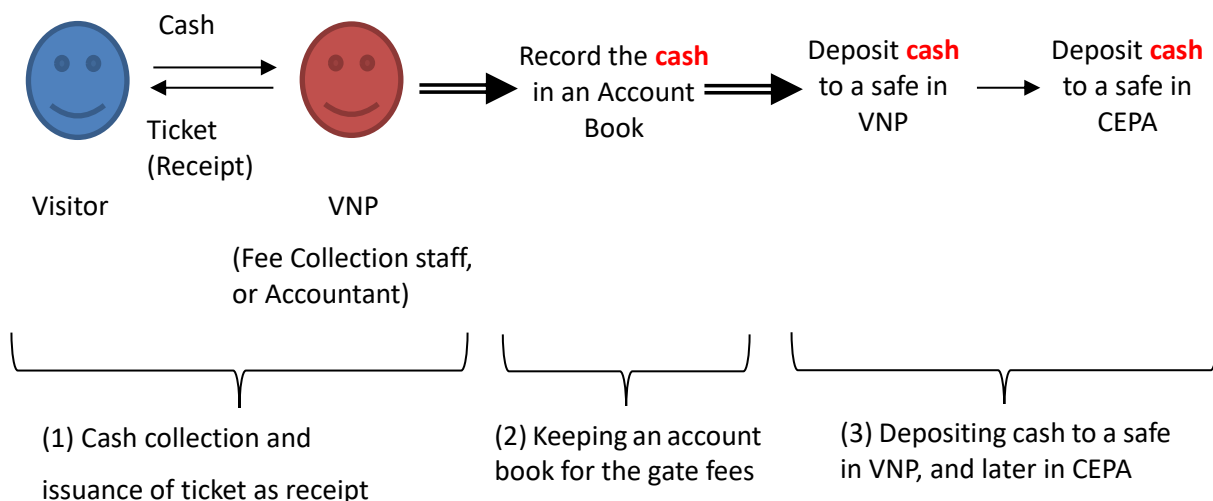


Figure 13.3. Proposed cash flow at VNP

13.3.3. Opening Hours

Fee collection staff at the VNP gate collect cash and provide ticket as receipt. Considering the gate

security and visitor services, opening hours of VNP needs to be discussed and following three options are suggested.

(Option 1) Simple plan:

In order to operate and manage the Park efficiently, opening hours of VNP is core time (8:00 – 17:00) only, and single shift of the staff (2 Fee Collection staff and 4 Security staff) is adopted. The shift includes working hours from 7:30 to 17:30.

After closing the gate at 17:00, the Fee Collection staff examines the cash and ticket book to ensure the amount of cash and ticket book are in order, and bring them to the Accountant at the Information Center Complex for check, and deposit the cash in a safe for security and bring back the ticket book to the gate with a memorandum to the Fee Collection staff next day, telling them the starting number of the ticket next day and other issues where necessary.

(Option 2) Full-service plan:

In order to provide full service to the visitors, opening hours of VNP is from 6:00 to 19:00 to host birdwatchers and sunset viewers, and double shift of the staff (2 Fee Collection staff and 4 Security staff at each shift) is adopted. The first shift operates from 5:30 to 12:30, and the second shift from 12:00 to 19:30. Between 12:00 and 12:30, when these shifts overlap, the staff jointly examines and succeeds the cash, ticket book, and other issues where necessary.

After closing the gate at 19:00, the Fee Collection staff examines the cash and ticket book to ensure the amount of cash and ticket book are in order, and bring them to the Accountant either at the Information Center Complex or staff house for check, and deposit the cash in a safe for security and bring back the ticket book to the gate with a memorandum to the Fee Collection staff of the following day, telling them the starting number of the ticket on the following day and other issues where necessary.

(Option 3) Hybrid plan:

In order to balance the efficiency in the park management and the quality of visitor services, Simple plan is adopted in weekdays, and Full-service plan is adopted in weekends, public holidays, and other peak seasons for tourism.

The shifts and cash management processes follow the methodologies of relevant options.

These options are summarized as below, including pros and cons of respective options.

Table 13.7 Comparison of options for VNP opening hours and shifts of the staff

	Option 1. Simple plan	Option 2. Full-service plan	Option 3. Hybrid plan
VNP opening hours	8:00 – 17:00	6:00 – 19:00	(weekdays) 8:00 – 17:00 (weekends) 6:00 – 19:00
Shifts of the staff	Single (7:30 – 17:30)	Double (5:30 – 12:30,	(weekdays) Single

		12:00 – 19:30)	(weekends) Double
Pros	<ul style="list-style-type: none"> The most efficient in terms of park management Less hassle in terms of security is expected for earlier closing time. 	<ul style="list-style-type: none"> Encouraging tourists and tour operators by hosting them at the most popular timing in the Park. Relatively short working hours for the staff at each shift, who are expected to keep their concentration on their duties. 	<ul style="list-style-type: none"> Flexible shift of staff enables cost-effective park management by addressing more visitors at weekends.
Cons	<ul style="list-style-type: none"> Discouraging tourists and tour operators by closing the park at the good timing for bird watching. Long working hours for the staff at the shift. 	<ul style="list-style-type: none"> Security concerns may increase as some visitors at twilight are likely to become nuisance. More cost and human resources are required, which can be a burden for park management. 	<ul style="list-style-type: none"> Complex shifts of staff may be confusing and more time and efforts are required for staff management. Foreign tourists and tour operators may want to take advantage of less visitors at weekdays, and single shift in weekdays may miss such tourism opportunities from marketing viewpoint.

The issue of VNP opening hours requires coordination with the By-law on the Varirata National Park Management.

In order to put into practice this proposal of fee collection at VNP gate, several issues in addition to what are previously discussed need to be addressed as below.

- Development of respective TOR for the Accountant and the Fee Collection staff and recruitment of them.
- Training of the Accountant and the Fee Collection staff to familiarize themselves with this proposed fee collection system (cash management system)
- Preparation of signboards to show the gate fee table, stamps, leaflets, and other items necessary for the gate fee collection at the VNP gate.
- Provision of a safe at the Information Centre Complex in VNP to deposit cash, and at the Accountant house to keep cash after office hours.
- Protocol of secured cash delivery from VNP to CEPA office, in coordination with the Finance Officer.

13.4. Suggestion of Actions for Improved Financial Management

Table 13.8 list of actions to be taken and their priorities for improved financial management, while Table 13.9 shows the action plan.

Table 13.8: A list of actions and their priorities for improved financial management

Actions	Priority
Introduction of the new gate fee system and its public announcement	High
Appointment/Recruitment of a Finance Officer, an Accountant and Fee collection staff	High
Development of cash management system, including gate fee collection in the Park, bookkeeping, and depositing cash in a safe place	High
Training of the Fee collection staff and the Security staff at the gate to provide visitors with a good park experience and to secure appropriate collection of the gate fees	High
Preparation of tickets (receipt book), signboards, stamps, leaflets and other items for the gate fee collection	High
Coordination with the Park Manager, the Head of Administration, and other Heads for smooth operation	High
Development of a Financial Management Plan of VNP, including review of expenditure and strategic planning of income generation from the gate fees and other forms of opportunities	High
Coordination with the Department of Treasury on the management of revenues	High
Coordination with tour operators concerning the new gate fee system, particularly for birdwatchers	Medium
Further arrangements on lease fees with Digicel Ltd and the Department of Police	Medium
Further discussion with NCDC for the transfer of the management rights of VNP to NCDC	Medium
Development of marketing and promotion strategy of VNP, and its implementation	Medium
Monitoring of visitor numbers and activities by Installing sensor cameras at the gate and other strategic locations	Medium

Table 13.9: Action Plan

Action	2018	2019	2020	2021	2022
Introduction of the new gate fee system and its public announcement	X				
Appointment/Recruitment of a Finance Officer, an Accountant and Fee collection staff	X				
Development of cash management system, including gate fee collection in the Park, bookkeeping, and depositing cash in a safe place	X				
Training of the Fee collection staff and the Security staff at the gate to provide visitors with a good park experience and to secure appropriate collection of the gate fees	X	X			
Preparation of tickets (receipt book), signboards, stamps, leaflets and other items for the gate fee collection	X	X			
Coordination with the Park Manager, the Head of Administration, and other Heads for smooth operation	X	X	X	X	X
Development of a Financial Management Plan of VNP, including review of expenditure and strategic planning of income generation from the gate fees and other forms of opportunities		X	X		
Coordination with the Department of Treasury on the management of revenues	X	X	X		
Coordination with tour operators concerning the new gate fee	X	X	X	X	

system, particularly for birdwatchers									
Further arrangements on lease fees with Digicel Ltd and the Department of Police	X	X	X	X					
Further discussion with NCDC for the transfer of the management rights of VNP to NCDC			X	X	X	X			
Development of marketing and promotion strategy of VNP, and its implementation			X	X	X	X	X	X	X
Monitoring of visitor numbers and activities by Installing sensor cameras at the gate and other strategic locations	X	X	X	X	X	X	X	X	X

CHAPTER 14: SECURITY CONTROL

Security issues are of the utmost importance and priority for the park management, and its legal basis and enforcement consist of the core of the security system in the Park. Enforcing security is one of the purposes of protected area establishment, as well as one of the conditions to effectively and appropriately manage the area over long term (Braack et al. 2006).

In the 1980s and 90s, the number of visitors to the Park was 500-1,000 per weekend, which has now decreased to circa 50 per weekend. Deterioration in the Park's security situation is believed to be one of the biggest reasons behind it. Decrease in the visitor number has led to low revenue from the gate fees, affecting the park management. Improvement in the security situation in the Park is expected to increase the visitor numbers as well as income from the gate fees. Security issues therefore need to be addressed to realize effective park management.

Rules and regulations of the Park have been discussed in detail in CEPA, and it is expected to be authorized and gazetted as by-law to have clear guidelines. Enforcement, particularly in terms of human resources has been examined through trial patrol and discussions. This chapter summarises the current status and some proposed activities to reinforce security and safety of the Park.

14.1. Current Issues in Security

Appropriate rules and regulations are the basis for the security management of the Park. Security personnel is also essential to enforce the rules and regulations, including instructing the visitors on the expected behaviors and patrolling the Park to protect the visitors, facilities and wild fauna and flora from vandalism and misconduct. Awareness raising to the visitors and local people is one of the "soft" approaches to reinforce security, which is however discussed in the Education and/or Visitor section.

Currently there are no security guards manning the Park and attending to the needs of park visitors. The simple reason is that there are no funding made available to CEPA to hire appropriate personnel to enforce security measures. In addition, there are no security systems and guidelines developed for the Park.

"National Parks Regulation 1984" sets rules and regulations of the Park, however there is no clear instruction to visitors, such as signboards, on the use of the Park. Intervention to visitors by park staff is poor, which is suspected to have induced many visitor misbehaviors and vandalism in the Park, such as;

- Making fire anywhere in the Park, including along tracks
- Arson on toilet facilities,
- Parking vehicles in undesignated areas,
- Drinking alcohol, strolling around and abusing other visitors, and
- Throwing away trash and beer cans anywhere in the Park.

Robbery and attack to visitors are also threats to the park management, particularly in remote areas such as Boundary track. With limited human resources, it cannot help but focus patrol efforts in the popular sites among visitors. Visitors need advice on security situations in the Park and along certain tracks.

Poaching of wildlife and tree cutting for firewood and other purposes pose another threat to the Park. Details of individual cases are still not very clear, but some local people are suspected to have been utilizing natural resources in the Park illegally. Cooperation with neighbouring local communities is essential for the park management, and how to achieve their support without compromising conservation is a challenge.

As per the human resources, a trial patrolling by local people as security guards has been implemented, as one of the measures to beef up security, in the weekends from 19th November 2016 to 1st January 2017, totaling 7 weeks. The security guards were nominated from the relevant landowners (4 clans namely Ianari, Nadeka, Omani and Narime). The guards were deployed in two shifts, morning shift from 5am to 11am, and afternoon shift from 12am to 6pm, covering 6 hours each. Two security guards were assigned for each shift. The guards of morning shift were stationed at the toll gate of the Park, while afternoon shifts were to patrol on foot around the main picnic area, the main lookout and the self-guide track.

Results of the trial patrol revealed that;

- Most of the guards did not report to the Park on time, and went back home some hours earlier, resulting in short working hours.
- Some patrols were conducted out of the assigned routes, resulting in difficulty in controlling the security guards.

Reasons behind such unsatisfactory situation include;

- No public transport early in the mornings, and difficulties in reporting to the Park on time, particularly for the morning shift.
- Some people nominated as guards prioritised their private interests, such as playing soccer, rather than respecting their guard schedule.
- Heavy rains from 17th to 18th December deterred the guards from reporting.

Solutions were suggested as below;

- CEPA should provide accommodation (lodging house) in the Park, and the guards of morning shift should come to the Park in the night before and stay in the Park, without additional payment for staying overnight. However, the guards are anticipated to cause environmental problems, such as issues in fire management, waste management and noise management. The Utilization code for

the lodging house is recommended, and the security manager (discussed later) is responsible for the behaviors of the guards at the lodging house.

- A manager for security issues at the site is necessary, particularly on weekends. Outsourcing is therefore, one of the alternatives, since CEPA's capacity is still limited to providing the service at such a distance. They are expected to appear and manage the patrol activity every assigned days, including the management of working hours and areas of the security guards.
- Provision of facilities and gears for rainy days should be considered, such as a shade house at the toll gate and rain coats/boots/parasol for the guards.
- Revised TOR for the security guards should be applied.

14.2. Proposed Security System

(1) Rules and regulations

The By-laws of the Varirata National Park have been drafted for discussion, which are stipulated in the *National Parks Act 1982*, *National Parks Regulation 1984*, and the *National Parks By-laws 1974*. The draft needs to conform to the draft Protected Area Bill (PA Bill) and the draft Protected Area Regulations to obtain legal guidance.

The draft addresses the issues such as;

- Opening hours
- Gate fees
- Conduct of persons
- Control of wildlife
- Permits for camping, hunting and fishing, and
- Delegation of powers

Particularly in "Conduct of persons", dos and don'ts of visitor behavior are clearly stipulated and most of the issues caused by vandalism and misconduct are addressed straightforward.

According to the information in March 2018, PA Bill has not been taken to the Parliament, and waiting for the endorsement by the relevant authority. PA Regulations still need improvement and inclusion of establishment of marine protected areas.

Close monitoring of those PA Bill and PA Regulations is being done, an engagement of a lawyer is required at this point to fine-tune the By-law. This would accelerate the process and prompt gazettelement would be facilitated.

(2) Enforcement

Security issues and management approaches can be summarized as below;

Table 14.1. Summary of security issues and management approaches.

Security issue	Management approaches	Remarks
Facilities in the Park	1. Facilities must not be damaged. <ul style="list-style-type: none"> Trained rangers patrol the area to make sure all facilities are safe. 	4 guards each day; 2 at the main gate and 2 for patrol.
Wild fauna and flora in the Park	1. Consumptive use of wildlife should not be permitted without park authority's prior approval. <ul style="list-style-type: none"> Security guards should be trained to spot and record the evidence of consumptive use of wildlife. Park Manager, Head of Administration and security guards should be familiarized with prosecution procedures. 	Coordination with the other Heads (Conservation, Community affairs) is essential.
Safety of all visitors	1. Adoption of holistic approach, including multiple and fully integrated levels of authorities. <ul style="list-style-type: none"> CEPA and Park Manager NCD and Koiari Community Police Koiari LLG and landowners 	- CEPA and Park Manager should work closely with NCD, Central Community Police and landowners.
	2. Main gate should function as check point. <ul style="list-style-type: none"> All vehicles should be checked at the main gate, and guidance to rules and regulations is provided. The existing main gate should be refurbished. 	- All visitors are subject to security check. - Simple park rule leaflet should be prepared.
	3. Options of another check point should be considered. <ul style="list-style-type: none"> (Option 1: outside the Park) just after the junction of main Sogeri road and the road to the main gate. (Option 2: inside the Park) road block by chain or other means, at the junction of Main picnic area and Main lookout road. The two check points and security manager should be equipped with VHF radios for communication. 	- Two check points are more secure, and cost more.

(a) Security Guards

The above management approaches require a certain volume of trained personnel as security guards. Considering the current limited capacity of CEPA for security issues, hiring a few officers may not be sufficient. The experience of trial patrolling by local people indicates that managing local people as casual security guards seems to require much more time and effort. Outsourcing to a private security company therefore would be a practical option, at least until CEPA's or local people's capacity is developed to a certain level.

Some security companies have been approached to explore the possibilities, and two companies responded with some details below.

Table 14.2. A comparison of the Cost of two private security companies.

Description	Company A	Company B
Hourly rate for Security Guards at Varirata National Park	K4.5	K6

Daily flat rate for Escort Unit		K150	K300
A package of 4 Security Guards and 1 Escort Unit	(Pattern 1) 8am – 5pm (9h)	K312/day	K516/day
	(Pattern 2) 6am – 6pm (12h)	K366/day	K588/day
	(Pattern 3) 6am – 7pm (13h)	K384/day	K612/day
Rough estimates of monthly rate	Weekends only (10 days/month)	K3,120-3,840	K5,160-6,120
	Everyday (30 days/month)	K9,360-11,520	K15,480-18,360

* Government 10% tax is not included.

A rough estimate of monthly rates show that a plan of weekend service only costs K3,500-6,800, while another plan of everyday service K10,300-20,200, inclusive of 10% government sales tax.

The type of security services needs to be examined for further detailed discussions. However, the figures above provide an idea of how much it costs if outsourcing is implemented. Considering that they are already trained and experienced, and looking at the balance of expected abilities and cost, outsourcing of security services seems a reasonable option. Contractors, if adopted, would require good coordination with the Park Manager and Head of Administration in the field operations.

With regards to the deployment of the security guards, two (2) at the main gate and two (2) for patrol is suggested. A fee collection staff at the main gate collects gate fees from visitors and handles cash. The main gate is also expected to function as a check point. The main gate is therefore, likely to face risks and threats to robbery and violence, and hence, the presence of security guards is fundamental.

Patrol in the Park, particularly along popular tracks and picnic sites, is also important. Vandalism took place in some major tourist spots in the past, and some unexpected people were confirmed walking around the Park. Park visitors need to be protected from such misconduct, and patrolling as a team would have an impact on such people.

Patrol is also expected to contribute to conservation. Any trace of poaching and tree cutting may be found during the patrol, needs to be reported to the officers concerned. Such reporting procedure needs to be developed.

To prepare for emergency cases, such as visitor’s injury, fire and robbery, security guards need to be equipped with gear like VHF handy radios, emergency medical kits, whistles, etc. Mountain bikes may be useful to reach the spot of emergency in a shorter time, however its use must be restricted to emergency cases only, for conservation of soil and natural environment, and for the safety of visitors.

(b) Check points

The main gate is expected to function as a check point, where gate fees are collected, guidance on park use is provided, and security is checked. In order to offer such multiple purposes including security, the main gate is recommended to be refurbished to play its expected roles and to deliver good visitor services. The refurbishment may include;

- Stronger gate for security purposes
- Securer box office for fee collection staff to handle cash
- Power supply for VHF radios and other equipment
- Shade house for security guards for rainy days

- Information signboard to instruct visitors dos and don'ts in the Park
- Other explanation panels such as VNP map, history, local culture, etc.

Options of establishment of another check point is worth considering, particularly at the junction of the Main picnic area and the Main lookout road. Vandalism in and around Main lookout has been reported many times, most of which seemed to occur under alcohol influence. Some people go to the Main lookout with a car carrying alcoholic beverages, and enjoy themselves there. A road block to stop such cars driving to the Main lookout is expected to reduce misconduct to a great degree. This check point will screen visitors with cars, and special regulations should be developed for a screening process. In general, cars with alcohol drinks should not be allowed to go past the check point, while cars with disabled or elderly people without alcohol should be allowed to pass the check point. A chain or other means should be considered to operate the point.

14.3. Key Actions for Improved Security System

Table 14.3 lists up actions to be taken and their priorities for improved security systems in the Park, while Table 14.4 shows the Action Plan.

Table 14.3: A list of actions and their priorities for improved security system

Actions	Priority
Engagement of a lawyer to fine-tune the By-law of VNP (should consider special regulations for screening process at the check point)	High
Gazettement of the By-law of VNP	High
Decision making on outsourcing security guards to a private security company	High
Secure funding and prepare budget for outsourcing security guards	High
Preparation and implementation of bidding for contracting out security guards	High
Development of detailed security plan by contractors, in coordination with Park Manager and Head of Administration	High
Preparation and purchase of security gears	Medium
Refurbishment of the main gate	Medium
Decision making on establishment of another check point	High
Design and installment of another check point	High
Development of special regulations for screening process (in coordination with By-law)	High

Table 14.4: Action Plan

Action	2018	2019	2020	2021	2022
Engagement of a lawyer to fine-tune the By-law of VNP (should consider special regulations for screening process at the check point)	X				
Gazettement of the By-law of VNP	X	X			
Decision making on outsourcing security guards to a private security company	X	X			

Secure funding and prepare budget for outsourcing security guards	X	X	X						
Preparation and implementation of bidding for contracting out security guards		X	X						
Development of detailed security plan by contractors, in coordination with Park Manager and Head of Administration		X	X	X					
Preparation and purchase of security gears				X	X	X			
Refurbishment of the main gate				X	X	X			
Decision making on establishment of another check point	X	X							
Design and installment of another check point		X	X						
Development of special regulations for screening process (in coordination with By-law)	X	X							

CHAPTER 15: FACILITY MANAGEMENT AND DEVELOPMENT

Facilities in VNP have been deteriorating over time since independence, and their renovation was regarded as one of the essential needs to improve park management. Since 2015, facility development has been implemented, adopting a principle of two-step development, revival as the first step and further improvement as the second step. The first step was taken by 2018, and this chapter discusses the details of the second step.

15.1. Current Status of Existing Facilities

Facility assessment was carried out in October and November 2015 to comprehend the types of facilities, their locations, numbers and current status. The assessment provided basic information for the development planning in VNP such as facility distribution map and database.

Total of 284 facilities were identified in VNP. Some facilities were found damaged and their repair/ replacement/ improvement were sought. A summary of damaged facilities is as below.

Table 15.1 Damage Condition of Facilities and Necessity of Repair/ Replacement/ Improvement

Category	Condition	Necessity of Repair/ Replacement/ Improvement
(1) Traffic line		
1) Road	• Good condition. Main roads were paved.	• Maintenance on asphalt pavement shall be implemented.
2) Track	• Good condition is kept by regular maintenance.	• Current maintenance is good.
3) Bridge	• Most of them are missed or broken completely.	• Repair or replacement is urgent.
4) Hand trail	• 2 hand trails have been missed.	• Replacement is urgent.
(2) Open area		
	• No problem at moment.	• Need to consider countermeasures for increasing of visitors.
(3) Ranger's facility		
	• Rangers' houses are damaged much.	• Life line improvement is urgent.
	• Life line is not enough completely.	• Rangers' houses repair or replacement is

Category	Condition	Necessity of Repair/ Replacement/ Improvement
		necessary.
(4) Station (Shelter, information center, etc.)		
1) Shelter	<ul style="list-style-type: none"> Shelters in Lake site are damaged much. The Other shelters are good condition comparatively. 	<ul style="list-style-type: none"> Replacement is necessary as soon as possible. Maintenance on the other shelters shall be taken.
2) Tollgate	<ul style="list-style-type: none"> Safety is not enough. 	<ul style="list-style-type: none"> Improvement is advisable.
3) Information center	<ul style="list-style-type: none"> Building has been broken completely. No functions 	<ul style="list-style-type: none"> Small scaled simple building is required to recover the function to provide minimum requirements (guide for visitors, evacuation and rest).
(5) Camping facility	<ul style="list-style-type: none"> Most of the facilities are broken with bad spiral, no maintenance-bad condition-no usage-bad condition again. Most of the facilities are not available. 	<ul style="list-style-type: none"> Countermeasure for secure the safety is urgent. Maintenance is quite importance. Some of facilities are necessary to be taken away.
(6) Car parking facility	<ul style="list-style-type: none"> Some of car stop piles have been broken and sign of car entrance can be found. 	<ul style="list-style-type: none"> Repair or replacement of car stop piles and publicizing of car parking rule are necessary. Expansion of car parking area is necessary for future increasing number of visitors.
(7) Water supply system	<ul style="list-style-type: none"> No water supply system to Rangers' area. No function of water supply system at main picnic area. 	<ul style="list-style-type: none"> Water supply system development for rangers' areas are necessary. No functioned system at main picnic area shall be considered to be taken away.
(8) Toilet	<ul style="list-style-type: none"> About 90% of toilets are not available. 	<ul style="list-style-type: none"> Repair/ replacement and maintenance shall be taken as one set.
(9) Others (Sign board)		
1) Traffic sign, 2) Road sign	<ul style="list-style-type: none"> Most of facilities are not much damaged. Number of sign boards are not enough. 	<ul style="list-style-type: none"> Sign boards shall be improved with traffic rule development.
3) Track sign	<ul style="list-style-type: none"> Most of distance piles and reference piles are broken completely. 	<ul style="list-style-type: none"> Those piles shall be replaced with development of guide maps preparation.

(Source: Facility Assessment Report of Varirata National Park, CEPA-JICA Team, 2015)

Considering the expected functions of facilities in the Park such as contribution to biodiversity conservation, provision of security for visitors, education, and recreation, efforts for facility revival were focused upon some key facilities, and their development as of December 2018 is summarized as below.

Table 15.2 .Summary of Facilities Targeted and their Outcome

Facilities Targeted	Outcome
Repair / replacement of toilets	- Some toilets were renovated by CEPA

Repair / replacement of shelters in Lake site	- Not yet
Improvement of camping facilities	- Not yet
Repair / replacement of car stop piles	- 80 PVC piles and 153 wood piles were installed at Main Picnic Area, Picnic Site 3, Camp Site, and Lake Site.
Repair / replacement of wooden bridges on tracks	- Wood bridge at Main Picnic Area was repaired. - New wood bridge was installed between Main Picnic Area and Information Center Complex.
Preparation of track sign boards and guide map, including distance piles	- 23 sign boards to show the direction were renovated. - 4 big signboards were installed at key spots to explain park regulation, VNP description, and bird watching project. - Guide maps for 4 tracks have been prepared. - The whole of 79 distance piles, 100m each, were replaced with stronger structure along 4 tracks.
Construction of Information Center Complex (ICC), including renovation of the existing Information Center	- 3 car parking lots were renovated, and wooden-bar type car stop pile was installed at the car park. - New drainage was constructed next to the ICC. - Old Information Center was renovated to be an Auditorium. - New Information Center was constructed. - Timber decking was constructed to connect the Auditorium and the New Information Center, to make the ICC.

Construction of the ICC was the biggest outcome in the facility development in recent years. The ICC comprises of the renovated old Information Center (IC), New IC, and connecting timber decking.

The old IC has a simple structure with pillars, roof, minimum walls, and without doors, decorated with some reliefs on the wall and the central pillar. The size is approximately 10m x 10m. The old IC is expected to be used as an Auditorium, and its expansive atmosphere with minimum walls makes it a suitable venue for open-minded workshops and the like.

The new IC has a modern style structure, with an administration office, a store room and a gallery room. The gallery room exhibits a series of beautiful photos and information on the natural history of VNP, the cultural background of Koiari people, and simple explanations of some ecology key words. The size is almost similar to the old IC (10m x 10m). The new IC is expected to function as an education center and an administration office for the Park.

Timber decking connects the two ICs in the air, and can be accessed by slope from the road and by stairs from Main Picnic Area. It provides a relaxing atmosphere in the open-air environment and wooded feeling on the floor. A signboard and some totem poles are located around the decking to welcome visitors to the ICC.

Construction of the ICC was completed at the end of November 2018, and its official inauguration is planned in March 2019. Some minor defects have been observed, and being addressed by the

contractor.

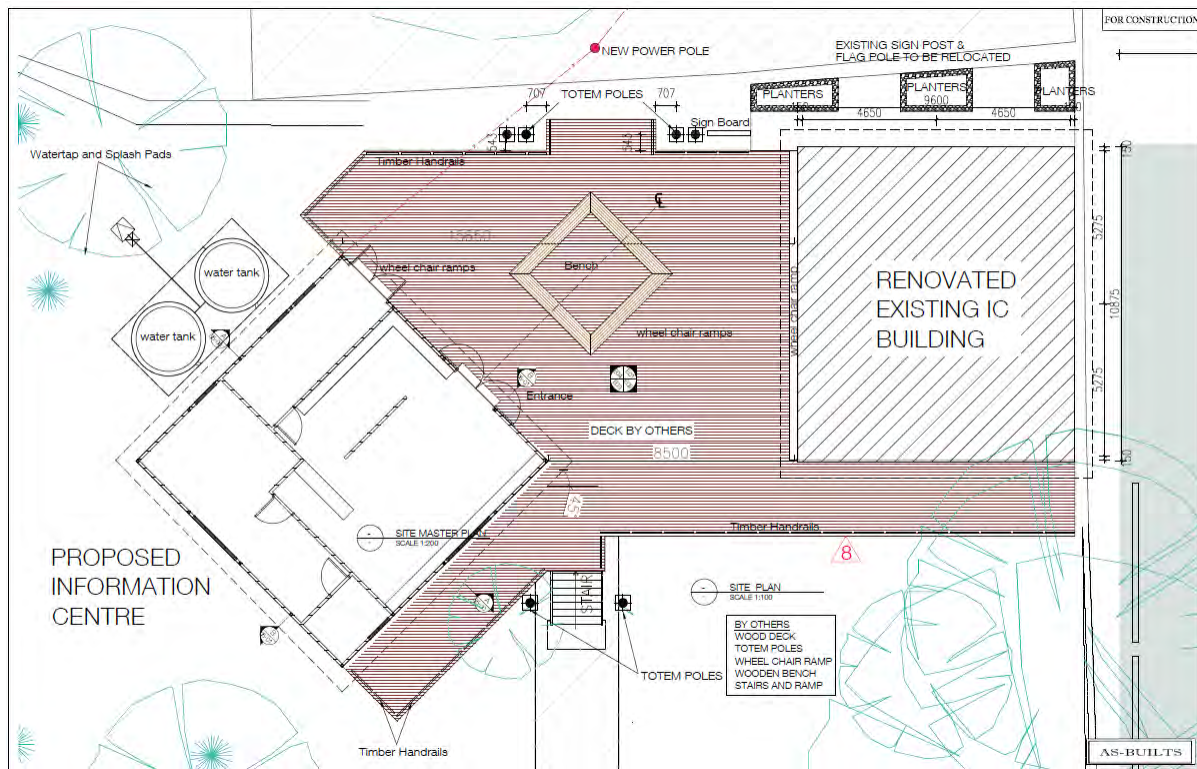


Figure 15.1. A plan of Information Center Complex (ICC)

15.2. Proposed Facility Development and Management

In order to maximize the benefit of the new and renovated facilities, reinforcing the functions of these facilities and its maintenance are focused as first priority. We recognise that there are some facilities in the target list but yet to be developed, such as camping facilities and the shelter at Lake Site, however, development of such facilities is pursued with fundraising efforts.

(1) Reinforcing the functions of facilities

The ICC was constructed, however no regular staff has been posted to manage the ICC and the Park. It is expected to deploy the staff in early 2019, and some office equipment should be procured. Such equipment includes; UPS, a cabinet and cash box.

Other equipment may be required to operate the ICC and the Park, and potential partners, such as GEF5, will be approached for funding.

Required official equipment and field gear for the duties include;

- Uniform
- PCs and printers

- Internet connection
- 2-way handy radios
- Bicycles
- Gum boots and rain coats
- Digital cameras
- Torches and batteries
- Mops and brooms, and so on.

Another key issue is how to secure funding. Maintenance of ICC is expected to be the responsibility of CEPA, under the proposed MOU between CEPA and JICA. Types of maintenance expenditure include the costs below.

Table 15.3. Estimated cost of ICC Maintenance

Expenditure	Quantity	Unit Cost (PGK)	Yearly Total (PGK)
Electricity	12 months	100	1,200
Salary for Park Coordinator (Head)	12 months	2,000	24,000
Salary for 2 Park Staff (Security, Fee Collection, and other duties)	12 months	3,000	36,000
Regular maintenance and cleaning, including purchase of consumables	12 months	750	9,000
Total Annual Budget			70,200

* In addition to this annual expenditure, an estimate of PGK90, 000 needs to be secured for periodical maintenance in every three years.

Annual maintenance fee should be 1% of the total construction cost, which means PGK9, 000 per annum for maintenance and PGK750 per month. Other than the annual maintenance fee, periodical maintenance fee needs to be secured, 10% of the total construction cost for every 3 years for example. This calculation suggests PGK 90,000 every 3 years.

This clearly shows that it is essential to secure funds for ICC maintenance, roughly PGK100, 000 per year. This consists of PGK 70,000 as annual budget, and one third of the periodical maintenance cost of PGK90, 000 (= PGK30, 000).

Capacity building of the staff is also required for proper maintenance of the facilities. Not only the ICC but also the other facilities needs to be regularly monitored to inspect the conditions. Monitoring results should be recorded and updated in an inventory sheet, which will help the budget estimate for facility management.

The Park Coordinator is expected to regularly monitor the facilities at first, and develop a monitoring manual. Park staff should be trained with the monitoring manual under the supervision of the Park Coordinator. A simple version of the inventory sheet for monitoring purposes should also be developed.

(2) Remaining facilities in the Target List

There are facilities targeted for renovation by 2018 but yet to be developed, such as;

- Camping facility (door keys, gate, toilet)
- Toilet (cleaning, maintain, replace)
- Handrail (along the track)
- Rangers’ house and quarter (water supply)
- Shelter at the Lake site (restoration and repair)
- Toll gate (improve to bigger toll gate)

These facilities also need to be renovated as soon as possible, particularly the toll gate and toilets. As all the visitors pass the toll gate and visitors in who desperately need the toilets can use these facilities. The status of these facilities plays key roles in visitors’ experience and satisfaction at VNP.

Renovation of these facilities are however not addressed eagerly due to lack of funding. How to secure funding is again a challenge.

Some toilets have been renovated by CEPA, through funding from Digicel, and Coca-Cola and UNDP has been implementing a joint project to renovate lakes in the Park. Good collaboration with such private or private-public initiatives should be sought, and coordination role is required in CEPA to connect the willing organization and the facilities in need.

15.3. Key Actions for Improved Facility Development and Management

Table 15.4 lists up actions to be taken and their priorities for improved facility development and management in the Park, while Table 15.5 shows the Action Plan.

Table 15.4: A list of actions and their priorities for improved security system

Actions	Priority
Procurement of UPS, cabinet and cash box	High
Secure funding for the required official equipment and field gears	High
Procurement of the required official equipment and field gears	High
Internal allocation of budget within CEPA for ICC maintenance	High
Facility monitoring by the Park Coordinator to develop a monitoring manual	High
Training of the Park Staff for facility monitoring	Medium
Development of simpler version of the inventory sheet	Medium
Regular monitoring by the Park Staff	Medium
Secure funding for the remaining facilities	High

Table 15.5: Action Plan

Action	2019	2020	2021	2022	2023
Procurement of UPS, cabinet and cash box	X				



Secure funding for the required official equipment and field gears	X	X	X	X	X	X	X	X	X	X
Procurement of the required official equipment and field gears	X	X	X							
Internal allocation of budget within CEPA for ICC maintenance	X	X	X	X	X	X	X	X	X	X
Facility monitoring by the Park Coordinator to develop a monitoring manual	X	X	X							
Training of the Park Staff for facility monitoring		X	X	X	X					
Development of simpler version of the inventory sheet		X	X	X	X					
Regular monitoring by the Park Staff				X	X	X				
Secure funding for the remaining facilities	X	X	X	X	X	X	X	X	X	X

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