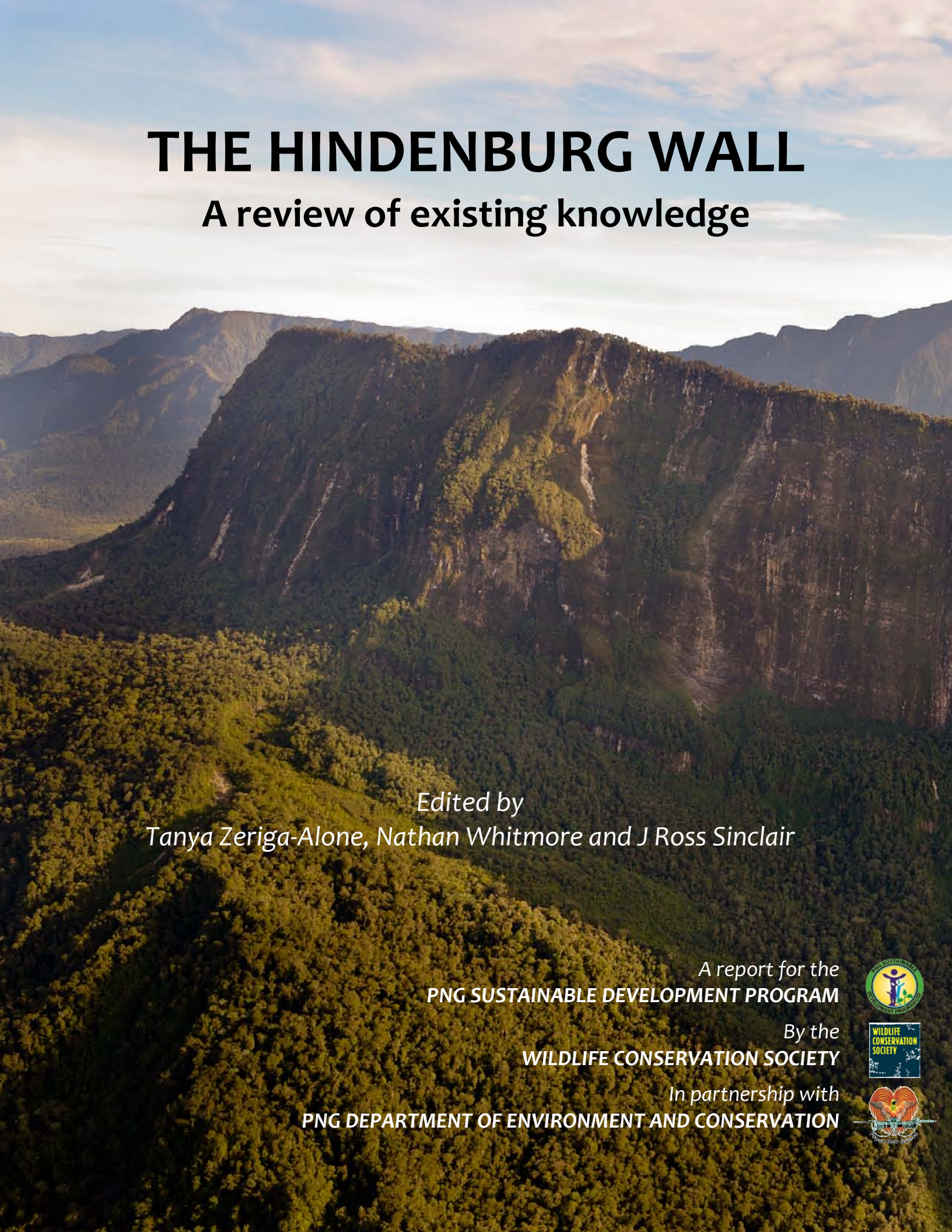
THE HINDENBURG WALL

A review of existing knowledge



Edited by
Tanya Zeriga-Alone, Nathan Whitmore and J Ross Sinclair

A report for the
PNG SUSTAINABLE DEVELOPMENT PROGRAM
By the
WILDLIFE CONSERVATION SOCIETY
In partnership with
PNG DEPARTMENT OF ENVIRONMENT AND CONSERVATION

This review is published by:
Wildlife Conservation Society
Papua New Guinea Program
PO BOX 277, Goroka, EHP
PAPUA NEW GUINEA
Tel: +675-532-3494
wcspng@wcs.org
www.wcs.org

Editors:
Tanya Zeriga-Alone, Nathan Whitmore and J Ross Sinclair.

Contributors:
Ken Aplin, Arison Arihafa, Barry Craig, Bensolo Ken, Chris J. Muller and Stephen Richards.

The Wildlife Conservation Society is a private, not-for-profit organisation exempt from federal income tax under section 501c(3) of the Inland Revenue Code.

The opinions expressed in this publication are those of the contributors and do not necessarily reflect those of the Wildlife Conservation Society or PNG Sustainable Development Program.

Acknowledgement:
The editors would like to thank the contributing writers and also the following: (PNGSDP) **Tricia** Caswell, Stanis Tao, Susil Nelson and Ginia Siaguru; (WCS) Zoe Coulson-Sinclair and Seb Delgarno; (DEC) Secretary Gunther Joku and Rose Singadan; (Rocky Roe Photographics) Rocky Roe; (UPNG) Phil Shearman.

Images:
Rocky Roe (Pages: Front cover, II-VIII, XIV, 1, 4, 7, 8, 24, 40, 60, 63, 74, back cover), Steve Richards (Pages: 19, 27, 28, 36, 84), Ignacio Pazposse (Pages: IX, 21, 31, 37, 41, 61, 64, 75).

Suggested citation:
Zeriga-Alone, T., Whitmore, N. and Sinclair, R. (editors). 2012. The Hindenburg Wall: A review of existing knowledge. Wildlife Conservation Society Papua New Guinea Program, Goroka, PNG.

ISBN:
978-0-646-59013-4

Contents

Organisational Profiles

PNG Sustainable Development Program

PNGSDP was established in 2002 with the mission of promoting development that meets the needs of the present generation and establishes the foundation for continuing progress for future generations of Papua New Guineans. This is achieved by using funds generated from its 64% share in Ok Tedi Mining Limited to support development in PNG, in particular for the people of the Western Province. PNGSDP's objective is to support selected sustainable development programs through projects and initiatives in keeping with the aims and aspirations outlined in the UN Millennium Development Goals.

www.pngsdp.com

Wildlife Conservation Society

WCS is a global not-for-profit organization that has been dedicated to conserving the earth's biodiversity since its establishment in 1898. WCS currently works in more than 50 nations - concentrated in the developing world - to enhance natural resource management and biodiversity conservation. The goals of the WCS programme in PNG are to promote the sustainable use and rehabilitation of terrestrial and coastal marine ecosystems and to identify and implement measures to address the effects of climate change. This approach aims to safeguard biodiversity, livelihoods, cultural heritage, and user rights of Papua New Guineans.

www.wcs.org

PNG Department of Environment and Conservation

DEC is vested with powers to protect environmental values and for the sustainable use of natural resources as mandated by the Fourth Goal of the PNG National Constitution. Its mission is to ensure PNG's natural resources are managed to sustain environmental quality, human well being and support improved standards of living. The Directive Principles of DEC include the wise use of natural resources and the environment in the interest of development and in trust for future generations, the conservation and replenishment of the environment and its sacred, scenic and historical qualities, and giving adequate protection to PNG's unique plants and animals.

www.dec.gov.pg

Participating Authors

Kenneth Aplin
Australian National Wildlife Collection
CSIRO, PO Box 284
Canberra City
Australia
Email: aplin.ken@gmail.com

Arison Arihafa
Wildlife Conservation Society
Papua New Guinea Program
PO BOX 277, Goroka, EHP
Papua New Guinea
Email: aarihafa@wcs.org

Barry Craig
South Australian Museum
North Terrace
Adelaide, SA 5000
Australia
Email: Barry.Craig@samuseum.sa.gov.au

Bensolo Ken
Wildlife Conservation Society
Papua New Guinea Program
PO BOX 277, Goroka, EHP
Papua New Guinea
Email: bken@wcs.org

Chris J. Muller
Planet Earth Pty Ltd
19 William St
Balaclava, VIC 3183
Australia
Email: chrismuller@gmail.com

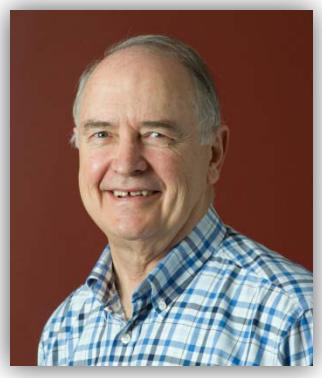
Stephen Richards
Museum & Art Gallery of the Northern Territory
P.O. Box 4646
Darwin, NT 0801
Australia
Email: stephen.richards@nt.gov.au

J. Ross Sinclair
Wildlife Conservation Society
Papua New Guinea Program
PO BOX 277, Goroka, EHP
Papua New Guinea
Email: rsinclair@wcs.org

Nathan Whitmore
Wildlife Conservation Society
Papua New Guinea Program
PO BOX 277, Goroka, EHP
Papua New Guinea
Email: nwhitmore@wcs.org

Tanya Zeriga-Alone
Wildlife Conservation Society
Papua New Guinea Program
PO BOX 277, Goroka, EHP
Papua New Guinea
Email: tzeriga@wcs.org

Foreword



Office of the Chairman

Right in the middle of the island of New Guinea is the towering face of the Hindenburg Wall - or series of walls - stretching over 50km, close to vertical for much of the way, and with sheer 2 km rises in parts. These and surrounding mountains contribute to the flows of four of the world's great rivers: two north, two south, two west into Indonesia and two east into Papua New Guinea. The unique karst topography - the steep ridges, deep ravines, precipitous cliffs, sinkholes, caves, carved outcrops, pinnacles and peaks, narrow river terraces - sustains an arc of known biodiversity, and science tells us to expect much more when careful studies have been completed.

Few people have made their homes in this rugged country, and few pass through it. It is one of earth's landscapes least disturbed by our species - maybe the least disturbed large area in tropical latitudes.

Papua New Guinea Sustainable Development Limited is delighted to work with the Government and people of Papua New Guinea to make the wonders of the Hindenburg Wall and its environs known to more humans, to facilitate its study, and to preserve substantial areas for appreciation by future generations. The recognition of the area as a World Heritage Site would help us to advance these objectives. In the meantime, I invite you to sample the wonders of the Wall in this review of what has become known from earlier studies.

Ross Garnaut
Chairman

Letter of Support

DEPARTMENT OF ENVIRONMENT AND CONSERVATION
OFFICE OF THE SECRETARY

In Papua New Guinea we are blessed with so much natural beauty and so many unique plants and animals. One place that highlights this is the Hindenburg Wall. Although little is known about this place within our own country, the Hindenburg Wall is considered a natural wonder of the world. The paleo-ecological importance of the Hindenburg Wall is clear from its complex limestone topographies and multitude of ecological niches favouring high species diversity and endemism. Acknowledging this unique landscape both for PNG, within the Oceania region and even globally, in 2006 my department proposed the Hindenburg Wall as part of UNESCO World Heritage Site.

Although we can be rightly proud of this landscape, we know very little about it and the species it contains. Thirty years ago a major conservation needs assessment noted the lack of scientific study for the area and little has changed until today. For these reasons, I am delighted that my department has worked with Papua New Guinea Sustainable Development Company Limited and the Wildlife Conservation Society to produce this review that brings together what we know about the Hindenburg Wall. This is first step to gaining an understanding of this little known part of Papua New Guinea and I hope begins the path to us learning more about this unique place and eventually protecting it for future generations.

Gunther Joku
Acting Secretary

About this Review

This book is a review of literature on the biological, geological, cultural and anthropological knowledge of the Hindenburg Wall and adjacent areas.

Naming of the Hindenburg Wall

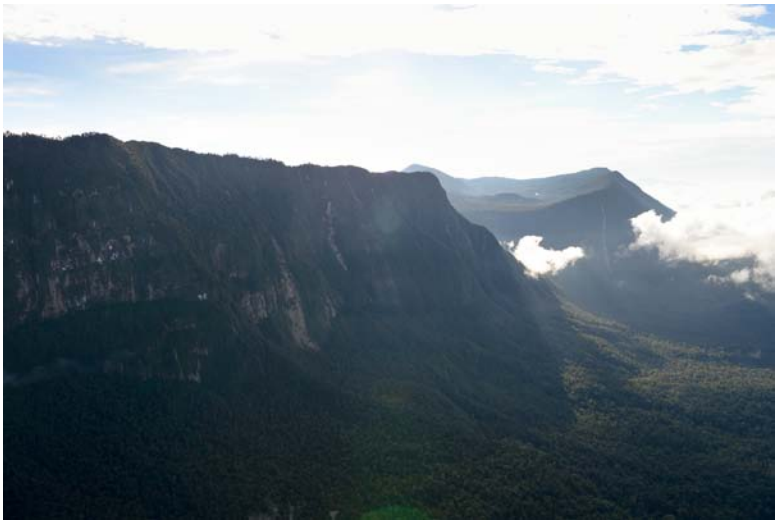
The first European to succeed in entering the highlands of central New Guinea was Richard Thurnwald, a member of the Kaiserin-Augusta-Fluss Expedition of 1912-13. He arrived at the source basin of the Sepik River (in the Telefomin vicinity) on 19 September 1914. It was either Richard Thurnwald or Walter Behrmann, the expedition geographer, who named the high mountains south of the source basin of the Sepik, the Hindenburg Range. Paul von Hindenburg (1847-1934), after which the mountain range and wall were named, was a Prussian-German field marshal, statesman and politician, who served as the second president of Germany from 1925 to 1934. During much of von Hindenburg's life New Guinea was under German administration (1884-1914), before first passing to British (1914) and then Australian (1921) administration, before Papua New Guinea became independent in 1975.

*'**Papua New Guinea**' versus '**New Guinea**'*

Papua New Guinea is the name of the sovereign political state that occupies the eastern half of the island of New Guinea. When considering questions of biogeography or geology the land mass is the usual unit of scientific description. As this is a literature review we have tried to be consistent and faithful to the parent material in our use of "Papua New Guinea" versus the "island of New Guinea" or in some cases "mainland New Guinea".

Altitude

Unless otherwise stated, altitudes are metres above sea level.



Executive Summary

THE HINDENBURG WALL
A review of existing knowledge

A review of existing knowledge

This review summarises 130 years of exploration and research conducted in the vicinity of the Hindenburg Wall. It is a critical first step to gaining an understanding of this little known part of Papua New Guinea (PNG). It was commissioned by The PNG Sustainable Development Program (PNGSDP) and carried out by the Wildlife Conservation Society (WCS) in partnership with the PNG Department of Environment and Conservation (DEC).

The Hindenburg Wall

Thousands of endemic species, those found nowhere else on earth, live among the diverse but poorly known assemblages of flora and fauna in Papua New Guinea. Many unique and interesting species continue to be discovered in areas which have been largely overlooked. The Hindenburg Wall is one such area. It encapsulates all the best characteristics of the wild in PNG: visually stunning, largely unspoiled, biologically diverse, yet poorly known.

The Hindenburg Wall is a spectacular landform that has been described as a natural wonder of the world and is part of a proposed UNESCO World Heritage Site. Rather than a single structure, the Hindenburg Wall is a series of almost vertical walls stretching approximately 50 km across the Star Mountains (Fig. 1).

The submission to UNESCO stated "it is extremely difficult to identify a World Heritage or other property that is genuinely comparable with [the Hindenburg Wall]."

The Hindenburg Wall is in the centre of the island of New Guinea near the border of PNG and Indonesia. The wall occurs in the North Fly District of Western Province. The Wall is made up of a series of escarpments which emerge dramatically from the foothills of the Star Mountains with steep dissected ridges, deep ravines, narrow river terraces, outcrops and pinnacles.

The Hindenburg Wall is classified as karst topography: sedimentary rock outcrops that consist primarily of calcium carbonate. The interaction of soluble rock, in this case limestone, and water, produce unique landforms including towering karsts characterized by tall, precipitous cliffs riddled with caves and sinkholes.

Karst landforms harbour a unique flora that supports animal species different from non-karst areas. Consequently, karst areas have been described as "arks of biodiversity". Yet despite their uniqueness and undoubtedly important biology, the biodiversity of karst areas is probably less well known than almost any other habitat in PNG.

Much of the area along the Hindenburg Wall is uninhabited and has had little human disturbance, consequentially enhancing its potential as a conservation landscape. Critically Endangered species of global significance survive in the area but it remains completely unprotected by legislation.

Geomorphology and climate

The island of New Guinea was formed through the collision of the north-bound Indo-Australian tectonic plate with the west-bound Pacific Plate. The Star Mountains are part of the mountainous spine that runs the length of the island from west to east. This central mountain chain divides the island of New Guinea into distinct northern and southern lowland areas, while between them is a high mountain cordillera. In this part of New Guinea, rapid tectonic uplift commenced around 7 million years ago. It continues at a reduced rate even today.

The general rainfall pattern in PNG is influenced by the alternating northerly monsoon winds in the north and south-easterly trade winds in the south. Due to the fact that the Hindenburg Wall spans a large altitudinal gradient it is exposed to both climatic systems.

The Hindenburg Wall is located in the "mid-altitude fringe high rainfall zone" characterized by continuous heavy rainfall. Higher elevations on the Hindenburg Plateau experience lower rainfall than the foothills, the wall itself and its surrounding slopes.

The persistent cloud cover, high rainfall, low temperatures and consistent humidity of the Hindenburg Wall has implications for the distribution of plants and animals.

The Hindenburg Wall catchment is of vital importance for much of Western Province as it forms the catchment for the Fly and the Strickland rivers which in turn are used by the local communities for water, fisheries, and transport.

Exploration and anthropological research

The Northern Fly district in which most of the Hindenburg Wall sits is one of the most sparsely populated areas within PNG with fewer than 2.3 people per square km.

Over 130 years ago in the late 1870's European explorers began their first expeditions into the area. These included Luigi D'Albertis (1870s), the first European explorer to come within sight of the highlands of central New Guinea, Richard Thurnwald (1912-13), the first European to succeed in entering the highlands of central New Guinea, and Leo Austen (1922), a Papuan administration Patrol Officer, the first to reach the southern foothills of the Hindenburg Range.

Perhaps the most notable expedition was the 1965 Australian Star Mountains Expedition which crossed the Star Mountains northwards. This expedition was conducted in the colonial era style of geographic discovery and collected substantial anthropological, linguistic, biological and geological data.

Additional biological surveys relevant to the ecology of the Hindenburg Wall were conducted by Dutch researchers in 1959, 1966 and 1975 in the Star Mountains of what is now Indonesian New Guinea.

The indigenous inhabitants of central New Guinea have been termed the "Mountain-Ok" people, after the name for the sub-family of languages. More recently, the Mountain-Ok people are being called the "Min". The cultures of the Mountain-Ok people are, like their languages, closely related. Professional anthropological research of the Mountain-Ok has been extensive.

The relative homogeneity of languages among the Mountain-Ok and the shared mountain environment have created a relatively homogenous culture. Kinship is usually reckoned through mother and/or father and most marriages occur between people within villages rather than between villages. Marriage reinforces existing ties rather than creating new ones.

Villages typically consisted of no more than a dozen family houses, built around a central cleared plaza with a men's cult house at the 'upstream' end.

Men's rituals are focused around a series of initiations where inductees are introduced to the men's cult secrets. Sorcery was believed to

be common and these practices continue today despite widespread allegiance to Christianity.

Historically, the most important crop for Mountain-Ok groups was taro and a great deal of effort was invested in growing large tubers.

Domestic pigs were more numerous among the central and more populous Mountain-Ok groups than among peoples on the fringe, who had better access to wild animals.

Abandonment of traditional practices in favour of a cash economy is now common in the region of the Mountain-Ok. Initiation rituals and much of the traditional knowledge are now lost to younger generations. With the widespread abandonment of the men's cult and a significant number of men entering paid employment, the women have been forced to switch to the easier cultivation of sweet potato. Consequently, the knowledge and skills required for the cultivation of taro and associated men's cult rituals are being lost.

The traditional pre-Christian beliefs, traditional knowledge of plants and animals have not necessarily disappeared despite the majority of the population of central New Guinea professing adherence to Christianity.

Vegetation of the Hindenburg Wall

The tectonic history of the island of New Guinea has left a legacy of "biological signatures" among plant and animal groups. The ancient Gondwanic (Australasian) flora is mixed with Laurasian (Asiatic) elements as a result of invasion and immigration by the Asian floras from the west and north.

The island of New Guinea has a rich and diverse flora of between 15,000-20,000 species of vascular plants, including approximately 2,000 species of orchids. The only area in PNG where flora is adequately known is from Pindaunde Valley on Mt. Wilhelm. The plants of the Hindenburg Wall remain poorly described.

Vegetation on the Hindenburg Wall is controlled by several abiotic features, including elevation and topography, the dominant limestone substrate, rainfall, cloud and wind.

The forest of the upper Ok Tedi River catchment starts at foothill rainforests (500-1000 m) where some commercial logging occurs of mixed tree species. The lower-montane forest (1000-1800 m) is dominated by secondary forest in different stages of succession. Above the settlement zone is low-altitude mid-montane forest (1800-2200 m) which is characterise by reduced solar radiation and continuous cloud cover and rain, leading to low plant growth and frequent landslides. Mid-montane forest is found above the Hindenburg Wall with lower rainfall and variable composition of forest communities. Subalpine heathlands occur in this zone, and are dominated by sedges and grasses which occur in swampy inter-montane basins above 1800 m.

The Star Mountains is botanically very diverse, with many high altitude species and an estimated >3000 species of plants in the altitudinal range from 1800-3500 m.

Further botanical surveys are needed for an adequate understanding of flora of the Hindenburg Wall area. Recent botanical surveys elsewhere in PNG in montane forests and karst landforms have found over a dozen species of plants new to science, and a similar number of new species could be anticipated from the Hindenburg Wall area.

The Star Mountains are considered one of the most important areas for conservation because the rugged landscape and low human population means its botanical character is still largely intact. Currently, there are no sites with formal protection in the Star Mountains.

Vertebrates of the Hindenburg Wall

The patterns of vertebrate[1] diversity and distribution have been strongly influenced by New Guinea's complex tectonic history. Most groups of vertebrates have strong links with those of Australia.

[1] Animals possessing a backbone.

Tectonic movements over vast time periods combined with mountain-building gave rise to distinct and complex biogeographic groupings of vertebrates that we are only just starting to understand.

The vertebrate fauna of island of New Guinea show high levels of endemism[2]. The Upper Ok Tedi is thought to have a particularly high level of endemism as a result of the high rainfall and persistent cloud cover that compresses ecological zonation and allows many species to coexist in a comparatively small area.

The Hindenburg Wall itself appears to act as a barrier between the south and the north with the foothills having species related to the south, while the Hindenburg ranges have species related to the north, with minimal mixing between the two.

Mammals of the Hindenburg Wall

At least 242 mammal[3] species are present in PNG, of which at least 57 are endemic.

There are potentially 108 mammalian species inhabiting the Hindenburg Wall area. Bats, rodents and marsupials comprise the greater proportion of the mammalian diversity on the island of New Guinea, with bats being especially numerous. Included amongst the bat fauna is Bulmer's Fruit-Bat, *Aproteles bulmera*, which was thought to be extinct until rediscovered on the Hindenburg Wall. The species is currently ranked as Critically Endangered by the International Union of the Conservation of Nature (IUCN) [4].

Many bats of Papua New Guinea roost in caves and some form huge maternity colonies. Consequently, the protection of the karst landscapes which they inhabit would likely safeguard the future of many species.

Birds of the Hindenburg Wall

Birds are the best known class of animal in the region. There are 781 species of birds in Papua New Guinea, with 76 endemic and 28 considered globally threatened.

347 species of birds, including at least 16 species of Bird of Paradise, are likely to occur in the vicinity of the Hindenburg Wall and Ok Tedi area, which represents about 45% of the PNG total.

One species from the area is classified by the IUCN as Endangered (Vulturine Parrot) while six are classified as Vulnerable (New Guinea Harpy-Eagle, Doubled-Wattled Cassowary, Single-Wattled Cassowary, Black Saber Tailed Bird of Paradise, Sheep-Makers Crowned Pigeon, and Macgregor's Bird of Paradise).

Reptiles & amphibians of the Hindenburg Wall

There are over 600 species of reptiles and amphibians known from the island of New Guinea, more than 80% of them endemic. New Guinea's forests support a high diversity of herpetofauna[5], especially frog species, many of which are new to science. The numbers of new species discovered recently at similar elevations elsewhere in PNG indicate that the Ok Tedi headwaters and the Hindenburg Wall are likely to harbour a diverse herpetofauna including many species new to science.

There are at least seven families of reptiles in the Upper Ok Tedi area, including three snake families and at least four lizard families. Around 50 species have so far been identified with skinks making up nearly 50% of the total.

The conservation status has not been assessed for over three quarters of the reptile species likely to be present on the Hindenburg Wall.

The frog fauna of the island of New Guinea appears to have evolved and radiated from relatively few progenitors (i.e. direct ancestors). Four of the five families of native frogs in New Guinea are represented in the upper Ok Tedi

[2] Native only to that particular area.
[3] A class of warm blooded vertebrates possessing hair.
[4] The IUCN categorises species from highest to least extinction risk: 1) Critically Endangered (CE), 2) Endangered (EN), 3) Vulnerable (VU), 4) Near Threatened (NT), and 5) Least Concern (LC). Other categories are Data Deficient (DD) and Not Evaluated (NE).
[5] Collective name for all reptiles and amphibians.

area. More than 45 frog species are already known from the region and many more species probably remain undiscovered.

Recent rapid biological surveys conducted at comparable elevations in the upper Strickland basin and the Muller range, just east of the Hindenburg Wall, revealed a total of 61 species of herpetofauna (49 frogs, 12 reptiles), of which at least 25 species of frogs were new to science.

Studies of Papua New Guinean frogs are in their infancy and there is a pressing need for research on basic taxonomy and ecology.

Butterflies of the Hindenburg Wall

The island of New Guinea boasts nearly 1000 described butterfly species, of which approximately 840 are recorded from PNG. For its land area, New Guinea's butterfly fauna is one of the most diverse in the world.

As many as 458 butterfly species may occur in the vicinity of the Hindenburg Wall, representing approximately half of the known butterflies in PNG. Such diversity alone would grant the area 'hotspot' status.

Several species of the world's largest butterfly genus, the Birdwings (genus *Ornithoptera*) are likely to occur in the vicinity of the Hindenburg Wall. The Endangered Ornithoptère Méridional (*Ornithoptera meridionalis*) will likely be found in the vicinity of the Hindenburg Wall, as will two other Birdwing species, *Ornithoptera goliath* (the second largest butterfly in the world) and *Ornithoptera priamus.*

Birdwings are the only butterflies in PNG that are considered to be threatened under IUCN criteria, but detailed assessments of all PNG species are required because many taxa are known to occupy very small ranges and others should probably be listed as Data Deficient.

Many butterfly species in the Hindenburg Wall area are likely to occupy very narrow altitudinal ranges and the sheer gradient and exaggerated relief of the Hindenburg Wall has acted as a barrier preventing lowland species in the south from dispersing to the north.

Habitat loss is the most important potential impact on the survival of butterfly species. Many butterflies are sensitive to degradation of their environment and even slight changes in the structure and composition of forest can result in a loss of butterfly species.

Pristine habitats such as those in the vicinity of the Hindenburg Wall can quickly become degraded and lose sensitive groups like butterflies if not managed properly. Impacts of particular concern in the vicinity of the Hindenburg Wall include habitat destruction and the introduction of invasive species such as parasitic flies and wasps, cane toads and invasive ants.

Conservation and further research

The Hindenburg Wall is proposed as a UNESCO World Heritage Site as part of the 'Sublime Karst of Papua New Guinea' along with two other sites. A major Conservation Needs Assessment conducted over 30 years ago noted a lack of scientific study and highlighted the importance of future studies for the Hindenburg Wall. Despite its importance no biodiversity inventory or formal protection has eventuated for the Hindenburg Wall.

Dozens of species new to science await discovery on the Hindenburg Wall. Recent surveys of the Nakanai Mountains and Muller Range, sites also proposed for World Heritage listing, revealed over 100 species new to science at each site. An equivalent survey of the Hindenburg Wall would likely reveal a similar number of new species.

There is also a paucity of basic ecological information for species we know to exist in the vicinity of the Hindenburg Wall. These include some of PNG's most iconic and at risk species, including the Critically Endangered Bulmer's Fruit-Bat and Long-Beaked Echidna. A further 13 species of threatened birds and mammals are also likely to occur in this area. Protecting

the Hindenburg Wall will go a long way to ensuring the survival of these species.

Protection of the Hindenburg Wall will buffer against future biodiversity losses resulting from climate change. Incorporating a large intact area of contiguous forest along an altitudinal gradient, the Hindenburg Wall and its surrounding landscapes offer potential refuge for many species against the impacts of climatic change. Additionally, the area's high biodiversity offers a large reservoir for genetic adaptation to a world with a changing climate.

The Hindenburg Wall additionally represents a notable carbon sink due to its vast standing stock of forest. Thus the existence of this forest in itself helps mitigate against future climate change.

The undoubted aesthetic and spiritual values of the Hindenburg Wall should be complemented by surveys to describe its biodiversity value and importance.

World Heritage listing and protection

The Hindenburg Wall is worthy of a UNESCO World Heritage listing given an assessment of the literature presented in this report.

Protecting the Hindenburg Wall area would not only provide security for the landscape and its biodiversity but also safeguard the many cultural and archaeological sites which lie within it.

The exceptional and iconic landscape of the Hindenburg Wall remains mysterious and largely unknown***.*** Despite being a wonder of the natural world, few people know of its existence, even within PNG. Closer scientific exploration of this unique area will inevitably turn the eyes of the world to PNG and its iconic Hindenburg Wall.

An expanded bibliography

An expanded bibliography is provided with references cited in this review and others relevant to the Western Province.

Chapter 1

The Hindenburg Wall

One of the last great wild places

Thousands of endemic[6] species live among the diverse but poorly known assemblages of flora and fauna in Papua New Guinea (PNG). The land harbours 7% of the world's biodiversity in less than 1% of the area. Rivalling this biodiversity is a stunning array of landforms ranging from alpine grasslands above 4000 m elevation to lowland forests that meet the sea. Although there is a long history of biological expeditions in PNG, many unique and interesting species continue to be discovered in the areas which have been largely overlooked. The Hindenburg Wall is one such area and it encapsulates all the best characteristics of the wild in PNG: visually stunning, largely unspoiled and biologically diverse, yet poorly known.

A natural wonder of the world

The Hindenburg Wall is a spectacular landform that has been described as a natural wonder of the world. Along with the Muller Range and Nakanai Mountains, the Hindenburg Wall is a proposed UNESCO World Heritage Site called *The Sublime Karst of Papua New Guinea*. The submission to UNESCO[7] described the Hindenburg Wall as an exceptional testimony to a cultural tradition (i.e. the many caves and overhangs that contain artefacts, paintings and stone carvings), a superlative natural phenomenon of exceptional natural beauty and aesthetic importance, an outstanding example of a major stage of earth's history, an outstanding example of ecological processes, and among the most important natural habitats for in-situ conservation of biological diversity (Hamilton-Smith 2006). In terms of the last two biological criteria, it described the area as "data deficient". Further underlying the unique quality of this area, the submission concluded that "it is extremely difficult to identify a World Heritage or other property that is genuinely comparable with this."

Rather than a single structure, the Hindenburg Wall is a series of walls that, in total, span 50 km within the Star Mountains (Fig. 1). With a mixture of high rainfall (more than 7 m annually), steep topography and rapid uplift, the area is highly dynamic and landslides are a common occurrence. Such conditions promote diversity and endemism, and there are undoubtedly many new and exciting species to be discovered.

The geological and geomorphological composition of the Hindenburg Wall is quite complex, but it can be understood as a spectacular example of karst topography. Karsts are created by an interaction between an outcrop of soluble rock (in this case limestone) and water flowing both above and below ground. They include many dramatic and unique landforms, including the towering karsts of the Hindenburg Wall, which are characterized by tall, precipitous cliffs riddled with caves and sinkholes. Such a complex landform results in numerous microhabitats and a multitude of ecological niches. In turn this often results in high species diversity. High species endemism also occurs on karsts with

[6] Endemic means restricted to one particular area and found nowhere else on earth.

[7] "The Sublime Karsts of Papua New Guinea" 2006. Submission to UNESCO for World Heritage Tentative List.

surface and cave levels, both of which provide ideal conditions for speciation[8].

The unique karst flora that also supports animal species different from non-karstic areas arises from a combination of highly alkaline conditions, thin soil cover and desiccation on porous limestone bedrock. Animals that live underground in a karst landscape, such as arthropods and fishes, often evolve specializations to cope with fluctuating levels of light, water quantity, temperature, humidity, gas concentrations, and organic material. The relative stability and antiquity of some subterranean karst ecosystems often enable ancient faunas to persist.

These characteristics have lead to karstic areas being described as "arks of biodiversity" (Clements 2006). Despite their uniqueness and undoubted biological importance, the remoteness and difficulty of working in the karst landscapes of PNG have ensured that their biodiversity is probably less well known than any other habitat type.

Biological surveys have been recently undertaken in other karst areas in PNG – the Muller Range and Nakanai Mountains - where many new species of mammals, frogs, plants and insects were discovered, and rare species of birds recorded. In total over 2,000 species were recorded including approximately 350 that were new to science (Richards and Gamui 2011). Although little is known about the biodiversity of the Hindenburg Wall, a similar pattern of discovery could be expected. Such a biological survey would likely result in the discovery of at least a 100 species that are new to science.

Much of the area along and around the Hindenburg Wall is uninhabited by humans, making it less disturbed than virtually any other part of the country and further enhancing its potential as a conservation landscape. Critically Endangered species of global significance such as Bulmer's fruit-bat and the long-beaked echidna are known to survive in the area.

Despite being truly a natural wonder of the world, the Hindenburg Wall is completely unprotected. And despite the global significance of this remarkable area, there has been no previous summary of knowledge of the biological and cultural values of the Hindenburg Wall.

Location of the Hindenburg Wall

The Hindenburg Wall is situated in the centre of the island of New Guinea near the border of PNG and Indonesia. The wall occurs in the North Fly District of Western Province, the largest province in PNG. The area is bordered by Sandaun Province to the north, Southern Highlands to the east, and the Indonesian Province of Papua to the west.

The Hindenburg Wall is a series of escarpments on the southern side of the Star Mountains. These mountains run from the snow-capped Mt Julianna which rises 4700 m above sea level in the west to the Strickland Gorge in the east. On the southern boundary between the southern foothills and the Star Mountains, the landform falls abruptly in a series of east west escarpments towards the Fly and Digul river headwaters. The Hindenburg Wall forms part of this southern escarpment. This area lacks the extensive inter-montane valleys that occur in other parts of the PNG highlands. The landscape consists of steep dissected ridges, deep ravines and narrow river terraces with karst outcrops (dolines) and pinnacles. Potassium-argon dating from the central highlands suggests that the present relief was attained some 1.6 to 1.9 million years before present (Gillieson and Hope 1990).

Four great rivers originate in the Star Mountains: the Sepik to the north-east, the Fly to the south-east, the Idenburg/Memberamo to the north-west and the Digul to the south-west. The narrow watershed of the Hindenburg Wall separates the wide lowland plains of the Sepik and Fly basins. Above the summit of the wall,

[8] Speciation is a process in which one species diverges into two new species.

the Hindenburg Plateau extends northward to the slopes of the Bahrman Mountains.

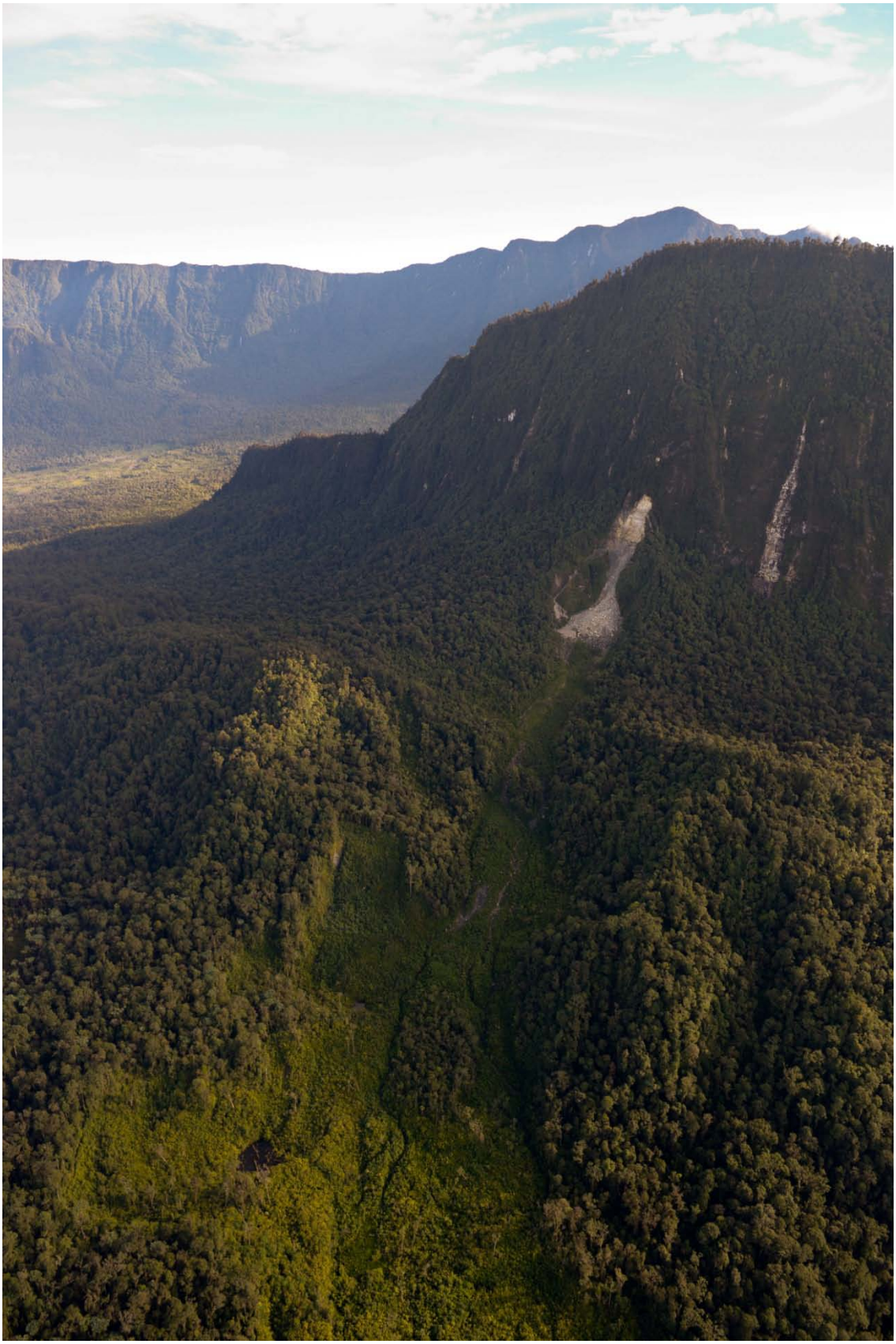
This review focuses on the southern fringe of the area and more specifically on the Hindenburg Wall, Upper Ok Tedi and Hindenburg Plateau. The lower reaches of the Upper Ok Tedi river start at 600 m at the Ok Kam Junction, and the Kam basin hosts the headwaters of the Ok Tedi River (also known as the Alice River), a major western tributary of the Fly River drainage. This upland country is within the highest rainfall regime of the southern mid-altitude fringe.

The Hindenburg Wall is a barrier for species dispersing from the south. However, there is mixing of species in the zone between the Hindenburg Wall and the Victor Emanuel range near Telefomin. These two mountain masses are adjacent high spots within a continuous mountain range and share biogeographic similarities. Indeed the birds of Hindenburg Plateau and the Victor Emanuel Range are considered a single unit because of their biogeographic similarities (Gilliard and Lecroy 1961).

A review of existing knowledge

This report is a review of literature pertaining to the Hindenburg Wall. It is a critical first step to gaining an understanding of the area. The review summarises 130 years of exploration and biological, geological, cultural and anthropological research that has been conducted in the vicinity of the Hindenburg Wall.

Figure 1: The Hindenburg Wall (shaded red) shown in relation to the Ok Tedi river and mine (shaded yellow) and its location in Papua New Guinea (insert).



Chapter 2

Geomorphology and climate

A tectonic history of collision and uplift

At its most basic level the island of New Guinea was formed through the collision of the north bound Indo-Australian plate with the west bound Pacific Plate. This collision was augmented by the movements of three smaller Plates: Philippine Sea, Caroline and Solomon plates (Polhemus 2007). These plate motions led to island arcs being pushed against the leading edge of the Australian Craton[9] (Polhemus 2007). As a result, the island of New Guinea may be thought of as an amalgam of three geological provinces (Pigram and Davies 1987, Williamson and Hancock 2005). The first province, essentially part of the Australian block, underlying the Fly Platform and much of PNG to the south (Loffler 1977). The second province, comprising the mountainous spine of PNG, is the New Guinea Orogen[10] - a primary collision zone which can be divided into the western (Highlands and Ramu–Sepik regions) and eastern (Papuan Peninsula and Islands) orogens (Loffler 1977, Williamson and Hancock 2005). The third province, the Melanesian Arc, is a series of formerly separate island arcs that are now welded onto the northern margin of the mountainous spine.

The Star Mountains are part of the mountainous spine of the island of New Guinea that runs the length of the island from west to east. This central mountain chain divides the island of New Guinea into distinct northern and southern lowland areas, while between them is a high mountain cordillera. This cordillera is a

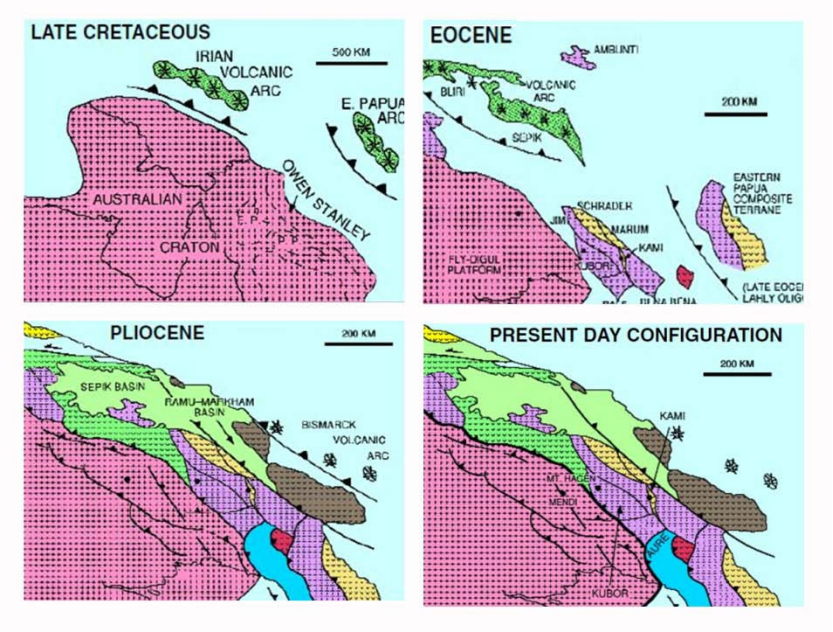


Figure 2: The geological and tectonic history of PNG: In the Late Cretaceous (`70 million years ago) the collision of the volcanic arcs, during the Eocene (56-37 million years ago) terranes sutured to the craton, during the Pliocene (5.3-3.6 million years ago) the Bismark volcanic arc collision with the Australian craton, and present-day configuration. (Modified from Williamson and Hancock 2005)

[9] A craton is a large, coherent domain of Earth's continental crust that has attained and maintained long-term stability.

[10] An Orogen is a long track of highly deformed rock cuased by a severe structural deformation of the Earth's crust.

result of tectonic activities that started 68-61 million years ago in the Late Cretaceous (Williamson and Hancock 2005).

The far western and eastern parts of the central cordillera originally formed as separate islands, perhaps as early as the Late Cretaceous (Williamson and Hancock 2005), as the northward-moving Indo-Australian tectonic plate began to fragment ahead of its collision with the westward-moving Pacific Plate (Polhemus 1997: Fig. 2). With the onset of collision, oceanic island arcs made up primarily of volcanic rocks formed to the north of these continental fragments (Doutch 1972, Audley-Charles 1991). Continued northward drift of the Australian landmass over the past 10-12 million years saw the various island groups gradually come together to form the modern island of New Guinea. During the same period, collision forces also caused rapid vertical uplift along the entire length of the island, resulting in formation of the central cordillera.

The Darai limestone of the Hindenburg Wall was formed in a deep water basin between Australia and the early islands of the proto-New Guinea (Davies 1990). In this part of New Guinea, rapid tectonic uplift commenced around 7 million years ago. It continues at a reduced rate even today.

Heavy rain and persistent cloud cover

The general rainfall pattern in PNG is influenced by the alternating northerly monsoon winds from December to March and south-easterly trade winds from May to October. During the season of the south-easterly trade winds there is a decrease in rain in the south and an increase in rain on the unexposed northern side. This pattern is reversed for the northerly monsoon winds. The trade winds and monsoon westerlies are effectively capped by a strong temperature inversion layer at ~2000 m. As a result the highland regions of the island of New Guinea are not generally affected by trade and monsoon winds but rather have a climate dominated by local convection (Prentice and Hope 2007). Due to the fact that it spans a large altitudinal gradient, the Hindenburg Wall is exposed to both climate systems.

The Hindenburg Wall is located in the "mid-altitude fringe high rainfall zone" which is characterized by continuous heavy rainfall. Rainfall recorded at the OK Tedi Mine reveals that this area is one of the wettest areas in PNG (over 7000 mm per year). Rainfall is seasonal with a maximum between December and March (average of 29 mm per day) and minimum between April and August (average 15 mm per day). In Tabubil (500 m) rainfall maxima and minima were identified as March-April and August respectively (Hyndman and Menzies 1990). With increasing altitude there is a decreased difference between the wettest and driest months (Hyndman and Menzies 1990). Higher elevations on the Hindenburg Plateau experience lower rainfall than the foothills, the wall itself and its surrounding slopes.

The Hindenburg Wall has persistent cloud cover, especially in the ***area*** to the south (Hyndman 1979). In this part of PNG, for every 200 m increase in elevation, the average temperature decreases by about 1^{o}C. However, despite this temperatures in the area around the Hindenburg Wall are lower than other sites in PNG at a similar elevation. For example, the mean maximum temperature for Wau is 25^{o}C, whereas at a similar elevation Ok Mountain is only 20^{o}C (Hyndman and Menzies 1990). This lower average temperature has been attributed to the heavy rainfall and perpetual cloud cover.

The giant escarpments of the Hindenburg Wall and the Bahrman Range give rise to unique patterns of air movement that have sculpted the rock surface and caused stunted vegetation along the wall (Hyndman 1984). The high rainfall and lower temperatures in the area affects relative humidity, which never falls below 80% and doesn't change with altitude (Hyndman and Menzies 1990). This persistent cloud cover, high rainfall, low temperatures and

consistent humidity have implications for the distribution of plants and animals.

Karstic soils

In general the soils of the Northern Fly area are derived from weathered rock and are relatively low in nutrients due to leaching from high rainfall. Where karst features are common, such as around the Hindenburg Wall, limestone soils are dominated by shallow, stony Rendzinas (a dark, greyish-brown, humus-rich soil formed by weathering of carbonate rocks). On very steep slopes Orthents (formerly called Lithosols) dominate, whereas deeper red and brown calcareous soils are common on older surfaces and stable slopes (Wood 1982). Such karstic environments have been associated with endemism and rarity in the tropics (Tuyet 2001, Salas *et al.* 2005).

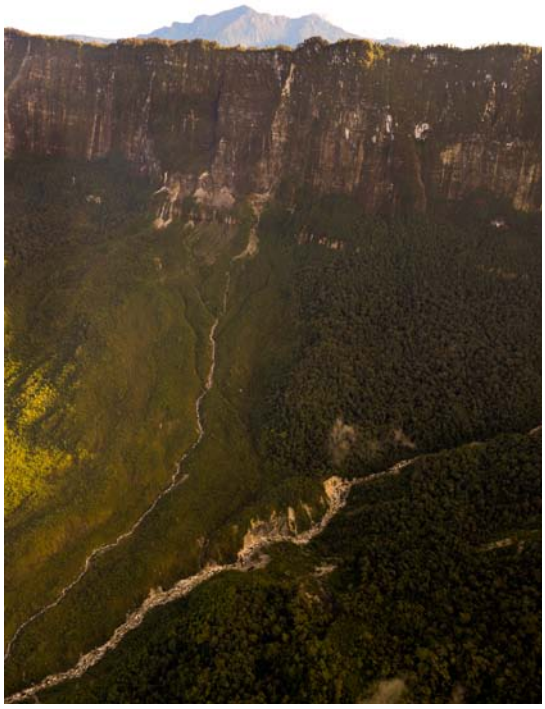
Soil formation is influenced more by topography, climate and vegetation than by the parent material according to a soil study in the Antares region of the Star Mountains (Reijnders 1964).

A spectacular karst-dominated landform

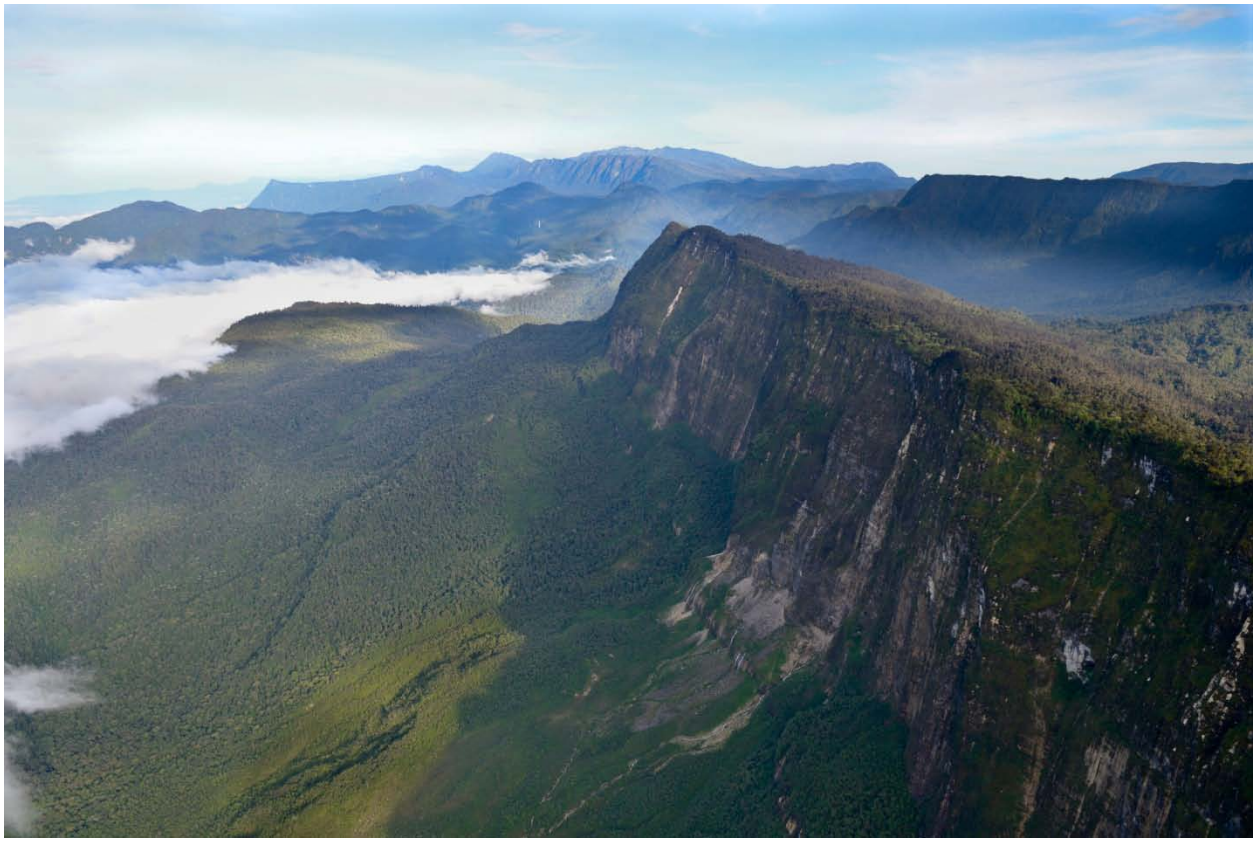
The Hindenburg Wall is a spectacular landform, ***stretching up to 50 km long*** and rising to heights of almost 2 km. The structure is a series of walls within a karstic landscape. With soluble limestone and high rainfall, a landform ***The Hindenburg Wall and its surrounding forests form part of the upper catchment of the Fly River***. This catchment is of vital importance for the provisioning of ecosystem services[11] to many people in Western Province who rely on its water supplies and harvest its fish. In addition the karstic environment creates a substantial groundwater reservoir (Hamilton-Smith2006).

of tower karsts has formed with tall precipitous cliffs riddled with caves and sinkholes.

The Hindenburg Wall has been estimated to be retreating at the rate of 2-3 m per 100 years due to high rainfall and the large number of landslips (Gillieson 1983). The combination of high rainfall, steep topography and frequent earthquakes, means the Hindenburg Wall is prone to massive landslides. For example, in January 1977, 5-7 million m^3 of the Hindenburg Wall fell into the Ok Kam River and resulted in the river bed aggrading by more than 2 m. The water was discoloured downstream and fish were killed for weeks after the slide (Byrne *et al.* 1978, Blong 1986). The frequency of landslips in the area is not known but Byrne *et al.* (1978) estimate that one large landslide occurs approximately every 10 years.



[11] The services a natural ecosystem provides e.g. water and air quality, wild game, erosion control, and CO_2 sequestration.



Chapter 3

Exploration and anthropological research

Sparsely populated and remote even today

The Hindenburg Wall falls within the North Fly District of Western Province of PNG. The North Fly District encompasses the Hindenburg Range in the north and the plains of the Ok Tedi, Strickland and Fly Rivers. Less than a quarter of the North Fly District is inhabited and the population density across the district is low at 2.3 people per km^2 (NRI 2010). The 51,000 people who inhabit the Northern Fly district are mostly based around the centres of Kiunga and Tabubil.[12] Annual incomes and agricultural potential are low across most of the district. Agriculture is constrained by steep slopes in the ranges, and by high rainfall and flooding in the valleys. The Ok Tedi mine provides a source of income through salaries, royalties and remittances (NRI 2010).

Access within the district is somewhat limited, however a road built by Ok Tedi Mining Ltd links Tabubil and the district capital, Kiunga. Water transport is the norm along the river systems. Communities east of the Ok Tedi river and in the Hindenburg Range remain remote and hard to access (NRI 2010).

Over 130 years ago European explorers first began their journeys into this remote region that was to western eyes unexplored and even uninhabited region.

[12] For the purpose of this chapter, the geographical limits of the 'Hindenburg Wall' are the international border to the west as, and the Strickland River to the east, along the southern slopes of the Wall and into the hinterland at the top (north) of the Wall. This is justificied because of cultural and ecological continuities in the fields of anthropology outside the strict boundaries of the Wall.

History of European exploration

Luigi D'Albertis was the first European explorer to come within sight of the highlands of central New Guinea. He and his engineer Lawrence Hargrave took the steam launch *Neva* up the Fly River, into its eastern tributary (the Palmer) to a point about 15 km south of the Donaldson Range, a south-eastern spur of the Hindenburg Range. On 17 June 1876 he recorded: "At last I have seen the lofty mountains of the interior of New Guinea . . . like giants of differing heights towering one above the other, and extending from the principal chain down to the river". He named the range 'Victor Emmanuel' after the King of Italy (D'Albertis 1881, Goode 1977).

The first European to succeed in entering the highlands of central New Guinea was Richard Thurnwald, a member of the Kaiserin-Augusta-Fluss Expedition of 1912-13 (Craig 1997b). He arrived at the source basin of the Sepik River (in the Telefomin vicinity) on 19 September 1914. It was either he or Walter Behrmann, the Expedition geographer, who named the high mountains south of the Sepik source basin, the Hindenburg Range (Thurnwald 1916, Behrmann 1924).

In 1922 a Papuan administration Patrol Office called Leo Austen was the first to reach the southern foothills of the Hindenburg Range. He followed the Ok Tedi north until, on the 6th of November, he reached a point most likely about 8 km north of the present-day town of Tabubil. His description of the Ok Tedi at that point suggests that he was at the confluence of the Ok Tedi, Ok Mabiong and Ok Kam (account and maps: Austen 1923a, 1923b, 1925).

During a second patrol by Austen in 1924 *(Austen 1926)*, he followed the Palmer

upstream to the Tully (Wai Moi), struck north across country to the western end of the Donaldson Range. Afterwards he then went west to the Fly River below its exit through the ranges at Gum Gorge. This is about 15 km south-west of the Dap Range and arguably the most eastern extent of the Hindenburg Wall.

Lieutenant-Governor Hubert Murray, the administrator of what was then called Papua, was keen to send a patrol to cross the central range from the Fly to the Sepik. Austen was greatly disappointed when Murray chose Charles Karius and Ivan Champion for this expedition (Champion 1966), which made an unsuccessful attempt to cross the Hindenburg Range to the Sepik in 1926-27. They made their way through the lower ranges at the western end of Mt Blucher, enabling Karius to explore the headwaters of the Murray River at the eastern end of the Hindenburg Range while Champion befriended the people of Bolobip, a village at the foot of the Dap Range.

Their second attempt in late 1927 was successful. Bolobip men led the patrol up the wall of the Dap Range and north across the limestone barrier to the Sepik headwaters, where the Feramin villages are located. They continued on through Telefomin, down along the Sepik where Thurnwald had struggled over a dozen years before, to meet the Papuan government yacht *Elevala* at the junction of the Sepik and October Rivers on 19 January 1928.

Karius and Champion were followed in 1935 and 1936-37 by a gold prospecting expedition run by an American, J. Ward Williams, with Stuart Campbell as pilot for the expedition's aircraft. Campbell flew reconnaissance in 1935 over the Hindenburg Range and down the valley of the Sepik (Campbell 1938, Kienzle and Campbell 1938, Williams 1961). To enable the expedition to fly in to the Sepik source basin, they first had to follow the trail of Karius and Champion through Bolobip to Telefomin and prepare a landing strip. This they did, and explored the valleys to the north and north-east of Telefomin, but found no worthwhile signs of gold. However, both Williams and Campbell made ethnographic collections, the former now housed in the Los Angeles County Museum of Natural History and the latter in the Australian Museum in Sydney. These were the first artefacts to have been collected directly from the Mountain-Ok of central New Guinea.

The airstrip at Telefomin was extended and improved for military purposes during WW2 and a Patrol Post was established there by Ivan Champion in 1948. But it wasn't until 1964 that Olsobip Patrol Post was established in the Fly headwaters, a day's walk west of Bolobip and about 12 km south of the Hindenburg Range. This facilitated the administration of the people (Angkeiakmin, Faiwolmin and Wopkaimin) living along the southern side of the Hindenburg Range in the shadow of the Wall.

In 1965 six members of the Australian Star Mountains Expedition set out west from Telefomin to the Kauwol Valley, crossed the Star Mountains northwards to Busilmin in the Din Valley, and returned along the Ilam valley headwaters to Tifalmin and Telefomin (Shepherd 1974). During the three month expedition, they collected anthropological and linguistic data, and herpetological and botanical specimens. Tom Hayllar collected bats and insects for the South Australian Museum while David Cook studied the geology and Mike Shepherd recorded evidence of glaciation in the Star Mountains. A number of sinkholes and caves were explored, and the mountains Capella (4015 m) and Scorpion (3713 m) were scaled. Subsequently, in 1967, 1972, 1981 and 1983 Barry Craig walked between Telefomin and the Ok Tedi-Fly River headwaters via Tifalmin, crossing the Hindenburg Wall north of Tabubil, during ethnographic surveys of central New Guinea.

Anthropological collections and literature

The people of central New Guinea have been termed the 'Mountain-Ok',[13] after the name for the sub-family of languages, coined by linguist Alan Healey (Healey 1964). These languages are spoken from the Sibil Valley in [West] Papua eastwards as far as the Strickland River. More recently, the Mountain-Ok are being called the Min. The cultures of the Mountain-Ok are, like their languages, closely related. Indeed the suffix *–min* indicates 'people', thence Telefol-min, Wopkei-min, and Faiwol-min. Note that Telefomin is the spelling for the location of the District administrative centre and airstrip, while Telefolmin is the name for the people inhabiting Ifi-taman (Ifi-valley), in which Telefomin is located, and Elip-taman (Elip-valley) to the north.

The earliest professional anthropological research of the Mountain-Ok was carried out at Telefomin by Ruth Craig in 1962-65, 1967 and 1972. Her paper on marriage practices of the Telefolmin was published in 1969. Dan Jorgensen also carried out research at Telefomin between 1974-75. His PhD thesis (Jorgensen 1981) examined the theme of order and entropy in the society, religion, and the life of the Telefolmin with an emphasis on the interpretation of secret rites and myths of the men's cult. The Jorgensen thesis provided a base-line exposition of a central Mountain-Ok society against which variations in the accounts of the cultures of other Mountain-Ok societies were later compared (e.g. Craig 1990).

Robert Brumbaugh was based at the Misinmin/Telefolmin village of Namindumavi, during 1977-78. His research and PhD thesis focused on the men's cult (Brumbaugh 1980). His research provided an overview of the Afek myth widespread among the Mountain-Ok and includes reference to the Wopkaimin and Faiwol-speaking groups living south of the Hindenburg Range.

[13] 'Ok' means 'water' or 'river' in this sub-family of languages. More recently, the Mountain-Ok are being called the Min.

Bryan Cranstone of the British Museum spent several months among the Tifalmin west of Telefomin in 1964 collecting and documenting ethnographic material for the British Museum. His ethnography was subsequently published (Cranstone 1971). He allocated part of the collection to the museum in Port Moresby, now the Papua New Guinea National Museum and Art Gallery (PNGNMAG). Cranstone's research extended the observations of the Dutch Star Mountains Expedition of 1959 (Brongersma and Venema 1962, Kooijman 1962) and the early observations and collections at Telefomin by Campbell (1938).

During 1969-70, Wilson Wheatcroft was based among the Tifalmin to research religious symbolism as expressed in the male initiation cult (Wheatcroft 1976). His illustrated chapter on the Tifalmin was published in the National Geographic Society's 1973 book, *Primitive Worlds* (Wheatcroft 1973). A portion of Wheatcroft's ethnographic collection was sold to Charles Penney, who subsequently donated it to the South Australian Museum (Penney 1988).

During 1965-67, a team of anthropologists attached to the Ethnological Museum in Basel, Switzerland, carried out several research projects in the Sepik River basin. As part of this enterprise, Meinhard and Gisela Schuster spent some months at Eliptaman, the valley immediately north of Telefomin, and collected ethnographic material for the Basel Museum. A profusely-illustrated report was published by M. Schuster (1969).

The two research projects most relevant to the relationship between humans and the flora/fauna were those by human ecology researchers George Morren (1968-69) among the Mianmin around the May River headwaters north of Eliptaman, and David Hyndman (1973-74, 1975 and subsequently) among the Wopkaimin of the Ok Tedi headwaters.

Morren and Frodin (1992) produced 'A Preliminary Vernacular Guide to the Vegetation of Northern Telefomin District,

Papua New Guinea' in addition to Morren's published version (Morren 1986) of his PhD thesis (1974), This includes a listing of over 1500 ethnobotanical records for both Mianmin and Telefolmin. Morren collected ethnographic material, about half of which he presented to the PNG Museum and the other portion he kept for teaching purposes.

David Hyndman's PhD thesis on Wopkaimin subsistence (Hyndman 1979), contains detailed lists of species of plants and animals, including their scientific, common and vernacular names. The maps in his thesis are regarded as the most comprehensive and detailed of those produced by the researchers of the Mountain-Ok region. Hyndman's collection of ethnographic material was deposited in the University of Queensland museum.

The Ok Tedi copper-gold deposits have generated opportunities for a great deal of research and publication. One of the earliest and most accessible studies was Richard Jackson's 1982, *Ok Tedi: the Pot of Gold*. Subsequently other researchers have reported on the environmental, social and cultural impacts of the mine (e.g. Maunsell and Partners 1982, Craig and Hyndman 1990).

In 1982, Christopher Roberts (1982) recorded and transcribed songs of the Wopkeimin, and obtained translations and explanations of the significance of the imagery in the songs. These were published as *Music of the Star Mountains* in Mandarin Chinese (Taiwan) (Roberts 1996). An English version is to be prepared during the second half of 2012.

East of the Ok Tedi headwaters, Barbara Jones carried out research among the Fegolmin/Faiwolmin living in villages on the Fly River headwaters, directly beneath the Hindenburg Wall. The subject of her research was food and illness, including beliefs about witchcraft and sorcery, curative practices and the roles of spirits and ghosts. Her thesis was presented in 1980. No ethnographic collection was made.

Further east again, in 1968 Frederick Barth worked among the Faiwol-speaking 'Baktamin/Baktaman'[14] of the Murray Valley, south-east of the Hindenburg Range. His first publication (Barth 1971) on the intertribal relationships in the southern Mountain-Ok region provides a useful overview of cultural features in the region. His first book (Barth 1975) provides a more detailed exposition of the Baktamanmin men's initiation rites. His second book (Barth 1987) identifies the circumstances and processes that lead to change and thus, variation in cultural practices. Barth's ethnographic collection was distributed between two museums in Norway.

Across the eastern side of the Murray River from the Baktamanmin are the Bimin-speaking Kwermin, who were studied in 1994-5 by Sveinn Eggertsson. His 1997 PhD thesis and 2003 book (Eggertsson 1997, 2003) explain how the Kwermin draw an analogy between skin and knowledge, where coming to know something is referred to as 'making it skin' and involves 'narratives of growth'. The book includes accounts of the male ritual cycle, witchcraft and sorcery. Eggertsson made a small ethnographic collection which he retains for teaching purposes.

To the north of the Kwermin are the Bimin-Kuskusmin, who were studied by John Fitz Porter Poole (1971-73). His PhD thesis (Poole 1976) on male initiation ritual includes numerous references to flora and fauna of special significance to the Bimin-Kuskusmin. He wrote and published many papers and his ethnographic collection was presented to the PNGNMAG.

Further north of the Bimin are the Oksapmin. They are well outside the Hindenburg Range region and do not speak a Mountain-Ok language but many aspects of their culture are similar to that of the Mountain-Ok societies. Arnold Perey carried out research among the

[14] The Baktamin/Baktaman should be termed Baktaman-min; Bak is the river, -taman- is 'valley' and -min is 'people'; thus, 'the people of the Bak Valley'.

Oksapmin (during 1967-68). His PhD thesis (Perey 1973) provides a description of the economy, social organisation and other aspects of the culture of the Oksapmin. He made a significant collection of Oksapmin artefacts which he donated to the PNGNMAG and a small portion he retained for study purposes. A multi-authored publication on the Oksapmin (Weeks 1981) covered issues of development and change among the Oksapmin.

Turning back westwards from the Oksapmin, Roger Lohmann lived with the Asabano (previously called the Duranmin) on the headwaters of the Om/Strickland River, during 1994-95. His research and subsequent PhD thesis (Lohmann 2000) focused on the circumstances of the rapid conversion of the Asabano to Christianity and consequent loss of indigenous religious beliefs. Joel Robbins investigated the Christian beliefs of the Urapmin (west of Telefomin) during 1991-93, the results of which were presented in his PhD thesis (Robbins 1998).

Don Gardner worked among the West Miyanmin near the present-day location of Yapsei airstrip, 1975-76. His PhD thesis (Gardner 1981) focused on men's cult and social organisation. Eytan Bercovitch carried out research among the Nalumin (Atbalmin) on the Din River, about 20 km south of Yapsei and well north of the Star Mountains, during 1981-1985. His PhD thesis (Bercovitch 1989) focused on "secrecy as it occurs in their everyday lives rather than in their religion".

Thomas Michel did research among the Ngalum speakers on the Indonesian border west of Tumolbil and north of the Star Mountains in 1983-84. He published a paper (Michel 1988) demonstrating the link between ecological zones and hunting trophy arrays in men's cult houses (cf. Craig 1990b).

Pamela Swadling published evidence (1983) for the origin and dispersal of the peoples of central New Guinea, sites of archaeological and traditional significance, sources of materials for stone tool manufacture, and data about trade routes and trade goods. Swadling *et al.* (1990) provided radio-carbon dating evidence that people have been in the Ifi valley, where Telefomin is located for about 17,000 years, and evidence from an excavation in the village of Telefolip, the most sacred site of the Mountain-Ok, indicated it was established 300 to 400 years ago.

During the 1980s, the technology and cultural significance of looped string bags was studied in central New Guinea and the upper Sepik by Maureen MacKenzie (MacKenzie 1986). Her work was subsequently published as a book (MacKenzie 1991).

The Upper Sepik-Central New Guinea Project identified some 12,000 objects collected from the upper Sepik and central New Guinea. The project was carried out at the South Australian Museum and University of Adelaide between 2004-2010 (see www.uscngp.com). It set up a searchable database documenting items held in museum and private collections worldwide. Of these about 10,000 objects are associated with precise collection localities. The USCNGP website includes translations of two of Thurnwald's Sepik reports.

Biological expeditions

The first biological survey relevant to the ecology of the Hindenburg Wall came in 1959 by the Dutch based in the Sibil Valley in the western Star Mountains (Brongersma and Venema 1962). There are numerous publications (many in Dutch) on the flora and fauna resulting from that expedition and other researchers have worked on the large collections made from the then-Dutch New Guinea Star Mountains.

The Australian Star Mountains Expedition 1965 resulted in significant plant and herpetological collections, and several specimens of bats. Around 500 specimens of plants went to the Lae Herbarium and subsequently, certain plants were sent to overseas specialists, especially in the Netherlands. Over 460 specimens are in the South Australian Museum along with Fred

Parker's collection of 116 frogs and fifteen specimens of bats and an insect collection (that is stored by species name rather than by locality). It is thought the reptile specimens may have ended up at Harvard University.

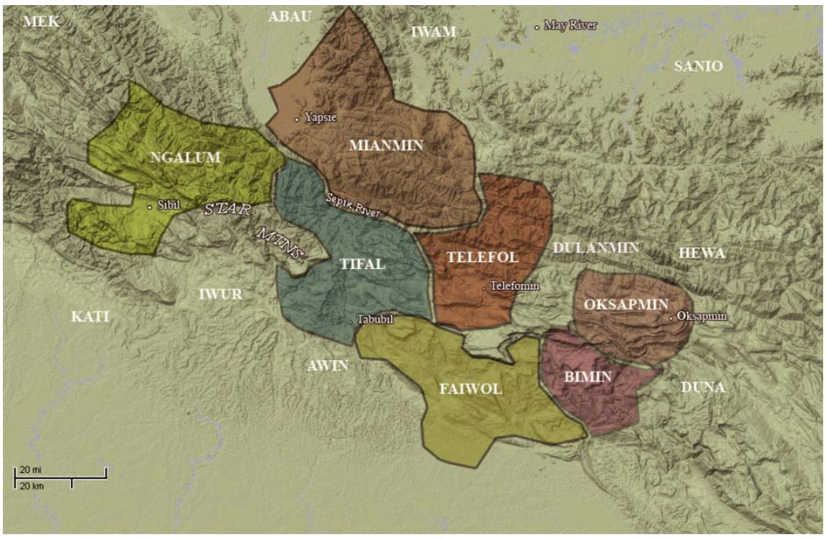
The Dutch botanist Cornelis Kalkman of the Herbarium at Leiden collected in the Hindenburg Range and Telefomin areas in 1966. Kalkman had previously published material from the Dutch 1959 Star Mountains Expedition, of which he was a member (Kalkman 1963). J.F. Veldkamp, also of the Leiden herbarium, collected in the PNG Star Mountains in 1975 during a joint expedition with the Lae Herbarium.

Language and Kinship of the Mountain Ok

The Mountain-Ok share a sub-family of languages. Papua New Guineans are typically multi-lingual, especially if they have trade partners in other language groups. The relative homogeneity of language and mountain environment (settlements are generally around 1500 m) is correlated with relative homogeneity of culture. Kinship is usually reckoned cognatically (i.e. through mother and/or father) and most marriages occur between people within villages rather than between villages. Marriage reinforces existing ties rather than creates new ones. As most people are connected to most other people by a number of kinship links, friendships are more important than kin ties for day to day social interaction. However, the relationship between siblings, and those between brothers-in-law are important and these relatives are often found together in the same household.

Rituals of the Mountain Ok

Men's rituals were focused around a series of initiations, the first taking place around the age of 6 to 8 years. The earlier stages of initiation usually took place in the local settlement's men's house but later stages of initiation (there may be as many as eight) were organised in cult houses at a more central location (e.g. Ifitaman Telefolmin organised higher level rites at Telefolip, Angkeiakmin performed theirs at Bolovip and Wopkeimin at Bultem). These rites introduced those to be initiated to the men's cult secrets, each level providing more knowledge than previous ones. Those to be initiated were instructed to forget what they were told at the previous level as it was not the true story and that each proceeding level was the 'true and complete version'. Rituals involved the hunting of certain animals and 'feeding' them to the ancestors to enlist supernatural assistance in hunting, warfare and gardening. The skulls and other bones of ancestors were preserved in string bags in the men's houses and among some groups in the family houses as well. Some groups considered these relics too 'hot' to keep in the settlements and placed the skulls and bones in rock shelters some distance away. Cannibalism was practised



The languages of the Hindenburg Wall. There is relative homogeneity of language and mountain environment in the region shown that is correlated with a relatively homogeneity of culture.

by some groups, though avoided by many individuals, but headhunting was unknown. Sorcery was believed to be common and ritual specialists could be called upon for healing and divination. These beliefs continue today despite widespread allegiance to Christianity: predominantly Roman Catholic in the south and Protestant in central and northern areas.

Material culture of the Mountain-Ok

Material culture is relatively homogenous throughout the Mountain-Ok region. Men used bows and arrows for hunting and warfare, and made large wooden rectangular shields for defence. They also used wooden spatulate clubs and stone-headed clubs in warfare, traded stone adze blades from far to the west in West Papua and from the headwaters of the Leonhard-Schultze River, via the Oksapmin, in the north-east. They grew, traded and smoked tobacco in bamboo pipes. They also made musical instruments including the hourglass-shaped wooden hand drum with lizard-skin tympanum, and the jaw's harp. The of men's cult houses, as well as some family houses of the Mountain-Ok, were decorated with carved and painted boards bearing designs like those on their wooden shields. Shells for ornament and as valuables were traded in from neighbouring groups. The skills of women in making looped string carrying bags ('bilums' in Pidgin English; "men" in Mountain-Ok languages) were highly regarded. Women wore short reed skirts open at the sides and men wore gourd phallocrypts. Houses were gable-roofed rectangular buildings not usually larger than 25 m^2 with one or two hearths and a small doorway requiring one to stoop to enter. Settlements consisted of family houses, rarely more than a dozen, built around a central cleared plaza with a men's cult house or houses at the 'upstream' end.

Important crops of the Mountain-Ok

The most important crop for most Mountain-Ok groups was taro. This plant is more difficult and slower to grow than sweet potato and much ritual was devoted to ensuring success in gardening enterprises. A great deal of pride was invested in growing large taro tubers. Most households had several gardens at different stages of cultivation in several locations for continuity of supply and to minimise risk from plant diseases. Domestic pigs were more numerous among the central and more populous Mountain-Ok groups, partly because land use for horticulture pushed wild animals to the periphery. Peoples on the fringe, having better access to wild animals, had few truly domesticated pigs – usually only piglets captured in the wild and reared in the settlement.

Unexplained man-made cave structures

The Hindenburg Plateau contains cave systems which have been used and augmented by humans. Aside from their use as hunting shelters, constructed pit structures have also been found within them. Gillieson (1980) speculated variously that these pit structures in the Selminum Tem Cave could have been pit traps, animal storage pits or may have had a role in ritual. The Tifalmin hunters who accompanied Gillieson were unable to explain the structures.

Changing culture, changing ecosystems

Change and the abandonment of traditional practices in favour of a cash economy, more scattered settlements with iron roofs on larger houses, and modern technologies are now common in the region of the Mountain-Ok. Several primary schools and high schools at Telefomin and Tabubil have played a significant role in providing ideas and skills that replace those previously acquired through a traditional initiation process. As a consequence much traditional knowledge and many skills are now lost among the younger generations. The presence of the Ok Tedi mine has accelerated this process.

It should not be assumed that traditional beliefs are lost because people profess adherence to Christianity. Although the majority of the population of central New

Guinea may profess adherence to Christianity, their traditional pre-Christian beliefs and knowledge associated with the men's cult, ancestral sprits, bush spirits, and the practice of magic and sorcery have not necessarily been forgotten or abandoned completely. Or, that in the context of a money economy derived from the wealth of the Ok Tedi mine, traditional taxonomies and knowledge of the uses of plants and animals have been irretrievably depleted.

The knowledge and skills required for the cultivation of taro were strongly supported by aspects of the men's cult rituals and required considerable investment of male energies in felling and clearing trees, and fencing gardens. With the widespread abandonment of the men's cult and a significant number of men working at the Ok Tedi mine, women in the absence of their husbands and brothers have been forced to switch to the easier cultivation of sweet potato.

Such cultural changes have flow-on ecological effects. For example access to shotguns and a lessening of respect for certain animals previously restricted by cult practices could cause a serious decline in those animal populations. Similarly, the widespread switch from taro as a staple food to sweet potato has implications for gardening practices and resulting in pig husbandry (as pigs can eat sweet potato raw but taro has to be cooked before it can be fed to pigs). This in turn could bolster feral pig populations and increase their deleterious effect on the biota of the area.

Table 1: Chronology of major expeditions in the vicinity of the Hindenburg Wall

Year	Researcher	Location	Topic / purpose	Collection location
1935-37	J. Williams & S. Campbell	Telefomin	Gold prospecting	Angeles County Museum of Natural History & Australian Museum
1962-72	R.Craig	Telefolmin	Marriage practices	-
1964	B. Cranstone	Tifalmin	Ethnographic collection	British Museum & PNG NMAG
1965	Australian Star Mountains Expedition	Star Mountains	Anthropological & ecological collection & exploration	Lae Herbarium, South Australia Museum, Harvard University
1965-67	M. & G. Schuster	Eliptaman	Ethnographic collection	Basel Museum
1966	Leiden Herbarium	Hindenburg Range & Telefomin	Botanical collection	Unknown
1967-83	B. Craig	Telefomin-Ok Tedi	Ethnographic survey	-
1967-68.	A. Perey	Oksapmin	Social organisation	PNG National Museum & Art Gallery
1968	F. Barth	Baktamin/Baktaman'	Intertribal relationships	Two Norwegian museums
1968-69	G. Morren	Mianmin	Human ecology	PNG National Museum & Art Gallery
1969-70	W.Wheatcroft	Tifalmin	Religious symbolism	South Australian Museum
1971-73	J. Poole	Bimin-Kuskusmin	Male initiation ritual	PNG National Museum & Art Gallery
1974-75	D. Jorgensen	Telefolmin	Order & men's cult	-
1973-85	D. Hyndman	Wopkaimin	Ethnobotany	Uni. Queensland, Lae Herbarium
1975	Lae & Leiden Herbariums	Hindenburg Ranges	Botanical collection	Unknown
1975-76	D. Gardner	Miyanmin	Men's cult	-
1977-78	R. Brumbaugh	Namindumavip	Men's cult & Afek myth	-
1980	B. Jones	Fegolmin/Faiwolmin		-
1981-85	E. Bercovitch	Atbalmin	Secrecy	-
1982	R. Jackson	Ok Tedi	Impact of mining	-
1982	Maunsell & Partners	Ok Tedi	Impact of mining	-
1982	C. Roberts	Wopkeimin	Songs of the Wopkaimin	-
1983	P. Swadling	Central New Guinea	Archaeological sites	-
1983-84	T. Michel	Ngalum	Hunting trophies	-
1986	M. MacKenzie	Central New Guinea	Significance of bags	-
1991-93	J. Robbins	Urapmin	Christian beliefs	-
1994-5	S. Eggertsson	Kwermin	Rituals and sorcery	Private collection
1994-95	R. Lohmann	Asabano	Religious conversion	-
2004-10	South Australia Museum & University of Adelaide	Upper Sepik Central New Guinea Project	Collection database	www.uscngp.com

Chapter 4

Vegetation of the Hindenburg Wall

Flora affinities to Gondwana and Laurasia

The tectonic history of the island of New Guinea has left a legacy of 'biological signatures' among the plant and animal groups amassed there (Polhemus and Polhemus 1998). New Guinea's biota shows affinities with both the south-east Asian continental elements to the west and north, and the Australian elements to the south, mainly of Gondwanic origin.

A synthesis of the flora of New Guinea explains the Gondwanic origin of many plants in New Guinea (Walker and Hope 1982, cited in Gressit 1982). As the leading edge of the Australian plate moved towards Southeast Asia, the rainforest that originally covered a significant part of the Australian continent combined with other vegetated land fragments. About 23 million years ago some plants of Gondwanic origin on this landmass ended up in what is now the island of New Guinea. Examples of such plants include *Nothofagus* and *Podocarcpus,* which have been present on New Guinea since the mid-Miocene. This ancient Gondwanic flora was then exposed to invasion and immigration by the Asian floras to the west and north, around the time when the Australian and south-east Asian crustal plates reached their present positions about 10 million years ago (late Miocene).

Rich but inadequately understood flora

The island of New Guinea has a rich and diverse flora of between 15,000-20,000 different species of vascular plants, including approximately 2,000 species of orchids and more than 2,000 species of pteridophytes (ferns and allies). The number of lower plants is unknown (Johns 1993). From a review of literature, Johns (1993) stated that the only area in PNG where flora is adequately known is from Pindaunde Valley on Mt. Wilhelm. Consequently, the plants of the Hindenburg Wall remain poorly described.

Environmental controllers of vegetation

Vegetation on the Hindenburg Wall is controlled by several abiotic features:

(1) Elevation and topography: the Hindenburg Wall rises from 600 m to an average of 2,200 m a.s.l at the rim of the wall and this increase in altitude happens within a plane of less than 1 km.
(2) Limestone: the dominant substrate known for its floristic endemism
(3) Climate: the area has the highest rainfall in PNG with annual precipitation exceeding 6000 mm (Loffler 1977) and persistent cloud cover (Hyndman 1979)
(4) Wind: the unique patterns of air movement around the giant scarps of the Hindenburg Wall have cause stunted vegetation along the wall (Hyndman 1984).

Four different vegetation zones are identified in the upper Ok Tedi rainforest by Hyndman and Menzies (1990): (1) foothill rainforest, (2) lower-montane rainforest, (3) low altitude mid-montane rainforest and (4) mid-montane rainforest (Table 2). Others have identified three divisions: the lower-montane (900-1300 m), mid-montane (1300-2700 m) and upper-montane (above 3000 m, Johns 1976, Johns 1993).

The forest on the upper Ok Tedi starts at foothill rainforests from 500-1000 m. The dominant substrate is old weathered soil, an

extension of the soil from the Australian continent. Being in the shadow of the central mountains, this zone gets higher than usual rain. The foothill rainforest has mixed tree species and is also where commercial logging occurs.

The lower-montane forest is the main human settlement zone between 1000-1800 m and is dominated by secondary forest in different stages of succession (Hyndman and Menzies 1990). The cultivation zone, between 1200-1750m, comes under the shade of cumulus clouds along the rim of the Hindenburg Wall. This cloud cover reduces night-time cooling, increases plant respiration and therefore decreases net photosynthesis and decreases crop production. Moss forest, as low as 1750 m, restricts the upper boundary of agriculture and therefore human settlement.

Above the settlement zone is low-altitude mid-montane forest from 1800-2200 m. The wall itself experiences reduced solar radiation, and continuous cloud cover and rain. Such conditions impede photosynthesis, leading to low plant growth but greater ephyphitic and fungal growth (Gillieson and Hope 1990). No food production takes place in this zone, although edible pandanus 'nuts' do occur (Hyndman 1984, Hyndman 1986, Gillieson and Hope 1990). Landslides play a predominant geomorphic role in this zone.

The mid-montane forest is found above the Hindenburg Wall and is gently undulated, with a few peaks exceeding 3000-3500 m. The soil substrate on the crest of the wall is subject to slipping. This zone receives half the rainfall of lower vegetation zones. Variation in the forest community composition occurs due to the elevation, cloud cover and rainfall. Subalpine heathlands occur in this zone, and are dominated by sedges and grasses which occur in swampy inter-montane basins above 1800 m.

The Star Mountains is botanically very diverse, with many high altitude species and an estimated >3000 species of plants in the altitudinal range from 1800-3500 m (Johns 1993).

Several genera are particularly diverse in the area and local endemics also occur*. Pandanus* and *Schefflera* are particularly diverse groups in the Ok Tedi headwaters and include many locally endemic species (Hyndman and Menzies 1990). Twelve *Pandanus* species occur in the Ok Tedi area, many of which are endemic to New Guinea, with one species, *P. iwen,* locally endemic. *P. iwen* is an understorey plant that grows in mid-montane rainforest (Hyndman and Menzies 1990). Twenty *Schefflera* species occur in the Ok Tedi headwaters, again many of which are endemic to New Guinea, with nine locally endemic.

Several threatened plants occur in the region. Most notable among them is *Calophyllum heterophyllum* which grows into a canopy tree on low ridges at 100m altitude, but forms only shrubs and saplings on poor loam soils at 120 to 1300 m (WWF PNG and PNG FSC National Initiative 2006). Other threatened plants such as *Santalum macgregorim, Alloxylon brachycarpum* and *Flindersia ifflaina* occur at lower elevations in Western Province (and into parts of West Papua) where they can be found in savannah vegetation, monsoon and gallery forest and in lowland rainforests <50 m in altitude.

Further research and conservation

Further botanical surveys are needed for an adequate understanding of flora of the Hindenburg Wall area. Like almost all areas in PNG, the flora of the Hindenburg Wall area is poorly known. Each new survey undertaken in PNG results in the discovery of many species new to science. For example, in a recent Rapid Assessment Program survey undertaken in the karst landforms and montane forests of the Muller Range found one genus and 15 species of plants new to science (Takeuchi 2011), while a similar assessment in the Kaijende Highlands of Enga Province found a further 16 plants new to science (Takeuchi 2007). These two localities lie in the central range of the PNG highlands

and have karst topography and altitudes similar to the Hindenburg Wall. Therefore a similar number of new species could be anticipated from such an equivalent assessment.

Current knowledge of plant diversity in PNG is somewhat biased towards lower-montane forest zone due to the greater collection effort that has taken place there in the past. This is well-illustrated by an analysis of the plant voucher plant specimens held at the PNG National Herbarium and the University of PNG Biology Department (Hyndman and Menzies 1990). By extension, other forest zones in PNG, such as those on the Hindenburg Wall, remain relatively understudied.

Karstic environments are noted for their floristic endemism and the recent survey of the Strictland basin by Takeuchi (2011) continues this pattern. Given the low sampling saturation of rapid biological surveys many more botanical discoveries await in the karstic areas of PNG (Takeuchi 2011).

The Star Mountains, of which the Hindenburg Wall is a part, are considered one of the most important areas for conservation in PNG (Johns 1993). Despite the intrinsic ecological values of the Star Mountains there are currently no sites with formal protection.

The Hindenburg Wall's natural botanical character is still largely intact as a consequence of the rugged character of landscape and low human population. However, substantial deforestation has occurred on the Hindenburg plateau. Much of this coincided with the 1997-1998 El Niño drought and likely were a consequence of fires associated with subsistence agriculture.

Mid-montane forest above the Hindenburg Wall where subalpine heathlands occur in swampy inter-montane basins above 1800 m. (© Stephen Richards)

Table 2: Botanical descriptions of the vegetation zones of the Hindenburg Wall.

Zone	Type	Alt (m)	Description	Dominant species
1	Foothill forest	500-1000	Also referred to as hill forest, low altitude forest, upland rainforest, sub-montane rainforest Mixed evergreen forest with closed canopy with 2-3 poorly defined but heterogeneous layers	Emergent trees up to 30 m include *Syzygium*, *Caldcluvia* and *Vitex*; the second layer, the canopy reaching 20-25 m represents *Barringtonia*, *Syzygium*, *Linociera* and *Horsfieldia*; and the third strata 10-15 m includes young canopy trees of *Linociera*, *Urophyllum rostratum* and *Dysoxyllum* among others
2	Lower-montane	1000-1800	Mixed evergreen forest with 20-30 m canopy; also referred to as mid-montane forest, mid-mountain vegetation and mid-mountain rainforest. This is a settlement zone throughout the central highlands of New Guinea	*Castanopsis acuminatissima* stands above the canopy up to 40 m; no clear stratification of the forest compared to other forest zones
2a	Secondary woodland		Succession communities derived from abandoned gardens leading to advanced woodland	Pioneer stage consists of ferns, forbs and grasses. Later a young forest establishes together with vegetation such as gingers, *Acalypha* and *Cordyline terminalis*. In time this gives way to *Albizia-Callicarpa-Cyathea* woodland. This results in a secondary forest where *Albizia falcataria* and *Meliosma pinnata* rise to 30 m as emergents while *Callicarpa, Euodia, Glochidion* and *Saurauia* form the canopy at 10-12 m in older secondary forest. Other species such as *Macaranga, Maesa, Symplocos* and *Bambusa* occur in the understory
3	Low altitude mid-montane	1800-2200	Narrow band on the slopes and base of the Wall - distinctive low altitude mid-montane rainforest	*Syzygium* and *Garcinia* dominate the canopy to 30 m high while *Pandanus antaresensis* stands tall at 25 m. *Schefflera forbesii* is the only prominent epiphyte in this heavily mossed zone. There is an irregular understory of 10-12 m of tree ferns, *Matthaea, Myristica subalulata, Cinnamomum* and *Cryptocarya sp* among others. The shrub layer consists of young plants of higher layers, ferns, *Rhododendron* and *Mackinlaya* bushes and gingers; the ground is usually wet, bare of herbs and covered in moss and sodden litter. Furthermore, this zone has low forest dominated by *Macaranga* due to unstable environment
	Moss forest	1800-2500	Moss forest sheer face of the Wall	9-10 m tree stratum of *Ficus* and *Saurauia* occurs covered by moss thicker than on the downslope
4	Mid-montane Rainforest	2200- 3000		Typical species of mid-montane - dominated by *Nothofagus pullei* and *Pandanus brosimos* and scambling bamboo. On the plateau conifers occur but more typical of exposed areas. Dotted across the drier more northern portion of the plateau are subalpine heath lands dominated by sedges and grasses. The wet southern portion of the plateau has emergents over 30 m dominated by *Nothofagus pullei* and *Conandrium polyanthum* while the canopy of 20-25 m height is dominated by *Canarium, Pittosporum rostratum, Elaeocarpus* and *Aglaia*. The understory is <10 m and consists of *Homalanthus, Urophyllum rostratum, Pandanus brosimos, Matthaea,* and *Sloaena*. The exposed areas contain more conifers, *Libocedrus papuana* occurs in the emergent layer at over 50 m while the conifer *Dacrycarpus compactus* occurs in the canopy layer of 30-40 m together with other angiosperms like *Garcinia, Ascarina, Dissochaeta, Eurya,* and *Syzygium* and *Aglaia,* among others. The understory is 10-20 m and consists of *Pandanus iwen* rather than *P. brosimos* together with *Xanthomyrtus*, *Dacrycarpus compactus, Cinnamomum* and many others. Then at <10 m height, saplings of canopy and emergent species occur together with ferns of *Dicksonia* and *Nastus productus* at ground level.

(Modified from Hyndman 1979, Hyndman and Frodin 1980, Frodin and Hyndman 1982)

Chapter 5

Vertebrates of the Hindenburg Wall

Biogeography

Like the flora of New Guinea, the pattern of vertebrate biodiversity is also correlated with the tectonic history (Heads 2001). But whereas the flora shows a close affinity to the Asian continent, most groups of New Guinean vertebrates have strong links with those of Australia. For example, the two land masses share 13 bird families that are absent from Asia (Dingle 2004), including the Birds of Paradise and Rifle Birds (Paradisaeidae), which are all endemic to Australia and New Guinea (Beehler *et al.* 1986) and not found in Asia.

Tectonic movements over eons resulted in the accretion of land to the main island of New Guinea (Fig. 2). These lands (terranes) were habitats in their own right with distinct plants and animal communities before they joined mainland New Guinea. For example the absence of Birds of Paradise (Paradisidae) from the northern islands of PNG is "…not because they are unable to fly there, or were there and went extinct, but because their early Tertiary ancestors did not live in the region." (Heads 2001).

Subsequent mountain-building processes gave rise to distinct north–south and east–west sub-divisions in many groups of vertebrates (Aplin 1998). These occurred in the northern margin of the Australian Craton, as well as in the terranes accreted to the margin separating the north and south of the island of New Guinea (Michaux 1989, Joseph *et al.* 2001). The fauna of the Hindenburg Wall area contains elements that do not occur further east. This part of the country appears to represent an incursion of western New Guinea fauna into eastern New Guinea, and the faunal discontinuity lies some 100 km east of the border with Indonesia (Hyndman and Menzies 1990).

The vertebrate fauna of New Guinea shows high levels of endemism. Approximately a third of the New Guinea species are endemic to Papua New Guinea (Department of Environment and $C_o$nservation 2010). Hyndman and Menzies (1990) attributed the high endemism found on their Upper Ok Tedi study to be the result of the high rainfall and persistent cloud cover that compresses ecological zonation and allows many species to coexist in a comparatively small area. The region also appears to be enriched through an admixture of plants and animals of two biogeographic regions. While some biota is typical of eastern New Guinea, for many groups the available information indicates a greater proportion is typical of western New Guinea (Hyndman and Menzies 1990).

The Hindenburg Wall itself appears to act as a barrier between the south and the north. The foothills have species related to the south, while the Hindenburg ranges have species related to the north, with minimal mixing between the two.

Biodiversity of karst environments

Karst landscapes in Papua New Guinea are known to be biodiversity 'hotspots'. The existing knowledge on the biodiversity of the Hindenburg Wall, while limited, appears to follow this general pattern. Only a comprehensive survey will result in a better understanding of this.

Mammals

At least 242 mammal species are present in PNG of which at least 57 are endemic (Bonaccorso 1998). The history of describing new species in New Guinea dates back to the late 1800s and continues through to the present day.

Based on mammal diversity and distribution, three zoogeographic regions have been identified for the island of New Guinea: the Austral, Tumbunan and Oceanic Provinces (Flannery 1995). The Austral Province ranges from the Trans-Fly to Moresby and coastal grassland areas including Popondetta. Species restricted to these areas are also found in Australia, including the Agile Wallaby and short-nosed bandicoots. The Tumbunan Province is diverse, covering areas from near sea-level to areas over 5000 m in altitude and including numerous habitats ranging from lowland rainforest to moraine abandoned by retreated glaciers.

A rapid biological assessment of the Muller Range east of the Hindenburg Wall recorded one monotreme, nine marsupials , 12 murid rodents and one feral canid – the New Guinea Singing Dog (*Canis familiaris* "hallstromi") (Aplin and Kale 2011). There has been scientific debate over whether the New Guinea Singing Dog is unique (Bulmer 2001, Savolainen *et al.* 2004) and consequently, the designation of these dogs as a native animal and conservation priority is questionable. The reports of a large population inhabiting the open tops of the Mueller Range and a known distribution across the montane elevations of the central cordillera (Richards and Gamui 2011) suggests there is a good possibility that a similar population may exist in the vicinity of the Hindenburg Wall.

There are potentially 108 mammalian species inhabiting the Hindenburg Wall area (Annex 1) and there remains the possibility that three other Critically Endangered species exist in the vicinity of the Hindenburg Wall: the Central Ranges Tree-Kangaroo (*Dendrolagus notatus*), Black Spotted Cuscus (*Spilocuscus rufoniger*) and the Telefomin Cuscus (*Phalanger matanim*). For all three species, this would require range extensions to their known distribution of only a few tens of kilometres.

Bats, rodents and marsupials comprise the greater proportion of the mammalian diversity in New Guinea, with bats especially numerous. The order Chiroptera is well represented and highly diverse in PNG, with 91 (9%) of the global 986 extant species, and representatives of six of the global 18 extant families, occurring there. On the island of New Guinea, within the two suborders of bats, all 34 species of Megachiroptera ('megabats') belong to a single family, the Pteropodidae (Old World fruit-bats), whereas the 55 species of Microchiroptera ('microbats') are from five families. The Megachiroptera in this region are generally larger and fruit eating, and are characterised by the large 'flying foxes' seen flying over forest or water. In contrast, the Microchiroptera are mainly insectivorous, although diets also include fruit, nectar, pollen and other animals (Table 3).

Most bat families are well represented in the lowlands, whereas only a single vespertilionid species is found above 3000m. The Pteropodidae and Molossidae are present above 2000m, but emballonurid bats are restricted to below 1600m. The Rhinolophidae and Hipposideridae in PNG reach only as high as the mid-montane altitudes likely because food availability (i.e. insects) becomes a limiting factor.

PNG may be considered a transit zone for bats in that it shares 70 species with surrounding areas: Australia to the south (30 shared species), Indonesia to the west (incl. West Papua 49 species) and the Solomon Islands to the east (30 species) (Bonaccorso 1998). Of the bats in PNG, at least 19 species (21%) are considered endemic to PNG and 14 species (15%) endemic to the island of New Guinea. Eighteen species of the bats in PNG are widely distributed in countries not immediately

adjacent to PNG. Our assessment is that some 30 known bat species might inhabit the Hindenburg Wall area.

Table 3: Species richness for six bat families, and distribution of bat species by diet for PNG.

Family	%
Pteropodidae	38
Emballonuridae	11
Hipposideridae	14
Rhinolophidae	4
Vespertilionidae	26
Molossidae	7

Diet type	%
Frugivorous	31
Frugivorous/nectivorous	3
Nectivorous	3
Insectivorous	60
Carnivorous/insectivorous	3

(Modified from Bonaccorso 1998)

One species thought to be extinct was rediscovered on the Hindenburg Wall: Bulmer's Fruit-Bat, *Aproteles bulmerae*. When first described in 1970, it was only known from late Pleistocene fossil remains. In 1975 an anthropologist working in the vicinity of the Hindenburg Wall collected a live specimen of the fruit-bat but its identity as the 'extinct' species was not revealed until it was shipped to University of PNG (Hyndman and Menzies 1980). Seventeen years later in 1992, two biologists found about 300 Bulmer's Fruit-Bats roosting at Luplupwintem Cave in the Hindenburg Wall. Another population of these fruit-bats was later identified in the vicinity of Crater Mountain, based on recent hunting trophies (Bonaccorso 1998). The species is currently ranked as Critically Endangered by the IUCN.

Many bats of Papua New Guinea roost in caves and some form huge maternity colonies, consequently the protection of the karst landscapes which they inhabit would likely safeguard the future of many species. Struebig *et al.* (2009) argued that as relatively rare landscape features, limestone karst outcrops serve as vital shelter for cave-roosting bats and, are likely to be important population reservoirs for forest fragments.

Table 4. Origin and affinities of birds of Hindenburg and the Victor Emanuel Ranges

Origin and affinity	Species
Eastern	*Accipiter fasciatus polycryptus*, *Patchycephala modesta telefomensis*, *Lanius schach stresemanni*
Northern Highlands	*Melidectes rufocrissalis ruficrissalis*
Western	*Rallicula rubra telefomensis*, *Aegotheles archiboldi*, *Pachycephala tenebrosa tenebrosa*, *Paradigalla brevicauda*, *Ephimachus fastosus stresemanni*, *Astrapia splendidissima Elliott-smithi*, *Parotia carolae clelandiae*, *Pteridophora alberti alberti*, *Zosperops fuscicapilla fuscicapilla*
Migrants from the north	*Capella megala*, *Pluvialis dominica fulva*, *Muscicapa griseistica*
Eastern limits at Telefomin	*Rallicura rubra telefomensis*, *Aegothelis archiboldi*, *Astrapia spendidissima Elliott-smithi*, *Zosterops fuscicapilla fuscicapilla*
Western limits at Telefomin	*Pachycephala modesta telefomensis*, *Lanius schach stesemanni*

(Modified from Hyndman 1979, Hyndman and Frodin 1980, Frodin and Hyndman 1982)

Birds

Birds have long excited the interest of explorers, collectors, scientists, amateur naturalists and the indigenous people of New Guinea and they are better known than other groups of animals in the region. There are 781 species of birds in Papua New Guinea, with 76 endemic to the country and 28 considered globally threatened.

347 species of birds including at least 16 species of Bird of Paradise are likely to occur in the vicinity of the Hindenburg Wall and Ok Tedi area (Gregory 1995) , comprising about 45% of the PNG total (Table 5 and Annex 2). Bird diversity is high within all vegetation zones, from the foothill forest in the south to lower-montane and mid-montane in the north.

One species from the area is classified as Endangered (Vulturine Parrot *Psittrichas fulgidus*), while six species known from the area have a Vulnerable conservation status (New Guinea Harpy-Eagle *Harpyopsis novaeguineae*, Doubled-Wattled Cassowary *Casuarius casuaris*, Single-Wattled Cassowary *C. unappendiculatus*, Black Saber Tailed Bird of Paradise *Epimachus fastosus*, Sheep-Makers Crowned Pigeon *Goura scheepmakeri*, and Macgregor's Bird of Paradise *Macgregoria pulcha)*, and another two species are Near Threatened (Dwarf Cassowary *Casuarius benneti* and Shield-Billed Bird of Paradise *Loboparadisea sericea*).

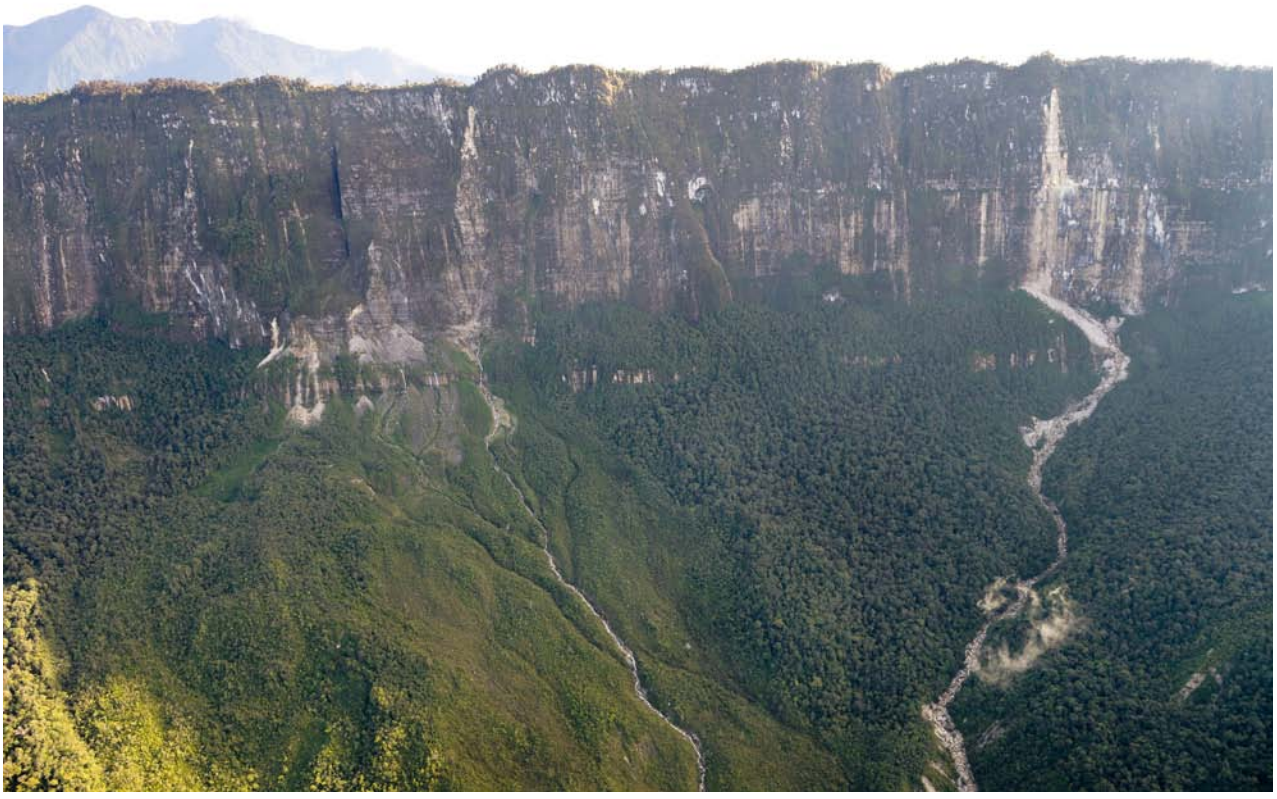


Table 5. Bird families likely to occur in the vicinity of the Hindenburg Wall.

Family	Common Name	No. species
Casuariidae	Cassowaries	3
Podicipedidae	Grebes & Dabchicks	2
Frigatidae	Frigatebirds	1
Phalacrocoridae	Cormorants	2
Anhingidae	Darters	1
Ardeidae	Herons & Egrets	5
Threskiornithidae	Ibises & Spoonbills	1
Accipitridae	Hawks, Kites & Eagles	16
Falconidae	Falcon	5
Anatidae	Ducks	6
Megapodiidae	Megapodes	2
Phasianidae	Quails, Pheasants & Allies	2
Turnicidae	Button-Quail	1
Rallidae	Rails, Moorhens & Coots	9
Recurvirostridae	Stilts & Avocets	2
Glareolidae	Coursers & Pratincoles	1
Charadriidae	Plowers & Dotterels	2
Scolopacidae	Curlews, Sandpipers, Snipes & Allies	10
Columbidae	Pigeons & Doves	22
Psittacidae	Parrots, Lorys & Cockatoos	29
Cuculidae	Cuckoos, Koels & Coucals	12
Strigidae	Typical Owls	1
Podargidae	Frogmouths	2
Aegothelidae	Owlet-Nightjars	3
Caprimulgidae	Nightjars	3
Hemiprocnidae	Tree-Swifts	1
Apodidae	Swifts & Swiftlets	6
Alcedinidae	Kingfishers & Kookaburras	9
Meropidae	Bee-Eaters	1
Coraciidae	Rollers	1
Bucerotidae	Hornbills	1
Pittidae	Pittas	2
Hirundinidae	Swallows & Martins	1
Motacillidae	Wagtails & Pipits	2
Campephagidae	Cuckoo-Shrikes & Trillers	1
Laniidae	Shrikes	1
Turdidae	Thrushes	2
Orthonychidae	Logrunners & Allies	5
Syliidae	Old World Warblers	7
Acanthizidae	Australian Warblers	12
Maluridae	Fairy-Wrens	3
Rhipiduridae	Fantails	9
Mygiagridae	Monarchs	10
Eopsaltridae	Australian Robins	16
Pachycephalidae	Whistlers, Pitohuis &Allies	18
Climacteridae	Australian Treescreepers	1
Dicaeidae	Flowerpeckers & Berrypeckers	8
Nectariniidae	Sunbirds	2
Zosteropidae	White-Eyes	2
Meliphagidae	Honeyeaters	27
Estrildidae	Mannikins, Parrot-Finches & Allies	1
Dicruridae	Drongos	1
Cracticidae	Butcherbirds & Allies	1
Artamidae	Wood-Swallows	1
Ptilonorhynchidae	Bowerbirds	1
Paradisaeidae	Birds Of Paradise	14

As there is no observable difference between the bird populations of the Hindenburg and Victor Emanuel Ranges, they have been considered a single biogeographic single unit (Gilliard and Lecroy 1961). Indeed, these two ranges are adjacent high spots on a continuous mountain block. The sharp escarpment of the Hindenburg Wall forms a barrier for foothill species from the south to move north, while the gradual undulating plains and mountain ranges on the north are less of a barrier to dispersal.

The Hindenburg Range has more bird species with western affinity than eastern affinities (Table 4). However, there have been some incursions by grassland species from the east, and by species from the north.

Reptiles and amphibians

There are at least 600 species of reptiles and amphibians on the island of New Guinea (Allison 2007), with over 80% of them endemic. Studies in New Guinea have shown that forests have a high diversity of herpetofauna, especially frog species, and that many of them are new to science (Hyndman and Menzies 1990). The numbers of new species discovered recently at similar elevations elsewhere in PNG indicate that the Ok Tedi headwaters and the Hindenburg Wall are likely to harbour a diverse herpetofauna including many species new to science. For example, a short survey of the Strickland headwaters at 1115 m recently documented 21 species of herpetofauna including seventeen species of frog, three of which appear to be new to science (Richards and Dahl 2011).

There are at least six families of reptiles in the Upper Ok Tedi area, including three snake families and at least four lizard families. Together, 47 species have been identified, with skinks making up nearly 50% of the species (Table 6). Two lizard families (geckos and dragons) are found mainly in the foothill forests while skinks and snakes are represented in hill and montane forests. Monitors lizards are also present at lower elevations.

The conservation status of three quarters of the reptile species likely to be present on the Hindenburg wall have not been assessed by the IUCN. All of the species which have been assessed thus far have been assigned a classification of Least Concern.

The snakes of PNG have been studied more extensively than most groups of reptiles and despite their diversity and abundance lizard species remain little studied in New Guinea. There are five lizard families present in PNG, containing more than 20 genera and approximately 150 species. The closest affinities of this fauna are with Australia. The lizard fauna is dominated by skinks, while geckos, dragons and monitors contain just twelve genera (Hyndman and Menzies 1990). New Guinea's geckos all belong to widespread genera of Indo-Malayan origin.

Rugged topography has a strong influence on frog distribution in New Guinea. The central mountain ranges are a barrier between the northern and southern lowland faunas and their many large drainage systems harbour many locally distinctive communities. The isolated ranges, especially those of the southeast peninsula and northern basins also support many restricted-range endemic frog species.

High frog diversity in PNG is further explained by the fact that in many species, the frog emerges from the egg as a fully formed frog, with no need for streams or pools of water. This has allowed many species to evolve in the constantly wet forest environments of New Guinea.

While herpetofauna diversity generally decreases with increasing elevation (Richards and Dahl 2011) frog diversity is often very high in New Guinea's lower- and mid-montane zone (Hyndman and Menzies 1990, Richards and Dahl 2011).

The New Guinean frog fauna appears to have evolved and radiated from relatively few progenitors. There are only five native families

of frogs in New Guinea (Allison 2007). All but one are represented in the upper Ok Tedi area: Microhylidae (twelve genera), Hylidae (two genera), Ranidae and Myobatrachidae (one genus each) (Table 7).

All four frog families are widespread across New Guinea. At the family level, the frog fauna of New Guinea has affinities to South East Asia in the west (Ranidae and Microhylidae) and with Australia in the south (Hylidae and Myobatrachidae). Both the Hylidae and Myobatrachidae occur throughout Australia but minimally or not at all to the west of New Guinea while the Ranidae and Microhylidae are distributed throughout much of Asia, but scarcely penetrate the Australian continent (Menzies 2006).

The majority of New Guinean frogs are hylids and microhylids. Microhylid frogs have undergone a particularly spectacular adaptive radiation that includes many bizarre forms. The hylids, by comparison, show less morphological variety but still include some spectacular species. However, relatively few myobatrachids are found in the island of New Guinea (seven species) compared to the more than 125 found in Australia.

More than 45 named frog species are already known from the Ok Tedi area (Table 7) and many more species remain undiscovered or new to science (Hyndman and Menzies 1990). By comparison, at a similar altitudinal range in Wau, Gressitt and Nadkarni (1978) (in Hyndman and Menzies 1990) recorded 22 species.

A recent Rapid Assessment Survey conducted at a comparable altitudinal gradient in the upper Strickland Basin and the Muller Range, just east of Hindenburg, revealed a total of 61 species of herpetofauna (49 frogs, twelve reptiles) (Richards and Dahl 2011). They reported that at least 25 species of frogs were new to science, and 14 of these were discovered for the first time.

Studies of Papua New Guinean frogs are in their infancy and there is a pressing need for studies on basic taxonomy and ecology. Kraus (2011) recently discovered two new species of Microhylidae frogs within existing collections previously taken from the Star Mountains including *Oreophryne ampelos* from the Hindenburg Range itself (Kraus 2011)

Nyctimystes oktediensis a frog recorded from the vicinity of the Hindenburg Wall but of which virtually nothing is none of its behaviour or ecology (© Stephen Richards)

Green Tree Boa *Morelia viridis* a geographically widespread species predominately of Foothill Forest, and Lower Montane that is classified as Least Concern by IUCN (© Stephen Richards)

Table 6: Reptiles likely to occur in the vicinity of the Hindenburg Wall.

Family	Scientific Name	Common Name	IUCN	Distribution	Refs
Boidae	*Apodora papuana*	Papuan Olive Python	NE	WD,FF,LM	7
	Candoia aspera	New Guinea Ground Boa	NE	WD,FF,LM,LA	2,5,7,
	Candoia carinata	Pacific Tree Boa	NE	WD,FF	7
	Leiopython albertisi	D'albertis Python	NE	WD,FF,LM,LA	7
	Morelia boeleni	Boelen's Python	NE	FF,LM,LA	5,7,8
	Morelia viridis	Green Tree Boa	LC	WD,FF,LM	1,5,7,8
Colubridae	*Boiga irregularis*	Brown Tree Snake	NE	WD,FF,LM	7,8
	Dendrelaphis calligastra	Northern Tree Snake	LC	WD,FF,LM	7
	Dendrelaphis gastrostictus	Tree Snake	NE	WD,FF,LM	7
	Dendrelaphis punctulatus	Common Tree Snake	LC	WD,FF,LM	7
	Stegonotus cucullatus	Slatey Grey Snake	NE	FF,LM,LA	5,7,8
	Stegonotus diehli	Deihl's Little Ground Snake	NE	WD,FF	1,5,7
	Tropidonophis doriae	-	NE	WD,FF,LM,LA	7
	Tropidonophis multiscutellatus	Common Keelback	LC	FF,LM,LA	1,5,7
	Tropidonophis statistictus	PNG Montane Keelback	LC	LA	7
Elapidae	*Acanthophis rugosus*	Death Adder	LC	WD,FF,LM,LA	7
	Aspidomorphus muelleri	Muller Crowned Snake	NE	WD,FF,LM,LA	5,7,8
	Micropechis ikaheka	Small Eyed Snake	NE	WD,FF,LM,LA	5,7,8
	Toxicocalamus angusticinctus	Fly River Forest Snake	NE	FF	5,7
	Toxicocalamus preussi	-	NE	WD,FF,LM	7
	Toxicocalamus stanleyanus	-	NE	WD,FF,LM	7
Gekkonidae	*Cyrtodactylus derongo*	-	NE	-	9
	Cyrtodactylus loriae	-	NE	FF	4,5
	Cyrtodactylus mimikanus	-	-	FF	3,5
	Cyrtodactylus serratus	-	NE	-	9
	Hemidactylus frenatus	Common House Gecko	LC	FF	5
	Nactus sp	-	-	-	9
Scincidae	*Carlia aramia*	-	NE	SF	5
	Emoia caeruleocauda	-	-	FF	5
	Emoia cyanogaster	-	-	LM,LA,SF	5
	Emoia pallidiceps	-	-	LM,LA	5
	Emoia physicae	-	-	FF	5
	Emoia submetallica	Madeay's Emo Skink	LC	LM,LA	5
	Eugongylus rufescens	-	-	FF	5
	Lobulia stanleyana	-	NE	LM,LA,SF,	5
	Prasinohaema flavipes	Common Green Tree Skink	LC	LM,LA,SF	5
	Sphenomorphus aruensis	-	-	FF	5
	Sphenomorphus cinereus	-	NE	LM,LA,SF	5
	Sphenomorphus jobiensis	-	NE	LM,LA,SF	5
	Sphenomorphus leptofasciatus	-	NE	FF,LM,LA,SF	2,5
	Sphenomorphus papuae	-	-	-	9
	Sphenomorphus nigriventris	-	NE	FF,LM,LA,SF	2,5
	Sphenomorphus pratti	-	NE	FF	5
	Sphenomorphus schultzei	-	-	LM,LA	5
	Sphenomorphus simus	-	NE	FF,SF	2,5
Agamidae	*Hypsilurus dilophus*	-	NE	-	9
	Hypsilurus modestus	-	NE	FF	1,5

IUCN status: CE = Critically Endangered, EN = Endangered, VU = Vulnerable, DD = Data Deficient, LC = Least Concern, NT = Near Threatened, NE = Not Evaluated but in IUCN database, - = no record in IUCN database at present. Distribution: FF = Foothill Forest, LM = Lower Montane, LA = Low-Altitude Mid-Montane, MM = Mid-Montane, WD = Geographically Widespread, SF = Secondary Forest with montane zone.. References: 1= Hyndman 1979, 2= Hyndman 1980, 3 = Hyndman 1984, 4 = Hyndman 1985, 5 = Hyndman & Menzies 1990, 6 = Menzies & Hyndman 1991, 7 = O'Shea 1996, 8 = Division of Wildlife undated, 9 = Richards (pers. comms 2012)

Table 7: Amphibians likely to occur in the vicinity of the Hindenburg Wall.

Family	Scientific name	IUCN	Elevation	Refs
Hylidae	*Litoria amboinensis*	LC	FF	8
	Litoria angiana	LC	FF,LM,LA	1,2
	Litoria arfakiana	LC	LM,LA,MM	1,2
	Litoria auae	LC	FF, LA	8
	Litoria bulmeri	DD	MM	1,2
	Litoria dorsivena	DD	LM,LA	1,3,5
	Litoria eucnemis	LC	FF	1,2
	Litoria havina	LC	FF,LA	8
	Litoria iris	LC	LM,LA	1,2
	Litoria leucova	DD	LM,LA	2
	Litoria majikthise	DD	FF	2,4
	Litoria micromembrana	LC	LM,LA	2
	Litoria modica	LC	LM,LA	1,2
	Litoria multiplica	LC	LM,LA	2
	Litoria nigropunctata	LC	LM,LA	1,2
	Litoria pronimia	LC	FF,LM	8
	Litoria prora	LC	FF,LM	8
	Litoria richardsi	DD	-	8
	Litoria thesaurensis	LC	FF,LM	8
	Litoria timida	LC	FF	8
	Nyctimystes humeralis	LC	LM,LA	1,2
	Nyctimystes pulcher	LC	LM,LA	1,2
	Nyctimystes oktediensis	NE	-	8
	Nyctimystes zweifeli	LC	LM,LA	1,2
Leptodactilidae	*Lechriodus aganoposis*	LC	LM,LA	1,2
	Lechriodus melanopyga	LC	FF	1,2
Microhylidae	*Albericus rhenaurum*	LC	FF	1,2
	Albericus tuberculus	LC	LM,LA	8
	Asterophrys turpicola	LC	FF	1,2
	Austrochaperina derongo	LC	LM,LA	1,2
	Callulops sagittatus	DD	MM	8
	Choerophryne sp	LC	LM,LA	1,2
	Cophixalus cryptotympanum	DD	LM,LA,MM	1,2
	Pseudocallulops eurydactylus	DD	LA	1
	Mantophryne lateralis	LC	LA	8
	Metamagnusia slateri	LC	FF,LM,LA	1
	Oreophryne ampelos	-	LA	7
	Oreophryne notate	DD	LA,MM	6
	Sphenophryne cornuta	LC	LA,LM	1,2
	Xenorhina anorbis	DD	LA,LM	8
	Xenorhina brachyrhyncha	-	LA	7
	Xenorhina mehelyi	LC	FF	2
	Xenorhina similis	LC	LM,LA,MM	2
Ranidae	*Rana daemeli*	LC	FF	2
	Rana garritor	LC	FF	2
	Rana grisea	DD	FF,LM,LA	2
	Rana supragrisea	LC	FF,LM,LA	2

IUCN status: CE = Critically Endangered, EN = Endangered, VU = Vulnerable, DD = Data Deficient, LC = Least Concern, NT = Near Threatened, NE = Not Evaluated but in IUCN database, - = no record in IUCN database at present. Distribution: FF = Foothill Forest, LM = Lower Montane, LA = Low-Altitude Mid-Montane , MM = Mid-Montane, WD = Geographically Widespread, SF = Secondary Forest with montane zone. References: 1= Hyndman 1979, 2 = Hyndman & Menzies 1990, 3 = Menzies & Zweifel 1976, 4 = Richards & Bickford 2004, 5 = Richards & Parker 2004, 6 = Zweifel, 7 = Kraus (2011).8 = Richards (pers. comms 2012)

Chapter 6

Butterflies of the Hindenburg Wall

The New Guinea Butterfly Fauna

The Island of New Guinea boasts nearly 1000 described butterfly species, of which approximately 840 are recorded from Papua New Guinea (PNG) (Tennent 2006). For its area, the island of New Guinea's butterfly fauna is one of the most diverse in the world (Parsons 1998). This fauna has particularly high rates of endemism, including some spectacular radiations of closely related species (e.g. the genera *Delias* Hübner and *Philiris* Röber, which, combined, comprise nearly 25% of the total fauna). Several of these are cryptic, typical of tropical radiations (see Hajibabaei *et al*. 2006). The island of New Guinea is also home to the world's largest butterflies, the Birdwings (*Ornithoptera*).

Such high diversity results from a complex interplay of equatorial landmass, dynamic geological evolution and climatic processes, leading to localised isolation for extended periods and resultant speciation. A range of interpretations for the geological evolution of mainland New Guinea have been proposed by various authors (e.g. Audley-Charles 1981, Coleman and Packham 1976, Davies 1990, Davies 2009, Davies *et al*. 1997, Pigram and Davies 1987) but it is generally thought to comprise a series of stacked volcanic terranes that have become successively attached onto the northern margin of the Australian Plate, forming the mountain range of central New Guinea. The southern, relatively low-lying portion of the New Guinea mainland consists of uplifted basin strata that formed in the gulf between northern Australia and New Guinea following the initial mountain forming. Since there is great variation in topographic relief on the island of New Guinea, with high mountain ranges and peaks separated by deep, extensive valleys, climatic fluctuations significantly affected the distribution of the island's fauna. Populations endured expansion and contraction of their ranges, promoted by glacial cycles which led to repeated isolation and in turn explosive speciation, whereby one species would give rise to a number of daughter species over a relatively short time frame. The Pleistocene period is believed to have been the primary time period for speciation but Müller and Beheregaray (unpublished) demonstrated that diversification within *Delias* was mostly of Pliocene age.

Phylogenetic studies of the origins of New Guinea butterflies point to both Australian and Asian ancestries. The geographical distributions of certain genera (e.g. *Tellervo*, *Cressida*) suggest a Gondwanan component to the New Guinea fauna, with closest relatives in South America.

***Distinct faunistic zones*, marked by pronounced endemicity, are apparent** for the many archipelagos within the New Guinea region (see Simpson 1977) but are not so obvious on the mainland. However, both Eliot (1969) and Brooks (1950) noted that the New Guinea fauna could be grouped into four zones based on their independent studies of the butterfly tribe Neptini and genus *Taenaris*, respectively. They considered the southern zone to span an area from the southern part of the Snow Mountains to the Gulf of Papua. The Hindenburg Wall district falls at the junction of this and the Central Cordillera Hill Zone, which

can be further subdivided into faunistic zones along its axis.

Butterflies are increasingly being recognised as valuable environmental indicators, both for their rapid and sensitive responses to subtle habitat or climatic changes and as representatives for the diversity and responses of other wildlife (Brereton *et al.* 2011). For example, Kerr *et al.* (2000) found that butterflies, including Skippers (Hesperiidae), could be used to predict richness among Hymenoptera at a range of study sites in the USA.

Previous work around the Hindenburg Wall

Collections of Lepidoptera in the vicinity of the Hindeburg Wall have been scant. It was only after 1870 that penetration of the forbidding New Guinea interior was begun in earnest (Parsons 1998). The naturalist L. M. d'Albertis collected in the Fly River region in 1875. Previously, within mainland New Guinea, the only documented exploits of butterflies within the interior were those of Alfred Wallace (collectors sent by him into the mountains in 1858) and those of d'Albertis and the botanist Odoardo Beccari during 1872-73 into the Arfak Mountains, West Papua. Australian Walter Wilson Froggatt was appointed Assistant Entomologist to the 1885 Australian Geographical Society NG Expedition to the Fly and Strickland Rivers led by explorer H. O. Forbes (Parsons 1998).

In Europe, an ever-increasing interest in New Guinea butterflies lead to sponsorship of various collectors by the wealthy British collector Lord Walter Rothschild in the early 1900's (Parsons 1998). Most of the collections that were made by Alfred Stanley Meek were in the eastern part of the country and also in the Snow Mountains. The Pratts (Antwerp Pratt and his sons) collected widely in both eastern Papua New Guinea and in both Papua and West Papua Province, Indonesia, periodically from 1901 to 1920. Several other collectors and expeditions visited the central ranges of the New Guinea mainland during this time. In particular, the Dutch Military Expeditions of Netherlands New Guinea (Indonesia) saw numerous trips during the period 1907 – 1915 (Parsons 1998). During the 1930's, four major biological field surveys were carried out in New Guinea by the Archbold Expeditions, financed by American oil millionaire Richard Archbold. These targeted mountainous parts of Dutch New Guinea.

The first documented expeditions to collect Lepidoptera in the remote highlands of the Central Cordillera in western Papua New Guinea were undertaken by W. W. Brandt. Brandt collected extensively in Papua New Guinea between 1949 and 1963. Localities visited close to the Hindenburg Wall include Kiunga near sea level and Eliptamin and Feramin in the Telefomin area (both Western Province). During 1970, O. K. McCaw collected some butterflies and other insects near Ok Tedi (Western Province). Some of these are held in the Australian Museum, Sydney. M. J. Parsons visited Telefomin during the 1980's, as did R. Straatman. H. van Mastrigt compiled a significant collection on butterflies from Indonesian New Guinea, including the Star Mountains (van Mastrigt 1989, 1990, 2000, Morinaka *et al*. 1991, 1993). Closer to the Hindenburg Wall, R. Lachlan collected in the area surrounding Ok Tedi during the 1990's, his efforts resulting in the discovery of several new species in remote high-altitude areas (Lachlan 1999a, 1999b, 2000) (see below). During 2008, C. Muller briefly visited Kiunga and the Tabubil area to gain new butterfly records.

Butterflies in the Hindenburg Wall Area

In the Hindenburg Wall and immediate surrounding district there are no records of butterflies having ever been collected or recorded. A desktop assessment of available literature and personal records/observations suggest that as many as 458 known butterfly species may occur in the vicinity of the Hindenburg Wall (Annex 3), representing approximately half of the known butterflies in Papua New Guinea and as many as two-thirds

of those occurring on the mainland. Such diversity would grant the area 'hotspot' status and be comparable to the species diversity at Mount Kinabalu, Malaysia, one of the world 'hotspots' for butterflies (Häuser *et al*. 1997). The Wall is situated at the border of the Southern Zone (comprising lowland New Guinea south of the Central Cordillera), the 'Western Sub Province' (incorporating the Star Mountains of far western Papua New Guinea and eastern Papua Province, Indonesia) and the 'Central Divide' (Hagen Range east of Wabag). Undoubtedly, the potential biodiversity richness of this area may be attributed to some overlap of these faunistic zones.

Highland habitats are important for butterflies. Parsons (1998) noted from a desktop study of all of the then known butterflies in New Guinea and its satellite islands that about 37% of the fauna occur at elevations greater than, or equal to, 1500m, thus confirming the importance of highland habitats. Approximately 10% occur only above 1500m and were classed by Parsons (1998) as truly montane species.

The world's largest butterfly genus, Delias, comprises 257 described species, at least half of which are endemic to New Guinea and its satellite islands. A detailed phylogenetic revision is in preparation (Muller, unpublished). There are undoubtedly numerous species within the genus that are likely to occur on and proximal to the Hindenburg Wall, some of which may yet await discovery. A significant proportion of *Delias* species occupy only very small areas and altitudinal ranges (e.g. single islands or narrow mountain ranges). Several are known from such restricted places in the eastern part of Papua Province, Indonesia and bordering Papua New Guinea, including the Star Mountains. Indeed, four species have been described recently from single localities in the vicinity of Ok Tedi, namely *D. binniensis* Lachlan (Mt. Binni), *D. akrikensis* (Mt. Akrik), *D. inopinata* (Mt. Akrik) and *D. felis* (Mt. Binni) (Lachlan 1999a, 2000).

Since Delias ***are well studied it has become apparent that there are*** two main groups with similar distributions in western Papua New Guinea. These are the western species occurring in the Star Mountains of far western Papua into Indonesian Papua and those that occur in the Central Cordillera east of the Wabag area (Enga Province). Owing to lack of data it is uncertain whether or where these *Delias* groups meet. The Hindenburg Wall lies in this transitional zone and would therefore be of great interest for a study of its butterfly biodiversity.

Delias *butterflies are well documented in general*, owing to their beauty and appeal with collectors,. By contrast, other groups comprising less conspicuous species, such as Hesperiidae and Lycaenidae, are likely to contain numerous species new to science, particularly in remote highland areas that are un- or under-explored. The Hindenburg Wall is one such place.

In similar limestone habitats such as in the Muller Range and other uplifted blocks in Enga Province there are numerous endemic butterfly species. Many of these species are only known from a few specimens (e.g. Parsons 1986). The Hindenburg Wall is therefore likely to harbour unique endemics. A new genus of Hawk Moth (Sphingidae) was discovered by R. Lachlan in the early 1990's in the Ok Tedi area (Lachlan 1999b). Since no documented entomological surveys have been undertaken in or around the Hindenburg Wall, these may even represent various conspicuous butterflies such as *Delias* and other macro species. Recent explorations in limestone habitats in other Provinces have yielded several new butterfly species, including *Delias* (e.g. Müller 1999, 2001, 2002).

Endemic butterfly species, and the general endemicity of an area, are indicative of its biogeographical relationships to other areas (Vane-Wright 1991). The percentage of endemic species in the New Guinea butterfly fauna are high and suggest that speciation was very rapid in certain genera with an apparent recent

history in New Guinea. Those butterflies which are endemic to mainland New Guinea can be considered as very useful indicators of areas of endemism within the main landmass. They imply that such areas have been geologically distinct for relatively long periods of time. It follows that these areas of endemism may well indicate regions of probable geological and/or geographical significance (Parsons 1998). For example, they may, at one time or another have been separated by significant stretch of water. This is possible for the island of New Guinea which a composite mainland and island terranes (e.g. Kikkawa *et al*. 1981).

Mountain building (orogenesis) in New Guinea has had much impact on speciation in butterflies, with many species have distinct sister species on the northern and southern sides of the Central Cordillera (e.g. in the genus *Ornithoptera*, *Elymnias* and *Parthenos*). More locally, barriers separating individual mountain ranges have undoubtedly influenced speciation with the Pierid genus *Delias*. Axelrod and Raven (1982) suggested that 90% endemicity characterising the 9,000 New Guinea angiosperms[15] was a major result of the elevations of the mountains to their present heights during the Pliocene-Pleistocene, and to the creation of their accompanying moist temperature environments. Although Menzies (1975) attributed arboreal hylid frog speciation to recent events, Muller *et al*. (in prep.) implied that speciation in *Delias* was most prominent during the Pliocene.

Several Birdwing Butterflies (genus Ornithoptera) are likely to occur in the vicinity of the Hindenburg Wall. The Endangered Ornithoptère Méridional (*Ornithoptera meridionalis*) occurs primarily in lowland and hinterland habitats on the New Guinea mainland south of the Central Cordillera. It has been collected at Kiunga, to the south of the Hindenburg Wall at approximately 50m elevation. Since it has been recorded at 770m at Lake Kutubu (Southern Highlands Province), its presence in the lower extremities of the Hindenburg Wall cannot be ruled out. The Chimaera Birdwing (*Ornithoptera chimaera*), previously listed as Near Threatened under IUCN criteria but recently down-graded to Least Concern by Muller and Tennent (in press), is also likely to occur in the Hindenburg Wall area. It is a large, powerful, high-flying species that is common but restricted to primary forest and forest margins in upland areas at altitudes between 1,200 and 2,800m. The species has been recorded as locally commonly in the Porgera area (Enga Province). Two other Birdwing species, *Ornithoptera goliath* (the second largest butterfly in the world) and *O. priamus* are known to occur at several sites proximal to the Hindenburg Wall and therefore presumably occur there. It occupies a very wide altitudinal range, being recorded at near sea level in Gulf Province (C. Muller pers. obs.) to 2,300m in the Telefomin area (Parsons 1998). *O. priamus* is ubiquitous and abundant throughout much of Papua New Guinea from sea level to approximately 1,600m. It was observed very commonly in the Tabubil area in March, 2008 (C. Muller, pers. obs.).

Only the Birdwing Butterflies represent species that are Red-Listed under IUCN criteria in mainland New Guinea. Few others have been assessed. A study by Muller and Tennent (in press) and Tennent and Muller (in press) of 200 randomly selected species occurring in Indonesia and Papua New Guinea did not reveal any species in dire need of conservation. However, more detailed assessments of all New Guinea butterflies are required as numerous species occupy very small habitats and many more are data deficient.

In the Hindenburg Wall area there are likely to be many butterfly species that occupy very narrow altitudinal ranges. Certain species in the subfamily Satyrinae are known only from narrow ranges, less than a few 100 m, despite being recorded from several provinces (e.g. *Platypthima septentrionalis*). Certainly the shear

[15] Flowering plants.

gradient and exaggerated relief of the Hindenburg Wall would have undoubtedly acted as a barrier for lowland species to the south, inhibiting dispersal to the north in this part of the Central Cordillera.

There are negligible Entomological collections in the Papuan section of the 'Western Sub-Province' (as defined in the Mammals section here-in) by comparison to those in Indonesia. Since there are numerous endemics known from the latter area, one can assume that Papua New Guinea also hosts much opportunity for new discoveries in this sub-province.

Many butterfly species occur outside of the altitudinal range of the Hindenburg Wall (i.e. not at 600 - 2200m). This is particularly so for lowland species in the subfamilies Hesperiinae and Satyrinae, which feed on monocots, often in swampy environments. Many such species are known from unique specimens from Kiunga (Western Province) at near sea level. At the other end of the scale, several species (particularly those in the genus *Delias* and certain *Ocybadistes*, *Taractrocera* hesperiids) are only known from very high elevations (>2200m) in the region and would therefore not likely be present in the Hindenburg Wall itself.

Table 8. Butterflies likely to occur in the vicinity of the Hindenburg Wall shown by family. Only the number of species within families with IUCN categories of Critically Endangered (CE), Endangered (EN), Vulnerable (VU), and Near Threatened (NT) threatened are shown.

Family	Number of Species	IUCN
Hesperiidae	90	
Papilionidae	22	EN (1)
Pieridae	60	
Lycaenidae	179	
Nymphalidae	107	

Conservation of Butterflies

Pristine habitats, such as those in the vicinity of the Hindenburg Wall, if not managed properly can quickly become degraded and lose sensitive species dependent on certain habitats.

Habitat loss is the most important potential impact on the survival of butterfly species. Most butterflies are sensitive to degradation of their environment. Even slight changes in the structure and composition of forest can result in a loss of important butterfly species.

Butterflies are very sensitive to any changes in biotic composition being, for the most part, monophagous (feeding on only one plant species as larvae). Additionally, many species in the family Lycaenidae have complex symbiotic relationships with ants, which in turn are associated with certain plants. Therefore, alterations to plant species composition can significantly affect butterfly communities. Reductions in plant species diversity results in reduced butterfly diversity.

Clearing of original habitat can produce edge effects, whereby the forest microclimate is altered at the forest edge. A significant proportion of butterfly species, such as those that inhabit disturbed forest may be adversely affected by edge effects.

Riverine habitats are of prime importance for butterflies. Flooding, clearing, modification and degradation of these habitats can affect populations. Besides clearing and degradation, these habitats may be influenced by changes to water regimes and contamination of the waters themselves.

Once an area becomes more accessible habitat degradation can soon follow. Unemployed squatters, in particular, will be directly dependent on natural resources for food and shelter, resulting in clearing of land for gardens and firewood. A large area surrounding the mining town of Tabubil (Western Province) is denuded, as a result of several thousand squatters trying to maintain a living.

While fire in wet tropical areas is often considered to be uncommon, it has had a

marked impact on environments throughout PNG. Repeated burning practices have converted much forested land to 'permanent' grasslands. This is particularly evident in the Lae-Wau-Bulolo Valley, the Markham Valley and is widespread in the Western Highlands Province. Grasslands are largely inhospitable to butterflies. Reducing the opportunity for squatter settlements by minimising access is the most efficient means of mitigating fire hazards.

Degradation of native forest communities may result from the introduction and domination of invasive plant species. In such situations, the process is gradual, with vines covering and 'choking' trees, eventually eradicating the canopy and hence reducing species diversity. This is evident at Simberi Island, New Ireland Province. The invasive plants manifest in clearings, e.g. in abandoned gardens.

Pest fauna are associated with invasive plants and the introduction of human settlement. Several flies (Diptera) and wasps (Hymenoptera) are parasites of butterfly larvae, many of which are more common in altered environments. The parasites lay eggs inside the eggs, larvae or even pupae of the butterfly host and the parasite completes its life cycle inside the immature butterfly, eventually hatching out once its host has died. Viruses also kill many butterfly larvae. Larger pests, such as cane toads (*Bufo* sp.) and rats have been known to feed on the early stages of Birdwings. Several species of introduced rats (*Rattus* sp.) are now prevalent in PNG (Flannery 1995).

A large proportion of lycaenid butterflies are associated with ants and usually the larvae of each species are attended by only a single ant species. The butterflies cannot survive without the ants and therefore the potential impacts are doubled. Invasion of pest ant species, e.g. the Crazy and Fire Ants (genus *Anoplolepis* and *Paratrechina*, respectively), could significantly affect the well-being of the native ants and the lycaenid butterflies which they attend.

An unidentified butterfly found in the vicinity of the Hindenburg Wall.
(© Stephen Richards)

Chapter 7

Conservation and further field research

A globally significant but unstudied site

The Hindenburg Wall has been proposed as a UNESCO World Heritage Site together with the Nakanai and Muller Ranges as part of the *Sublime Karst of Papua New Guinea*. It would be fair to assume that sites of such global significance would be well understood and well protected. While the Nakanai and Muller Ranges have been the subject of a recent biodiversity inventory through a Rapid Biological Assessment no such equivalent survey has been conducted for the Hindenburg Wall. In a major Conservation Needs Assessment conducted in 1993, the Hindenburg Wall was noted for its lack of scientific study and was highlighted as an important site for future studies (Swartzenruber 1993). These have not occurred and we are no closer to understanding the biological values of this area than we were almost 30 years ago.

It is almost certain that dozens, if not hundreds of species new to science await discovery on the Hindenburg Wall. Recent surveys of the sites also proposed for World Heritage listing – the Nakanai Mountains and Muller Range – revealed over 100 species new to science at each site.

Of the vertebrate species that we already know exist, little information on population sizes or trends exist. For the four major groups reviewed in this report: mammals, birds, reptiles and amphibians experts have insufficient information to assign an IUCN threat status to a third of the nearly 360 vertebrate species listed as likely to occur in the vicinity of the Hindenburg Wall.

For almost all of the species likely to inhabit *the Hindenburg Wall there is a paucity of information* at the most basic ecological level. Most of the information on their natural history is rudimentary or often entirely speculative.

Although the biodiversity of the Hindenburg Wall has not been fully investigated the area is known to harbour a number of peculiar life forms including freshwater polychaete worms (which are normally a marine group), and an extensive cave-adapted fauna which lives off the dung of cave roosting birds and bats (Hamilton-Smith 2006).

Some of PNG's most iconic and at-risk species occur in the vicinity of the Hindenburg Wall. These include the Critically Endangered Bulmer's fruit-bat and the Critically Endangered long-beaked echidna. The latter is currently ranked as the highest priority Endangered mammal in the world by the Zoological Society of London (ZSL 2012). In addition, a further 13 species of threatened birds and mammals are likely to occur in the area (Table 9). Protecting the Hindenburg Wall would go a long way to ensuring the survival of these species.

Threats to the biodiversity

The protection of the Hindenburg Wall will buffer against biodiversity losses from multiple threats. It is difficult to assess the relative importance of threats to biodiversity in the absence of conservation research. Although anecdotal, the decimation of a large population of the Critical Endangered Bulmer's Fruit-Bat by local people at Luplupwintem Cave close to the edge of the Hindenburg Wall only 2 years after

it was discovered there in 1975, suggests hunting and harvesting may pose significant threats to some species and groups. In this situation, the introduction of the cash economy and shotguns was thought to have caused the decline, highlighting how improved hunting technology also poses a threat to some species. In the forests at the base of the wall both industrial logging and clearance for subsistence agriculture – overwhelmingly the two most important drivers of forest change in PNG (Shearman *et al.* 2008) – are threats to the integrity of forests. Despite a relatively low human population substantial deforestation has occurred above the Wall due to fire – the most recent large-scale event being associated with the 1997-1998 El Niño induced drought – likely from fires associated with subsistence agriculture (Fig. 3).

Refugia from climate change

The protection of the Hindenburg Wall may buffer against future biodiversity losses resulting from climate change. As a large intact area of contiguous forest along an altitudinal gradient, the physical structure of the Hindenburg Wall offers many potential refugia against climatic depredations, while its high biodiversity offers a large reservoir for genetic adaptation to a world with a changing climate.

The Hindenburg Wall contains vast standing stocks of carbon in its forests, and so represents a notable carbon sink which in itself helps mitigate against future climate change.

A world treasure

While the Hindenburg Wall possesses undoubted aesthetic and spiritual properties, quantitative surveys of the area are required to document both the current significance of the area and to allow the formation of a baseline from which the success of future management can be judged.

The Hindenburg Wall has the characteristics worthy of UNESCO World Heritage status as shown by the information presented in this review. The granting of any protection to the Hindenburg Wall area would not only provide security for the landscape and its biodiversity but also safeguard the many cultural and archaeological sites which lie within it.

Despite being called a wonder of the natural world by the scientific community, few people even within Papua New Guinea know of the existence of the Hindenburg Wall. As we move into the 21st Century this exceptional and iconic landscape remains mysterious. Closer scientific exploration of the Hindenburg Wall will inevitably turn the eyes of the world to Papua New Guinea and this iconic wonder.

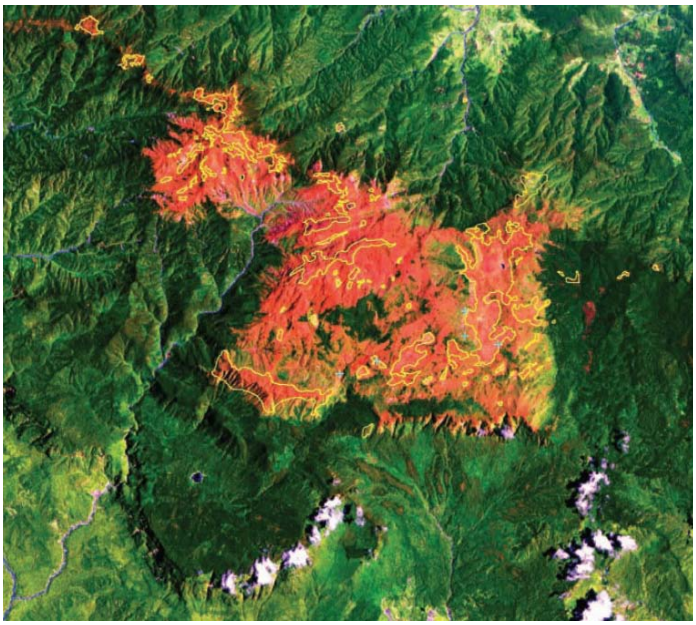


Figure 3: Deforestation on the plateau above the Hindenburg Wall (The Wall can be seen in the lower part of the figure). An image from 2002 has 1972 forest/grassland boundaries overlain (yellow lines). A large area of forest has been lost on the upper slopes of the Wall. Locations of fires from 2002-2004 are shown with + symbol. These crosses shows that forest converted to grassland prior to 2002 has continued to be burned since suppressing regrowth of forest. (Reproduced from Shearman et al. 2008)

Table 9. Vertebrate species threatened with extinction likely to occur in the vicinity of the Hindenburg Wall.

Scientific Name	Common Name	IUCN
Mammals		
Aproteles bulmerae	Bulmer's Fruit-Bat	CE
Zaglossus bartonii	Long-Beaked Echidna	CE
Phalanger matanim	Telefomin Cuscus	EN
Spilocuscus rufoniger	Black-Spotted Cuscus	EN
Dactylopsila megalura	Great Tailed Triok	VU
Dasyurus albopunctatus	New Guinea Quoll	VU
Dendrolagus dorianus	Doria's Tree Kangaroo	VU
Dendrolagus goodfellowi	Goodfellow's Tree Kangaroo	EN
D. notatus	Central Ranges Tree Kangaroo	EN
Pseudochirops corrinae	Plush-Coated Ringtail	VU
Thylogale brunii	New Guinea Pademelon	VU
Birds		
Psittrichas fulgidus	Vulturine Parrot	EN
Harpyopsis novaeguineae	New Guinea Harpy-Eagle	VU
Casuarius casuaris	Doubled-Wattled Cassowary	VU
C. unappendiculatus	Single-Wattled Cassowary	VU
Epimachus fastosus	Black Saber Tailed Bird Of Paradise	VU
Goura scheepmakeri	Sheep-Makers Crowned Pigeon	VU
Macgregoria pulcha	Macgregor's Bird Of Paradise	VU
Casuarius benneti	Dwarf Cassowary	NT
Loboparadisea sericea	Shield-Billed Bird Of Paradise	NT

IUCN status: CE = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened (Source IUCN 2011)

References cited & Expanded bibliography

This list of references includes an expanded bibliography covering studies of the Western Province in either a social, ecological or environmental context. Those references from the expanded bibliography that are not cited in the text of this review are preceded with an asterisk (*).

*ALLEN, B.J., HIDE, R.L., BOURKE, R.M., AKUS, W., FRITSCH, D., GRAU, R., LING, G., & LOWES, E. 2002. Agricultural Systems of Papua New Guinea. ALLEN, G. R. & COATES D. 1990. An Ichthyological Survey of the Sepik River, Papua New Guinea. Records of the Western Australian Museum (Supplement) 34: 31-116.

*ALLEN, L. 1984. Production, Consumption and Gender: Male Female Relations Among the South Mountain Ok. Ba Hons Thesis. The Australian National University, Canberra.

ALLISON, A. 2007. Herpetofauna of Papua. IN: MARSHALL, A.J & BEEHLER, B.M. (eds). The Ecology of Papua: Part One. The Ecology of Indonesia Series Volume IV. Periplus Editions, Singapore. Pp 564-616.

APLIN, K.P. 1998. Vertebrate zoogeography of the Bird's Head of Irian Jaya, Indonesia. IN: MIEDEMA, J, ODÉ, C. and DAM, M.A.C. (eds). Perspectives on the Bird's Head Peninsula of Irian Jaya, Indonesia. Proceedings of an interdisciplinary conference. Rodopi Publishers, Leiden, The Netherlands. Pp 803-890.

APLIN K.P & KALE, E. 2011. The Non-Volant Mammal Fauna of the Muller Range, Papua New Guinea. IN: RICHARDS, S. J. & GAMUI, G. B. (eds.) Rapid Biological Assessments of the Nakanai Mountains and the Upper Strickland Basin: Survey the Biodiversity of Papua New Guinea's Sublime Karst Environments. RAP Bulletin of Biological Assessment 60. Conservation International, Arlington, VA. Pp 211-221

*ARNOLD, G. O. & GRIFFIN, T. J. 1978. Intrusions and Porphyry Copper Prospects of Star Mountains, Papua New Guinea. Economic Geology 73: 785-795.

*ASMUTH, H. 1996. Zur besonderen Bedeutung von Sago, in Materialen zur Ausstellung: Sagohammer und Konservendose - Einblicke in die Kulturder Gargar in Neuguinea. Institut und Sammlung für Völkerkunde der Universität Göttingen, Göttingen.

*ATTENBOROUGH, R. D., BURKOT, T. R. & GARDNER, D. S. 1997. Altitude and the Risk of Bites From Mosquitoes infected with Malaria and Filariasis Among the Mianmin People of Papua New Guinea. Transactions of the Royal Society of Tropical Medicine and Hygiene 91: 8-10.

*ATTENBOROUGH, R. D., PORTEOUS, R. K. & GARDNER, D. S. 1995. Longitudinal Weight Growth Patterns in the Highland Fringes of West Sepik Province, Papua New Guinea: a Comparison of Three Groups. Annals of Human Biology 22: 131-50.

AUDLEY-CHARLES, M.G. 1991. Tectonics of the New Guinea Area. Ann Rev Earth Plant Sci 19:17-41

AUDLEY-CHARLES, M. G. 1981. Geological history of the region of Wallace's Line. IN: WHITMORE, T. C. (Ed.) Wallace's Line and Plate Tectonics Clarendon Press, Oxford. 91 pps.

AUSTEN, L. 1923a. Report of a Patrol of the Tedi (Alice) River and the Star Mountains, Western District. Papua, Annual Report for 1921-22.

AUSTEN, L. 1923b. The Tedi River District of Papua. Geographical Journal 62:335-349.

AUSTEN, L. 1925. Report of a Patrol from Wukpit Camp (Tedi River) to Star Mountains. Territory of Papua, Annual Report 1922-23.

AUSTEN, L. 1926. Recent Explorations in the North-West District of Papua. Geographical Journal 67:434-41.

*AUSTIN, C. C., HAYDEN, C. J., BIGILALE, I., DAHL, C. & ANAMINIATO, J. 2008. Checklist and Comments on the Terrestrial Amphibian and Reptile Fauna From Utai, Northwestern Papua New Guinea. Herpetological Review 39: 40-45.

AXELROD, D. I., RAVEN, P. H. 1982. Palaeobiogeography and origin of the New Guinea flora. IN GRESSITT, J. L. (ed.) Biogeography and Ecology of New Guinea. Monographiae Biol. 42: 919-941.

*BAMBRICK, H. 1998. Slow Growth and Reduced Body Size of the Mianmin of Papua New Guinea: Adaptive Or Pathological Response To Nutritional and Environmental Stress? Research Essay, ANU.

*BARNISH, G. & ASHFORD, R. W. 1990. Strongyloides of Fuelliborni and Other intestinal Helminths in Papua New Guinea: Distribution According To Environmental Factors." Parassitologia 32: 245-263.

*BARTH, F. 1969. Introduction. IN: BARTH, F. (ed.), Ethnic Groups and Boundaries: The Social Organisation of Culture Difference. Allen & Unwin, London. Pp. 9-38.

BARTH, F. 1971. Tribes and Intertribal Relations in the Fly Headwaters. Oceania 41:171-191.

BARTH, F. 1975. Ritual and Knowledge among the Baktaman of New Guinea. Yale University Press, New Haven.

BARTH, F. 1987 Cosmologies in the Making: A Generative Approach to Cultural Variation in Inner New Guinea. Cambridge Studies in Social Anthropology. Cambridge University Press, Cambridge.

*BAYLISS-SMITH, T. 1985. Subsistence Agriculture and Nutrition in the Bimin Valley, Oksapmin Sub-District, Papua New Guinea. Singapore Journal of Tropical Geography 6: 101-15.

BEEHLER, B., PRATT, T. & ZIMMERMAN, D. 1986. Birds of New Guinea, Guildford, Surrey, Princeton University Press.

*BEHRMANN, W. 1924. Der Sepik (Kaiserin Augusta-Flusz) und Sein Stromgebiet. Aufgenommen während der Kaiserin Augusta-Fluß-Expedition 1912-1913 in Deutsch-Neuguinea. Dietrich Reimer: Berlin [Three maps, 1:250,000; Map 1 includes the data from Thurnwald's trek to the Sepik source basin].

*BEHRMANN, W. 1917. Der Sepik (Kaiserin-Augusta-Fluss) und sein Stromgebiet: Geographischer Bericht der Kaiserin-Augusta-Fluss-Expedition1912-13 auf der Insel Neuguinea. Ernst Siegfried Mittler und Sohn. Berlin.

*BEHRMANN, W. 1922. Im Stromgebiet des Sepik. Scherl, Berlin.

*BELLWOOD, P. 1995. Comment on: Predicting Similarity in Material Culture among New Guinea Villages from Propinquity and Language: a Log-Linear approah'. Current Anthropology 36(5): 769-88.

*BENTLEY, K. W. 2007. Otml Community Health Study (2 Vols). Volume 1: Design, Conduct and Analysis of the Otml Chs Food and Nutrition Studies. Volume 2: including: Health Status, the Ok Tedi-Fly River Communities Etc. Canberra, Centre For Environmental Health Pty Ltd, Woden, Australia.

*BERAN, H. & CRAIG, B., (eds). 2005. Shields of Melanesia. Crawford House Publishing, Adelaide.

*BERCOVITCH, E. 1989. Disclosure and Concealment: a Study of Secrecy among the Nalumin People of Papua New Guinea. PhD thesis, Stanford University.

*BERCOVITCH, E. 1994. The Agent in the Gift: Hidden Exchange in Inner New Guinea. Cultural Anthropology 9(4): 498-536.

*BERCOVITCH, E. 1996. The Woman Who Ran Away: Gender, Power, and Place Among the Atbalmin of the West Sepik, Papua New Guinea. Pacific Studies (Special Issue: Women, Age, and Power: the Politics of Age Difference Among Women in Papua New Guinea and Australia) 19: 15-40.

*BERCOVITCH, E. 1998. Dis-Embodiment and Concealment Among the Atbalmin of Papua New Guinea. IN: LAMBEK, M. & STRATHERN, A. (eds). Bodies and Persons: Comparative Perspectives From Africa and Melanesia... Cambridge University Press. Cambridge, U.K . Pp 210-231.

*BINO, R. 1996. Notes on Behaviour of New Guinea Singing Dogs *(Canis lupus dingo)*." Science in New Guinea 22: 43-47.

*BIRD, M. 1996. The North-West Patrol [Computer File]: across New Guinea from the Fly to the Sepik 1926-1996. Canberra, Australian National University.

*BIRGE, N. 1980. Vegetable Co-Operative At Oksapmin. Harvest 6: 27.

*BLACK, J. R. 1939a. Diaries Hagen-Sepik Patrol 1937-1939. Papers of John Russell Black, National Library of Australia, Canberra. Unpublished.

*BLACK, J. R. 1939b. Hagen-Sepik Patrol Field notes, April-June 1939. Papers of John Russell Black, National Library of Australia, Canberra. Unpublished.

*BLINKOFF, I. R. 2000. Creating and Maintaining Access Fields in Sokamin, Papua New Guinea. Phd Thesis. Rutgers University, New Brunswick,NJ.

BLONG, R. J. 1986. Natural Hazards in the Papua New Guinea Highlands. Mountain Research and Development 6: 233-246.

*BOLTON, J. & FYFE, A. 2010. Stringbag Patterns and Colour Dyes of the Upper Sepik Basin and Border Mountains.

*BOLTON, J. & FYFE, A. 2009. Knots, Loops & Braids: Exploring Threads of History, Gender & Sociality in Upper Sepik Fibre crafts.

BONACCORSO, F. J. 1998. Bats of Papua New Guinea, Washington D.C., USA, Conservation International.

*BORAM, C. 1980. Oksapmin Children. New Haven, Conn. Human Relations Area Files.

*BOROK, B. 1965. Patrol Report, Amanab 13, 1964/65.

*BOURKE, R. M. 2000. Impact of the 1997 Drought and Frosts in Papua New Guinea.IN: GROVE, R. H. & CHAPPELL, J. (eds). El Niño - History and Crisis: Studies from the Asia-Pacific Region. Kapwell, UK, the White Horse Press. Pp 149-170.

*BOURKE, R.M., ALLEN, B.J., HIDE, R.L., FRITSCH, D., GRAU, R., LOWES, E. , NEN, T., NIRSIE, E., RISIMERI, J. & WORUBA, M. 1993. Agricultural Systems of Papua New Guinea. Working Paper No. 3. West Sepik Province. Department of Human Geography, Australian National University, Canberra.

*BOYCE, T. M. 1992. infrastructure and Security: Problems of Development in the West Sepik Province of Papua New Guinea. Canberra Papers on Strategy and Defence No. 93, Strategic and Defence Studies Centre, the Australian National University.

*BOYD, D. J. 2005. Beyond the Ipomoean Revolution: Sweet Potato on the 'Fringe' of the Papua New Guinea Highlands. IN: BALLARD, C., BROWN, P. , BOURKE, R. M. & HARWOOD T. (eds). the Sweet Potato. Oceania: a Reappraisal. Sydney, Oceania Monograph 56, Oceania Publications, University of Sydney. Pp 137-147.

*BRAGGE, L. W. 1964. Patrol Report, Green River No. 7, 1963/64.

*BRENNER, M. E. 1998. Adding Cognition To the Formula For Culturally Relevant instruction in Mathematics." Anthropology & Education Quarterly 29: 214-244.

BRERETON, T. M., CRUIKSHANKS, K. L., RISELY, K., NOBLE, D. G., ROY, D. B. 2011. Developing and launching a wider countryside butterfly survey across the United Kingdom. *Journal of Insect Conservation* 15: 279-290.

*BRITTEN, R. M. 1981. The Geology of the Frieda River Copper Prospect, Papua New Guinea. Phd Thesis. The Australian National University, Canberra.

BRONGERSMA, L. D. & VENEMA G.F. 1962. To the Mountains of the Stars. (Transl. by Alan G. Readett.) Hodder & Stoughton, London.

*BROOK, D 1977. Caves and Karsts of the Hindenburg Ranges, the Geographical Journal. Vol 143.

BROOKS, C. J. 1950. A revision of the genus *Tenaris* Hubner (Lepidoptera: Amathusiidae). Transactions of the Royal Entomological Society, London 101: 179-238, 8 pls.

*BRUMBAUGH, R. C. 1980b. Models of Separation and a Mountain Ok Religion. Ethos 8: 332-48.

*BRUMBAUGH, R.C. (ed.) 1984. Telefol Weng Sang (Telefol Folk Stories). Oral History XII, 3:1-107; XII, 4: 1-101.

*BRUMBAUGH, R.C. 1990. Afek Sang: the Old Woman's Legacy to the Mountain Ok. IN: B. CRAIG AND D. HYNDMAN (eds), Children of Afek: Tradition and Change Among the Mountain-Ok of Central New Guinea. Oceania Monographs No.40.Sydney. Pp. 54-87.

BRUMBAUGH, R.C.1980a. A Secret Cult in the West Sepik Highlands. PhD Thesis, Anthropology, State University of New York at Stony Brook.

*BRUTTI, L. & BOISSIÈRE, M. 2002. Le Donneur, Le Receveur Et La Sage Femme. Échanges De Cochons a Oksapmin (Papouasie Nouvelle-Guinée)." Journal De La Société Des Océanistes 114-115: 141-157.

*BRUTTI, L. 1997. Defending indigenous People's intellectual Property: the Case of the Liawep of Papua New Guinea." international institute For Asian Studies Newsletter 15: 26.

*BRUTTI, L. 1997. Waiting For God: Ecocosmological Transformations Among the Oksapmin (Sandaun Province - Png).IN: STEWART , P. J. &. STRATHERN, A. (eds).. Millennial Markers. Townsville, Centre For Pacific Studies, James Cook University. Pp 87-131.

*BRUTTI, L. 1999. 'Après Nous Le Déluge', Les Effets De La Présence D'une Compagnie Minière Sur Le Système Agricole Et Le Commerce Des Produits Cultivés Dans La Région De Oksapmin (Papouasie Nouvelle-Guinée." JATBA, Revue D'ethnobiologie 41: 183-200.

*BRUTTI, L. 1999. De La Transformation De L'écologie Par L'idéologie. IN: BAHUCHET, S. BLEY, D. PAGEZY, H. & VERNAZZA-LICHT, N. (eds). L'Homme Et La Forêt Tropicale. Châteauneuf De Grasse, Éditions De Bergier. Pp 75-87.

*BRUTTI, L. 1999. 'on His Holiness' Secret Service': Representations of Catholicism in Contemporary Evangelised Papua New Guinea. IN: SCHMID, C.K. (ed). Expecting the Day of Wrath: Versions of the Millennium in Papua New Guinea. Port Moresby, the National Research institute in Association with the European Commission Programme .Avenir Des Peuples Des Forets Tropicales. Pp 44-56.

*BRUTTI, L. 2000. Afek's Last Son: integrating Change in a Papua New Guinean Cosmology. Ethnohistory 47: 101-111.

*BRUTTI, L. 2001. Where Anthropologists Fear To Tread: Notes and Queries on Anthropology and Consultancy, inspired By a Fieldwork Experience. Social Analysis 45: 94-107.

*BRUTTI, L. 2005. Waiting For Company Or Waiting For God? L'application Du Modèle Du Giving Environment Aux Oksapmin De Papouasie Nouvelle-Guinée." Journal De La Société Des Océanistes 120-121: 84-93.

*BÜHLER, A. 1959. Notizen von der Sammlung der Sepik River Expedition. Unpublished.

BULMER, S. 2001. Lapita Dogs and Singing dogs and the History of the Dog in New Guinea. IN: CLARK, G.R., ANDERSON A.J., & VUNIDILO, T. The Archaeology of Lapita Dispersal in Oceania: papers from the Fourth Lapita Conference, June 2000, Canberra, Australia. Terra Australis 17. Pandanus books. Canberra.

*BUSH, T. 1985. Form and decoration of arrows from the highlands of Papua New Guinea. Australian Museum Records 37: 255-93.

BYRNE ,G.M. GHIYANDIWE & JAMES P.M. (1978) Ok Tedi Landslide Study. Geological survey of Papua New Guinea Report no. 78/3

*CALCUTT R. A. 1956. Patrol Report, Green River No. 1, 1956/57.

*CAMPBELL, S. 1937. Diary: Second Expedition to Upper Fly and Sepik Rivers. 1936-1937. Aircraft: Sikorsky Amphibian and Waco Amphibian. Mitchell Library archives, Sydney. Unpublished, MLMSS 7200.

CAMPBELL, S. 1938. The Country between the Headwaters of the Fly and Sepik Rivers in New Guinea. Geographical Journal 92:232-258.

*CAPE, N. 1980. Malnutrition in Oksapmin. Teaching Methods and Materials Centre, Occasional Paper No. 4,. Port Moresby, University of Papua New Guinea.

*CAPE, N. 1981. Agriculture. S. G. IN: WEEKS, S. (ed). Oksapmin: Development and Change. University of Papua New Guinea, Port Moresby.. Pp 149-190.

*CAPE, N. 1982. Possible Causes of Malnutrition in Oksapmin, West Sepik (Poster). IN: BOURKE, R. M. & KESAVAN, V. (eds). Proceedings of the Second Papua New Guinea Food Crops Conference: Part Three. Port Moresby, Publications Section, Department of Primary industry. Pp 565.

*CAPE, N. 1982. Working with Farmers. IN: BOURKE, R. M. & KESAVAN, V. (eds). Proceedings of the Second Papua New Guinea Food Crops Conference: Part Three. Port Moresby, Publications Section, Department of Primary industry. Pp 537-546.

*CAPE, N. 1987. Papua New Guinea: the Education of An Extension Worker. Thoughts on How An Outsider Can Work in Village Development. RRDC Bulletin, Reading Rural Development Communications No. 22: 27-32.

*CAPE, N. 1987b. Research and Evaluation of Health in Papua New Guinea. Maed. Thesis. University of Manchester.

CHAMPION, I. F. 1966. Across New Guinea from the Fly to the Sepik. Melbourne: Lansdowne Press.[with postscript on establishment of Telefomin Patrol Post in 1948]

*CHISHOLM R. H. 1966. Patrol Report, Amanab No. 1, 1966/67.

*CHISHOLM R. H. 1968. Patrol Report, Green River No. 3, 1968/69.

*CHISHOLM R. H. 1969. Patrol Report, Green River No. 1, 1969/70.

CLEMENTS, R., SODHI, N.S., SCHILTHUIZEN, M., & NG, P.K.L. 2006. Limestone Karsts of Southeast Asia: Imperiled Arks of Biodiversity. Bioscience 56:733-742

*COATES, D. & B. M. F. MYS 1989. Preliminary Report on Population Statistics and Socio-Economic Data For the Sepik and Ramu River Catchments. FAO Report- a Report Prepared For the Sepik River Fish Stock Enhancement Project, PNG/85/001 Field Document No. 4. Rome, FAO.

*COATES, D. 1989. Fish Fauna of the Sepik and Ramu River Floodplain Regions: Summary of information on Fish Ecology, Identification of Vacant Niches and Categories of Species Suitable of Stocking. FAO Report- a Report Prepared For the Sepik River Fish Stock Enhancement Project, PNG/85/001 Field Document No. 3, November 1989. Rome, FAO: 37.

COLEMAN, P. J., PACKHAM, G. H. 1976. The Melanesian borderlands and India – Pacific plates' boundary. Earth Science Reviews 12: 197-233.

*COLGAN, D. J. & FLANNERY, T. F. 1992. Biochemical Systematic Studies in the Genus Petaurus (Marsupialia, Petauridae). Australian Journal of Zoology 40: 245-256.

*CONRAD, R. & W. DYE. 1975. Some Language Relationships in the Upper Sepik Region of Papua New Guinea. Papers in New Guinea Linguistics No. 18, Pacific Linguistics; Series A 40. Research School of Pacific Studies, Australian National University.

*CORRIGAN, J. C. 1960. Patrol Report, Amanab No. 1, 1960/61.

*COTTLE, A. T. 1953. Patrol Report, Green River No. 2, 1953/54.

*CRAIG, B. 1993. Continuities and Discontinuities in the Material Culture of the Mountain-Ok and their Neighbours. COMA: Bulletin of the Conference of Museum Anthropologists 24:45-64.

CRAIG, B. 1996. 'Sepik' and 'Telefolmin' In, Turner, Jane (ed.) *The Dictionary of Art*. Vol.24:65-74. London: Macmillan.

*CRAIG, B. 1997a. Lowland-Ok and Mountain-Ok. IN: OLIVER, P. (ed.) Encyclopedia of Vernacular Architecture of the World; Vol. 2. Cambridge University Press. Cambridge. Pp.1184-7.

*CRAIG, B. & HYNDMAN, D. (eds). 1990. Children of Afek: Tradition and Change Among the Mountain-Ok of Central New Guinea. Sydney: Oceania Monographs No.40. University of Sydney.

*CRAIG, B. & SWADLING, P. 1983. Trading Spheres in the Ok Tedi Impact Region. IN: Swadling, P. (ed). How Long Have People Been in the Ok Tedi Impact Region? Port Moresby, Png National Museum. Pp 111-121.

*CRAIG, B. 1965. Australian Star Mountains Expedition. Unpublished.

*CRAIG, B. 1967. Houseboards of the Telefomin Sub-District, New Guinea. Man 2: 260-73.

*CRAIG, B. 1968a. Ethnographic Collection of the Upper Sepik Ethnographic Expedition 1968. Unpublished.

*CRAIG, B. 1968b. Report to the Wenner-Gren Foundation for Anthropological Research on the Upper Sepik Ethnographic Expedition 1968. Unpublished.

*CRAIG, B. 1968c. Upper Sepik Ethnographic Expedition. Unpublished.

*CRAIG, B. 1969a. Catalogue of Ethnographic Specimens Collected During the Upper Sepik Ethnographic Expedition 1969. Unpublished.

*CRAIG, B. 1969b. Houseboards and Warshields of the Mountain-Ok of Central New Guinea: Analysis of an Art Style. M.A. Thesis, Sydney University.

*CRAIG, B. 1970. Art Styles of the Upper Sepik. Unpublished.

*CRAIG, B. 1973. Upper Sepik Field Diary. 1972-3. Unpublished.

*CRAIG, B. 1975. The Art Style of Yellow River, West Sepik District, Papua New Guinea. Baessler-Archiv 23: 417-45.

*CRAIG, B. 1976. The Keram Style in the Abau area of the Upper Sepik, PNG. Baessler-Archiv 24: 181-95 (with a 1983 postscript in Vol. 31:351-55).

*CRAIG, B. 1980a. Legends of the Amto, Simaiya Valley (including a brief description of the material culture. Oral History 8: 1-113.

*CRAIG, B. 1980b. Legends of the Abau, Idam Valley, Oral History 8: 1-92.

*CRAIG, B. 1983. Report of Mountain-Ok Field Survey, June 6 to July 7; August 28 to September 9, 1983. Papua New Guinea National Museum Art Gallery. Unpublished.

*CRAIG, B. 1988. Art and Decoration of Central New Guinea. Shire Ethnography publication Nr. 5. Aylesbury, Bucks.: Shire.

CRAIG, B. 1990. Relic and Trophy Arrays as Art Among the Mountain-Ok of Central New Guinea. IN F. ALLAN AND LOUISE HANSON (eds.), Art and Identity in Oceania. University of Hawaii Press, Honolulu.

*CRAIG, B. 1990. The Telefomin Murders: Whose Myth? IN: CRAIG, B. & HYNDMAN, D. (eds) Children of Afek: Tradition and Change Among the Mountain-Ok of Central New Guinea. Sydney, University of Sydney. Pp 115-150.

*CRAIG, B. 1990a. Is the Mountain-Ok Culture a Sepik Culture? IN: LUTKEHAUS,N., KAUFMANN, C. , MITCHELL, W. E., NEWTON, D., OSMUNDSEN, L., & SCHUSTER M. (eds), Sepik Heritage: Tradition and Change in Papua New Guinea. Durham, N.C.: Carolina Academic Press, pp. 129-49

*CRAIG, B. 1990b. Relic and Trophy Arrays as Art Among the Mountain-Ok of Central New Guinea. IN: Hanson, F. A. & Hanson, L. (eds), Art and Identity in Oceania. Crawford House Press, Bathurst. Pp. 196-210.

*CRAIG, B. 1995. Arrow designs in northern and central New Guinea and the Lapita Connection. IN: SMIDT, D., TER KEURS, P. & TROUWBORST, A. (eds). Pacific Material Culture, Essays in Honour of dr. Simon Kooijman on the Occasion of his 80th Birthday. Mededelingen van hetRijksmuseum voor Volkenkunde, Leiden. Pp.237-59.

*CRAIG, B. 1997. The Fate of Thurnwald's Sepik Ethnographic Collections, in M. Schindlbeck (ed.), Gestern und Heute - Traditionen in der Südsee. Berlin: Baessler-Archiv XLV, pp. 387-408.

CRAIG, B. 1997b. The Fate of Thurnwald's Sepik Ethnographic Collections. In, M. Schindlbeck (ed.) Gestern und Heute - Traditionen in der Südsee. Baessler-Archiv XLV, Berlin. Pp.387-408.

*CRAIG, B. 2002. Abau, in M. Ember & I. Skoggard (eds), Encyclopedia of World Cultures. Supplement. MacMillan, New York. Pp. 1-5.

*CRAIG, B. 2005a. Highlands of Central New Guinea. IN: Beran, H. & Craig, B. (eds). Shields of Melanesia. Crawford House, Adelaide. Pp. 117-26.

*CRAIG, B. 2005b. Upper Sepik Area IN: Beran, H. & Craig, B. (eds). Shields of Melanesia, Adelaide: Crawford House, pp. 75-89.

*CRAIG, B. 2005c. What Can Material Culture Studies Tell Us about the Past in New Guinea?, in A. Pawley, R. Attenborough, J. Golson & R. Hide (eds), Papuan Pasts: Cultural, Linguistic and Biological Histories of Papuan-Speaking Peoples.. Pacific Linguistics, Research School of Pacific and Asian Studies, Australian National University. Canberr. Pp. 493-513.

*CRAIG, B. 2008. Sorcery divination among the Abau of the Idam Valley, Upper Sepik, Papua New Guinea. Journal of Ritual Studies 22: 37-51.

CRAIG, B. AND D. HYNDMAN, D. (eds) 1990. Children of Afek. Tradition and Change among the Mountain-Ok of Central New Guinea. Oceania Monograph 40. University of Sydney, Sydney.

*CRAIG, B., LEWIS, G. & MITCHELL, W.E.. 2008. War Shields of the Torricelli Mountains, West Sepik Province, Papua New Guinea. Oceania 78(3):241-59.

*CRAIG, R. 1969. Marriage among the Telefolmin. IN: GLASSE, R. M. & MEGGIT, M. J. (eds). Pigs, Pearlshells and Women : Marriage in the New Guinea Highlands. Prentice-Hall, Eaglewood Cliffs. Pp. 176-97.

*CRAIG, R. 1969. Marriage Among the Telefomin. IN: GLASSE ,R. M. & MEGGITT ,M. J., (eds). Pigs, Pearlshells, and Women: Marriage in the New Guinea Highlands. Englewood Cliffs, Prentice-Hall, inc. Pp 176-197.

*CRANSTONE, B. 1990. The Tifalmin and their Environment: Material Culture of a Mountain-Ok People. IN: CRAIG , B. &.HYNDMAN, D. (eds). Children of Afek:

Tradition and Change Among the Mountain-Ok of Central New Guinea. Sydney, University of Sydney. Pp 35-53.

*CRANSTONE, B. A. L. 1964a. Tifalmin collection. Archives of the National Museum of Papua New Guinea, Port Moresby. Unpublished.

*CRANSTONE, B. A. L. 1964b. Field Notes of the British Museum Ethnographical Expedition to New Guinea. Archives of the British Museum,London. Unpublished.

*CRANSTONE, B. A. L. 1964c. Collection Notes in the British Museum Register. Unpublished.

*CRANSTONE, B. A. L. 1965a. The British Museum Ethnographical Expedition to New Guinea 1963-4. British Museum Quarterly 29(3-4): 109-18.

*CRANSTONE, B. A. L. 1965b. A House Board from Telefomin, Territory of New Guinea. British Museum Quarterly 30:56-9.

*CRANSTONE, B. A. L. 1967. Some Boards from a New Guinea Haus Tambaran. Man 2: 274-7.

*CRANSTONE, B. A. L. 1968. War Shields of the Telefomin Sub-District, New Guinea. Man 3: 609-24.

*CRANSTONE, B. A. L. 1971. The Tifalmin: a Neolithic People in New Guinea'. World Archaeology 3: 132-42.

*CRANSTONE, B. A. L. 1990. The Tifalmin and Their Environment: Material Culture of a Mountain-Ok People. IN: CRAIG, B. & HYNDMAN, D. (EDS), CHILDREN OF AFEK: Tradition and Change Among the Mountain-Ok of Central New Guinea. Sydney: Oceania Monographs No.40.Pp. 35-53.

CRANSTONE, B.A.L. 1971. The Tifalmin: A 'Neolithic' People in New Guinea. In: World Archaeology, Vol. 3, No. 2, Archaeology and Ethnography. Taylor & Francis, Ltd. Pp. 132- 142

D'ALBERTIS, L.M. 1881. New Guinea: What I Did and What I Saw. 2 vols. London.

*DAUR, L. 1977. West Sepik Province. Harvest 4: 29-40.

DAVENPORT, C., VAN MASTRIGT, H. 2008. Revision of *Delias mysis* (Fabricius, 1775) and closely related species (Lepidoptera: Pieridae). Suara Serangga Papua (SUGAPA) 3: 15-31.

DAVIES, H. L. 1990. Structure and evolution of the border region of New Guinea. IN: CARMAN, G. J., CARMAN, Z. (eds) Petroleum Exploration in Papua New Guinea), pp. 245–270. Port Moresby: P.N.G. Chamber of Mines and Petroleum.

DAVIES, H. L. 2009. New Guinea, Geology. IN: GILLESPIE, R., CLAGUE, D. (eds.), The Encyclopedia of Islands, Berkeley, University of California Press, p. 659-664.

DAVIES, H. L., PEREMBO, R. C. B., WINN, R. D., KENGEMAR, P. 1997. Terranes of the New Guinea Orogen. IN: HANCOCK, G. (ed.), Proceedings of the PNG Geology, Exploration and Mining Conference 1997, Madang, The Australasian Institute of Mining and Metallurgy, Melbourne, p. 61-66.

DAVIES, H.L. 1990. Structure and Evolution of the Border Region of Papua New Guinea. IN: CARMAN, G.J AND CARMAN, Z (eds). Petroleum Exploration in Papua New Guinea: Proceedings of the First PNG Petroleum Convention, Port Moresby, 12-14th February 1990. pp 245-270. PNG Chamber of Mines and Petroleum, Papua New Guinea.

DEPARTMENT OF ENVIRONMENT AND CONSERVATION 2010. Papua New Guinea's Fourth National report to the Convention on Biological Diversity. Department of Environment and Conservation, Port Moresby.

*DEWAR, G. I. 1967. Patrol Report, Amanab No. 1. 1967/68.

*DICKINSON, H. 2005. Windows of New Guinea. Bannockburn, Vic., Harley Dickinson.

*DORNSTREICH, M. D. & G. E. B. Morren. 1974. Does New Guinea Cannibalism Have Nutritional Value?, Human Ecology 2(1): 1-12.

DOUTCH H.F.1972. The Paleogeography of Northern Australia and New Guinea and its Relevance to the Torres Strait Area IN: WALKER, D. (ed) Bridge and Barrier the Natural Cultural History of Torres Strait. Canberra, Australia. Pp 1-10.

*DUDGEON, D. 1994. The influence of Riparian Vegetation on Macroinvertebrate Community Structure and Functional-Organization in 6 New-Guinea Streams. Hydrobiologia 294: 65-85.

*EASTOE, C. J. 1983. Sulfur Isotope Data and the Nature of the Hydrothermal Systems At the Panguna and Frieda Porphyry Copper-Deposits, Papua New Guinea. Economic Geology 78: 201-213.

*ECONOMIST INTELLIGENCE UNIT 1972. a Study of Less Developed Areas. Melbourne, the Economist intelligence Unit Australia Pty.

EGGERTSSON, S. 1997. Knowledge and Skin among the Kwermin of Papua New Guinea. PhD thesis, Anthropology, University of Manchester.

EGGERTSSON, S. 2003. Transforming Skins. Kwermin Sequences of Growth. University of Iceland Press, Reykjavik.

ELIOT, J. N. 1969. An analysis of the Eurasian and Australian Neptini (Lepidoptera: Nymphalidae). Bulletin of the British Museum of Natural History (Entomology) Supplement 15: 1-155, 101.

*EWERS, W. H. & JEFFREY, W. T. 1971. Parasites of Man in Niugini. Milton, Queensland, the Jacaranda Press.

*FIELD MUSEUM. <www.fmnh.org/research_collections/anthropology/anthro_sites/pacific_web/myth.htm>

*FLANNERY, T. & G. STEER 1986. Living Fossils. Paradise 59: 23-30.

*FLANNERY, T. 1989. Tracking the Mountain Giants. Paradise72: 29-34.

FLANNERY, T. 1995. Mammals of New Guinea, Chatswood, NSW, Reed Books.

*FLANNERY, T. F. & SERI , L. 1990. The Mammals of Southern West Sepik Province, Papua New Guinea: their Distribution, Abundance, Human Use and Zoogeography. Records of the Australian Museum 42: 173-208.

*FLANNERY, T. F. 1998. Throwim Way Leg: An Adventure. Melbourne, Text Publishing.

*FOLEY, W. A. 1986. The Papuan Languages of New Guinea. Cambridge: Cambridge University Press.

*FOLEY, W. A. 2000. The Languages of New Guinea. Annual Review of Anthropology 29: 357-404.

*FOLEY, W. A. 2005. Linguistic prehistory in the Sepik-Ramu basin. IN: PAWLEY, A., ATTENBOROUGH, R., GOLSON & HIDE, R. (eds), Papuan Pasts: Cultural, Linguistic and Biological Histories of Papuan-Speaking Peoples; Pacific Linguistics 572. Pacific Linguistics, Research School of Pacific and Asian Studies, Australian National University. Canberra.

FRODIN, D.G. AND D.C. HYNDMAN, 1982. Ethnobotany of the Ok Tedi Drainage. Working Paper 14 IN MAUNSELL & PARTNERS PTY, Ok Tedi Environmental Study - Volume 5: Population and Resource Use, Ethnobiology, pp.209-340.

*FUTDOK, W., ITOWOLOK, F,. MECKLENBURG, F., & ENSEP , R. B. M. 1987. Faiwol Bakan Awon Umi Mit Uta Ko: Birds in the Faiwol Area. Ukarumpa, Papua New Guinea, Summer institute of Linguistics.

*FYFE, A. & BOLTON, J.. 2011. An Analysis of Associations Between String Bag Variability, Language and Geographical Distance in the Upper Sepik Basin and Border Mountains.

*FYFE, A. 2008. Gender, mobility and population history: exploring material culture distributions in the Upper Sepik and Central New Guinea. PhD Thesis, University of Adelaide.

*FYFE, A. 2009. Exploring Spatial Relationships between Material Culture and Language in the Upper Sepik and Central New Guinea. Oceania 79:121-161.

*FYFE, A. 2009. Exploring Spatial Relationships Between Material Culture and Language in the Upper Sepik and Central New Guinea Oceania 79: 121- 161.

*GAMMAGE, B. 1998. The Sky Travellers; Journeys in New Guinea 1938-39. Melbourne University Press, Melbourne.

*GAMUI, B. 2004. Scientific Research As a Tool in Mobilizing Local Communities For Biodiversity Conservation. Paper Presented At: 18th Annual Meeting Society For Conservation Biology July 30th To August 2nd, 2004 - New York, New York, USA.

*GARDNER, D. 1988. Book Review: Cosmologies in the Making - a Generative Approach To Cultural Variation in inner New Guinea - Barth,F. American Ethnologist 15: 795-796.

*GARDNER, D. 1988. Mianmin Leaders and the Distinction Between Big Men and Great Men. Unpublished Paper: 35pp.

*GARDNER, D. 1988. Mianmin Women: Myth and Reality. D. Gewertz, Ed. Myths of Matriarchy Reconsidered. University of Sydney. Pp 144-169.

*GARDNER, D. 1999. Anthropophagy, Myth, and the Subtle Ways of Ethnocentrism. IN: GOLDMAN, L. R.(ed). the Anthropology of Cannibalism. Westport, Conn. and London, Bergin and Garvey. Pp 27-50.

*GARDNER, D. 2004. The Advent and History of Miyanmin Identity. IN: MEIJL, T. V. & MIEDEMA, J., (eds). Shifting Images of Identity in the Pacific. Leiden, KITLV Press. Pp 269.

*GARDNER, D. S. 1980. The Determinants of Mianmin Settlement and Residential Patterns: a Reply To Morren. Mankind 12: 215-225.

GARDNER, D. S. 1981. Cult Ritual and Social Organisation among the Mianmin. PhD Thesis, The Australian National University.

*GARDNER, D. S. 1981. The Determinants of Mianmin Settlement and Residential Patterns: a Reply To Moreen. Mankind 12: 215-225.

*GARDNER, D. S. 1983. Performativity in Ritual: the Mianmin Case. Man 18: 346-60.

*GARDNER, D. S. 1984. a Note on the Androgynous Qualities of the Cassowary: Or Why the Mianmin Say It Is Not a Bird. Oceania 55: 137-145.

*GARDNER, D. S. 1987. Spirits and Conceptions of Agency Among the Mianmin of Papua New Guinea. Oceania 57: 161-177.

*GARDNER, D. S. 1995. The Nena Project Socio-Economic Impact Assessment: Cultural Impacts. a Report For Environmental Monitoring and Management Pty. Ltd & Highlands Gold Ltd.

*GARDNER, D. S., D. JORGENSEN, G. E. B. MORREN AND R. PAULSEN 1995. The Cultural Context of the Nena Project. a Report To Highlands Gold Ltd.

*GARRETT, D. R. Jr. 2009. The Asabano People of Papua New Guinea and their Medical System. MA Thesis. Trent University Canada, Petereborough, ontario.

*GELL, A. 1975. Metamorphosis of the Cassowaries: Umeda Society, Language and Ritual. London: The Athlone Press, University of London.

*GELL, A. 1992. Under the sign of the cassowary. IN: JUILLERAT, B. (ed.) Shooting the Sun: Ritual and Meaning in West Sepik. Smithsonian Institution Press, Washington. Pp. 125-43.

*GEYLE, A. M. 1954. Patrol Report, Green River No. 3, 1954/55.

*GIBSON, J., G. DATT, B. ALLEN, V. HWANG, R. M. BOURKE & D. PARAJULI 200. Mapping Poverty in Rural Papua New Guinea.

GILLIARD, E. T. & LECROY, M. 1961 Birds of the Victor Emmanuel and Hindenburg Mountains, New Guinea. Bulletin of the American Museum of Natural History 123.

GILLIARD, E. T. 1961. Four New Birds from the Mountains of Central New Guinea. American Museum of Natural History, 2031: 1-8.

GILLIESON, D. 1983. Geomorphology of limestone caves in the Highlands of Papua New Guinea. PhD thesis,University of Queensland.

GILLIESON, D. S. & HOPE, G. 1990. Development of the Mountain Ok Environment. IN: CRAIG, B. & HYNDMAN, D. (eds.) Children of Afek: Tradition and Change among the Mountain Ok of Central New Guinea. Oceania Monographs No.40, University of Sydney, Sydney.

GILLIESON, D. S. 1980. Pit Structure from Selminum Tem Cave, Western province, Papua New Guinea. Australian Archaeology 10: 26-32.

*GILLIESON, D. S. 1985. Geomorphic Development of Limestone Caves in the Highlands of Papua New Guinea. Zeitschrift Fur Geomorphologie 29: 51-70.

GOODE, J. 1977. Rape of the Fly. Nelson, Melbourne.

*GORDON, R. J. & K. WAIKO 1980. intensive Ethnographic and Sociological Studies in Papua New Guinea. Oral History 8:75-90.

*GRAHAM, G. A. 1981. A sociolinguistic survey of Busa and Nagatman.IN: LOVING, R. (ed.), Sociolinguistic Surveys of Sepik Languages. Workpapers in Papua New Guinea Languages, 29. Summer Institute of Linguistics, Ukarumpa. Pp. 177-92.

GREGORY, P. 1995. Birds of the Ok Tedi Area, Port Moresby, Post Printing.

GRESSITT, J. & NADKARNI, N. 1978. Guide to Mt. Kaindi: Background to Montane New Guinea Ecology. Handbook No.5 Wau, Wau Ecology Institute.

*GUBERMAN, S. R. & P. M. GREENFIELD 1991. Learning and Transfer in Everyday Cognition. Cognitive Development 6: 233-260.

*GUDDEMI, P. 1992a. When horticulturalists are hunter-gatherers: the Sawiyano of Papua New Guinea. Ethnology 31: 303-14.

*GUDDEMI, P. 1992b. We Came From This: Knowledge, Memory, Painting and 'Play' in the Initiation Rituals of the Sawiyano of Papua New Guinea. PhD Thesis, University of Michigan.

HAJIBABAEI, M., JANZEN, D. H., BURNS, J. M., HALLWACHS, W., HEBERT, P. D. N. 2006. DNA barcodes distinguish species of tropical Lepidoptera. Proceedings of the National Academy of Sciences of the United States of America, 103, 968-971.

HAMILTON-SMITH, E. 2006. Submission to UNESCO for World Heritage Tentative List of 'The Sublime Karst of Papua New Guinea'.

*HAMPTON, O. W. 1999. Culture of Stone; Sacred and Profane Uses of Stone among the Dani. Texas A and M University Press. College Station.

*HATANAKA, S. & L. W. BRAGGE 1973. Habitat, Isolation and Subsistence Economy in the Central Range of New Guinea. Oceania 44: 38-57.

*HATANAKA, S. 1988. Traditional Trade in the Highland Fringe of New Guinea. Zagreb, XII international Congress of Anthropological and Ethnological Sciences.

HÄUSER, C. L., SCHULZE, C. H., FIEDLER, K. 1997. The Butterfly Species (Insecta: Lepidoptera: Rhopalocera) of Kinabalu Park, Sabah. The Raffles Bulletin of Zoology 45: 281-304.

*HAYS, T. E. 1990. The Centrality of the Mek-Ok Region in the Diffusion of Tobacco in New Guinea. Paper Given At Conference: the Mek and their Neighbours. Seewiesen.

HEADS, M. 2001. Regional Patterns of Biodiversity in New Guinea Plants. Botanical Journal of the Linnean Society 136: 67-73.

HEALEY, A. 1964. The Ok Language Family of New Guinea. PhD Thesis, Linguistics, Australian National University. 258 pp.

*HEALEY, P. & HEALEY, A. 1977. Telefol Dictionary. Pacific Linguistics; Series C No. 46. Department of Linguistics, Research School of Pacific & Asian Studies, Australian National University. Canberra.

*HERRMANN, S., KRUGER, G. & ROGGENBUCK, K. (eds). 1996. Sagohammer und Konservendose - Einblicke in die Kultur der gargar in Neuguinea. Gottingen: Institut und Sammlung fur Volkerkunde der Universitat Gottingen.

*HOPE, G. 1976. Final Report (on Completion of a Queen Elizabeth II Fellowship in Biological Science). Canberra.

*HOPE, G. 1983. Appendix 7.5: Vegetation Clearance Dates From the Border Region.IN: SWADLING, P. (Ed). How Long Have People Been in the Ok Tedi Impact Region? Port Moresby, PNG National Museum. Pp 130-133.

*HOPE, G. S. 1983. The Vegetational Changes of the Last 20,000 Years At Telefomin, Papua New Guinea. Singapore Journal of Tropical Geography 4: 25-33.

*HUBER, P. 1974. Identity and Exchange: Kinship and Social Order Among the Anggor of New Guinea. PhD Thesis, Duke University.

*HUBER, P. B. 1979. Anggor Floods: Reflections on Ethnogeography and Mental maps. Geographical Review 69: 127-39.'

*HUBER, P. B. 1980. The Anggor Bowman: Ritual and Society in Melanesia. American Ethnologist 7: 43-57.

*HUBER, P. B. 1990. Masquerade as Artifact in Wamu. IN: Lutkehaus, IN: KAUFMANN ,C., MITCHELL, W. E. NEWTON, D. , OSMUNDSEN, L. & SCHUSTER, M. (eds), Sepik Heritage: Tradition and Change in Papua New Guinea. Carolina Academic Press Durham, N. C. Pp. 150-159.

*HÜSEMER, M. 1996. Anbauwirtschaft, in Materialen zur Ausstellung: Sagohammer und Konservendose - Einblicke in die Kultur der Gargar in Neuguinea. Institut und Sammlung für Völkerkunde der Universität Göttingen, Göttingen. Pp. 22-3.

*HUTCHINGS, R. 1968. Patrol Report, Amanab No. 1, 1968/69.

*HYNDMAN, D. 1994. Ancestral Rain Forests and the Mountain of Gold. Westview Press, Boulder.

HYNDMAN, D. & MENZIES J.T. 1980. *Aproteles bulmerae* (Chiroptera: Pteropodidae) of New Guinea is Not Extinct. Journal of Mammalogy 61: 159-160.

HYNDMAN, D. 1979. Wopkaimin Subsistence: Cultural Ecology in the New Guinea Highlands fringe. Doctor of Philosophy, University of Queensland.

HYNDMAN, D. 1984. Ethnobotany of Wopkaimin Pandanus: Significant Papua New Guinea Plant Resource. Economic Botany 38: 287-303.

HYNDMAN, D. 1986. Men, Women, Work and Group Nutrition in a New Guinea Mountain Ok Society. In: MANDERSON, L. (ed.) Shared Wealth and Symbol: Food, Culture and Society in Oceania and South East Asia. Press Syndicate, University of Cambridge.

*HYNDMAN, D. 1990. The Ok Tedi Mining Project: Problems with the Pot of Gold. IN: CRAIG, B. & HYNDMAN, D. (eds). Children of Afek: Tradition and Change Among the Mountain-Ok of Central New Guinea. Sydney, University of Sydney. Pp 161-168.

HYNDMAN, D. 1994. Ancestral Rain Forests and the Mountain of Gold. Westview Press, Boulder

HYNDMAN, D. C. & MENZIES, J. I. 1990. Rain Forests of the Ok Tedi Headwaters, New Guinea: an Ecological Analysis. Journal of Biogeography 17: 241-273.

*HYNDMAN, D. C. & MORREN, G. E. B. 1990. The Human Ecology of the Mountain-Ok of Central New Guinea: a Regional and Inter-Regional Approach. IN: CRAIG, B. & HYNDMAN, D. (eds), Children of Afek: Tradition and Change Among the Mountain-Ok of Central New Guinea. Oceania Monographs No.40, Sydney. Pp. 9-26.

*HYNDMAN, D. C. (undated). Collection notes held at the Papua New Guinea National Museum & Art Gallery. Unpublished.

*HYNDMAN, D. C. 1984. Hunting and the Classification of Game Animals among the Wopkaimin, Oceania June 54: 289.

HYNDMAN, D.C. AND D.G. FRODIN, 1980. Ethnobotany of Schefflera in the Ok Tedi Region, Papua New Guinea. Ethnomedicine VI(1-4): 101-126.

IUCN. 2011. IUCN Red List of Threatened Species. Version 11.2 <www.iucnredlist.org> Downloaded on 17 April 2012

*JACKSON, R. 1980. Mineral Resources and Mining in Papua New Guinea - Digging in For a Difficult Decade? Yagl-Ambu. Papua New Guinea Journal of the Social Sciences and Humanities 7: 1-8.

*JEFFRIES, A. 1950. Patrol Report, Green River No. 1, 1950/51.

JOHNS, R. J. 1976. A Provisional Classification of the Montane Vegetation of New Guinea. Science in New Guinea 4: 105-117.

JOHNS, R. J. 1993. Biodiversity and Conservation of the Native Flora of Papua New Guinea. . In: BEEHLER, B. M. (ed.) Papua New Guinea Conservation Needs Assessment, Volume 2. Biodiversity Support Program, Washington, D.C., USA.

*JOHNSTON, B. R. & JORGENSEN, D. 1994. Mineral Development, Environmental Degradation, and Human Rights: the Ok Tedi Mine, Papua New Guinea.IN: JOHNSTON, B. R (ed). Who Pays the Price? : the Sociocultural Context of Environmental Crisis. Washington, D.C., Island Press. Pp 86-98.

*JONES, B. 1980. Consuming Society: Food and Illness among the Faiwolmin. PhD Thesis, University of Virginia.

*JORGENSEN, D. & B. JOHNSTON 1994. Mineral Development, Environmental Degradation, and Human Rights. B. Johnston, Ed. Who Pays the Price? Development and Human Rights. Washington, Island Press. Pp 86-98.

*JORGENSEN, D. (No Date). Who and What Is a Landowner? Mythology and Marking the Ground in a PNG Mining Project. Anthropological Forum.

*JORGENSEN, D. (No Date.). History and the Genealogy of Myth in Telefolmin. Paper Presented At the École Des Hautes Études En Sciences Sociales (Paris) and At the Centre De Recherche Et Documentation Sur l'Océanie (Marseilles), June, 1998.

*JORGENSEN, D. 1980. What's in a Name? the Meaning of Meaninglessness in Telefolmin. Ethos 8: 349- 66.

*JORGENSEN, D. 1981. Life on the Fringe: History and Society. IN: GORDON, R, (ed) Telefomin: the Plight of Peripheral People in Papua New Guinea. Volume 1: the inland Situation. Cambridge, Ma, Cultural Survival, inc. Pp 59-79.

*JORGENSEN, D. 1981. Order or Disorder in Melanesian Religions? Man 16: 470-2.

JORGENSEN, D. 1981. Taro and Arrows: Order, Entropy, and Religion among the Telefolmin. PhD Thesis, Anthropology and Sociology, University of British Columbia.

*JORGENSEN, D. 1983. Mirroring Nature? Men's and Women's Models of Conception in Telefolmin. Mankind (Special Issue: Concepts of Conception: Procreation Ideologies in Papua New Guinea,) 14: 57-65.

*JORGENSEN, D. 1983. Appendix 7.6: Some Notes on the Geography of the Afek Myth Cycle From the Telefolmin View. P. Swadling, Ed. How Long Have People Been in the Ok Tedi Impact Region? Port Moresby, PNG National Museum. Pp 133-4.

*JORGENSEN, D. 1983. Principal Telefol Gardening and Hunting Areas. IN: SWADLING, P. (ed.), How Long Have People Been in the Ok Tedi Impact Region. Records of the Papua New Guinea National Museum No.8. Papua New Guinea National Museum, Waigani.

*JORGENSEN, D. 1983. The Clear and the Hidden: Person, Self and Suicide Among the Telefolmin of Papua New Guinea. Omega: the Journal of Death and Dying 14: 113-26.

*JORGENSEN, D. 1983. The Facts of Life, Papua New Guinea Style. Mankind (Special Issue: Concepts of Conception: Procreation Ideologies in Papua New Guinea), 14: 1-12.

*JORGENSEN, D. 1985. Femsep's Last Garden: a Telefol Response To Mortality. D. A. Counts and D. R. Counts, Eds. Ageing and Its Transformations: Moving Towards Death in Pacific Societies. Pittsburgh, University of Pittsburgh Press.

*JORGENSEN, D. 1987. Oceanic Religions: History of Study. M. Eliade, Ed. the Encyclopedia of Religion Vol. 11. New York, Macmillan. Pp 49-53.

*JORGENSEN, D. 1990. Placing the Past and Moving the Present: Myth and Contemporary History in Telefolmin. Culture 10: 47-56.

*JORGENSEN, D. 1990. Production and the Aims of Exchange: Telefol Crop Regimes in Historical Perspective. Unpublished Paper.

*JORGENSEN, D. 1990. Secrecy's Turns. Canberra Anthropology 13: 40-47.

*JORGENSEN, D. 1990. The Telefolip and the Architecture of Ethnic Identity in the Sepik Headwaters. B. Craig and D. Hyndman, Eds. the Children of Afek. Sydney, Oceania Monographs. Pp 151-60.

*JORGENSEN, D. 1991. Big Men, Great Men and Women: Alternative Logics of Gender Difference. M. Godelier and M. Strathern, Eds. Big Men and Great Men: Personifications of Power in Melanesia. Cambridge, Cambridge University Press. Pp 256-271.

*JORGENSEN, D. 1991. Echidna and *Kuyaam*: Classification and Anomalous Animals in Telefolmin. Journal of the Polynesian Society 100: 365-80.

*JORGENSEN, D. 1991. Telefolmin. T. Hays, Ed. Encyclopedia of World Cultures, Vol. 2: Oceania,. Boston, G.K.Hall. Pp 321-4.

*JORGENSEN, D. 1993. Magalim Goes To Work: History, Mining and Ideas About Nature in Telefolmin. Washington, American Anthropological Association.

*JORGENSEN, D. 1993. Money and Marriage in Telefolmin: From Sister Exchange To Daughter As Trade Store. R. A. Marksbury, Ed. the Business of Marriage: Transformations in Oceanic Matrimony. Pittsburgh and London, University of Pittsburgh Press. Pp 57-82.

*JORGENSEN, D. 1993. one, Two, Three Bougainvilles? Pacific Viewpoint 34: 103-106.

*JORGENSEN, D. 1994. Locating the Divine in Melanesia: An Appreciation of the Work of Kenelm Burridge. Anthropology and Humanism 19: 130-7.

*JORGENSEN, D. 1994. Pacific Peoples in the Modern World. G. Burenhult, Ed. the Illustrated Encyclopedia of Humankind: Traditional Peoples Today. New York, American Museum of Natural History. Pp 99-120.

*JORGENSEN, D. 1996. Regional history and Ethnic Identity in the Hub of New Guinea: the Emergence of the Min, Oceania 66(3): 189.

*JORGENSEN, D. 1998. Who and What Is a Landowner? Mythology and Marking the Ground in a Papua New Guinea Mining Project. Anthropological Forum 7: 599-627.

*JORGENSEN, D. 1998. Whose Nature? invading Bush Spirits, Travelling Ancestors and Mining in Telefolmin. Social Analysis (Special Issue : S. Bamford, Ed, Identity, Nature and Culture: Sociality and Environment in Melanesia) 42: 100-116.

*JORGENSEN, D. 2004. Reflections on Recent Fieldwork in Telefomin (Sandaun Province, PNG).

*JORGENSEN, D. 2005. Third Wave Evangelism and the Politics of the Global in Papua New Guinea: Spiritual Warfare and the Recreation of Place in Telefolmin. Oceania 75: 444-462.

*JORGENSEN, D. 2006. Hinterland History: the Ok Tedi Mine and Its Cultural Consequences in Telefolmin. The Contemporary Pacific 18: 233-263.

*JUILLERAT, B. (undated). Notice de la Base de Gestion des Collections: Collection Bernard Juillerat; Museé du Quai Branly, Paris. Unpublished.

*JUILLERAT, B. 1977. Terminologie de Parenté iafar (Nouvelle-Guinée). Étude Formelle dun Système Dakota-Iroquois, L'Homme 17(4): 5-33.

*JUILLERAT, B. 1981. Organisation Dualiste et Complémentarité Sexuelle dans le Sépik Occidental, L'Homme 21(2): 5-38.

*JUILLERAT, B. 1982. Note sur les Rapports de Production dans l'Horticulture-Arboriculture Yafar (Nouvelle-Guinee), Journal d' Agriculture Traditionelle et de Botanique Appliquee 29: 285-93.

*JUILLERAT, B. 1991. Complementarity and Rivalry: Two Contradictory Principles in Yafar Society. IN: GODELIER, M. & STRATHERN, M. (eds). Big Men And Great Men: Personifications Of Power In Melanesia. Cambridge University Press, Cambridge. Pp.130-41.

*JUILLERAT, B. 1992a. Introduction. IN: JUILLERAT, B. (ed.), Shooting the Sun: Ritual and Meaning in West Sepik. Smithsonian Institution Press, Washington. Pp.1-19.

*JUILLERAT, B. 1992b. The Mother's Brother is the Breast: Incest and its Prohibition in the Yafar Yangis. IN: JUILLERAT, B. (ed.), Shooting the Sun: Ritual and Meaning in West Sepik. Smithsonian Institution Press, Washington. Pp. 20-124.

*JUILLERAT, B. 1996. Children of the Blood: Society, Reproduction and Cosmology in New Guinea. Trans. N. Scott. Berg, Oxford.

*KAIBO, J. 1967. Patrol Report, Amanab No. 5, 1962/63.

KALKMAN, C. 1963. Description of Vegetation Types in the Star Mountains Region, West New Guinea. Nova Guinea, Bot. 15:247-261.

*KARIUS, C. H. 1928. Attempt to cross New Guinea from the Fly to the Sepik by Karius and Champion, failed on account of lack of supplies,Territory of Papua, Annual Report for 1926-27.

*KARIUS, C. H. 1929. Exploration in the Interior of Papua and North-East New Guinea: the Sources of the Fly, Palmer, Strickland, and Sepik Rivers, The Geographical Journal 74: 305-20.

*KAUFFMAN, C. 1990. Swiss and German Ethnographic Collections as Source Materials: a Report on Work in Progress. IN: LUTKEHAUS, N., KAUFMANN, C. , MITCHELL, W. E. , NEWTON, D., OSMUNDSEN, L. & SCHUSTER, M. (eds), Sepik Heritage: Tradition and Change in Papua New Guinea. Carolina Academic Press, Durham, NC. Pp. 587-95.

*KELM, A. & KELM, H. 1975. Ein Pfeilschuss fur die Braut. Mythen und Erzahlungen aus Kwieftim und Abrau, Nordost Neuguinea. Franz Steiner Verlag, Wiesbaden.

*KELM, A. & KELM, H. 1980. Sago und Schwein. Ethnologie von Kwieftim und Abrau in Nordost-Neuguinea. Franz Steiner Verlag. Wiesbaden.

*KELM, A. 1990. Sanguma in Abrau and Kwieftim. IN: LUTKEHAUS, N., KAUFMANN, C., MITCHELL, W. E., NEWTON, D. , OSMUNDSEN, L. & SCHUSTER M. (eds). Sepik Heritage: Tradition and Change in Papua New Guinea. Carolina Academic Press, Durham, NC. Pp. 447-51.

*KELM, H. 1966. Kunst vom Sepik. II. Berlin: Museum fur Volkerkunde.

*KELM, H. n.d. Collection cards for the Yellow River Collection at the Ethnologisches Museum, Berlin.

KERR, J. T., SUGAR, A., PACKER, L. 2000. Indicator taxa, rapid biodiversity assessment, and nestedness in an endangered ecosystem. Conservation Biology 14: 1726-1734.

KIENZLE, W. & CAMPBELL, S. 1938. Notes on the Natives of the Fly and Sepik River Headwaters, New Guinea. Oceania 8:463-481.

KIKKAWA, J., MONTEITH, G. B., INGRAM, G. 1981. Cape York Peninsula: major region of faunal interchange. IN: KEAST, A. (ed.) Ecological Biogeography of Australia. Monographiae Biol., 41, 1697-1742.

*KIRK, A. A. 1984. The Distribution of Two Varieties of Bracken, (Pteridium Aquilinum (L.) Kuha) and Some Aspects of their Ecology in Papua New Guinea. Science in New Guinea 11: 7-18.

*KNOTT, R. D. 1964. Patrol Report, Amanab No. 1, 1964/65.

*KNOTT, R. D. 1965. Patrol Report, Amanab No. 10, 1964/65

*KONISHI, T., H. TOYOHARO & H. YOKOYAMA 1994. Taro in Papua New Guinea (in Japanese, English Summary). Overseas Scientific Research Team, Tokyo University of Agriculture, Ed. in Search of the Origins of Agriculture in Papua New Guinea: a Botanical Survey of Tropical Rain Forest. Tokyo, Committee of the Centennial Anniversary, Tokyo University of Agriculture. Pp 40-63.

KOOIJMAN, S. 1962. Material Aspects of the Star Mountains Culture. Nova Guinea 10, Anthropology No.2, pp.15-44.

KRAUS, F. 2011. New Frogs (Anura: Microhylidae) from the Mountains of Western Papua New Guinea. Records of the Australian Museum 63:53-60.

*KUCHIKURA, Y. 1990. Subsistence Activities, Food use, and Nutrition among the Mountain Ok in Central New Guinea, Man and Culture in Oceania 6: 113-37.

*KUMAGAI, K. 1988. Taim Balus Ikam: a Contact History and Social Change in the Mianmin People, Papua New Guinea. Hannan Ronsyu (Bulletin of Hannan University) 23: 1-20.

*KUMAGAI, K. 1989. Resources Lost By the Ancestor: Myth, Migration and Warfare Among the Mianmin. Hannan Ronsyu (Bulletin of Hannan University) in Japanese 25: 146-164.

LACHLAN, R. B. 1999a. A new species of *Delias* Hübner (Lepidoptera: Pieridae) from the Star Mountains, Papua New Guinea. Australian Entomologist 26: 33-35.

LACHLAN, R. B. 1999b. A new genus and species of hawk moth (Lepidoptera: Sphingidae) from Papua New Guinea. Australian Entomologist 26: 91–95.

LACHLAN, R. B. 2000. New species, subspecies and records of *Delias* Hübner (Lepidoptera: Pieridae) from the upper Ok Tedi and Tari regions, Papua New Guinea. Australian Entomologist 27: 71-96.

*LANDSBERG, J. J. & D. S. GILLIESON 1980. Toksave Bilong Graun: Common Sense Or Empiricism in a Folk Science Knowledge From Papua New Guinea. Capricornia 8: 13-23.

*LAYCOCK, D. C. 1975. Isolates: Sepik Region. IN: WURM, A. (ed.), New Guinea Area Languages and Language Study, vol 1: Papuan languages and the New Guinea linguistic scene; Pacific Linguistics. Series C, no.38 S. Research School of Pacific Studies, Australian National University, Canberra. Pp. 881-86.

*LAYCOCK, D.C. 1973. Sepik Languages: Checklist and Preliminary Classification. Pacific Linguistics B 25. Research School of Pacific Studies, Australian National University, Canberra.

*LEAN, G. A. 1991. Counting Systems of Papua New Guinea (17 Volumes)

*LEWIS, M. 1963. Journal of Collections from New Guinea, South Australian Museum Archives.

*LIND, J. J. 1962. Verslag van de Tournee door het Stamgebiedvan de Dera van 19-24 Maart. Algemeen Rijksarchief (General State Archives), Den Haag. Unpublished.

*LITTERAL, R. 1978. Changes in the Bibriari Communicative system. IN: Murane, J. (ed.), Language Planning and Grammatical Typologies. Workpapers on Papua New Guinea Languages 24. Summer Institute of Linguistics, Ukarumpa. Pp. 25-30.

*LITTLE, M. A. & G. E. B. MORREN Jr. 1976. Ecology, Energetics, and Human Variability. Dubuque, Iowa, Wm. C. Brown Company Publishers.

LOFFLER, E. 1977. Geomorphology of Papua New Guinea, Canberra, Australian National University Press.

*LOHMANN, R. I. 2000. Cultural Reception in the Contact and Conversion History of the Asabano of Papua New Guinea. Phd Thesis. University of Wisconsin, Madison, Madison.

*LOHMANN, R. I. 2000. The Role of Dreams in Religious Enculturation Among the Asabano of Papua New Guinea. Ethos 28: 75-102.

*LOHMANN, R. I. 2001. introduced Writing and Christianity: Differential Access To Religious Knowledge Among the Asabano. Ethnology 40: 93-111.

*LOHMANN, R. I. 2003. Glass Men and Spirit Women in Papua New Guinea. Cultural Survival Quarterly 27: 53-54.

*LOHMANN, R. I. 2005. The Afterlife of Asabano Corpses: Relationships with the Deceased in Papua New Guinea. Ethnology 44: 189- 206?

*LOHMANN, R. I. 2008. Sexual Snakes Strike Again: Immortality Expressed and Explained in a New Guinea Myth. . S. Dunis, Ed. Sexual Snakes, Winged Maidens and Sky Gods: Myth in the Pacific, An Essay in Cultural Transparency. Nouméa, New Caledonia:, Le Rocher-À-La-Voile and Papeete: Éditions Haere Po Tahiti. Pp 113-125.

LOHMANN, R.I. 2000. Cultural Reception in the Contact and Conversion History of the Asabano of Papua New Guinea. PhD thesis, University of Wisconsin-Madison.

*LOVING, R. & BASS, J. 1964. Languages of the Amanab Sub-District. Port Moresby: Department of Information and Extension Services.

*MACKENZIE, M. (undated). Untitled documents: Collection Notes Held at the Australian Museum. Unpublished.

*MACKENZIE, M. 1982. Untitled documents: collection notes held at the Papua New Guinea National Museum & Art Gallery. Unpublished.

*MACKENZIE, M. 1984. Untitled documents: collection notes held at the Papua New Guinea National Museum & Art Gallery. Unpublished.

*MACKENZIE, M. 1990. The Telefol String Bag: a Cultural Object with Androgynous Forms. IN: CRAIG, B. & HYNDMAN, D. (eds), Children of Afek: Tradition and Change Among the Mountain-Ok of Central New Guinea. Oceania Monographs No.40, Sydney. Pp. 88-108.

*MACKENZIE, M. 1991. Androgynous Objects: String bags and gender in central New Guinea. Harwood Academic Publishers, Chur, Switzerland.

MACKENZIE, M. A. 1986. The Bilum is the Mother of Us All: an Interpretative Analysis of the Social Value of the Telefol String Bag. MA thesis, Anthropology, Australian National University.

*MACKENZIE, M. A. 1990. The Telefol String Bag: a Cultural Object with androgynous Forms. B. Craig and D. Hyndman, Eds. Children of Afek: Tradition and Change Among the Mountain-Ok of Central New Guinea. Sydney, University of Sydney. Pp 88-108.

MACKENZIE, M.A. 1991. Androgynous Objects. String bags and gender in central New Guinea. Amsterdam: Harwood Academic Publishers.

*MARRIOTT , E. 1997. The Lost Tribe: a Harrowing Passage into New Guinea's Heart of Darkness, Henry Holt & Co.

*MARTIN, W. H. 1981. A Sociolinguistic Survey of Abau. IN: LOVING, R. (ed.), Sociolinguistic Surveys of Sepik Languages. Workpapers in Papua New Guinea Languages, 29. Summer Institute of Linguistics, Ukarumpa. Pp. 207-32.

*MASINGILA, J. O. 1994. Mathematics Practice in Carpet Laying. Anthropology & Education Quarterly 25: 430-462.

MAUNSELL AND PARTNERS PTY LTD 1982. Ok Tedi Environmental Study. Maunsell & Partners Pty Ltd, Melbourne.

*MCCARTHY, J. K. 1936. Report of patrol to the Yellow River Base Camp, Sepik Division.

*MCSWEEN, S. 1989. Traditional and Cash Crop Agriculture in Four Areas of Sandaun Province: a Compiled Profile and Analysis (Monitoring and Evaluation Unit). Vanimo, West Sepik Province Development Project..

*MEKEA, P. 1967. Patrol Report, Green River No. 2, 1967/68.

*MELK-KOCH, M. 1989. Auf der Suche nach der menschlichen Gesellschaft: Richard Thurnwald. Museum für Völkerkunde, Berlin.

MENZIES, J. I. 1975. Handbook of Common New Guinea Frogs. Handbook Wau Ecology Institute. No. 6, 68 pps.

MENZIES, J.I. 1976. Handbook of common New Guinea frogs. Wau Ecology Institute Handbook 1, viii + 74 pp.

MENZIES, J.I. 1991. A Handbook of New Guinea Marsupials and Monotremes, Kristen Press Inc, Madang.

*MICHEL, T. 1986. Raumkonzept Und Siedlungsstrategie in Den Star Mountains Von Neuguinea. Paideuma 32: 319-343.

*MICHEL, T. 1988. Kulthauser Als Okologische Modelle, Star Mountains Von Neuguinea. Paideuma 34: 225-241.

*MICHEL, T. 1990. Schweinefest Bei Den Nalumin (Papua-Neuguinea)

*MILES, D. & CAMERON, S. 1965. Preliminary Report: New Guinea Anthropological Expedition, 1964. Archives of the Anthropology Department,Australian Museum, Sydney. Unpublished.

*MITCHELL, W. E. 1975. Culturally Contrasting Therapeutic Systems of the West Sepik: the Lujere. IN: T. R. WILLIAMS (ed.), Psychological Anthropology. Mouton, The Hague. Pp 409-39.

*MITCHELL, W. E. 1977. Sorcellerie Chamanique: Sanguma chez les Lujere du Cours Supérìeur du Sépik. Journal de la Société des Océanistes 33:179-189.

*MITTON, R. D. 1972. Stone as a cultural factor in the Central and Eastern Highlands, Irian 1: 4-11.

*MOLNAR-BAHLEY, E. & DUGGAN, S. J. 1981. a Bibliography of the Western Sepik. Oral History 9: 1-25.

*MOORE, C. C. & ROMNEY, A. K. 1994. Material Culture, Geographic Propinquity, and Linguistic Affiliation on the North Coast of New Guinea: A Reanalysis of Welsch, Terrell, and Nadolski (1992). American Anthropologist 96: 370-92.

*MOORE, C.C. & ROMNEY, A.K. 1995. Commentary on Welsch and Terrells (1994) Reply to Moore and Romney (1994). Journal of Quantitative Anthropology 5: 75-84.

*MOORE, C.C. & ROMNEY, A.K. 1996. Will the “Real” Data Please Stand Up? Reply to Welsch (1996). Journal of Quantitative Anthropology 6: 235-61.

*MORGAN, R. 1992. Vegetable Production in Telefomin District. Fresh Produce News (17 April 1992) 60: 2-5.

MORINAKA, S., VAN MASTRIGT, H. J. G., SIBATANI, A. 1991. A review of *Delias eichhorni* Rothschild, 1904 and some of its allies from Irian Jaya (Lepidoptera, Pieridae). Bull. Biogeogr. Soc. Jap. 46: 133-149.

MORINAKA, S., VAN MASTRIGT, H. J. G., SIBATANI, A. *1993.* A study of the *Delias eichhorni* complex from New Guinea (Lepidoptera; Pieridae) (I). Bull. Biogeogr. Soc. Jap. 48: 17-26.

*MORREN JR., G. E. B. (undated). a Narrative and Visual Analysis of the Exploration of the Upper Sepik and Fly River Region, Papua New Guinea.

*MORREN JR., G. E. B. (undated). a Remote Sensing investigation of Sociocultural and Environmental Change in Papua New Guinea Tropical Forests.

*MORREN JR., G. E. B. 1991. New Technology and Regional Studies in Human Ecology: a Papua New Guinea Example. Applications of Space-Age Technology in Anthropology, NASA Science and Technology Laboratory, John C. Stennis Space Center, Mississippi.

*MORREN, G. B. (undated). Untitled documents: collection notes held by George Morren. Unpublished.

*MORREN, G. E. B. & HYNDMAN, D. C. 1987. The Taro Monoculture of Central New Guinea. Human Ecology 15: 301-315.

*MORREN, G. E. B. 1973. Woman the Hunter. Paper Presented At the 72nd Annual Meeting of the American Anthropological Association, New Orleans, 28 Nov-2 Dec, 1973: 14pp.

*MORREN, G. E. B. 1974. Settlement Strategies and Hunting in a New Guinea Society. PhD Thesis, Columbia University.

*MORREN, G. E. B. 1977. From Hunting To Herding: Pigs and the Control of Energy in Montane New Guinea. T. P.

Bayliss-Smith and R. G. A. Feachem, Eds. Subsistence and Survival: Rural Ecology in the Pacific. London, Academic Press. Pp 273-315.

*MORREN, G. E. B. 1979. Seasonality Among the Miyanmin: Wild Pigs, Movement, and Dual Kinship Organization. Mankind 12: 1-12.

*MORREN, G. E. B. 1981. a Small Footnote To the 'Big Walk': Environment and Change Among the Miyanmin of Papua New Guinea. Oceania 52: 39-65.

*MORREN, G. E. B. 1984. Warfare on the Highland Fringe of New Guinea: the Case of the Mountain Ok. B. Ferguson, Ed. Warfare, Culture and Environment. New York, Academic Press. Pp 169-205.

*MORREN, G. E. B. 1986. The Miyanmin: Human Ecology of a Papua New Guinea Society. Ann Arbor, UMI Research Press.

*MORREN, G. E. B. 1989. Mammals of the East Miyanmin Area, Telefomin District, Papua New Guinea, with Notes on Folk Knowledge and Taxonomy. Science in New Guinea 15: 119-135.

*MORREN, G. E. B. 1990. Remote Sensing and Controled Comparison: An Application To the Mountain Ok Region, Papua New Guinea. the Mek and their Neighbours Conference.

*MORREN, G. E. B. 1991. New Approaches in Landuse Studies For Environmental Managment in Papua New Guinea. IN: PEARL, M. BEEHLER, B. ALLISON, A. & TAYLOR, M. (eds). Conservation and Environment in Papua New Guinea: Establishing Research Priorities. Proceedings of a Symposium Held June 3, 1991, Honolulu, Hawaii. New York/ Washington, D.C., the Government of Papua New Guinea Through the Embassy, Washington D.C. and Wildlife Conservation international. Pp 63-74.

*MORREN, G. E. B. 1991. The Ancestresses of the Miyanmin and Teklefolmin: Sacred and Mundane Definitions of the Fringe in the Upper Sepik. A. Pawley, Ed. Man and a Half: Essays in Pacific Anthropology and Ethnobiology in Honour of Ralph Bulmer. Auckland, the Polynesian Society. Pp 298-305.

*MORREN, G. E. B. Ok Botanical Database. Dbase.

*MORREN, G. E. B., FRODIN, D. G. GABIR, W. E.,. AMIT a & AMIT K. 1992. a Preliminary Vernacular Guide To the Vegetation of Northern Telefomin District, Papua New Guinea. Department of Human Ecology Research Paper/New Jersey Agricultural Experiment Station Publication P-26501-1-92. New Brunswick, N.J.,, Rutgers,the State University of New Jersey.

MORREN, G. E. B., Jr. 1974. Settlement Strategies and Hunting in a New Guinea Society. PhD Thesis, Columbia University.

MORREN, G. E. B., Jr. 1986. The Miyanmin: Human Ecology of a Papua New Guinea Society. Studies in Cultural Anthropology No.9. Ann Arbor: UMI Research Press.

*MORREN, G. E. B., MCCAY, B. J. & GARDNER, D. 1981. Comments. Cultural Ecology, the Mianmin and Seasonality: An Exchange. Mankind 13: 74-81.

*MORREN, G.E.B. JR .& FRODIN D.G. 1992. A Preliminary Vernacular Guide to the Vegetation of Northern Telefomin District, Papua New Guinea. Department of Human Ecology Research Paper/New Jersey Agricultural Experiment Station Publication P-26501-1-92. Rutgers, The State University of New Jersey, New Brunswick, NJ.

*MULCAHEY B. H. 1965. Patrol Report, Green River No. 9, 1964/65.

MÜLLER, C. J. 1999. A new species of *Cethosia* and a new subspecies of *Delias* (Lepidoptera : Nymphalidae and Pieridae) from New Ireland, Papua New Guinea. Records of the Australian Museum 51: 169-177.

MÜLLER, C. J. 2001. A new species of *Delias* Hübner (lepidoptera : Pieridae) from New Ireland, Papua New Guinea. Australian Entomologist 28: 17-22.

MÜLLER, C. J. 2002. New butterfly taxa from New Ireland, Papua New Guinea (Lepidoptera: Nymphalidae and Lycaenidae). Australian Entomologist 29: 29-36.

MULLER, C. J., & TENNENT, W. J., In press. IUCN Red List assessments:

MÜLLER, C. J., BEHEREGARAY, L. B. 2010. Palaeo island-affinities revisited – Biogeography and systematics of the Indo-Pacific genus *Cethosia* Fabricius (Lepidoptera: Nymphalidae). *Molecular Phylogenetics and Evolution,* 57, 314-326.

MÜLLER, C. J., BEHEREGARAY, L. B. B., WAHLBERG, N. 2010. 'After Africa': the evolutionary history and systematics of the genus *Charaxes* Ochsenheimer (Lepidoptera: Nymphalidae) in the Indo-Pacific region. Biological Journal of the Linnean Society 100: 457-481.

MURRAY, A. 1988. A Study of the Birds of the Tabubil region, Western Province, Papua New Guinea. Muruk 3: 89-117.

*MUTAMBEK, J. & TUMANA, C. 2001. Malnutrition Status in Sandaun Province. IN: R. BOURKE, M. ALLEN M. G. & SALISBURY, J. G. (eds). Food Security For Papua New Guinea. Proceedings of the Papua New Guinea Food and Nutrition 2000 Conference, PNG University of Technology, Lae 26-30 June 2000. Canberra, Australian Centre For international Agricultural Research. Pp 451-456.

*MYS, B. M. F. & ZWEITEN, P. V. 1990. Subsistence Fisheries in Lower Order Streams: Notes on Species Preference, Fishing Methods, Catch Composition, Yield and Dietary Importance of Fish. FAO Report- a Report Prepared For the Sepik River Fish Stock Enhancement Project, PNG/85/001 Field Document No. 11. Rome, FAO.

*NAKANISHI, Y. & TOYOHARA, H. 1994. Rational Diversity of Shifting Cultivation Systems in Sparsely Populated Areas in East Sepik and Sandaun Provinces (in Japanese, English Summary). Overseas Scientific Research Team, Tokyo University of Agricultur. in Search of the Origins of Agriculture in Papua New Guinea: a Botanical Survey of Tropical Rain Forest. Tokyo, Committee of the Centennial Anniversary, Tokyo University of Agriculture. Pp 21-32.

*NAKANISHI, Y., TOYOHARA, H., MIYATA M. & AMANO, M. 1994. Traditional Cultivation and Cropping Patterns in Papua New Guinea. 1. Rational Diversity of Shifting Cultivation Systems in Sparsely Populated Areas (in Japanese). Japanese Journal of Tropical Agriculture 38(4): 328-334.

NATIONAL RESEARCH INSTITUTE (NRI). 2010. Papua New Guinea District and Provincial Profiles. <http://www.nri.org.pg/research_divisions/cross_divisional_projects/Web%20Version%20Profiles%20Report%20140410.pdf>

*NATIONAL STATISTICAL OFFICE 1981. Provincial Data System: Rural Community Register West Sepik Province. Papua New Guinea, National Statistical office.

*NETHERLAND INDIES 1911. Verslag der Commissie ter Voorbereiding van de Aanwijzing Eener Natuurlijke Grens Tusschen Het Nederlandsche en het Duitsche Gebied op Nieuw-Guinea, Ingesteld bij Besluit van den Gouverneur-Generaal DD. 11 Maart 1910 N. 8, Batavia Landsdrukkerij.

*NOVERA, J. 2009. Seasonality and Subsistence Hunting Practices Among the Sokamin People in Saundaun Province, Papua New Guinea. Honours Thesis. University of Papua New Guinea, Port Moresby.

*OHTSUKA, R. 1994. Subsistence Ecology and Carrying Capacity in Two Papua New Guinea Populations. Journal of Biosocial Science 26: 395-407.

*OKPUL, T., SINGH, D. WAGIH M. E. & HUNTER, D. 2002. a Review of Taro (*Colocasia Esculenta*) (L.) Schott) Genetic Resources of Papua New Guinea. Papua New Guinea Journal of Agriculture, Forestry and Fisheries 45: 33-45.

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

*PAGE, R. W. 1975. Geochronology of Late Tertiary and Quaternary Mineralized intrusive Porphyries in Star Mountains of Papua New Guinea and Irian Jaya. Economic Geology 70(5): 928-936.

*PAPER PREPARED FOR CONFERENCE The Mek and their neighbours, Seewiesen, 17-22 October 1990.

*PAPUA NEW GUINEA INSTITUTE OF MEDICAL RESEARCH, N. S., National Department of Health, (No Date). Papua New Guinea 1982/3 National Nutrition Survey: Provincial Tabulations West Sepik Province. Papua New Guinea institute of Medical Research and Nutrition Section, National Department of Health.

PARSONS, M. J. 1986. A new genus and twenty-six new species of butterflies Lepidoptera: Hesperiidae, Lycaenidae, Nymphalidae) from Papua New Guinea and Irian Jaya. Tyô to Ga 37: 103-177.

PARSONS, M. J. 1998. *The butterflies of Papua New Gui*nea: Their systematics and biology. Academic Press, London.

*PEARSON, M. 1981. Taro Diseases in the Hotmin Area (East Sepik Province) and Telefomin Area (West Sepik Province) of Papua New Guinea. Port Moresby, University of Papua New Guinea.

PENNEY, C.R. 1988. New Guinea Art and Crafts. The Charles Rand Penney Collection. Self published, Lockport, NY.

*PEREY, A. 1973. Oksapmin Society and World View. PhD Thesis, Anthropology, Columbia University.

PEREY, A. 1973. Oksapmin Society and World View. PhD Thesis, Columbia University.

*PETER, H. (undated). Notes for the Gargar Collection; Insititut und Sammlung für Völkerkunde der Universität Göttingen. Unpublished.

*PETER, H. 1990. Cultural Changes in Gargar society. IN: LUTKEHAUS,N., KAUFMANN, C. , MITCHELL, W. E., NEWTON, D., OSMUNDSEN, L., & SCHUSTER M. (eds), Sepik Heritage: Tradition and Change in Papua New Guinea. Durham, N.C.: Carolina Academic Press. Pp 245-50.

*PÉTREQUIN P. & PÉTREQUIN, A-M. 1990. Yeleme Axes, Mumyeme Adzes. The distribution of Polished Stone Blades in Central Irian Jaya (Indonesia).

PIGRAM, C. J., DAVIES, H. L. 1987. Terranes and the accretion history of the New Guinea orogen. BMR Journal of Australian Geology & Geophysics 10: 193-211.

PIGRAM, C.J. & DAVIS H.L 1987. Terranes and the accretion history of New Guinea orogen. Bureau of Mineral Resources, Journal of Australian Geology and Geophysics 10:193-211 .

POLHEMUS, D.A. & POLHEMUS, J.T. 1998 Assembling New Guinea: 40 million years of Island Arc Accretion as Indicated by the Distributions of Aquatic Heteroptera (Insecta). IN: HALL, R. & HOLLOWAY, J.D. (eds). Biogeography and Geological Evaoluation of South East Asia. pp, 327-340. Leiden, Netherlands.

POLHEMUS, D.A. 2007. Tectonic Geology of Papua. IN: MARSHALL, A.J & BEEHLER, B.M. (eds). The Ecology of Papua: Part One. The Ecology of Indonesia Series Volume IV. Periplus Editions, Singapore. Pp 137-164.

*POOLE, F. 1984. Cultural Images of Women As Mothers: Motherhood Among the Bimin-Kuskusmin of Papua New Guinea. Social Analysis 15: 73-101.

POOLE, F. J. P. 1976. The Ais Am: An Introduction to Male Initiation Ritual among the Bimin-Kuskusmin of the West Sepik District, Papua New Guinea. PhD Thesis, Cornell University.

*POOLE, F. J. P. 1981. Transforming 'Natural Woman': Female Ritual Leaders and Gender Ideology Among Bimin-Kuskusman. IN: ORTNER S. B. AND WHITEHEAD, H. (eds). Sexual Meanings: the Cultural Construction of Gender and Sexuality. Cambridge, Cambridge University Press. Pp 116-165.

*POOLE, F. J. P. 1982. Couvade and Clinic in a New Guinea Society: Birth Among the Bimin-Kuskusmin. IN: DEVRIES, M., BERG, R. &. LIPKIN, L. M, (eds). Use and Abuse of Medicine. New York, Praeger. Pp 54-95.

*POOLE, F. J. P. 1982. The Ritual Forging of Identity: Aspects of Person and Self in Bimin-Kuskusmin Male initiation. IN: Herdt, G. H. (ed). Rituals of Manhood. Male initiation in Papua New Guinea. Berkeley, University of California Press.

*POOLE, F. J. P. 1984. Symbols of Substance: Bimin-Kuskusmin Models of Procreation, Death, and Personhood. Mankind 14(3): 191-216.

*POOLE, F. J. P. 1985. Among the Boughs of the Hanging Tree: Male Suicide Among the Bimin-Kuskusmin of Papua New Guinea. IN: HEZEL, F. J. (ed). Culture, Youth and Suicide in the Pacific: Papers From An East-West Center Conference. Honolulu, East-West Center. Pp 152-178.

*POOLE, F. J. P. 1985. Coming into Social Being; Cultural Images of infants in Bimin-Kuskusmin Folk Psychology. IN: WHITE, G. M. & KIRKPATRICK, J. (eds). Person, Self, and Experience: Exploring Pacific Ethnopsychologies. Berkeley, University of California Press. Pp 183-242.

*POOLE, F. J. P. 1986. Personal Control, Social Responsibility, and Image of Person and Self Among the Bimin-Kuskusmin of Papua New Guinea. international Journal of Law and Psychiatry 9: 295-319.

*POOLE, F. J. P. 1986. The Erosion of a Sacred Landscape: European Exploration and Cultural Ecology Among the Bimin-Kuskusmin of Papua New Guinea. IN: TOBIAS, M. (ed). Mountain People. Norman, University of Oklahoma Press. Pp 169-182.

*POOLE, F. J. P. 1987. Morality, Personhood, Tricksters, and Youths: Some Narrative Images of Ethics Among Bimin-Kuskusmin. IN: LANGNESS L. L. AND. HAYS, T. E (eds). Anthropology in the High Valleys: Essays on the New Guinea Highlands in Honor of Kenneth E. Read. Novato, Calif, Chandler & Sharp Publishers. Pp 284-366.

*POOLE, F. J. P. 1987. Ritual Rank, the Self, and Ancestral Power: Liturgy and Substance in a Papua New Guinea Society. IN: LINDSTROM, L.(ed). Drugs in Western Pacific Societies: Relations of Substance. Lanham, University Press of America. Pp 149-196.

*POOLE, F. J. P. 1994. Ethnohistorical and Mythological Traditions of Places of Origin, Paths of Migration, and Formations of Communities Among the Bimin-Kuskusmin, West Sepik Sandaun Province, Papua New Guinea. IN: STRATHERN A. J. & STÜRZENHOFECKER, G. (eds). Migration and Transformations: Regional Perspectives on New Guinea. Pittsburgh and London, University of Pittsburgh Press. Pp 179-208.

*POOLE, F. J. P. 1996. The Procreative and Ritual Constitution of Female, Male, and Other: androgynous Beings in the Cultural Imagination of the Bimin-Kuskusmin of Papua New Guinea. IN: RAMET, S. P. (ED). Gender Reversals and Gender Cultures -Anthropological and Historical Perspectives. London, Routledge.

*POOLE, F. P. 1983. Cannibals, Tricksters and Witches: Anthropophagic Images Among the Bimin-Kuskusmin.IN: BROWN, P. & TUZIN, D. (eds). the Ethnography of Cannibalism. Washington, D.C., Society For Pschological Anthropology. Pp 6-32.

*POUWER, J. 1964. Social System in the Star Mountains, Towards a Reorientation of the Study of Social Systems, American Anthropologist 66:133-61.

PRENTICE, M.J. & HOPE, G.S. 2007. Climate of Papua. IN: MARSHALL, A.J & BEEHLER, B.M. (eds). The Ecology of Papua: Part One. The Ecology of Indonesia Series Volume IV. Periplus Editions, Singapore. Pp 177-206.

*READ, T. F. 1962. Patrol Report, Amanab No. 2, 1962/63.

REIJNDERS, J.J. 1964. A Pedo-Ecological Study of Soil Genesis in Tropics from Sea Level to Eternal Snow. Leiden, Netherlands.

*REYNDERS, J. J. 1962. Shifting cultivation in the Star Mountains Area, Nova Guinea 10: 45-73.

RICHARDS, S. & DAHL, C. 2011. Herpetofauna of the Strickland Basin and Muller Range, Papua New Guinea. IN: RICHARDS, S. J. & GAMUI, G. B. (eds.) Rapid biological assessments of the Nakanai Mountains and the upper Strickland Basin: survey the biodiversity of Papua New Guinea's sublime karst environments. RAP Bulletin of Biological Assessment 60. Arlington, VA.: Conservation International. Pp 190-197.

RICHARDS, S. J. & GAMUI, B. (eds.) 2011. Rapid Biological Assessments of the Nakanai Mountains and the Upper Strickland Basin: Surveying the Biodiversity of Papua New Guinea's Sublime Karst Environments. RAP Bulletin of Biological Assessment 60. Conservation International, Arlington, VA.

*ROBBINS, J. & WARDLOW, H. (eds). 2005. The Making of Global and Local Modernities in Melanesia : Humiliation, Transformation, and the Nature of Cultural Change. Anthropology and Cultural History in Asia and the indo-Pacific. Aldershot, Hants, England ; Burlington, VT, Ashgate.

*ROBBINS, J. 1994. Equality As a Value: Ideology in Dumont, Melanesia and the West. Social Analysis 36: 21-70.

*ROBBINS, J. 1995. Dispossessing the Spirits: Christian Transformations of Desire and Ecology Among the Urapmin of Papua New Guinea. Ethnology 34: 211-224.

*ROBBINS, J. 1997. 666, Or, Why Is the Millennium on the Skin? Morality, the State and the Epistemology of Apocalypticism Among the Urapmin of Papua New Guinea. IN: STEWART P. & STRATHERN, A. (eds). Millennial Markers. Townsville, Centre For Pacific Studies, James Cook University of North Queensland. Pp 35-58.

*ROBBINS, J. 1997. When Do You Think the World Will End? Globalization, Apocalypticism, and the Moral Perils of Fieldwork in Last New Guinea. Anthropology and Humanism 22: 6-30.

*ROBBINS, J. 1998. Becoming Sinners: Christianity and Desire Among the Urapmin of Papua New Guinea. Ethnology 37: 299-316.

*ROBBINS, J. 1999. God People Everywhere Are Praying To You: Changing Landscapes of Ritual in a Papua New Guinea Society. Pittsburgh,P.A., Deixis Publishing Foundation.

*ROBBINS, J. 1999. This Is Our Money: Modernism, Regionalism, and Dual Currencies in Urapmin. IN: AKIN, D. & ROBBINS, J. (eds). Money and Modernity : State and Local Currencies in Melanesia. Pittsburgh, Pa., University of Pittsburgh Press. Pp 82-102.

*ROBBINS, J. 2001. God Is Nothing But Talk: Modernity, Language, and Prayer in a Papua New Guinea Society. American Anthropologist 103: 901-912.

*ROBBINS, J. 2001. Secrecy and the Sense of An Ending: Narrative, Time, and Everyday Millenarianism in Papua New Guinea and in Christian Fundamentalism. Comparative Studies in Society and History 43: 525-551.

*ROBBINS, J. 2001. Whatever Became of Revival? From Charismatic Movement To Charismatic Church in a Papua New Guinea Society. Journal of Ritual Studies Special Issue: Pentecostal and Charismatic Christianity in Oceania.

*ROBBINS, J. 2002. My Wife Can't Break off Part of Her Belief and Give It To Me: Apocalyptic interrogations of Christian individualism Among the Urapmin of Papua New Guinea. Paideuma 48: 189-206.

*ROBBINS, J. 2004. Becoming Sinners: Christianity and Moral Torment in a Papua New Guinea Society. Berkeley, Calif., University of California Press.

*ROBBINS, J. 2005. The Humiliations of Sin : Christianity and the Modernization of the Subject Among the Urapmin. IN: ROBBINS J. & WARDLOW,H. (eds). the Making of Global and Local Modernities in Melanesia : Humiliation, Transformation, and the Nature of Cultural Change. Aldershot, Hants, England ; Burlington, VT, Ashgate. Pp 43-56.

*ROBBINS, J. 2006. on Giving Ground: Globalization, Religion, and Territorial Detachment in a Papua New Guinea Society. IN: Kahler, M. & Walter, B. F. (eds). Territoriality and Conflict in An Era of Globalization. New York, Cambridge. Pp 62-84.

*ROBBINS, J. 2006. Properties of Nature, Properties of Culture: Ownership, Recognition, and the Politics of Nature in a Papua New Guinea Society. IN: Biersack, A. & Greenberg, J. (eds). Reimagining Political Ecology. Durham and London, Duke University Press. Pp 171-191.

*ROBBINS, J. 2007. Continuity Thinking and the Problem of Christian Culture: Belief, Time, and the Anthropology of Christianity with CA Comment. Current Anthropology 48: 5-38.

*ROBBINS, J. 2007. You Can't Talk Behind the Holy Spirit's Back: Christianity and Changing Language Ideologies in a Papua New Guinea Society. IN: Makihara M. &. Schieffelin, B. B (eds). Consequences of Contact: Language Ideologies and Sociocultural Transformations in Pacific Societies. New York, Oxford University Press. Pp 125-139.

*ROBBINS, J. 2008. on Not Knowing Other Minds: Confession, intention, and Linguistic Exchange in a Papua New Guinea Community. Anthropological Quarterly 81: 421-429.

*ROBBINS, J. 2008. The Future Is a Foreign Country. Time, Space and Hierarchy Among the Urapmin of Papua New Guinea. IN: SATHER, C. & KAARTINEN, T. (eds). Beyond the Horizon: Essays on Myth, History, Travel and Society. Helsinki, Finnish Literature Society. Pp 23-36.

*ROBBINS, J. 2011. Crypto-Religion and the Study of Cultural Mixtures: Anthropology, Value, and the Nature of Syncretism. J Am Acad Relig 79: 408-424.

*ROBBINS, J. L. 1998. Becoming Sinners : Christian Transformations of Morality and Culture in a Papua New Guinea Society. Ph. D. University of Virginia.

ROBBINS, J.L. 1998. Becoming Sinners: Christian Transformations of Morality and Culture in a Papua New Guinea Society. PhD thesis, University of Virginia.

*ROBERTS J. M., MOORE, C. C. & ROMNEY, A. K. 1995. Predicting similarity in Material Culture among New Guinea Villages from Propinquity and Language: a Log-Linear approach. Current Anthropology 36: 769-88.

ROBERTS, C. 1982. Wopkeimin Music, [unpublished ms] Introduction, Song Scores and Vernacular Lyrics Translated with Commentary. 79 pp. Juilliard School of Music, New York.

ROBERTS, C. 1996. [Music of the Star Mountains] Text in Mandarin Chinese; published in Taiwan. [ISBN 957-32-3120-4]

*ROBINSON, E. D. 1932. Patrol Report, Ambunti to the Sepik-Dutch Border, and approximately 10 miles of the Yellow River, No A.4 of 1932 -33, Sepik District.

ROWLAND, P. 1995. A Specimen of Mountain Nightjar (*Eurostopodus archboldi*) from the Hindenburg Ranges. Muruk 7: 41.

SALAS, L.A, BEDOS, A., DEHARVENG, L., FRYER, S., HADIATY, R., HERYANTO, MUNANDAR, NARDIYONO, NOERDJITO, M., NOERDJITO, W., RAHMADI, C., RIYANTO, A., ROFIK, RUSKAMDI, A., STRUEBIG,,M.J., SUHARDJONO,Y., SUYANTO A., VERMEULEN, J.J, WALCK, C.,WIRIADINATA,H., MEIJAARD, E., STANLEY S. 2005. Biodiveristy, endemism and the conservation of limestone karsts in the Sangkulirang Peninsula, Borneo. Biodiversity 6: 15-23.

*SAXE, G. B. & T. MOYLAN 1982. The Development of Measurement Operations Among the Oksapmin of Papua New Guinea. Child Development 53: 1242-1248.

*SAXE, G. B. (in Press). Making Change in Oksapmin Tradestores: a Study of Shifting Practices of Quantification Under Conditions of Rapid Shift Towards a Cash Economy. South Pacific Journal of Psychology.

*SAXE, G. B. 1981). Body Parts As Numerals - a Developmental Analysis of Numeration Among the Oksapmin in Papua New Guinea. Child Development 52: 306-316.

*SAXE, G. B. 1982. Developing Forms of Arithmetical Thought Among the Oksapmin of Papua New Guinea. Developmental Psychology 18: 583-594.

*SAXE, G. B. 1985. Effects of Schooling on Arithmetical Understanding - Studies with Oksapmin Children in Papua New Guinea. Journal of Educational Psychology 77: 503-513.

*SAXE, G. B. 1999. Cognition, Development and Cultural Practices. E.Turiel, Ed. Culture and Development. New Directions in Child Psychology. SF, Jossey-Bass.

*SCHULTZE-JENA, L. 1914. Forschungen im Innern der Insel Neuguinea: Bericht des Führers über die wissenschaftlichen Ergebnisse der deutschen Grenzexpedition in das westliche Kaiser-Wilhelmsland 1910, in Mitteilungen aus den deutschen Schutzgebieten. Erg. 11. Berlin.

*SCHUSTER, M. 1967. Vorläufiger Bericht über die Sepik-Expedition 1965-67 des Museums für Völkerkunde zu Basel, Verhandlungen der Naturforschenden Gesellschaft in Basel 78(1): 268-82.

*SCHUSTER, M. 1968-9. Farbe, Motiv, Funktion: Zur Malerei von Naturvölkern. Basel: Museum für Völkerkunde.

*SCHUSTER, M. 1969. In the Heart of New Guinea: the Eriptaman, Sandoz Bulletin 14:19-3

*SCHUURKAMP, G.J.T. 1992. The Epidemiology of Malaria and Filariasis in the Ok Tedi Region of Western Province, Papua New Guinea. PhD thesis, University of Papua New Guinea.

*Schuurkamp, G.J.T. 1995. The Min of the Papua New Guinea Star Mountains. A Look at their Traditional Culture and Heritage. Ok Tedi Mining Ltd, Tabubil.

*SCHWARTZ, J., BRUMBAUGH, R. C. & CHIU, M. 1987. Short Stature, Growth Hormone, insulin-Like Growth Factors, and Serum Proteins in the Mountain Ok People of Papua New Guinea. Journal of Clinical Endocrinology and Metabolism 65: 901-905.

*SCHWARTZ, J., BRUMBAUGH, R. C. & ALLEN, J. 1990. Endocrine Aspects of Short Stature - Telefomin and Atbalmin. Paper Presented At the Conference: the Mek and their Neighbours.

*SCHWARTZ, T. 1967. Anthropological Research Opportunities in the Upper Sepik. Current Anthropology 8: 438-439.

*SEDDON, S. B. 1983. Economic Activities of Women in the Oksapmin Subdistrict, West Sepik Province. Unpublished Paper. Port Moresby, Education Research Unit, University of Papua New Guinea.

*SHEARMAN, P. 1999. The Sepik River: a Natural History. HUNNAM, P. & MEALEY, E. (eds) Suva, Fiji, WWF World Wide Fund For Nature, South Pacific Program.

SHEARMAN, P.L., BRYAN, J.E., ASH, J., HUNNAM, P., MACKEY, B. & LOKES, B., 2008. The State of the Forests of Papua New Guinea. Mapping the extent and condition of forest cover and measuring the drivers of forest change in the period 1972-2002. University of Papua New Guinea, 2008.

SHEPHERD, M. J. 1974. The 1965 Star Mountains Expedition. Niugini Caver 2:240-243.

SIMPSON, G.G. 1977. Too many lines; the limits of the Oriental and Australian zoogeographic regions. Proceedings of the American Philosophical Society 121: 107-120.

*SINCLAIR, J. 2001. Mastamak: the Land Surveyors of Papua New Guinea. Crawford House, Hindmarsh.

*SOGOLO, A. 2009. Spatial Distribution and Hunting intensity of Hunted Wildlife Populations in Sokamin, Sandaun Province Honours Thesis. University of Papua New Guinea., Port Moresby.

*SPICER, P. E. &. KEREU, R. K 1993. Organochlorine insecticide Residues in Human Breast Milk: a Survey of Lactating Mothers From a Remote Area in Papua New Guinea. Bulletin of Environmental Contamination and Toxicology 50: 540-546.

*STEER, M. 2005. Linguistic report for the Upper Sepik Central New Guinea Project. Research School of Pacific & Asian Studies, Australian National University, Canberra.

STRUEBIG, M.J., KINGSTON, T., ZUBAID, A., LE COMBER, S.C., MOHD-ADNAN, A., TURNER, A., KELLY J., BOŽEK, M., & ROSSITER, S.J. 2009. Conservation Importance of

Limestone Karst Outcrops for Palaeotropical Bats in a Fragmented Landscape. Biological Conservation 142:2089-2096.

*SWADLING P. 1983. How Long have People been in the OK Tedi Impact Region? Papua New Guinea National Museum & Art Gallery, Boroko.

SWADLING, P. 1983 How Long Have People Been in the Ok Tedi Impact Region? Hong Kong, Everbest Printing Co., LTD.

SWADLING, P., MAWE, T.,& TOMO, W. 1990. Archaeology of Telefolip. IN: CRAIG, B. & HYNDMAN, D. (Eds.), Oceania monographs: Vol. 40. Children of Afek: Tradition and change among the Mountain-Ok of Central New Guinea (pp.109–114). University of Sydney, Sydney, Australia.

SWARTZENDRUBER, J. F. 1993. Papua New Guinea Conservation Needs Assessment Symposium Report. Boroko: Department of Environment and Conservation.

TAKEUCHI, W. 2007. Vascular plants of the Kaijende Highlands, Papua New Guinea: Taxonomic and Vegetation Survey. A rapid biodiversity assessment of the Kaijende Highlands, Enga Province, Papua New Guinea. Arlington, VA, USA, Conservation International.

TAKEUCHI, W. 2011. Vascular plants of the Strickland Basin, Papua New Guinea: taxonomic and vegetation survey In: RICHARDS, S. & GAMUI, B. (eds.) Rapid biological assessments of the Nakanai Mountains and the upper Strickland Basin: Survey the biodiversity of Papua New Guinea's sublime Karst environments. RAP Bulletin of Biological Assessment 60. Conservation International, Arlington, VA.

*TAMAI, F. & KONISHI , T. 1994. Pitpit (*Saccharum Edule*), a Gramineus Vegetable of Papua New Guinea (in Japanese, English Summary). Overseas Scientific Research Team, Tokyo University of Agriculture, Ed. in Search of the Origins of Agriculture in Papua New Guinea: a Botanical Survey of Tropical Rain Forest. Tokyo, Committee of the Centennial Anniversary, Tokyo University of Agriculture. Pp 132-135.

*TAYLOR, J. L. 1961. From Wabag To Telefomin. Australian Territories 1: 28-35.

TENNENT, W. J. 2006. A checklist of the butterflies of Melanesia, Micronesia, Polynesia and some adjacent areas. *Zootaxa*, 1178, 1-209.

TENNENT, W. J., & MULLER, C. J., In press. IUCN Red List assessments

*TERRELL, J. & WELSCH, R.L. 1990. Trade Networks, Areal Integration, and Diversity along the north Coast of New Guinea. Asian Perspective 29, 2:155-65.

*TERRELL, J.E. & WELSCH, R.L. 1997. Lapita and the temporal geography of prehistory. Antiquity 71: 548-72.

*TERRELL, J.E. 2010. Language and Material Culture on the Sepik Coast of Papua New Guinea: Using Social Network Analysis to Simulate, Graph, Identify and Analyze Social and Cultural Boundaries Between Communities. Journal of Island and Coastal Archaeology 5: 3-32.

*THURNWALD, R. 1914. Entdeckungen im Becken des oberen Sepik, Mitteilungen aus den deutschen Schutzgebieten 27: 338-48.

THURNWALD, R. C. 1916. Vorstosse nach dem Quellgebiet des Kaiserin- Augusta-Flusses, dem Sand-Fluss und dem Nord-Fluss bis an das Kustengebirge. Mitteilungen aus den deutschen Schutzgebieten 29,2:82-93. Translation into English at www.uscngp.com ('Papers').

*TIESLER, F. 1984. Die Kürasse Neuguineas, Abhandlungen und Berichte des Staatlichen Museums für Völkerkunde, Dresden 41:46-85.

TUYET, D. 2001. Characteristics of Karst Ecosystems of Vietnam and Their Vulnerability to Human Impact. Acta Geologica Sinica 75:325-329

UNESCO. 2006. The Sublime Karsts of Papua New Guinea [Online]. Available: http://whc.unesco.org/en/tentativelists/5064/ [Accessed 28 August 2011].

VAN MASTRIGT, H. 2000. A review of the *Delias clathrata* group from Irian Jaya and Papua New Guinea (Lepidoptera, Pieridae). Neue Entomologische Nachrichten 48: 3-68.

VAN MASTRIGT, H. J. G. 1989. Taxonomy of the *Delias mesoblema* subgroup from Irian Jaya (Lepidoptera: Pieridae). Ent. Ber. Amst. 49: 8-14.

VAN MASTRIGT, H. J. G. 1990. New (sub)species of *Delias* from the central mountain range of Irian Jaya (Lepidoptera: Pieridae). Tijdschr. Ent., 133: 197-204.

VANE-WRIGHT, R. I. 1991. Transcending the Wallace Line: do the western edges of the Australian Region and the Australian plate coincide? Aust. Syst. Bot. 4: 183-197.

WALKER, D. & HOPE, G.S. 1982 Late Quaternary Vegetation History.-IN: GRESSITT,J . L. (ed.), The Biogeography and Ecology of New Guinea. Junk, The Hague. Pp. 263-287.

*WARNER, J. N. & GRASSL, C. O. 1958. The 1957 Sugarcane Expedition To Melanesia. Hawaiian Planters' Record 55: 209-236.

*WASHBURN, D. K. & CROWE, D. W. 1988. Symmetries of Culture: Theory and Practice of Plane Pattern Analysis. University of Washington Press, Seattle & London.

WEEKS, S. G. (ED.) 1981. Oksapmin: Development and Change. Occasional Paper No. 7. Educational Research Unit, University of PNG.

*WELSCH, R. L. & TERRELL, J..1991. Continuity and Change in Economic Relations along the Aitape Coast of Papua New Guinea, 1909-1900. Pacific Studies 14: 113-28.

*WELSCH, R. L. & TERRELL, J. 1994. Reply to Moore & Romney. American Anthropologist 96: 392-96.

*WELSCH, R. L. & TERRELL, J. 1998. Material Culture, Social Fields and Social Boundaries on the Sepik Coast of New Guinea. IN: STARK, M. T. (ed.), The Archaeology of Social Boundaries. Smithsonian Institution Press, Washington. Pp. 50-77.

*WELSCH, R. L. 1998. An American anthropologist in Melanesia: A.B. Lewis and the Joseph N.Field South Pacific Expedition, 1909-1913. University of Hawaii Press, Honolulu.

*WELSCH, R. L., TERRELL, J. & NADOLSKI, J. A. 1992. Language and Culture on the North Coast of New Guinea, American Anthropologist 94: 568-601.

*WELSCH, R.L. 1996. Language, Culture, and Data on the North Coast of New Guinea. Journal of Quantitative Anthropology 6: 209-34.

*WELSH, A. R. 1969. Patrol Report, Amanab No. 5, 1969/70.

*WEST. H. W. 1951. Patrol Report, Sepik District No. 1, 1950/51

*WESTON, P. & SMITH, J. 2009. Mianmin - English English - Mianmin Tok Pidgin - Mianmin Dictionary. Ukarumpa, SIL.

*WHALEN, J. B., BRITTEN, R. M. & MCDOUGALL, I. 1982. Geochronology and Geochemistry of the Frieda River Prospect Area, Papua New Guinea. Economic Geology 77: 592-616.

WHEATCROFT, W. G. 1973. Tifalmin. In Robert L. Breeden (ed.), Primitive Worlds: People Lost in Time, pp.56-83. National Geographic Society, Washington DC.

*WHEATCROFT, W. G. 1975. The Legacy of Afekan: Cultural Symbolic Interpretations of Religion among the Tifalmin of New Guinea. PhD Thesis, University of Chicago.

WHEATCROFT, W. G. 1976. The Legacy of Afekan: Cultural Symbolic Interpretations of Religion among the Tifalmin of New Guinea. PhD Thesis, Anthropology, University of Chicago.

WILLIAMS, J. W. 1961. New Guinea: From the Fly River in Papua to the Sepik and Mai Rivers in Mandated Territory. Explorers Journal 39,2:8-12.

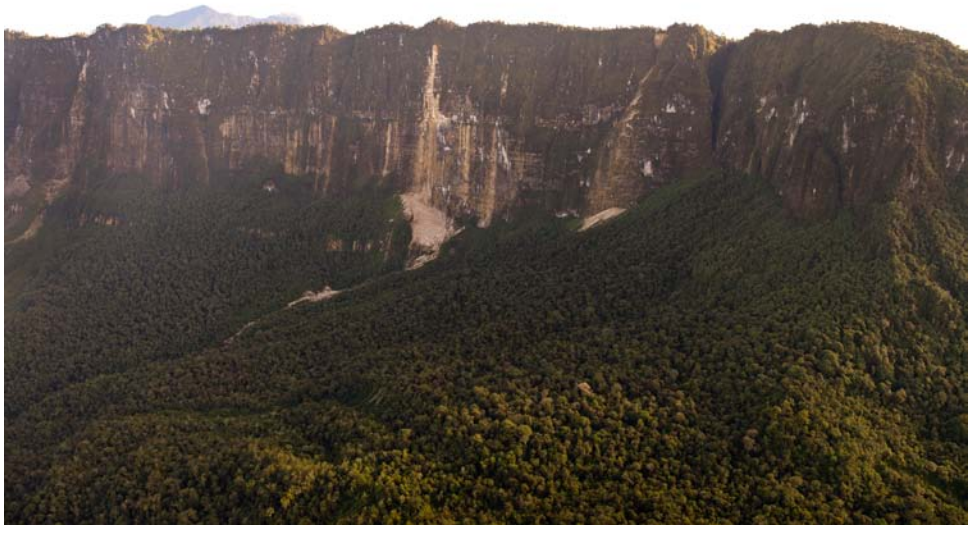
WILLIAMSON, A. & HANCOCK, G. (eds.) 2005. The Geology and Mineral Potential of Papua New Guinea, Port Moresby. Papua New Guinea Department of Mining.

WOOD, A.W. 1982. The soils of New Guinea. IN: GRESSITT, J.L (ed) Biogeography and Ecology of New Guinea. Monographiae Biologicae. Volume 42. Junk, The Hague. Pp 73-82.

WWF PNG & PNG FSC NATIONAL INITIATIVE 2006. High Conservation Value Toolkit for Papua New Guinea. Port Moresby: WWF Papua New Guinea.

ZOOLOGICAL SOCIETY OF LONDON 2012. Evolutionary Distinct and Globally Endangered [Online] http://www.edgeofexistence.org/mammals/top_100.php [Accessed 21 September 2012]

ZWEIFEL, R. G. 2003. A New Species of Microhylid Frog, Genus *Oreophryne*, from Papua New Guinea. American Museum Novitates 3419:1-8.



Annex 1

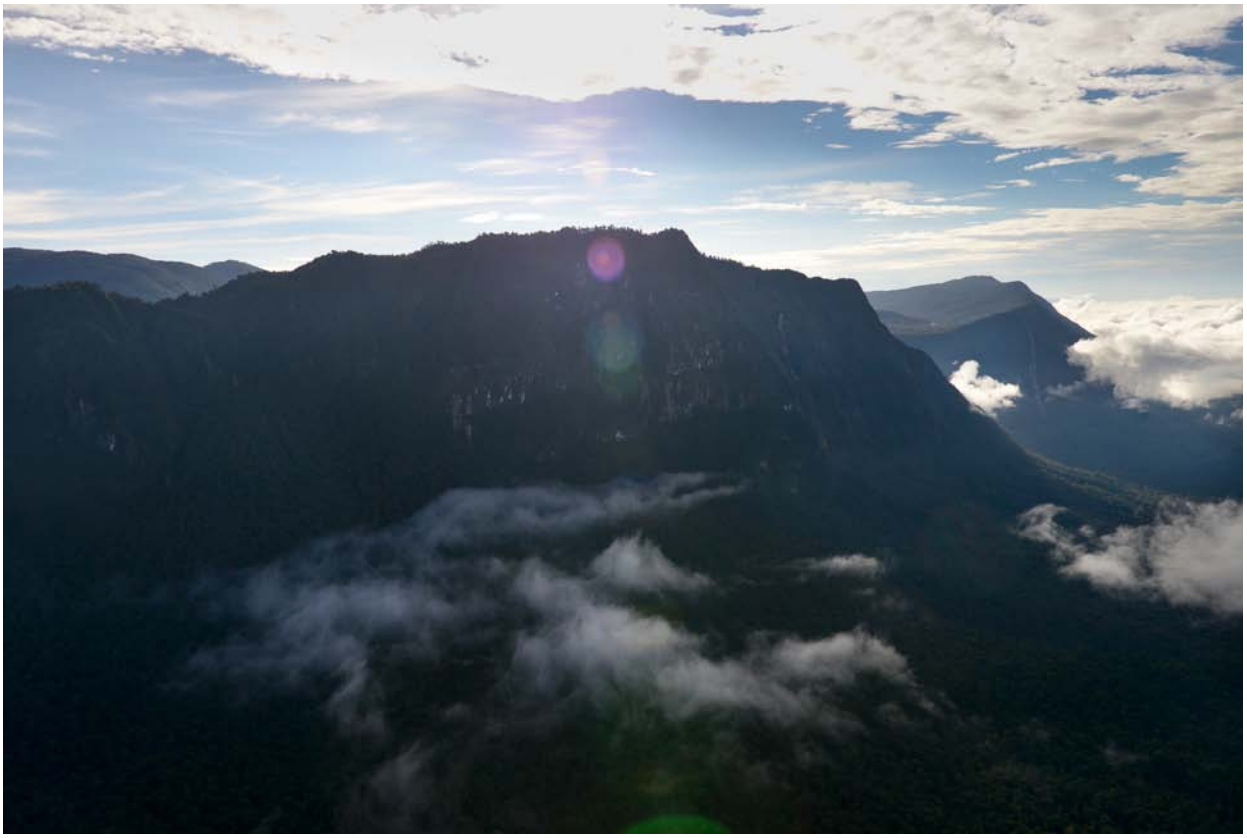
Mammals likely to occur in the vicinity of the Hindenburg Wall

Family	Scientific Name	Common Name	IUCN	Distribution	Refs
Tachyglossidae	*Zaglossus bartoni*	Long-Beaked Echidna	CE	WD,LM,LA,MM	1,2,3,5,7
Macropodidae	*Dendrolagus goodfellowi*	Goodfellow's Tree Kangaroo	EN	WD,FF,LM,LA,MM	2,4,5,7
	*Dendrolagus notatus**	Central Ranges Tree Kangaroo	EN	LM,LA,MM	8,9
	Dendrolagus spadix	Lowland Tree Kangaroo	LC	FF,LM,LA	4,5
	Dorcopsulus vanheurni	Small Dorcopsis	NT	WD,LM,LA	4,5,7,9
	Thylogale brunii	New Guinea Pademelon	VU	WD,FF,LM,LA,MM	4,8
Phalangeridae	*Phalanger carmelitae*	Mountain Cuscus	LC	E,LM,LA,SF,MM	1,2,4,5,7,8
	Phalanger gymnotis	Ground Cuscus	LC	WD,FF,LM,LA,SF	1,4,5,7
	*Phalanger matanim**	Telefomin Cuscus	CE	LM,LA,MM	4
	Phalanger mimicus	Southern Common Cuscus	LC	FF,LM,LA	4
	Phalanger orientalis	Northern Common Cuscus	LC	WD,FF	1,2,4,5,7,8
	Phalanger sericeus	Silky Cuscus	LC	WD,LM,LA,MM	2,4,5,7,8
	Phalanger vestitus	Stein's Cuscus	LC	W,FF,LM,LA	1,2,4,5,7
	Spilocuscus maculatus	Common Spotted Cuscus	LC	WD,FF,LM,LA	4,5,7
	*Spilocuscus rufoniger**	Black-Spotted Cuscus	CE	FF,LM,LA	2,4,7
Petauridae	*Dactylopsila megalura*	Great Tailed Triok	LC	LM,LA	4,5
	Dactylopsila palpator	Long-Fingered Triok	LC	WD,LM,LA,SF,MM	1,2,4,5
	Dactylopsila trivirgata	Stripped Possum	LC	WD,FF,LM,LA,SF	1,2,4,5,8
Acrobatidae	*Distoechurus pennatus*	Feather-Tailed Possum	LC	FF,LM,LA	4,5
Burramyidae	*Cercartetus caudatus*	Long-Tailed Pygmy Possum	LC	WD,MM	4,7
Petauridae	*Petaurus breviceps*	Sugar Glider	LC	WD,MM	1,2,4,5,7
Pseudocheiridae	*Pseudochirops corinnae*	Plush-Coated Ringtail	NT	LM,LA,MM	1,4,5,7
	Pseudochirops cupreus	Coppery Ring-Tail	LC	MM	1,4,5,7,8
	Pseudochirulus forbesi	Painted Ringtail	LC	LM,LA,MM	4,5
	Pseudochirulus mayeri	Pigmy Ring-Tail	LC	MM	1,4,5,7,8
Peramelidae	*Echymipera echinista*	Menzie's Echympiera	DD	FF	4
	Echymipera kalubu	Spiny Bandicoot	LC	WD,FF,LM,LA	1,2,4,7
	Echymipera rufescens	Rufescent Bandicoot	LC	WD,FF,LM	1,2,4,7
	Microperoryctes longicauda	Striped Bandicoot	LC	WD,LM,LA,SF,MM	1,2,4,5,7
Dasyuridae	*Dasyurus albopunctatus*	New Guinea Quoll	NT	WD,FF,LM,LA,MM	1,2,4 5,7,8
	Murexia longicaudata	Long-Tailed Dasyure	LC	WD,FF,LM	4
	Murexia melanurus	Black-Tailed Dasyure	LC	SF,FF,LM,LA,MM	4
	Murexia naso	Long-Nosed Dasyure	LC	MM	4
	Myoictis wallacei	Wallace's Three-Striped Dasyure	LC	FF,LM	4
	Neophascogale lorentzi	Speckled Dasyure	LC	WD,FF,LM,LA,MM	1,2,4,7
Muridae	*Abeomelomys sevia*	Menzie's Mouse	LC	MM	4
	Anisomys imitator	Uneven-Toothed Rat	LC	WD,FF,LM,LA,MM	4
	Coccymys ruemmleri	Rümmler's Mouse	LC	MM	4
	Crossomys moncktoni	Earless Water-Rat	LC	LA,MM	4
	Hydromys chrysogaster	Common Water-Rat	LC	LM,LA	4
	Hyomys dammermani	Western White-Eared Giant Rat	DD	MM	4
	Lorentzimys nouhuysi	Long-Footed Tree Mouse	LC	WD,LM,LA,MM	4,8

Family	Scientific Name	Common Name	IUCN	Distribution	Refs
	Macruromys major	Greater Small-Toothed Rat	LC	MM	4
	Mallomys aroaensis	De Vis's Woolly-Rat	LC	MM	4
	Mallomys rothschildi	Rothschild's Woolly-Rat	LC	LA,MM	1,4,8
	Mammelomys lanosus	Highland Mammelomys	LC	LA,MM	4
	Melomys leucogaster	White-Bellied Melomys	LC	WD,FF,LM,LA	4
	Melomys lutillus	Grassland Melomys	LC	WD,FF,LM,LA,MM	4
	Melomys rufescens	Black-Tailed Melomys	LC	WD,FF,LM,LA,MM	4,8
	Microhydromys argenteus	Southern Groove-Toothed Shrew Mouse	DD	LM,LA	11
	Mirzamys louisae	Mirza's Western Moss-Rat	NE	MM	12
	Parahydromys asper	Waterside Rat	LC	LM,LA	4
	Paraleptomys wilhelmina	Short-Haired Hydromyine	DD	LA,MM	4
	Paramelomys lorentzii	Lorentz's Paramelomys	LC	FF,LM,LA	4,8
	Paramelomys platyops	Lowland Paramelomys	LC	FF,LM,LA	4,8
	Paramelomys rubex	Montane Paramelomys	LC	LM,LA,MM	4,8
	Pseudohydromys ellermani	One-Toothed Shrew Mouse	LC	MM	4
	Pseudohydromys fuscus	Dusky Shrew Mouse	LC	MM	4
	Paramelomys rubex	Mountain Paramelomys	LC	LM,LA,MM	4,8
	Pogonomelomys brassi	Brass's Pogonomelomys	NT	FF	4
	Pogonomelomys mayeri	Shaw Mayer's Pogonomelomys	LC	LM,LA	4
	Pogonomys championi	Champion's Tree Mouse	DD	LA,MM	4
	Pogonomys loriae	Loria's Tree-Mouse	LC	WD,FF,LM,LA,MM	4,8
	Pogonomys macrourus	Chestnut Tree-Mouse	LC	WD,FF,LM,LA	4
	Rattus leucopus	Cape York Rat	LC	FF,LM,LA	4
	Rattus niobe	Moss-Forest Rat	LC	LM,LA,MM	4,8
	Rattus praetor	Large Spiny Rat	LC	WD,FF,LM,LA	4
	Rattus sordidus	Canefield Rat	LC	WD,FF,LM	4
	Rattus steini	Small Spiny Rat	LC	WD,SF,FF,LM,LA,MM	4
	Rattus verecundus	Slender Rat	LC	LM,LA,MM	4
	Uromys anak	Black-Tailed Giant Rat	LC	LM,LA, MM	4
	Uromys caudimaculatus	White-Tailed Giant Rat	LC	WD,FF,SF,LM,LA	4
	Xenuromys barbatus	Rock-Dwelling Giant Rat	LC	FF,LA,LM	4
Petropodidae	*Apoteles bulmerae*	Bulmer's Fruit-Bat	CE	LA,MM	1,4,6
	Dobsonia moluccensis	Moluccan Naked-Backed Fruit-Bat	LC	WD,FF,LM,LA,MM	1,4,6
	Macroglossus minimus	Dagger-Toothed Long-Nosed Fruit-Bat	LC	WD,FF,LM,LA	4,6
	Nyctimene albiventer	Common Tube Nosed Bat	LC	WD,FF,LM,LA	4,6
	Nyctimene cyclotis	Round-Eared Tube-Nosed Bat	DD	WD,FF,LM,LA,MM	4,6
	Nyctimene draconilla	Demonic Tube-Nosed Bat	DD	FF	4,6
	Pteropus neohibernicus	Greater Flying Fox	LC	WD,FF,LM,LA	4,6
	Syconycteris australis	Common Blossom-Bat	LC	WD,SF, FF,LM,LA,MM	4,6,8
	Syconycteris hobbit	Moss-Forest Blossom-Bat	VU	LA,MM	4,6
Emaballonuridae	*Emballonura beccarii*	Beccari's Sheathtail Bat	LC	FF,LM,LA	4
	Emballonura dianae	Large-Eared Sheath-Tailed Bat	LC	FF,LM,LA	6
	Emballonura furax	New Guinea Sheathtail Bat	DD	FF	6
	Emballonura raffrayana	Raffray's Shealthtail-Bat	LC	FF,LM,LA	4
	Mosia nigrescens	Lesser Shealth-Tailed Bat	LC	FF,LM	4,6
Hipposideridae	*Aselliscus tricuspidatus*	Trident Horseshoe-Bat	LC	FF	4
	Hipposideros ater	Dusky Horseshoe-Bat	LC	FF,LM,LA	4,6
	Hipposideros calcaratus	Spurred Horseshoe-Bat	LC	FF,LM	4,6
	Hipposideros cervinus	Fawn Horseshoe-Bat	LC	FF,LM,LA	4,6
	Hipposideros corynophyllus	Telefomin Horseshoe-Bat	DD	LA	4,6
	Hipposideros diadema	Diadem Horseshoe-Bat	LC	FF,LM	4,6
	Hipposideros maggietaylorae	Maggie Taylor's Horseshoe-Bat	LC	WD,FF	4,6
	Hipposideros wollastoni	Wollaston's Horseshoe-Bat	LC	LM,LA	4,6,8
Molossidae	*Chaerophon jobiensis*	Wrinkle-Lipped Bat	LC	FF,LM	6
	Tadarida kuboriensis	New Guinea Free-Tailed Bat	LC	LA,MM	6

Family	Scientific Name	Common Name	IUCN	Distribution	Refs
Rhinolophidae	*Rhinolophus arcuatus*	Western Horsehoe-Bat	LC	FF,LM	4,6
	Rhinolophus euryotis	New Guinea Horseshoe-Bat	LC	FF,LM,LA	4,6
	Rhinolophus megaphyllus	Eastern Horseshoe-Bat	LC	FF	4,6
Vespertilionidae	*Kerivoula muscina*	Fly River Trumpet-Eared Bat	LC	FF,LM,LA	4,6
	Miniopterus australis	Little Bentwing-Bat	LC	FF,LM,LA	4,6
	Miniopterus macrocneme	Small Melanesian Bentwing-Bat	DD	WD,FF,LM,LA,MM	4,6
	Miniopterus magnater	Western Bentwing-Bat	LC	FF	4,6
	Miniopterus medius	Javan Bentwing-Bat	LC	FF,LM	4,6
	Miniopterus propitristis	Large Melanesian Bentwing-Bat	-	FF,LM	4,6
	Nyctophilus microdon	Small-Toothed Nyctophilus	DD	LA,MM	4
	Nyctophilus microtismacrotis	Small-Eared Nyctophilus	LC	WD,FF,LM,LA,MM	4

IUCN status: CE = Critically Endangered, EN = Endangered, VU = Vulnerable, DD = Data Deficient, LC = Least Concern, NT = Near Threatened, NE = Not Evaluated but in IUCN database, - = no record in IUCN database at present. Distribution: FF = Foothill Forest, LM = Lower Montane, LA = Low-Altitude Mid-Montane, MM = Mid-Montane, WD = Geographically Widespread, SF = Secondary Forest within montane zone. References: 1 = Hyndman 1979, 2 = Hyndman & Menzies 1990, 3 = Jorgenson 1991, 4 = Flannery 1995, 5 = Whitehead 1995, 6 = Bonaccorso 1998, 7 = Hyndman & Menzies 1990, 8 = Richards & Gamui 2011, 9 =Menzies 1991, 10 = Musser and Norris .* Indicates lower probability.



Annex 2

Birds likely to occur in the vicinity of the Hindenburg Wall

Family	Species	Common Name	IUCN	Elevation (m)	Location	Ref
Casuariidae	*Casuarius benneti*	Dwarf Cassowary	NT	0–3,300	Wopkaimin	1,2,3
	Casuarius casuaris	Doubled Wattled Cassowary	VU	Lowland	Wopkaimin	1,2
	Casuarius unappendiculatus	Single-Wattled Cassowary	VU	0 –750	Wopkaimin	1,2
Podicipedidae	*Podiceps novaehollandiae*	Little Grebe	NE	Lowland	Wopkaimin	1,2
	Tachybaptus novaehollandiae	Australian Dabchick	LC	Lowland	Lake Wangbin	3
Fregatidae	*Fregata ariel*	Lesser-Frigate Bird	LC	Vagrant	Wopkaimin	1,2,3
Phalacrocoridae	*Phalacrocorax melanoleucos*	Little-Pied Comorant	LC	0–1,200	Wopkaimin	1,2
	Phalacrocorax sulcrirostris	Little Black Comorant	LC	Vagrant	OK Tedi Valley	3
Anhingidae	*Anhinga rufa*	Darter	LC	Lowland	lower Tabubil	1,2
Ardeidae	*Ardea picata*	Pied Heron	LC	Lowland	Tabubil	3
	Egretta alba	Greater Egret	NE	Lowland–highland	Wopkaimin, Ok Tedi Valley	1,2,3
	Egretta intermedia	Lesser Egret	NE	Lowland–highland	Wopkaimin, Telefomin, Victor Emanuel Range	1,2,3,4
	Egretta garzetta	Little Egret	LC	Lowland	Ok Tedi Valley	3
	Egretta novaehollandieae	White-Faced Heron	LC	Lowland–highland	Wopkaimin	1,2,3
Threskiornithidae	*Platalea regia*	Royal Spoonbill	LC	Lowland	Wopkaimin	1,23
Accipitridae	*Accipiter fasciatus*	Australian Goshawk	LC	0–1,200	Victor Emanuel Range,	2,4
	Accipiter melanochlamys	Black-Mantled Goshawk	LC	1,880–3,100	Wopkaimin	1,2
	Accipiter meyerianus	Meyer's Goshawk	LC	To at least 1,600	Wopkaimin	1,2,3
	Accipiter cirhocephalus	Collared Sparrowhawk	LC	0–1,000	Tabubil	3
	Accipiter poliocephalus	Grey-Headed Goshawk	LC	0–1,500	Tabubil	3
	Aquila gurneyi	Gurney's Eagle	NT	0– 1,500	Folomian	3
	Aviceda subcristata	Crested Hawk	LC	0–1,250	Ok Tedi, Tabubil	3
	Circus spilonotus	Papuan Harrier	LC	0–3,800	Tabubil	3
	Haliaeetus leucogaster	White-Bellied Sea Eagle	LC	Lowland vagrant	Ok Tedi Valley,	3

Family	Species	Common Name	IUCN	Elevation (m)	Location	Ref
	Haliastur indus	Brahminy Kite	LC	0–2,200	Wopkaimin	1,2
	Haliastur sphenurus	Whistling Kite	LC	Lowland	Wopkaimin	1,2
	Harpyopsis novaeguineae	New Guinea Harpy-Eagle	VU	0–3,200	Wopkaimin	
	Henicopernis longicauda	Long-Tailed Buzzard	LC	0–3,000	Wopkaimin	1,2
	Hieraaetus morphnoides	Little Eagle	LC	0–1,950	Wopkaimin, Tabubil	1,2,3
	Megatriorchis doriae	Doria's Hawk	NT	0–1,400**	Tabubil	3
	Milvus migrans	Black Kite	LC	0–1,750	Wopkaimin	1,2
Falconidae	*Falco berigora*	Brown Falcon	LC	0–1800	Tabubil	3
	Falco cenchroides	Australian Kestrel	LC	0–1500	Ok Tedi	3
	Falco longipennis	Australian Hobby	LC	Lowland	Tabubil	3
	Falco peregrinus	Australian Hobby	LC	0–2300	Ok Tedi	3
	Falco severus	Oriental Hobby	LC	0 1200	Wopkaimin	1,2,3
Anatidae	*Anas gibberifrons*	Grey Teal	LC	Lowland–highland	Wopkaimin	1,2
	Anas superciliosa	Pacific Black Duck	LC	Lowland	Wopkaimin	1,2,3
	Dendrocygna arcuata	Whistling Tree Duck	LC	Lowland	Wopkaimin	1,2,3
	Dendrocygna guttata	Spotted Whistling Duck	LC	Lowland	OK Tedi	3
	Anas waigiuensis	Salvadori's Teal	NE	Above 600	Wopkaimin, Tabubil	1,2,3
	Tadorna radjah	White-Headed Shelduck	LC	0–600	Wopkaimin	1,2,3
Megapodiidae	*Aepypodius arfakianus*	Wattled Brush Turkey	LC	800–2800	Mt Robinson, Ok Ma , Dawbin Creek	1,2
	Talegalla fuscirostris	Black-Billed Brush Turkey	LC	0–800	Wopkaimin	1,2
Phasianidae	*Coturnix chinensis*	Chinese Quail	LC	0–2,300	Victor Emanuel Range, Telefomin,	1,2
	Coturnix ypsilophora	Brown Quail	LC	0–1550	Wopkaimin	1,2
Turnicidae	*Turnix maculosa*	Red-Backed Buttonquail	NE	0–2,400	Victor Emanuel Range, Telefomin,	1,2
Rallidae	*Amaurornis olivaceus*	Rufous-Tailed Moorhen	NE	0–1,500	Tabubil, Wopkaimin	1,2,3
	Fulica atra	Black Coot	LC	0–3,500	Wopkaimin	1,2,3
	Gallinula tenebrosa	Dusky Moorhen	LC	Lowland	Lake Wangbin	2,3
	Gymnocrex plumbeiventris	Buff-Banded Rail	LC	0–3,600	Tabubil	2,3
	Rallina forbesi	Forbes Forest Rail	LC	Mid–montane	Uchemichi, Wopkaimin	1,2,4
	Rallus pectoralis	Lewin's Rail	NE	1,500–2,700	Victor Emanuel Range, Mt Ifal, Hindenburg Mts, Iikivip	1,2,4
	Rallina rubra	Chestnut Rail	LC	1,500–2,700	Mt Ifal, Victor Emanuel Range	1,2
	Rallus philippensis	Buff-Banded Rail	NE	0–3,600	Tabubil	2,3
Recurvirostridae	*Himantopus leucocephalus*	White-Headed Stilt	LC	0–mid altitudes	Tabubil, Wopkaimin	1,2,3
Glareolidae	*Stiltia isabella*	Australian Pratincole	LC	Highland	Wopkaimin	1,2,3
Charadriidae	*Charadrius dubius*	Little Ringed Plower	LC	0–1,500	Wopkaimin	1,2
	Pluvialis dominica	Pacific Golden Plover	LC	0–2,000	Telefomin	2,4
Scolopacidae	*Calidris acuminata*	Sharp-Tailed Sandpiper	LC	0–highland	Tabubil	3
	Calidris ruficollis	Red-Necked Stint	LC	Not documented	Tabubil	3
	Calidris tenuirostris	Great Knot	LC	Not documented	Tabubil	3
	Gallinago megala	Swinhoe's Snipe	LC	Highland	Victor Emanuel Range, Telefomin, Wopkaimin,Tabubil	1,2,3

Family	Species	Common Name	IUCN	Elevation (m)	Location	Ref
	Numenius minutus	Little Whimbrel	LC	0–1,000	Wopkaimin	1,2,3
	Numenius phaeopus	Whimbrel	LC	0–1,000	Tabubil	3
	Philomachus pugnax	Ruff	LC	Vagrant	Tabubil	3
	Tringa brevipes	Grey-Tailed Tattler	NE	Not documented	Tabubil	3
	Tringa glareola	Wood Sandpiper	LC	Not documented	Tabubil	3
	Tringa hypoleucos	Common Sandpiper	NE	0–3,300	Tabubil, Ok Tedi, Wopkaimin	1,2,3
Columbidae	*Columba vitiensis*	White-Throated Pigeon	LC	0–2,750	Tabubil	3
	Ducula chalconota	Rufescent Imperial Pegeon	LC	1,705–2,500	Mt Robinson, Ok Menga	3
	Ducula mullerii	Mullers's Imperial Pigeon	LC	Lowland	Wopkaimin	1,2,3
	Ducula pinon	Pinon Imperial Pigeon	LC	0–750	Wopkaimin	1,2,3
	Ducula rufigaster	Purple-Tailed Imperial Pigeon	LC	0–1,200	Tabubil	3
	Ducula zoeae	Zoe Fruit Pigeon	LC	Highest 1200	Victor Emanuel Range, Telefomin, Wopkaimin	1,2,3,4
	Goura scheepmakeri	Sheep-Makers Crowned Pigeon	VU	0–500	Wopkaimin	1,2
	Gymnophaps albertisii	D'albertis Mountain Pigeon	LC	All altitudes	Hindenburg Mts Mts, Ilkivip, Wopkaimin,	1,2,3,4
	Henicophaps albifrons	New Guinea Bronzewing	LC	0–1,200	Dablin Creek	3
	Macropygia amboinensis	Amboina Cuckoo Dove	LC	<1500	Victor Emanuel Range, Telefomin, Wopkaimin,	1,2,3,4
	Macropygia nigrisrostris	Black-Billed Cuckoo-Dove	LC	0–2,600	Wopkaimin	1,2,3
	Otidiphaps nobilis	Pheasant Pigeon	LC	0–1,900	Wopkaimin	1,2,3
	Ptilinopus iozonus	Orange-Bellied Fruit Dove	LC	0–2,400	Lower Tabubil	3
	Ptilinopus magnificus	Magnificent Fruit Dove	LC	0–1,450	Wopkaimin	1,2
	Ptilinopus magnifus	Wompoo Fruit Dove	LC	0–1,450	Ok Tedi	3
	Ptilinopus naina	Dwarf Fruit-Dove	LC	0–800	Lower Tabubil	3
	Ptilinopus ornatus	Ornate Fruit Dove	LC	0–2,400	Wopkaimin, Ok Tedi	1,2,3
	Ptilinopus perlatus	Pink-Spotted	LC	0–1,200	Ok Tedi	3
	Ptilinopus pulchellus	Beautiful Fruit Dove	LC	Up to 800 at least	Wopkaimin	1,2,3
	Ptilinopus rivoli	White-Breasted Fruit Dove	LC	200–3,400	Victor Emanuel Range, Mt Ifal, Hindenburg Mts, Wopkaimin	1,2,3,4
	Ptilinopus superbus	Superb Fruit Dove	LC	<1400	Hindenburg Mts, Eliptamin,	1,2,3,4
	Reinwardtoena reinwardtsi	Great Cuckoo Dove	LC	Extensive	Telefomin, Victor Emanuel Range Ranges, Uchemichi, Hindenburg Mts, Wopkaimin	1,2,3,4
	Trugon terrestris	Thick-Billed Ground Dove	LC	0–Tabubil	Ok Menga	3
Psittacidae	*Alisterus chloropterus*	Green-Winged King Parrot	LC	0–2,800	Telefomin, Victor Emanuel Ranges, Ok Menga	2,4
	Cacatua galerita	Sulphur Crested Cockatoo	LC	0–1,450	Telefomin, Tabubil	4
	Chalcopsitta scintillata	Greater Streaked Lory	NE	Lower altitudes	Tabubil	3
	Charmosyna josefina	Josephie's Lorikeet	LC	800–2,200	Ok Menga, Ok Tedi	3
	Charmosyna multistrata	Strreaked Lory	NT	200–1,800	Ok Menga, Ok Ma	3
	Charmosyna papou	Polymorphic Lorikeet	LC	1,450+	Victor Emanuel Range, Mt Ifal, Ilkivip, Hindenburg Mts	2,4
	Charmosyna placentis	Red-Flanked Lorikeet	LC	0–1,400	Low altitudes	3

Family	Species	Common Name	IUCN	Elevation (m)	Location	Ref
	Charmosyna pulchella	Fairy Lorikeet	LC	High mid–montane	Victor Emanuel Range, Mt Ifal, Uchemichi, Hindenburg Mts, Ok Ma, Ok Menga	2,4
	Charmosyna wilhelminae	Pigmy Lorrikeet	LC	1,00–2,200	Ok Tedi	3
	Cyclopsitta diophthalma	Double-Eyed Fig-Parrot	LC	0–1,600	Ok Menga	3
	Cyclopsitta gulielmitertii	Orange- Breasted Fig-Parrot	LC	0–800	Tabubil	3
	Eclectus roratus	Eclectus Parrot	LC	0 –1,000	Tabubil	3
	Geoffroyus geoffroyi	Red-Cheeked Parrot	LC	0–800	Ok Menga	3
	Geoffroyus simplex	Blue-Collared	LC	800–2300	Ok Menga	3
	Loriculus aurantiiformis	Papuan Hanging Parrot	LC	0–1,200	Ok Menga, Ok Ma	3
	Lorius lory	Western Black-Capped Lory	LC	0–1750	Ok Tedi	3
	Micropsitta bruijinii	Red –Breasted Pygmy Parrot	LC	Highland	Hindenburg Mts, Ilkivip, Ok Tedi	2,4
	Neopsittacus musschenbroekii	Musschenbroek's Lorikeet	LC	1,100–3,000	Victor Emanuel Range, Telefomin, Mt Ifal, Deikimdikin, Hindenburg Mts, Ok Tedi	3
	Neopsittacus pullicauda	Alpine Lorikeet	LC	1,600–3,800	Victor Emanuel Range, Mt Ifal, Deikimdikin, Iikivip, Hindenburg Mts, Ok Tedi	2,4
	Oreopsittacus arfaki	Blue-Cheeked Lorikeet	LC	1,000–timberline	Victor Emanuel Range, Mt Ifal, Hindenburg Mts, Iikivip, Ok Tedi	2,4
	Probosciger aterrimus	Palm Cockatoo	LC	0–1,300	Low altitudes	3
	Pseudeos fuscata	Dusky Lory	LC	0–1,500	Victor Emanuel Range, Telefomin, Tabubil	2,4
	Psittacella brehmii	Brehm's Parrot	LC	1,150–2,800	Hindenburg Mts, Uchemichi	2
	Psittacella madaraszi	Madarasz's Tiger Parrot	LC	1,200–2,500	Ok Menga	3
	Psittacella modesta	Modest Parrot	LC	Mid–mountain	Victor Emanuel Range, Telefomin, Hindenburg Mts, Iikivip, Uchemichi	2,4
	Psittaculirostris desmarestii	Large Fig-Parrot	LC	Lowland–1,500	Ok Menga	3
	Psittrichas fulgidus	Vulturine Parrot	EN	Foot hills–2,000	Ok Ma, Ok Menga, Mt Robinsosn	3
	Trichoglossus goldiei	Goldie's Lorikeet	LC	1,500–2,300	Hindenburg Mts, Ilkivip	2,4
	Trichoglossus haematodus	Coconut Lory	LC		Victor Emanuel Range, Telefomin, Deikimdikin Tabubil	2,4
Cuculidae	*Cacomantis castaneiventris*	Chestnut-Bellied Cuckoo	LC	Foothills–2,500	Victor Emanuel Range, Telefomin,	2,3,4
	Cacomantis flabelliformis	Fan-Tailed Cuckoo	LC	1,200–3,900	Victor Emanuel Range, Telefomin,	3
	Cacomantis variolosus	Brush Cuckoo	LC	Low–mid altitude	Tabubil	3
	Caliechthrus leucolophus?	White-Crowned Koel	LC	0–1500	Ok Tedi hill forest	3
	Centropus bernsteini	Lesser Black Coucal	LC	0–900	Tabubil escarpment	3
	Centropus menbeki	Greater Black Coucal	LC	0–1,275	Ok Menga	3
	Chrysococcyx meyeri	White-Eared Bronze-Cuckoo	LC	Sea level–1800	Tabubil	3
	Chrysococcyx minutillus	Malay Bronze-Cukoo	LC	0–1000	Tabubil	3
	Cuculus saturatus	Oriental Cuckoo	LC	0–4,400	Migrant	3
	Eudynamys scolopacea	Common Koel	NE	0–1,500	Ok Tedi hill forest	3
	Microdynamis parva	Dwarf Koel	LC	Lowland–1,450	Ok Menga	3
	Scythrops novaehollandiae	Channel-Billed Cuckoo	LC	Lowland	Vagrant	3
Strigidae	*Ninox theomacha*	Papuan Boobook	LC	0–2,500	Tabubil	3
Podargidae	*Podargus papuensis*	Papuan Frogmouth	LC	0–2,500	Tabubil escarpement	3

Family	Species	Common Name	IUCN	Elevation (m)	Location	Ref
	Podargus ocellatus	Marbled Frogmouth	LC	0–1,500	Ok Ma	3
Aegothelidae	*Aegotheles archboldi*	Archbolds Owlet Nightjar	LC	2,100–3,500	Victor Emanuel Range, Telefomin	2,3,4
	Aegotheles insignis	Reddish Owlet Nightjar	LC	Mid–mountain	Hindenburg Mts	2,3,4
	Aegotheles wallacii	Wallace's Owlet-Nightjar	DD	600–1,500	Tabubil plateau	3
Caprimulgidae	*Caprimulgus macrurus*	Long-Tailed Nightjar	LC	0–1,740	Victor Emanuel Range, Telefomin, Tabubil escarpment	2,3,4
	Eurostopus mystacalis	Mountain Nightjar	LC	0–1,500	Hindenburg Ranges	2,3,4
	Eurostopodus archboldi	Archbolds Owlet-Nightjar	LC	2,200–timberline	Mt Robinson	3
Hemiprocnidae	*Hemiprocne mystacea*	Moustached Tree-Swift	LC	0–4400	Tabubil	3
Apodidae	*Apus pacificus*	Fork-Tailed Swift	LC	Lowland	Vagrant	3
	Collocalia esculenta	Glossy Swiftlet	LC	0–above timberline	Victor Emanuel Range, Hindenburg Mts, Uchemichi,	2,3,4
	Collocalia hirundinacea	Mountain Swiftlet	LC	500 +	Victor Emanuel Range, Telefomin, Hindenburg Mts, Uchemichi, Ok Tedi	2,3,4
	Collocalia vanikorensis	Uniformed Swiflet	LC	0–1,450	Ok Tedi, Tabubil	3
	Hirundapus caudacutus	White-Throated Needlehair	LC	Lowland	Migrant	3
	Mearnsia novaeguineae	Papuan Spinetail	LC	Lowland	Vagrant	3
Alcedinidae	*Ceyx lepidus*	Dwarf Kingfisher	LC	0–1,200	Ok Ma, Mt Robinson	3
	Clytoceyx rex	Shovel-Billed Kingfisher	LC	0 2,100	Telefomin, Victor Emanuel Range	2,4
	Dacelo gaudichaud	Rufous-Bellied Kingfisher	LC	0–1,300	Tabubil	3
	Halcyon sancta	Sacred Kingfisher	NE	0 –1,800	Migrant	3
	Melidora macrorrhina	Hook-Billed Kingfisher	LC	Lowland	Tabubil	3
	Syma megarhyncha?	Mountain Kingfisher	LC	1,100–2,100	Ok Ma, Folomian	3
	Syma torotoro	Yellow-Billed Kingfisher	LC	0–1,200	lower Tabubil	3
	Tanysiptera sylvia	White-Tailed Paradise-Kingfisher	LC	Lowland	Vagrant	3
	Todiramphus macleayii	Forest Kingfisher	LC	0 –2,400	Vagrant	3
Meropidae	*Merops ornatus*	Rainbow Bee-Eater	LC	0–1,500	Tabubil	3
Coraciidae	*Eurystomus orientalis*	Dollarbird	LC	0–1,500	Tabubil	3
Bucerotidae	*Rhyticeros plicatus*	Blyth's Hornbill	NE	0–1,800	Tabubil	3
Pittidae	*Pitta erythrogaster*	Blue-Breasted Pitta	LC	0–1,200	Ok Ma	3
	Pitta sordida	Pitta Sordida	LC	0–1,200	Tabubil	3
Hirundinidae	*Hirundo ariel*	Fairy Martin	LC	Vagrant	Tabubil	3
	Hirundo daurica	Red-Rumped Swallow	LC	Lowland	Tabubil	3
	Hirundo nigricans	Tree Martin	LC	Migrant	Tabubil	3
	Hirundo rustica	Barn Swallow	LC	Lowland	Tabubil	3
	Hirundo tahitica	Pacific Swallow	LC	0–1,900	Tabubil	3
Motacillidae	*Motacilla cinerea*	Grey Wagtail	LC	600–2,500	Ok Tedi	3
	Motacilla flava	Yellow Wagtail	LC	Lowland–highland	Ok Tedi	3
Campephagidae	*Campochaera sloetii*	Golden Cuckoo-Shrike	LC	0–800	Tabubil	3
	Coracina boyeri	Boyer's Cuckoo-Shrike	LC	0–1,100	Ok Menga	3
	Coracina caeruleogrisea	Stout-Billed Cuckoo-Shrike	LC	0–2,100	Victor Emanuel Range, Telefomin, Hindenburg Mts, Ok Ma, Ok Menga	1,2,3

Family	Species	Common Name	IUCN	Elevation (m)	Location	Ref
	Coracina lineata	Yellow-Eyed Cuckoo-Shrike	LC	600 –1,450	Tabubil	3
	Coracina longicauda	Hooded Cuckoo-Shrike	LC	1,800–3,600	Folomian	3
	Coracina melas	New Guinea Cuckoo-Shrike	LC	0–1,200	Ok Ma, Ok Menga	3
	Coracina montana	Black Bellied Cuckoo-Shrike	LC	0–1,200	Victor Emanuel Range, Telefomin, Hindenburg Mts, Iikivip, Uchemichi, Mt Robinson	1,2,3
	Coracina morio	Mollucan Cuckoo-Shrike	LC	Foothills–1,500	Victor Emanuel Range, Telefomin, Ok Ma, Ok Menga	1,2,3
	Coracina novaehollandiae	Black-Faced Cuckoo-Shrike	LC	1,200+	Tabubil	3
	Coracina schisticeps	Grey-Headed Cuckoo-Shrike	LC	150–1,200	Tabubil	3
	Coracina tenuirostris	Cicadabird	LC	0–1,500	Tabubil	3
	Lalage leucomela	Varied Triller	LC	0–1,500	Ok Ma, Ok Menga	3
Laniidae	*Lanius schach*	Schach's Shrike	LC	800–2,750	Telefomin, Victor Emanuel Range Ranges,	1,2
Turdidae	*Saxicola caprata*	Black Chat Robins	LC	Lowland–2,850	Victor Emanuel Range, Telefomin, Hindenburg Mts, Uchemichi, Folomian	1,2,3
	Turdus poliocephalus	Island Thrush	LC	2,200–4,100	Ok Tedi	3
Orthonychidae	*Melampitta gigantea*	Greater Malampitta	LC	760 –1,070	Lake Wangbin	3
	Melampitta lugubris	Lesser Melampitta	LC	1,450–2,100	Ok Tedi	3
	Orthonyx temminckii	Logrunner	LC	1,200–2,800	Mt Robinson	3
	Ptilorrhoa castanonota	Chestnut-Backed Jewel	LC	350–1,450	Tabubil, Ok Tedi	3
	Ptilorrhoa leucosticta	Spotted Jewel-Babbler	LC	1,200–2,575	Ok Tedi	3
Syliidae	*Acanthiza murina*	Thornbill Warbler	LC	2,150–timberline	Victor Emanuel Range, Mt Ifal, Hindenburg Mts	1,2
	Gerygone chloronota	Green-Backed Warbler	LC	0–1,500	Victor Emanuel Range, Mt Ifal	1,2
	Gerygone cinerea	Grey Tree Warbler	LC	1,750–2,700	Victor Emanuel Range, Mt Ifal	1,2
	Gerygone palpebrosa	Black-Throated Tree-Warbler	LC	0–1,450	Victor Emanuel Range, Telefomin	1,2
	Ifrita kowaldi	Kowalds Tree-Babbler	LC	1,450–2,900	Victor Emanuel Range, Mt Ifal, Hindenburg Mts, Ok Tedi	3,3
	Megalurus timoriensis	Tawny Grassbird	LC	0–4,200	Victor Emanuel Range, Telefomin	1,2,3
	Phylloscopus trivirgatus	Island Leaf Warbler	LC	750–2,400	Victor Emanuel Range, Telefomin, Mittag, Hindenburg Mts, Uchemichi, Mt Robinson, Ok Tedi	1,2,3
Acanthizidae	*Crateroscelis robusta*	Alpine Wren Babbler	LC	1,400 –1,650	Victor Emanuel Range, Mt Ifal, Hindenburg Mts,	3
	Gerygone chloronota	Green-Backed Gerygone	LC	0–1,500	Ok Ma, Ok Menga	3
	Gerygone chrysogater	Yellow-Bellied Gerygone	LC	0–800	Ok Tedi	3
	Gerygone cinera	Grey Gerygone	LC	1,750–2,700	Ok Tedi	3
	Gerygone palepebrosa	Fairy Gerygone	LC	0–1,450	Ok Ma, Ok Menga	3
	Gerygone ruficollis	Brown-Breatsed Gerygone	LC	900–3,400	Ok Tedi	3
	Sericornis arfakianus	Salvadori's Wren Babbler	LC	700–1,700	Victor Emanuel Range, Telefomin,Mt Robinson, Folomian	1,2
	Sericornis nouhuysi	Large Scrub-Wren	LC	2,100–2,500	Lake Wangbin, Tabubil	3
	Sericornis papuensis	Meek's Bren Babblers	LC	1,700–3,500	Victor Emanuel Range, Mt Ifal, Hindenburg	1,2

Family	Species	Common Name	IUCN	Elevation (m)	Location	Ref
					Mts, Iikivip	
	Sericornis perspicillatus	Rufous Wren-Warbler	LC	850–2,600	Victor Emanuel Range, Mt Ifal, Telefomin, Hindenburg Mts, Uchemichi, Ilkivip	1,2
	Sericornis perspicillatus	Buff Faced-Scrub-Wren	LC	850–2,600	Ok Tedi	3
	Sericornis spilodera	Pale-Billed Scrub-Wren	LC	0–1650	Ok Ma, Ok Menga	3
Maluridae	*Clytomyias insignis*	Orange-Crowned Fairy Wren	LC	1,400–2,700	Lake Wangbin	3
	Malurus alboscapulatus	Black And White Fairy Wren	LC	0–3,000	Victor Emanuel Range, Mt Ifal,	1,2,3
	Malurus cyanocephalus	Emperor Fairy-Wren	LC	0–1,000	Tabubil	3
Rhipiduridae	*Rhipidura albolimbata*	Friendly Fantail	LC	1,400–timberline	Folomian	3
	Rhipidura atra	Black Fantail	LC	1,000–2,400	Tabubil	3
	Rhipidura brachyrhyncha	Dimorphic Fantail	LC	1,700–timberline	Lake Wangbin, Mt Robinson, Ok Tedi	3
	Rhipidura hyperythra	Chestnut-Bellied Fantail	LC	Foothills–1,750	ok Menga	3
	Rhipidura leucophyrs	Willie Wagtail	LC	0–1,300	Tabubil	3
	Rhipidura leucothorax	White-Bellied Thicket-Fantail	LC	0–1,350	Tabubil plateau	3
	Rhipidura rufidorsa	Rufous-Backed Fantail	LC	0–900	Ok Menga	3
	Rhipidura rufiventris	Northern Fantail	LC	0–1,550	Tabubil	3
	Rhipidura threnothorax	Sooty Thicket-Fantail	LC	0–800	Tabubil, Ok Ma, Ok Menga	3
Mygiagridae	*Arses telescopthalmus*	Frilled Monarch	LC	0–1,600	Ok Tedi	3
	Machaerirhynchus flaviventer	Yellow-Breasted Boatbill	LC	0–1,00	Ok Menga, Dablin Creek	3
	Machaerirhynchus nigripectus	Black-Breasted Boatbill	LC	1,300–3,000	Victor Emanuel Range, Telefomin, Hindenburg Mts, Mtifal, Ilkivip, Ok Tedi, Lake Wangbin	1,2,3
	Monarcha axillaris	Black Monarch	LC	950–2,200	Ok Menga, ok Ma	3
	Monarcha chrysomela	Golden Monarch	LC	0–1,200	Ok Menga, Ok Ma	3
	Monarcha frater	Black-Winged Monarch	LC	400 –1 ,600	Tabubil	3
	Monarcha guttula	Spot-Winged Monarch	LC	0–1,100	Ok Menga, Ok Ma	3
	Muscicapa griseisticta	Gray-Spotted Flycatcher	LC	Up to 1,400	Victor Emanuel Range, Telefomin, Ok Menga	1,2,3
	Myiagra alecto	Shining Flycatcher	LC	0–12,00	Ok Tedi	3
Eopsaltridae	*Drymodes superciliaris*	Northern Scrub-Robin	LC	Lowland–1,450	Dablin Creek, Ok Menga	3
	Eugerygone rubra	Garnet Robin	LC	1,450–3,600	Lake Wangbin, Ok Tedi	3
	Microeca flavigaster	Lemon-Breasted Robin Flycatcher	LC	0–1,400	Victor Emanuel Range, Telefomin	1,2
	Microeca flavovirescens	Olive Flycatcher	LC	0–1,000	Dablin Creek	3
	Microeca griseoceps	Gray-Headed Robin-Flycatcher	LC	600–1,500	Victor Emanuel Range, Telefomin,Ok Tedi	1,2,3
	Microeca papuana	Canary Flycatcher	LC	1,750–3,500	Victor Emanuel Range, Mt Ifal, Hindenburg Mts, Uchemichi, Ilkivip,Mt Robinson, Lake Wangbin, Ok Tedi	1,2,3
	Monachella muelleriana	Torrent Flycatcher	LC	Foothills–1800	Ok Menga	3
	Pachycephalopsis poliosoma?	White-Throated Shrike-Robin	LC	400 –2,150	Lake Wangbin	1,2,3
	Peneothello cyanus	Blue Grey Robin	LC	1,550–2,400	Hindenburg Mts Mts Uchemichi, Mt	1,2,3

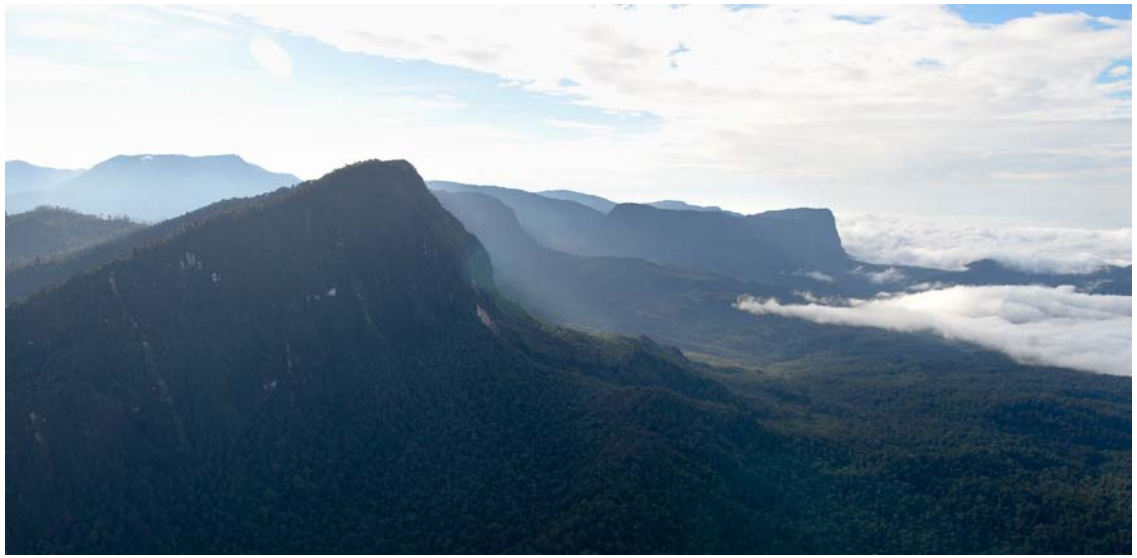
Family	Species	Common Name	IUCN	Elevation (m)	Location	Ref
					Robinson, Ok Tedi	
	Peneothello bimaculatus	White-Rumped Robin	LC	350–970	Mt Robinson, Ok Menga, Ok Ma	3
	Peneothello sigillatus	White-Winged Robin	LC	2,100–3,900	Victor Emanuel Range, Mt Ifal	1,2
	Poecilodryas albispecularis	White-Striped Robin-Flycatcher	LC	1,450–2,550	Hindenburg Mts Mts Uchemichi, Lake Wangbin	1,2,3
	Poecilodryas albonotata	White-Spotted Robin Flycatcher	LC	1,350 –2,700	Victor Emanuel Range, Telefomin, Hindenburg Mts, Iikivip. Ok Tedi	1,2,3
	Poecilodryas hypoleuca	Black-Sided Robin	LC	0–1,050	Lower Tabubil	3
	Tregellasia leucopus	White-Faced Robin Flycatcher	LC	500–1,800	Victor Emanuel Range, Telefomin, Tabubil	1,2,3
Pachycephalidae	*Aleadryas refinucha*	Red-Naped Whistler	LC	1,450–3,575	Victor Emanuel Range, Mt Ifal, Hindenburg Mts, Uchemichi, Ilkivip, Lake Wangbin, Ok Tedi	1,2,3
	Colluricincla megarhyncha	Rufous Shrike-Thrush	LC	0–2,150	Victor Emanuel Range, Telefomin, Ok tedi	1,2,3
	Pachycare flavogrisea	Gray And Yellow Whistler	LC	400–1,750	Victor Emanuel Range, Telefomin, Folomian	1,2,3
	Pachycephala aurea	Golden-Backed Whistler	LC	0 –750	Ok Tedi	3
	Pachycephala hyperythra	Rusty Whistler	LC	200–1,300	Dablin Vreek, Ok Menga	3
	Pachycephala lorentzi	Lorentz's Robin Whistle	LC	1,750–3,600	Victor Emanuel Range, Mt Ifal, Hindenburg Mts, Iikivip, Ok Tedi	1,2,3
	Pachycephala modesta	Gray Mountain Pachychepala	LC	1,450–3,500	Victor Emanuel Range, Mt Ifal	1,2,3
	Pachycephala monacha	Black-Headed Whistler	LC	750–1,600	Ok Menga	3
	Pachycephala rufiventris	Black-Backed Whistler	LC	0–600	Victor Emanuel Range, Telefomin	1,2
	Pachycephala schlegelii	Schlegel's Whistler	LC	1,450–3,650	Victor Emanuel Range, Mt Ifal, Hindenburg Mts, Iikivip, Ok Tedi	1,2,3
	Pachycephala simplex	Gray-Headed Whistler	LC	0–1,550	Mittag Mts, Mt Robinson	1,2,3
	Pachycephala soror	Sclater's Whistler	LC	600–2,200	Victor Emanuel Range, Telefomin, Hindenburg Mts, Uchemichi,Ok Menga, ok ma, Mt Robinson	1,2,3
	Pachycephala tenebrosa	Obscure Whistler	LC	1,450–2,150	Hindenburg Mts, Uchemichi, Ok Tedi	1,2,3
	Pitohui cristatus	Crested Pitohui	LC	400–1,000	Ok Menga, Ok Ma	3
	Pitohui dichrous	Black And Maroon Wood-Shrike	LC	600 –1,700	Victor Emanuel Range, Uchemichi,	1,2,3
	Pitohui ferrugineus	Rusty Pitohui	LC	0–1,500	Ok Tedi	3
	Pitohui kirhocephalus	Variable Pitohui	LC	0–1,000	Ok Menga, Ok Ma	3
	Pitohui negriscens	Dusky Wood-Shrike	LC	1,000–2,600	Hindenburg Mts, Uchemichi, Ok Tedi	1,2
Climacteridae	*Cormobates placens*	Papuan Tree Creeper	LC	1,250–2,600	Hindenburg Mts, Unchemchi,	1,2
Dicaeidae	*Dicaeum pectorale*	Red-Capped Midget Flowerpecker	LC	0–2,350	Victor Emanuel Range, Telefomin	1,2
	Melanocharis longicauda	Mid-Mountain Berrypicker	LC	700–1,900	Ok Tedi, Mt Robinson	3
	Melanocharis nigra	Black Berrypicker	LC	0 –1450	Dablin Creek, Tabubil, Ok Tedi	3
	Melanocharis crassirostris	Thick-Billed Flowerpecker	LC	1,500 –2,500	Hindenburg Mts, Ilkivip, Lake Wangbin	1,2
	Melanocharis versteri	Verster's Saw-Billed Flowerpecker	LC	1,450–timberline	Victor Emanuel Range, Mt Ifal, Hindenburg Mts, Ilkivip, Unchemchi, Ok Tedi	1,2,3
	Oreocharis arfaki	Yellow Flowerpecker	LC	1,450–3,000	Hindenburg Mts, Ilkivip, Ok Tedi,Lake Wangbin	1,2,3

Family	Species	Common Name	IUCN	Elevation (m)	Location	Ref
	Paramythia montium	Giant Alpine Flowerpecker	LC	2,500–timberline	Victor Emanuel Range, Mt Ifal, Hindenburg Mts, Ilkivip	3
Nectariniidae	*Nectarinia aspasia*	Black Sunbird	LC	Lowland–1,200	Ok Menga, Ok Ma	1,2,3
	Nectarinia jugularis	Yellow-Bellied Sunbird	LC	0–1,200	Vagrant	3
	Zosterops atrifrons	Yellow-Throated White-Eye	LC	400–1,450	Victor Emanuel Range, Telefomin, Ok Ma, Ok Menga, Dablin Creek	3
Zosteropidae	*Zosterops fuscicapilla*	Black-Capped White-Eye	LC	1,200–2,100	Hindenburg Mts, Mt Robinson, Dablin, Lake Wangbin, Ok Tedi	1,2,3
Meliphagidae	*Glycichaera fallax*	Green-Backed Honeyeater	LC	0–1,300	Dablin Creek	1,2,3
	Lichenostomus obscurus	Obscure Honeyeater	LC	100–1,400	Ok Ma, Ok Menga	3
	Lichenostomus subfrenatus	Sub-Bridled Honeyeater	LC	1,400–3,500	Victor Emanuel Range, Telefomin, Mt Ifal, Hindenburg Mts, Ilkivip, Unchemchi, Lake Wangbin, Ok Tedi	3
	Melidectes belfordi	White-Browed Honeyeater	LC	1,400 –3,800	Mt Ifal, Victor Emanuel Range of southeastern New Guinea,	1,2
	Melidectes fuscus	Sooty Honeyeater	LC	1140+	Lake Wangbin, Mt Binnie	3
	Melidectes rufocrissalia	Yellow-Browed Honeyeater	LC	1,200–2,300	Mid-mountain Forest	1,2,3
	Melidectes torquatus	Ornamental Honeyeater	LC	750– 2,700	Victor Emanuel Range, Telefomin, Mt Robinson	1,2,3,4
	Melilestes megarhynchus	Long-Billed Honeyeater	LC	0–1,750	Victor Emanuel Range, Telefomin, Tabubil	1,2,3
	Meliphaga albonotata	Scrub Honeyeater	LC	0–1,500	Tabubil	1,2
	Meliphaga analoga	Mimic Honeyeater	LC	0–1,200	Victor Emanuel Range, Telefomin	1,2,3
	Meliphaga mimikae	Mottled-Breasted Meliphaga	LC	800–1,750	Ok Ma, Ok Menga	3
	Meliphaga montana	Mountain Honeyeater	LC	500–1,150	Victor Emanuel Range, Telefomin	1,2
	Meliphaga orientalis	Hill-Forest Honeyeater	LC	800–1,750	Dablin Creek, Mt Robinson, Ok Tedi	3
	Melipotes fumigatus	Yellow-Faced Honeyeater	LC	1,000–4,200	Victor Emanuel Range, Mt Ifal	1,2,3
	Myzomela cruentata	Red Myzomela	LC	600–1,500	Victor Emanuel Range, Telefomin, Ok Tedi	3
	Myzomela eques	Red-Throated Myzomela	LC	0–1,100	Ok Menga, Dablin Creek, Ok Ma	1,2,3
	Myzomela obscura	Dusky Meliphaga	LC	0–100	Dablin Creek, Ok Ma	3
	Myzomela rosenbergii	Rosenberg's Myzomela	LC	600–4,000	Victor Emanuel Range, Telefomin, Mt Ifal,Iikivip, Hindenburg Mts,Ok Ma, Dablin Creek,	3
	Oedistoma iliolophus	Green Long-Billed Sunbird	LC	100–1,750	Ok Ma, Dablin Creek, Ok Menga	1,2,3
	Oedistoma pygmaeum	Pigmy Honeyeater	LC	0–1,300	Ok Menga, Ok Ma	1,2,3
	Oreostruthus fuliginosus	Red-And White Alpine Finch	LC	2,200–3,650	Hindenburg Mts, Ilkivip	1,2,3
	Philemon buceroides	Helmeted Friarbird		0–1,500	Tabubil	3
	Ptiloprora perstriata	Black-Backed Striated Honeyeater	LC	Above 1,500	Victor Emanuel Range, Mt Ifal, Hindenburg Mts, Ilkivip, Folomian	3
	Ptiloprora plumbea	Leaden Honeyeater	LC	1,000–1,900	Hindenburg Mts, Unchemchi, Lake Wangbin	1,2,3
	Pycnopygius cinereus	Gray Honeyeater	LC	500–2,000	Victor Emanuel Range, Telefomin	1,2
	Pycnopygius ixoides	Plain Honeyeater	LC	500–2,000	Victor Emanuel Range, Telefomin,Ok Menga	1,2,3
	Pycnopygius stictocephalus	Streak-Headed Honeyeater	LC	0–750	Ok Menga, Ok Ma	3
	Timeliopsis fulvigula	Mountain Straight-Billed	LC	750–2,500	Victor Emanuel Range, Luplupwintem cave	1,2

Family	Species	Common Name	IUCN	Elevation (m)	Location	Ref
		Honeyeater			just North of the range	
	Toxorhamphus novaeguineae	Yellow-Bellied Longbill	LC	0–1,200	OK Menga	1,2,3
	Toxorhamphus poliopterus	Yellow-Throated Sunbird	LC	400–2,450	Victor Emanuel Range, Telefomin, Dablin Creek, Lake Wangbin	3
	Xanthotis flaviventer	Tawny-Breasted Honeyeater	LC	0–1,500	Tabubil	1,2,3
	Xanthotis polygramma	Many-Spotted Honeyeater	LC	500–1,500	Victor Emanuel Range, Telefomin, Ok Menga, ok Ma	3
Estrildidae	*Erythrura trichroa*	Blue-Faced Parrot-Finch	LC	750–3,000	Ok Tedi	3
Sturnidae	*Aplonis metallica*	Metallic Starling	LC	0–1,000	Ok Ma, Ok Menga	3
	Aplonis mystacea	Yellow-Eyed Starling	NT	0–700	Ok Menga	3
	Mino anais	Golden Myna	LC	0–750	Tabubil	3
	Mino dumontii	Yellow-Faced Myna	LC	0–1500	Tabubil	3
Oriolidae	*Oriolus szalayi*	Brown Oriole	LC	0–1,400	Tabubil	3
Dicruridae	*Chaetorhynchus papuensis*	Mountain Drongo	LC	600–1,600	Victor Emanuel Range, Telefomin,,Dablin Creek, Ok Ma, Ok Menga	1,2,3
	Dicrurus hottentottus	Spangled Drongo	LC	0–1,450	Tabubil, Ok Tedi	3
Grallinidae	*Grallina bruijni*	Torrent-Lark	LC	400–2,400	Dablin creek, Lake Wangbin, Ok Menga	3
Artamidae	*Artamus leucorynchus*	White-Breasted Wood-Swallow	LC	0–800	Tabubil	3
	Artamus maximus	Giant Wood Swallow	LC	800–2,800	Victor Emanuel Range, Telefomin, Tabubil	1,2,3
Cracticidae	*Cracticus cassicus*	Hooded Butcherbird	LC	0–1,450	Tabubil, Ok Tedi	3
	Cracticus quoyi	Black Butcherbird	LC	0–1,400	Dablin creek	3
	Peltops blainvillii	Lowland Peltops	LC	0–550	Tabubil	3
	Peltops montanus	Mountain Peltops	LC	550–3,000	Ok Tedi	1,2,3
Ptilonorhynchidae	*Ailuroedus buccoides*	White-Eared Catbird	LC	0–800	Dablin Creek, Ok Menga	3
	Ailuroedus melanotis	Spotted Catbird	LC	900–2,250	Tabubil	3
	Amblyornis macgregoriae	Macgregor's Bowerbird	LC	1,200–3,300	Hindenburg Mts, Unchemchi	1,2
	Chlamydera lauterbachi	Yellow-Breasted Bowerbird	LC	Sl–1,750	Ok Tedi, Telefomin	3
Paradisaeidae	*Astrapia splendididissma*	Splendid Bird Of Paradise	LC	1800–3,450	Victor Emanuel Range, Mt Ifal, Hindenburg Mts, Iikivip, Deikimdikin, Luplupwintem	1,2,3,4
	Cicinnurus magnificus	Magnificent Bird Of Paradise	LC	Foothills–1,600	Victor Emanuel Range, Telefomin, Mittag, Ok Menga,Dablin Creek, Mt Robinson	1,2,3
	Cicinnurus regius	King Bird Of Paradise	LC	0–850	Ok Tedi	1,2,3,4
	Cnemophilus loriae	Loria's Bird Of Paradise	LC	1,450–3,000	Victor Emanuel Range, Mt Ifal, Hindenburg Mts, Iikivip	1,2,3
	Epimachus fastosus	Black Saber Tailed Bird Of Paradise	VU	1,300–2,540	Hindenburg Mts, Uchemichi,Lake Wangbin	1,2,3
	Epimachus meyeri	Gray-Saber Tailed Bird Of Paradise	LC	2,000–3,125	Victor Emanuel Range, Mt Ifal, Hindenburg Mts, Iikivip	1,2,
	Loboparadisea sericea	Shield-Billed Bird Of Paradise	NT	625–2,000	Victor Emanuel Range, Deikimdikin, Ok Tedi	1,2,3
	Lophorina superba	Superb Bird Of Paradise	LC	1,150 –2,300	Victor Emanuel Range Ranges, Hindenburg	1,2,3

Family	Species	Common Name	IUCN	Elevation (m)	Location	Ref
					Mts, Deikimdikin, Mt Binnie, Mt Robinson, Lake Wangbin	
	Macgregoria pulcha	Macgregor's Bird Of Paradise	VU	2,700–4,000	Victor Emanuel Range	1,2
	Manucodia atra	Glossy-Mantled Manucode	NE	0–1,000	Tabubil, Ok Tedi	3
	Manucodia chalybata	Crinkle-Collared Manucode	NE	0–1,750	Dablin Creek, Ok Ma	3
	Manucodia keraudrenii	Trumpet Manucode	LC	200–2,000	Ok Menga, Ok Tedi	3
	Paradigalla brevicauda	Blue And Yellow Wattled Bird Of Paradise	LC	1,600–2,580	Victor Emanuel Range, Mt Ifal, Lake Wangbin	1,2,3
	Paradisaea apoda	Greater Bird Of Paradise	LC	0–920	Ok Tedi, Ok Ma, Ok Menga	3
	Paradisaea minor	Lesser Bird Of Paradise	LC	0–1000	Victor Emanuel Range, Telefomin	1,2
	Paradisaea raggiana	Raggiana Bird Of Paradise	LC	0–1,600	Lukwi, Ok Menga	1,2,3
	Parotia carolae	Queen Carola's Six-Wired Bird Of Paradise	LC	1,200–1,800	Mt Robinson, Dablin Creek	1,2,3
	Pteridophora alberti	King Of Saxony Bird Of Paradise	LC	1,500–2,850	Victor Emanuel Range, Mt Ifal, Hindenburg Mts, Iikivip, Mt Binnie	1,2,3,4
	Ptiloris magnificus	Magnificent Riflebird	LC	0–1,450	Ok Ma, Ok Menga	3
Corvidae	*Corvus tristis*	Grey Crow	LC	0–1,400	Ok Tedi	3

IUCN status: CE = Critically Endangered, EN = Endangered, VU = Vulnerable, DD = Data Deficient, LC = Least Concern, NT = Near Threatened, NE = Not Evaluated but in IUCN database, - = no record in IUCN database at present. References: 1 = Hyndman (1979) 2= Beehler *et al.*(1986), Gregory (1995), 4 = Gilliard & Lecroy (1961).



Annex 3

Butterflies likely to occur in the vicinity of the Hindenburg Wall

Family	Scientific Name	IUCN	Elevation (m)	Distribution	Refs
Hesperiidae	*Chaetocneme antipodes*	-	<1500	FF, LM, MM, WD	1
	Chaetocneme editus	-	<1500	FF, LM, MM, WD	1
	Chaetocneme naevifera	-	<800	FF, WD	1
	Chaetocneme morea	-	700-1000	FF, LM	1
	Chaetocneme tenuis	-	<1500	FF, LM, MM, WD	1
	Netrocoryne thaddeus	-	<800	FF, WD	1
	Tagiades japetus	-	<1200	FF, LM, WD	1
	Tagiades trebellius	-	<1200	FF, LM, WD	1
	Tagiades nestus	-	<800	FF, WD	1
	Badamia exclamationis	-	<1000	FF, LM, WD	1
	Choaspes hemixanthus	-	<1200	FF, LM, WD	1
	Choaspes illuensis	-	<1500	FF, LM, MM, WD	1
	Allora doleschalii	-	<1100	FF, LM, WD	1
	Allora major	-	<1200	FF, LM, WD	1
	Hasora discolour	-	<1600	FF, LM, MM, WD	1
	Hasora takwa	-	<1000	FF, LM, WD	1
	Hasora hurama	-	<800	FF, WD	1
	Hasora khoda	-	<1600	FF, LM, MM, WD	1
	Hasora thridas	-	<1500	FF, LM, MM, WD	1
	Felicena dirpha	-	1000-2400	LM, MM, WD	1
	Toxidia inornata	-	<2000	FF, LM, MM, WD	1
	Toxidia arfakensis	-	1800-2500	MM	1
	Rachelia extrusa	-	<800	FF, WD	1
	Prada papua	-	<1200	FF, LM, WD	1
	Erionota thrax	-	<1000	FF, LM, WD	1
	Notocrypta waiguensis	-	<1800	FF, LM, MM, WD	1
	Notocrypta maria	-	500-1800	FF, LM, MM, WD	1
	Notocrypta renardi	-	<1800	FF, LM, MM, WD	1
	Notocrypta flavipes	-	<600	FF, WD	1
	Notocrypta caerulea	-	1200-2200	LM, MM	1
	Pastria albimedia	-	1200-1500	LM, MM	1
	Pastria grinpela	-	1500-2800	MM	1
	Pastria pastria	-	1500-1900	MM	1
	Banta banta	-	1100-2100	LM, MM	1
	Sabera caesina	-	<1000	FF, LM, WD	1
	Sabera fuliginosa	-	700-1800	FF, LM, MM, WD	1
	Sabera misola	-	<1800	FF, LM, MM, WD	1
	Sabera kumpia	-	<1500	FF, LM, MM, WD	1

Family	Scientific Name	IUCN	Elevation (m)	Distribution	Refs
	Sabera biaga	-	<1800	FF, LM, MM, WD	1
	Sabera fusca	-	~1500	MM	1
	Sabera dobboe	-	<1600	FF, LM, MM, WD	1
	Sabera aruana	-	<800	FF, WD	1
	Sabera table	-	<800	FF, WD	1
	Sabera dorena	-	<900	FF, WD	1
	Mimene kolbei	-	<1200	FF, MM, WD	1
	Mimene celiaba	-	<1100	FF, MM	1
	Mimene Caesar	-	<600	FF, WD	1
	Mimene basalis	-	<700	FF, WD	1
	Mimene atropatene	-	<600	FF, WD	1
	Mimene milnea	-	<600	FF, WD	1
	Mimene wandammensis	-	1200-1400	LM, MM	1
	Kobrona wama	-	<1200	FF, MM, WD	1
	Kobrona idea	-	<1200	FF, MM, WD	1
	Kobrona pansa	-	1900-2400	MM	1
	Kobrona Edina	-	1600-3400	MM	1
	Kobrona infralutea	-	<1100	FF, LM, WD	1
	Cephrenes augiades	-	<800	FF, WD	1
	Cephrenes moseleyi	-	<800	FF, WD	1
	Telicota argues	-	<1600	FF, LM, MM, WD	1
	Telicota colon	-	<1600	FF, LM, MM, WD	1
	Telicota augias	-	<600	FF, WD	1
	Telicota angiana	-	700-2000	FF, LM, MM	1
	Telicota aroa	-	1000-1600	LM, MM	1
	Telicota melanion	-	<800	FF, WD	1
	Telicota ohara	-	<800	FF, WD	1
	Telicota ixion	-	<1500	FF, LM, MM, WD	1
	Telicota sadra	-	<1500	FF, LM, MM, WD	1
	Telicota paceka	-	<1600	FF, LM, MM, WD	1
	Telicota subha	-	<1600	FF, LM, MM, WD	1
	Telicota kaimana	-	<1600	FF, LM, MM, WD	1
	Telicota vinta	-	<1600	FF, LM, MM, WD	1
	Telicota eurotas	-	<700	FF, WD	1
	Arrhenes marnas	-	<2500	FF, LM, MM, WD	1
	Arrhenes dschilus	-	<1600	FF, LM, MM, WD	1
	Arrhenes Elena	-	<1300	FF, LM	1
	Arrhenes germane	-	1000-2400	LM, MM, WD	1
	Arrhenes tranquil	-	<800	FF, LM	1
	Arrhenes Martha	-	<1500	LM, MM	1
	Suniana sunias	-	<2600	FF, LM, MM, WD	1
	Ocybadistes flavovittatus	-	<600	FF, WD	1
	Ocybadistes walker	-	<1300	FF, LM, WD	1
	Ocybadistes ardea	-	<1000	FF, LM, WD	1
	Ocybadistes papua	-	<1200	FF, LM, WD	1
	Taractrocera ilia	-	<1500	FF, LM, WD	1
	Borbo impar	-	<1200	FF, LM, WD	1
	Borbo cinnara	-	<800	FF, WD	1
	Pelopidas agna	-	<1600	FF, LM, WD	1
	Pelopidas lyelli	-	<800	FF, WD	1
	Caltoris philippina	-	<800	FF, WD	1
	Caltoris boisduvali	-	<600	FF, WD	1

Family	Scientific Name	IUCN	Elevation (m)	Distribution	Refs
Papilionidae	*Atrophaneura polydorus*	-	<1000	FF, LM, WD	1
	Troides oblongomaculatus	-	<800	FF, WD	1
	Ornithoptera priamus	-	<1600	FF, LM, MM, WD	1
	Ornithoptera goliath	LC, P	<2200	FF, LM, MM, WD	1, 4
	Ornithoptera chimaera	LC, P	1200-2000	LM, MM, WD	1, 4
	Ornithoptera meridionalis	EN, P	<770	FF	1
	Graphium agamemnon	-	<2000	FF, LM, MM, WD	1
	Graphium macfarlanei	-	<1200	FF, LM, WD	1
	Graphium wallacei	-	<1200	FF, LM, WD	1
	Graphium weiskei	-	250-3400	FF, LM, MM, WD	1
	Graphium codrus	-	<2000	FF, LM, MM, WD	1
	Graphium sarpedon	-	<1500	FF, LM, MM, WD	1
	Graphium euryplus	-	<1200	FF, LM, WD	1
	Graphium aristeus	LC	<800	FF, WD	1, 4
	Graphium thule	-	<1200	FF, LM, WD	1
	Papilio laglazei	-	200-1200	FF, LM, WD	1
	Papilio demoleus	-	<600	FF, WD	1
	Papilio aegeus	-	<1600	FF, LM, MM, WD	1
	Papilio ambrax	-	<1200	FF, LM, WD	1
	Papilio fuscus	-	<1000	FF, LM, WD	1
	Papilio Ulysses	LC	<1600	FF, LM, MM, WD	1, 4
	Papilio euchenor	-	<1600	FF, LM, MM, WD	1
Pieridae	*Catopsilia Pomona*	-	<1200	FF, LM, WD	1
	Eurema hecabe	-	<2000	FF, LM, MM, WD	1
	Eurema blanda	-	<1600	FF, LM, MM, WD	1
	Eurema puella	-	<1500	FF, LM, MM, WD	1
	Gandaca butryosa	-	<900	FF, WD	1
	Leuciacria acuta	-	1200-2000	LM, MM, WD	1
	Elodina hypatia	-	<1200	FF, LM, WD	1
	Saletara cycinna	-	<850	FF, WD	1
	Appias paulina	-	<1000	FF, LM, WD	1
	Appias albino	-	<900	FF, WD	1
	Appias celestina	-	<700	FF, WD	1
	Appias ada	-	<700	FF, WD	1
	Cepora perimale	-	<1200	FF, LM, WD	1
	Cepora abnormis	-	<800	FF, WD	1
	Delias aruna	-	<2300	FF, LM, MM, WD	1
	Delias doyley	-	1500-1600	MM	1
	Delias mysis	-	<1800	FF, LM, MM, WD	1
	Delias lara	-	<1200	FF, LM, WD	1, 6
	Delias gabia	-	<1400	FF, LM, MM, WD	1
	Delias mavroneria	LC	700-1600	FF, LM, MM, WD	1, 5
	Delias dice	-	300-1000	FF, LM, WD	1
	Delias ennia	-	<1500	FF, LM, MM, WD	1
	Delias enniana	LC	500-1200	FF, LM, WD	1, 5
	Delias sagessa	-	1400-2000	MM	1
	Delias geraldina	-	200-1800	FF, LM, MM, WD	1
	Delias aroae	-	1200-2600	LM, MM	1
	Delias subapicalis	-	1500-3700	MM	1
	Delias inopinata	-	2000	MM	1, 3
	Delias binniensis	-	2200	MM	1, 3
	Delias endela	-	1500-2600	MM	1

Family	Scientific Name	IUCN	Elevation (m)	Distribution	Refs
	Delias flavissima	-	2000-3000	MM	1
	Delias cunningputi	-	1500-2600	MM	1
	Delias cyclosticha	-	1200-1600	LM, MM	1
	Delias microsticha	-	1500-2000	MM, WD	1
	Delias carstensziana	-	2130-4100	MM	1
	Delias eichhorni	-	1600-3600	MM	1
	Delias hagenensis	-	2000-3000	MM	1
	Delias isocharis	-	1200-2700	LM, MM, WD	1
	Delias kummeri	-	1200-1800	LM, MM, WD	1
	Delias ligata	-	1200-1800	LM, MM, WD	1
	Delias akrikensis	-	2200	MM	1, 3
	Delias iltis	-	1400-2750	MM, WD	1
	Delias luctuosa	LC	1400-3000	MM, WD	1, 4
	Delias hapalina	-	1500-2400	MM, WD	1
	Delias weiskei	-	1400-2400	MM, WD	1
	Delias leucias	-	1400-3500	MM, WD	1
	Delias nieuwenhuisi	-	1700-1900	MM	1
	Delias campbelli	-	800-1600	FF, LM, MM, WD	1
	Delias niepelti	-	1500-2500	MM, WD	1
	Delias ladas	-	400-1800	FF, LM, MM, WD	1
	Delias eudiabolus	-	500-1000	FF, LM	1
	Delias ornytion	-	<1500	FF, LM, WD	1
	Delias roepkei	-	1800-2400	MM	1
	Delias clathrata	-	1800-2400	MM	1
	Delias felis	-	2200	MM	1, 3
	Delias discus	-	<1600	FF, LM, MM, WD	1
	Delias callima	-	1600-2400	MM	1
	Delias bornemanni	-	1500-2200	MM	1
	Delias nais	-	1000-2000	LM, MM, WD	1
	Delias hypomelas	LC	1200-1800	LM, MM, WD	1, 5
Lycaenidae	*Dicallaneura amabilis*	-	800-2100	FF, LM, MM, WD	1
	Dicallaneura decorata	-	<1600	FF, LM, MM, WD	1
	Dicallaneura kirsch	-	<1600	FF, LM, MM, WD	1
	Dicallaneura exiguus	-	~1400m	FF, LM, MM	1
	Dicallaneura ribbei	-	<500	FF, WD	1
	Dicallaneura hyacinthus	-	<1500	FF, LM, MM, WD	1
	Dicallaneura pulchra	-	<1100	FF, LM, WD	1
	Dicallaneura leucomelas	-	1200-2000	LM, MM	1
	Dicallaneura ekeikei	-	<500	FF	1
	Praetaxila poultoni	-	<600	FF	1
	Praetaxila huntei	-	<1600	FF, LM, MM, WD	1
	Praetaxila albiplaga	-	<1400	FF, LM, MM	1
	Praetaxila satraps	-	<1600	FF, LM, MM, WD	1
	Praetaxila segecia	-	<800	FF, WD	1
	Praetaxila heterisa	-	~2000	MM	1
	Praetaxila statira	-	<1000	FF, LM, WD	1
	Curetis barsine	-	<800	FF, WD	1
	Liphyra brassolis	-	<700	FF, WD	1
	Liphyra grandis	-	<800	FF, WD	1
	Logania hampsoni	-	<1100	FF, LM, WD	1
	Spalgis asmus	-	1000-1600	LM, MM, WD	1
	Pseudodipsas eone	-	<600	FF, WD	1

Family	Scientific Name	IUCN	Elevation (m)	Distribution	Refs
	Hypochrysops apollo	-	<1500	FF, LM, MM, WD	1
	Hypochrysops chrysargyrus	LC	<800	FF, WD	1, 5
	Hypochrysops arronica	-	<1600	FF, LM, MM, WD	1
	Hypochrysops luteus	-	~1400	MM	1
	Hypochrysops plotinus	LC	<1600	FF, LM, MM, WD	1, 5
	Hypochrysops narcissus	-	<1600	FF, LM, MM, WD	1
	Hypochrysops castaneus	-	<800	FF	1
	Hypochrysops cleon	-	<1300	FF, LM, WD	1
	Hypochrysops aristobul	-	<1500	FF, LM, MM	1
	Hypochrysops apelles	-	<1200	FF, LM, MM, WD	1
	Hypochrysops dicomas	-	<1500	FF, LM, MM, WD	1
	Hypochrysops meeki	-	1300-1900	MM, WD	1
	Hypochrysops geminatus	-	900-1800	FF, LM, MM, WD	1
	Hypochrysops pythias	-	<1100	FF, LM, WD	1
	Hypochrysops polycletus	-	<1600	FF, LM, MM, WD	1
	Hypochrysops antiphon	-	<2000	FF, LM, MM	1
	Hypochrysops heros	-	<1400	FF, LM, MM, WD	1
	Hypochrysops theon	-	<1400	FF, LM, MM, WD	1
	Hypochrysops dinawa	-	<1000	FF, LM	1
	Philiris Diana	-	<1600	FF, LM, MM, WD	1
	Philiris gloriosa	-	800-2000	FF, LM	1
	Philiris montigena	-	1500-2600	MM	1
	Philiris violetta	-	<1600	FF, LM, MM, WD	1
	Philiris harterti	-	<1400	FF, LM, MM, WD	1
	Philiris hemileuca	-	1200-2600	LM, MM	1
	Philiris vicina	-	<1500	FF, LM, MM, WD	1
	Philiris marginata	-	<1650	FF, LM, MM, WD	1
	Philiris fulgens	-	<1600	FF, LM, MM, WD	1
	Philiris misimensis	-	1500-1800	MM	1
	Philiris Helena	-	<1200	FF, LM, WD	1
	Philiris Agatha	-	<1800	FF, LM, MM, WD	1
	Philiris philotoides	-	1000-1600	LM, MM, WD	1
	Philiris argentea	-	400-1600	FF, LM, MM,	1
	Philiris ziska	-	<1500	FF, LM, MM, WD	1
	Philiris ignobilis	-	<1200	FF, LM, WD	1
	Philiris mayri	-	<1800	FF, LM, MM	1
	Philiris putih	-	<1500	FF, LM, MM	1
	Philiris doreia	-	<700	FF	1
	Philiris intense	-	<1200	FF, LM, WD	1
	Philiris dinawa	-	<1600	FF, LM, MM	1
	Philiris innotata	-	<1600	FF, LM, MM	1
	Philiris moira	-	<1400	FF, LM, MM, WD	1
	Philiris unipunctata	-	<1600	FF, LM, MM	1
	Philiris angabunga	-	1100-1800	LM, MM	1
	Philiris maculate	-	1400-1800	LM, MM	1
	Titea caerulea	LC	600-1200	FF, LM, WD	1, 5
	Titea sublutea	-	1500-3000	MM, WD	1
	Arhopala leo	-	<600	FF, WD	1
	Arhopala nobilis	-	<800	FF, WD	1
	Arhopala wildei	-	<900	FF, WD	1
	Arhopala chamealeona	LC	<1200	FF, LM, WD	1, 5
	Arhopala adherbal	-	<800	FF, WD	1

Family	Scientific Name	IUCN	Elevation (m)	Distribution	Refs
	Arhopala madytus	-	<1200	FF, LM, WD	1
	Arhopala meander	-	<600	FF, WD	1
	Arhopala philander	-	<800	FF, WD	1
	Arhopala leander	-	<1200	FF, LM, WD	1
	Arhopala ander	-	<600	FF, WD	1
	Arhopala micale	-	<600	FF, WD	1
	Arhopala aexone	-	<1000	FF, LM, WD	1
	Arhopala azenia	-	<800	FF, WD	1
	Arhopala admete	-	<600	FF, WD	1
	Arhopala thamyras	-	<1300	FF, LM, WD	1
	Arhopala helianthes	-	<600	FF	1
	Arhopala arta	-	<1600	FF, LM, MM	1
	Arhopala axina	-	<800	FF	1
	Arhopala axiothea	-	<600	FF	1
	Amblypodia annetta	-	<1000	FF, LM, WD	1
	Hypochlorosis antipha	-	<1200	FF, LM, WD	1
	Horaga syrinx	-	<600	FF, WD	1
	Hypolycaena phorbas	-	<1400	FF, LM, MM, WD	1
	Hypolycaena danis	-	<1600	FF, LM, MM, WD	1
	Deudorix diovis	-	<650	FF, WD	1
	Deudorix epijarbus	-	<650	FF, WD	1
	Deudorix littoralis	-	<2100	FF, LM, MM, WD	1
	Deudorix parsonsi	-	<1000	FF, LM, WD	1
	Deudorix Epirus	-	<1400	FF, LM, MM, WD	1
	Deudorix democles	-	<600	FF, WD	1
	Rapala varuna	-	<1800	FF, LM, MM, WD	1
	Bindahara meeki	-	<1900	FF, LM, MM, WD	1
	Bindahara phocides	-	<1400	FF, LM, MM, WD	1
	Anthene lycaenoides	-	<1500	FF, LM, MM, WD	1
	Anthene seltuttus	LC	<700	FF, WD	1, 5
	Candalides helenita	-	<1200	FF, LM, WD	1
	Candalides cupreus	-	<1600	FF, LM, MM, WD	1
	Candalides ardosiacea	-	<1200	FF, LM, WD	1
	Candalides pruina	-	1200-1800	LM, MM	1
	Candalides neurapacuna	-	1000-2100	LM, MM	1
	Candalides grandissima	-	800-2000	FF, LM, MM	1
	Petrelaea tombugiensis	-	<1100	FF, LM, WD	1
	Nacaduba subperusia	-	<650	FF, WD	1
	Nacaduba hermus	-	1200-1400	LM, MM, WD	1
	Nacaduba pactolus	-	<800	FF, WD	1
	Nacaduba berenice	-	<1600	FF, LM, MM, WD	1
	Nacaduba kurava	-	<1600	FF, LM, MM, WD	1
	Nacaduba cyanea	-	<1400	FF, LM, MM, WD	1
	Nacaduba major	-	600-1300	FF, LM, WD	1
	Nacaduba ruficirca	-	800-1600	FF, LM, MM, WD	1
	Nacaduba tristis	LC	<1200	FF, LM, WD	1, 4
	Erysichton lineate	-	<1600	FF, LM, MM, WD	1
	Erysichton Palmyra	-	<1600	FF, LM, MM, WD	1
	Danis danis	-	<1000	FF, LM, WD	1
	Danis phroso	-	<800	FF, WD	1
	Psychonotis caelius	-	<1600	FF, LM, MM, WD	1
	Psychonotis hebes	-	<1800	FF, LM, MM, WD	1

Family	Scientific Name	IUCN	Elevation (m)	Distribution	Refs
	Prosotas nora	-	<800	FF, WD	1
	Prosotas atra	-	<800	FF, WD	1
	Prosotas papuana	-	600-2000	FF, LM, MM, WD	1
	Prosotas gracilis	-	<800	FF, WD	1
	Prosotas dubiosa	-	<800	FF, WD	1
	Nothodanis schaeffera	-	<800	FF, WD	1
	Catopyrops Ancyra	LC	<1600	FF, LM, MM, WD	1, 5
	Ionolyce helicon	LC	<2400	FF, LM, MM, WD	1, 5
	Paraduba metriodes	-	<1400	FF, LM, MM, WD	1
	Paraduba owgarra	-	1200-1800	LM, MM, WD	1
	Theclinesthes miskini	-	<700	FF, WD	1
	Sahulana scintillate	-	<1400	FF, LM, MM, WD	1
	Thaumaina uranothauma	-	1500-2000	MM	1
	Upolampes evena	-	<1600	FF, LM, MM, WD	1
	Caleta mindarus	-	<800	FF, WD	1
	Pistoria nigropunctata	-	1400-1800	MM, WD	1
	Discolampa albula	-	200-2100	FF, LM, MM, WD	1
	Jamides soemias	-	<1500	FF, LM, MM, WD	1
	Jamides amarauge	-	<1600	FF, LM, MM, WD	1
	Jamides nitens	-	1200-1800	LM, MM	1
	Jamides cyta	-	<700	FF, WD	1
	Jamides celeno	-	<1000	FF, WD	1
	Jamides aetherialis	-	<1000	FF, LM, WD	1
	Jamides allectus	-	<1000	FF, LM, WD	1
	Jamides reverdini	-	<800	FF, WD	1
	Jamides aruensis	-	<1300	FF, LM, WD	1
	Jamides coritus	-	<1000	FF, LM, WD	1
	Epimastidia inops	-	<2000	FF, LM, MM, WD	1
	Catochrysops amasea	-	<1000	FF, LM, WD	1
	Catochrysops panormus	-	<1200	FF, LM, WD	1
	Callictita lara	-	1200-2200	LM, MM	1
	Callictita cyara	-	1200-2700	LM, MM	1
	Callictita tifala	-	1350-1750	LM, MM	1
	Pithecops dionisius	-	<1800	FF, LM, MM, WD	1
	Zizina labradus	-	<2600	FF, LM, MM, WD	1
	Zizula hylax	-	<1600	FF, LM, MM, WD	1
	Everes lacturnus	-	<1700	FF, LM, MM, WD	1
	Megisba strongyle	-	<800	FF, WD	1
	Celastrina philippina	-	<1500	FF, LM, MM, WD	1
	Udara dilecta	-	300-2200	FF, LM, MM, WD	1
	Udara rona	-	600-1800	FF, LM, MM, WD	1
	Udara cardia	-	<1200	FF, LM, WD	1
	Udara drucei	-	1200-2400	LM, MM, WD	1
	Udara owgarra	LC	1200-1800	LM, MM	1, 4
	Udara meeki	-	1200-2100	LM, MM	1
	Udara manokwariensis	-	1200-3000	LM, MM	1
	Udara sibatanii	-	1200-2800	LM, MM	1
	Udara davenporti	-	~1800	MM	1
	Udara Antonia	-	~1500-3000	MM	1
	Parelodina aroa	-	900-3000	LM, MM, WD	1
	Monodontoides argioloides	-	600-2400	FF, LM, MM, WD	1
	Euchrysops cnejus	-	<1600	FF, LM, MM, WD	1

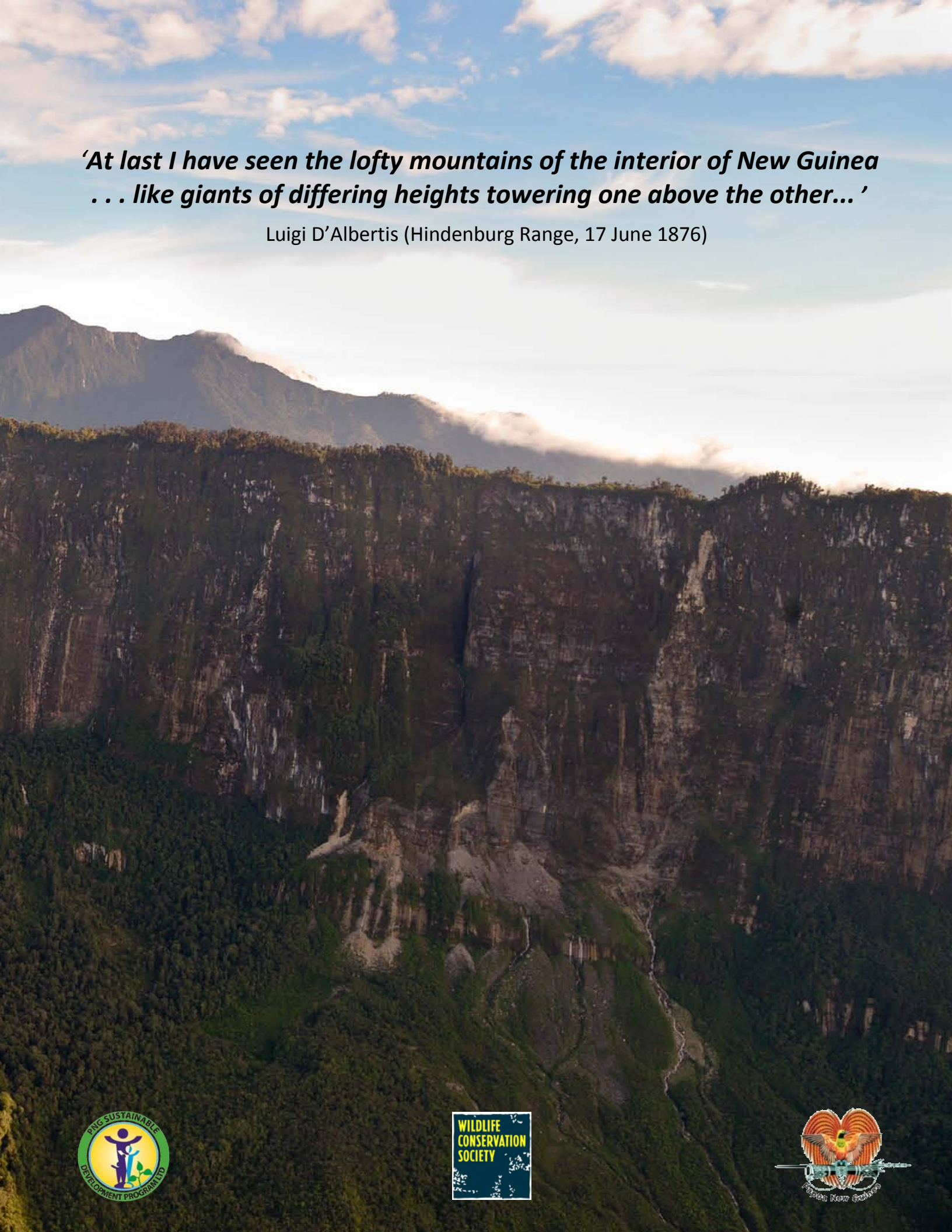
Family	Scientific Name	IUCN	Elevation (m)	Distribution	Refs
	Luthrodes cleotas	-	<800	FF, WD	1
Nymphalidae	*Libythea geoffroy*	-	<1500	FF, LM, MM, WD	1
	Tellervo nedusia	-	<1000	FF, LM, WD	1
	Tellervo zoilus	-	<2000	FF, LM, MM, WD	1
	Parantica weiskei	-	1500-2500	MM, WD	1
	Parantica schenkii	-	<1500	FF, LM, MM, WD	1
	Parantica melusine	-	<2200	FF, LM, MM, WD	1
	Ideopsis juventa	-	<850	FF, WD	1
	Tirumala hamata	-	<1700	FF, LM, MM, WD	1
	Danaus affinis	LC	<1500	FF, LM, MM, WD	1, 5
	Danaus chrysippus	-	<2000	FF, LM, MM, WD	1
	Danaus plexippus	-	<1500	FF, LM, MM, WD	1
	Euploea sylvester	LC	<2000	FF, LM, MM, WD	1, 4
	Euploea phanareta	-	<1200	FF, LM, WD	1
	Euploea leucostictos	-	<1000	FF, LM, WD	1
	Euploea tulliolus	-	<1200	FF, LM, WD	1
	Euploea stephensii	-	<1200	FF, LM, WD	1
	Euploea algae	LC	<1400	FF, LM, WD	1, 5
	Euploea netscheri	-	<800	FF, WD	1
	Euploea alcathoe	-	<1000	FF, LM, WD	1
	Euploea wallacei	-	<1700	FF, LM, MM, WD	1
	Euploea batesii	-	<1200	FF, LM, WD	1
	Protoploea apatela	-	<1500	FF, LM, MM	1
	Morphopsis albertisi	-	<2200	FF, LM, MM, WD	1
	Hyantis hodeva	LC	<1400	FF, LM, MM, WD	1, 4
	Taenaris catops	-	<1500	FF, LM, MM, WD	1
	Taenaris bioculatus	-	<1200	FF, LM, WD	1
	Taenaris honrathi	-	<1200	FF, LM, WD	1
	Taenaris dioptrica	-	<900	FF, WD	1
	Taenaris myops	-	<1300	FF, LM, WD	1
	Taenaris Cyclops	-	<800	FF, WD	1
	Taenaris schoenbergi	-	320-2500	FF, LM, MM, WD	1
	Taenaris dimona	-	<1200	FF, LM, WD	1
	Taenaris artemis	-	<800	FF, WD	1
	Mycalesis perseus	-	<1500	FF, LM, MM, WD	1
	Mycalesis duponchelii	-	<1200	FF, LM, WD	1
	Mycalesis mucia	LC	<800	FF, WD	1, 5
	Mycalesis discobolus	-	800-2500	FF, LM, MM, WD	1
	Mycalesis phidon	-	<1700	FF, LM, MM, WD	1
	Mycalesis terminus	-	<1600	FF, LM, MM, WD	1
	Mycalesis elia	-	<1800	FF, LM, MM, WD	1
	Mycalesis barbara	-	300-2000	FF, LM, MM, WD	1
	Mycalesis pernotata	-	<800	FF, WD	1
	Mycalesis cacodaemon	-	<1600	FF, LM, MM, WD	1
	Mycalesis bilineata	-	<1600	FF, LM, MM, WD	1
	Mycalesis fulvianetta	-	<1650	FF, LM, MM	1
	Mycalesis aethiops	-	<1800	FF, LM, MM, WD	1
	Mycalesis durga	-	<1000	FF, LM, WD	1
	Orsotriaena medus	-	<1200	FF, LM, WD	1
	Lamprolensis nitida	-	<1500	FF, LM, MM, WD	1
	Hypocysta isis	-	<1200	FF, LM, WD	1
	Harsiesis hygea	-	<1200	FF, LM, WD	1

Family	Scientific Name	IUCN	Elevation (m)	Distribution	Refs
	Altiapa decolour	-	1500-2700	MM, WD	1
	Altiapa klossi	-	2000-2600	MM	1
	Platypthima dispar	-	1250-2000	LM, MM	1
	Platypthima ornate	-	1500-2400	MM	1
	Platypthima septentrionalis	-	1500-1600	MM	1
	Platypthima homochroa	-	1200-2500	LM, MM	1
	Erycinidia virgo	LC	1400-2400	MM, WD	1, 4
	Erycinidia gracilis	-	1500-2400	MM, WD	1
	Ypthima arctoa	-	<1600	FF, LM, MM, WD	1
	Melanitis leda	-	<1500	FF, LM, MM, WD	1
	Melanitis amabilis	-	<1500	FF, LM, MM, WD	1
	Melanitis constantia	-	<1200	FF, LM, WD	1
	Elymnias agendas	-	<1200	FF, LM, WD	1
	Charaxes latona	LC	<1200	FF, LM, WD	1, 5
	Charaxes Jupiter	-	<1900	FF, LM, MM, WD	1
	Prothoe australis	-	<1200	FF, LM, WD	1
	Apaturina ermine	-	<1000	FF, LM, WD	1
	Helcyra chionippe	-	<1200	FF, LM, WD	1
	Dichorragia ninus	-	<1500	FF, LM, MM, WD	1
	Cyrestis acilia	-	<2000	FF, LM, MM, WD	1
	Cyrestis achates	-	<1200	FF, LM, WD	1
	Lexias aeropa	-	<1500	FF, LM, MM, WD	1
	Euthaliopsis aetion	LC	<1200	FF, LM, WD	1, 4
	Parthenos aspila	LC	<800	FF, WD	1, 4
	Pantoporia consimilis	LC	<1200	FF, LM, WD	1, 5
	Pantoporia venilia	-	<1600	FF, LM, MM, WD	1
	Neptis praslini	-	<1200	FF, LM, WD	1
	Neptis nausicaa	-	<1200	FF, LM, WD	1
	Neptis brebissonii	-	<1200	FF, LM, WD	1
	Phaedyma shepperdi	LC	<1200	FF, LM, WD	1, 5
	Mynes geoffroyi	-	<1200	FF, LM, WD	1
	Mynes websteri	-	300-2000	FF, LM, MM, WD	1
	Mynes aroensis	-	1200-2400	LM, MM, WD	1
	Symbrenthia hippoclus	-	<1500	FF, LM, MM, WD	1
	Doleschallia noorna	-	<800	FF, WD	1
	Doleschallia hexopthalmus	-	<1200	FF, LM, WD	1
	Doleschallia dascon	-	<1700	FF, LM, MM, WD	1
	Doleschallia nacar	-	<1200	FF, LM, WD	1
	Hypolimnas bolina	-	<1500	FF, LM, MM, WD	1
	Hypolimnas misippus	-	<1500	FF, LM, MM, WD	1
	Hypolimnas alimena	LC	<1200	FF, LM, WD	1, 5
	Hypolimnas antilope	-	<800	FF, WD	1
	Hypolimnas deois	LC	<1500	FF, LM, MM, WD	1, 4
	Hypolimnas pithoeka	-	<1000	FF, LM, WD	1
	Yoma algina	LC	<1300	FF, LM, WD	1, 5
	Junonia erigone	-	<1600	FF, LM, MM, WD	1
	Cethosia cydippe	-	<2300	FF, LM, MM, WD	1
	Vindula arsine	-	<1500	FF, LM, MM, WD	1
	Terinos alurgis	-	<800	FF, WD	1
	Cirrochroa regina	LC	<1200	FF, LM, WD	1, 5
	Algia felderi	-	<1000	FF, LM, WD	1
	Vagrans egista	-	<1200	FF, LM, WD	1

Family	Scientific Name	IUCN	Elevation (m)	Distribution	Refs
	Phalanta alcippe	-	<800	FF, WD	1
	Cupha prosope	-	<1200	FF, LM, WD	1
	Argyreus hyperbius	-	1200-3000	LM, MM, WD	1
	Acraea meyeri	-	<2200	FF, LM, MM, WD	1

Note that predictions are made with reference to available literature and personal records/observations of C. Muller IUCN status: CE = Critically Endangered, EN = Endangered, VU = Vulnerable, DD = Data Deficient, LC = Least Concern, NT = Near Threatened, NE = Not Evaluated but in IUCN database, - = no record in IUCN database at present. Distribution: FF = Foothill Forest, LM = Lower Montane, LA = Low-Altitude Mid-Montane , MM = Mid-Montane, WD = Geographically Widespread, SF = Secondary Forest with montane zone. References: 1 = Parsons 1998, 2 = Lachlan 1999a, 3 = Lachlan, 2000, 4 = Muller & Tennent (in press), 5 = Tennent & Muller (in press), 6 = Davenport & van Mastrigt, 2008

An unidentified butterfly found in the vicinity of the Hindenburg Wall. (© Stephen Richards)



'At last I have seen the lofty mountains of the interior of New Guinea . . . like giants of differing heights towering one above the other... '

Luigi D'Albertis (Hindenburg Range, 17 June 1876)