Executive Summary

Source: A Rapid Biodiversity Assessment of the Kaijende Highlands, Enga Province, Papua New Guinea: 11

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INTRODUCTION

Papua New Guinea (PNG) is an independent state occupying the eastern half of New Guinea, the world's largest and highest tropical island. In recognition of its extensive remaining forest cover, spectacular biological diversity and low human population density, New Guinea has been recognised as one of the world's five High Biodiversity Wilderness Areas (Mittermeier et al. 2003). In addition to extensive low- and mid-elevation tropical forests, New Guinea has extensive high-montane environments, particularly along the central mountainous spine of the island. This central cordillera, formed by uplift resulting from the collision of the Australian Plate with the Pacific Plate, presents dramatic gradients of topography, elevation, temperature and rainfall that have promoted rapid evolution of an exceptionally diverse biota. Although the montane birds and flora of New Guinea have been moderately well documented (e.g. Royen 1982, Beehler et al. 1986), documentation of most biota at high elevations has been sporadic at best and major gaps in survey effort continue to hinder meaningful discussions about conservation priorities for, and biogeographic relationships among, the New Guinean biota.

With an area of 12,800 km^2 Enga Province in Papua New Guinea's central highlands region includes a higher proportion of upper montane (>3,000 m) environments than any other province in Papua New Guinea (Löffler 1977). It is also the site of the Porgera Mine, a major open-pit gold mining operation that accounts for 14% of the country's export earnings, making it the world's eighth largest gold producer in terms of 2005 output. Remarkably, despite the substantial infrastructure established by this mining operation, Enga Province appears to have the lowest biological survey effort of any province in the country. Prior to this RAP survey only a handful of collections had been made in the province. The proximity of Porgera Mine to the vast Kaijende Highlands provided the opportunity to redress this paucity of biological information through a RAP biodiversity survey designed and conducted by Conservation International and the PNG Department of Environment and Conservation, and sponsored by the Porgera Joint Venture mining operation.

Scope of Project

The RAP biodiversity survey reported here was undertaken as part of a long-term commitment by Conservation International (CI) to assist with the establishment of a Conservation Area covering the Kaijende Highlands of Enga Province. Discussions between CI, the PNG Department of Environment and Conservation (DEC) and the Porgera Joint Venture partners (PJV) resulted in a consensus that CI would play a lead role in developing the project. To this end CI has established an office at Porgera with funding support from PJV. Locally-based CI staff are working with local landowners and local NGOs to establish the area (see Map) as a Conservation Area under the Conservation Area Act with assistance from the DEC.

The Mt. Kaijende Conservation Area will have a management plan and a development plan, rules, a management committee, and the steps towards establishment will allow for participation by the general public and by landowners. Follow-up awareness activities during 2007 have generated substantial support from local landowners, the PNG Mining Department and other stakeholders.

The RAP results reported here are the result of a successful partnership between CI, DEC, PJV and a number of local communities. We hope that the information gathered during this survey will play a useful role in informing the development of sustainable management strategies for this spectacular region.

RAP SURVEY OVERVIEW AND OBJECTIVES

Conservation International's Rapid Assessment Program (RAP) is an innovative biological inventory program designed to use scientific information to catalyze conservation action. RAP methods are designed to rapidly assess the biodiversity of highly diverse areas and to train local scientists in biodiversity survey techniques. Since 1990, RAP's teams of expert and host-country scientists have conducted 60 terrestrial, freshwater aquatic (AquaRAP), and marine biodiversity surveys and have contributed to building local scientific capacity for scientists in 26 countries. Biological information from previous RAP surveys has resulted in the protection of millions of hectares of tropical forest, including the declaration of protected areas in Bolivia, Peru, Ecuador, and Brazil and the identification of biodiversity priorities in numerous countries.

The primary objective of this RAP survey was to document the plant, herpetofauna, bird and mammal diversity of the Kaijende Highlands, a vast region of near-uninhabited montane forest and grasslands in Enga Province. The information we gathered will be used to make recommendations about the conservation significance of, and management options for, the remarkable biodiversity of this area. Survey sites were selected to include the major habitat types contained within the proposed Mt. Kaijende Conservation Area.

The specific aims of this RAP survey were to:

- Produce an overview of the diversity and conservation significance of selected plant and animal taxa at elevations between 2,000 and 3,300 m.
- Evaluate threats to biodiversity of the region, and recommend management strategies for their mitigation that are relevant to local communities, government agencies, and the nearby Porgera Mine.
- Provide on-site training in biodiversity inventory techniques for staff from DEC.
- Make RAP data available for decision-makers at all levels of Government, and to local communities, NGOs and the general public, with a view to promoting the establishment of a Conservation Area in the Mt. Kaijende Highlands.

Study Area

The Kaijende Highlands incorporate an extensive area of montane habitats (>2,000 m elevation) adjacent to the Porgera Mine in Enga Province, Papua New Guinea (see Map). Population density in the proposed Conservation Area is extremely low, but trails linking small villages and others used by hunters criss-cross the area. A well-travelled trail through the high-montane grasslands of the Kaijende Highlands links Porgera Town with the Mt. Kare goldfields.

As in most areas of Melanesia, land ownership in this region is complex and numerous clans lay claim to parts of the Kaijende Highlands. The area behind Mt. Kumbepara, from Omyaka to the Porgera Reservoir, is owned by the Pulumaini, Angalaini, Tieni and Aipakani clans. The Omyaka camp site was on Pulumaini land. The Lake Tawa area belongs to people from Kole and Kanzawi villages (Paiela) who also own the Mt. Kare area. The Paiela Road area is owned by the Pulumaini, Angalaini, Tieni and Tuanda clans. Land around Suyan is owned by the Aipakani-Kealo/Pepe (Suyan Camp), and the Timain and Paiam clans (areas behind Suyan).

Site Descriptions

The climate of the Kaijende Highlands area, extrapolated from rainfall and temperature data collected at the PJV Environment Department offices on the Porgera Mine site at around 2,200 m, is relatively aseasonal. Mean monthly minimum air temperature recorded daily between 2001 and 2004 varied between just 11.3 and 13.0°C and mean monthly maximum temperature varied between 18.8 and 21.0°C (Figure 1). Precipitation is high, with a long-term (1974 – 2006) mean annual rainfall of 3,679.6 mm (range 2,505.8 – 4,413.0 mm) but rainfall shows a more pronounced seasonal effect than temperature (Figure 2). The mean monthly rainfall calculated for each month over 33 years was 306.6 mm when calculated across all months, but there are distinctly wetter and drier 'seasons' with a maximum mean monthly rainfall of 370 mm in March and a minimum of 246.6 mm in July. Figure 2 shows long-term (1974 – 2006) mean monthly rainfall and the 2005 total rainfall for Porgera Mine to illustrate the period leading up to and including this RAP survey. The RAP survey was conducted during a year when rainfall in September was much higher than the long-term mean. However maximum and minimum monthly rainfall totals at Porgera over the same period do not follow the trend shown by the monthly means illustrated in Figure 2; they show that most months can be extremely wet (> 450 mm) or extremely dry (<150 mm) in any given year.

Although the Porgera climate data probably broadly reflect conditions at the lower elevations throughout the Kaijende Highlands, including Lake Tawa, it should be noted that climate in the area varies dramatically with topography and altitude. The highest elevations of the Kaijende Highlands experience climatic conditions that are much more extreme than those reported for Porgera, and air temperatures recorded in the upper-montane grasslands around Omyaka and Waile Creek during this survey regularly dropped to 5°C. Unfortunately, comprehensive rainfall and temperature data for these high-montane sites are unavailable.

The survey was conducted around four major 'sites' at elevations between 2,000 m and 3,400 m. These localities provided access to a range of habitats including montane grasslands, upper montane forests, mid-montane forest, and disturbed mid-montane forest regrowth and gardens. Geologically, this highland area is on the New Guinea Fold Belt (Hill and Hall 2003), and lies to the south of the complex system of geological terranes that have accreted to northern New Guinea (Pigram and Davies 1987). The survey schedule and location of major sites are presented in Table 1. The major vegetation formations of the study area are described in detail in Chapter 1 and a gazetteer for, and brief descriptions of vegetation at, each major site and each 'sub-site' are presented in Appendix 1. The general topography of Lake Tawa, and the location of significant collection sites and habitats around this valley are illustrated in Figure 3.

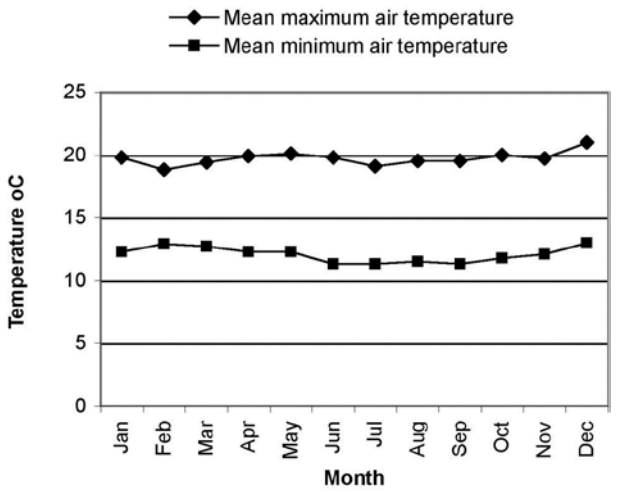

Figure 1. Mean monthly minimum and maximum air temperature recorded daily between 2001 and 2004 at the Porgera Mine.

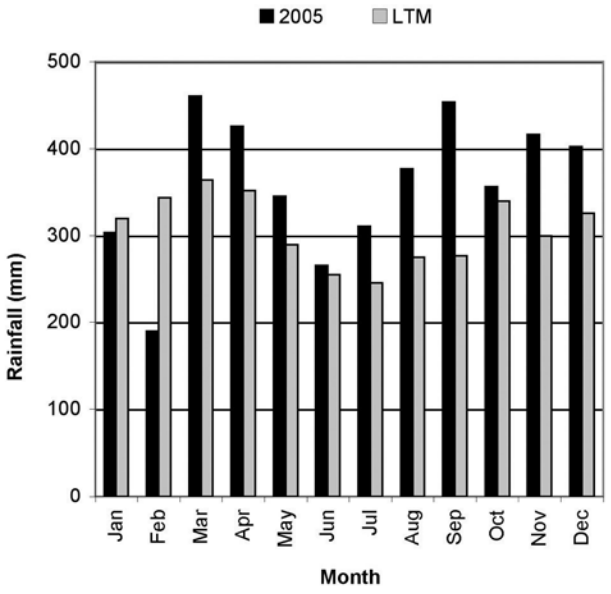

Figure 2. Long-term (1974–2006) mean monthly rainfall and total monthly rainfall for 2005 at the Porgera Mine. The RAP survey was conducted between 19 August and 9 September 2005.

SUMMARY OF RAP RESULTS BY TAXONOMIC GROUP

Vegetation

The flora of the Kaijende Highlands occurs in three principal vegetation formations: 1) lower montane forest, 2) upper montane forest, and 3) subalpine grassland. A total of 492 tracheophytic plant species were documented during this survey including 112 ferns and lycophytes, 6 gymnosperms, 69 monocots, and 305 dicots from a total of 262 genera. At least 16 plants are determined as species new to science, including five arborescent taxa, five understory shrubs, two vines, two orchids, and two ferns.

Herpetofauna

Seventeen frog and two reptile species were documented from montane forests and montane grassland habitats in the Kaijende Highlands. At least eight of the frog species are undescribed and one of these probably warrants recognition as a new genus. This survey documented the second known population of *Callulops glandulosus*, and a very large species of *Albericus* found at Lake Tawa may represent only the second known population of *A. fafniri*. Both of these species were considered Data Deficient by the Global Amphibian Assessment. One other frog, *Litoria becki*, found only in high-montane grassland habitats, was considered Vulnerable in the recent Global Amphibian Assessment. Although the reptile fauna was depauperate, this reflects the high-elevation focus of our survey and the low diversity is probably typical of sites at similar elevations elsewhere in New Guinea. One of the two species documented, a skink of the genus *Sphenomorphus*, may represent an undescribed taxon.

Birds

Nineteen days of surveys, including a series of 'walking censuses' undertaken at key sites, detected 102 species of birds. The Long-bearded Melidectes (*Melidectes princeps*) was recorded for the first time west of the Mount Hagen massif. The Ribbon-tailed Astrapia (*Astrapia mayeri*), a spectacular long-tailed species with a severely circumscribed distribution centered on our study area, was common from 2,117 m at Lake Tawa to 3,200 m at Omyaka Camp. Although the Crested Bird of Paradise (*Cnemophilus macgregorii*) was not encountered on this survey, one local informant at Omyaka Camp stated that it was present and the species was apparently collected in a DEC field survey (Kula 1989). It appears that there is a substantial geographic break in this species' range between the Hagen/Giluwe area and the Star Mountains of Papua (Indonesia). This provides an intermedi-

ate-stage example of Diamond's "drop-out" phenomenon (Diamond 1972). The Kaijende Highlands support a rich upland bird fauna that might best be conserved through the creation of a large contiguous community-managed reserve that encompasses uninhabited traditional hunting lands.

Mammals

This survey confirmed the occurrence of one monotreme, 18 marsupials, nine rodents, two bats, and two non-native placental mammals (wild-living dogs and pigs) in the Kaijende Highlands. Previous surveys in this area had recorded just one marsupial species, three rodent species, and one bat species that were not detected in the current survey. Our survey brings the total number of native marsupials, rodents, and bats recorded in the Kaijende Highlands to 35 and in Enga Province to 39. Significant new records for the Kaijende Highlands include the third vouchered locality for Calaby's Pademelon (*Thylogale calabyi*) and the first record of the Giluwe Rat (*Rattus giluwensis*) outside of the immediate vicinity of Mt. Giluwe in Southern Highlands Province.

Table 1. Summary of survey schedule and major site locations of the Kaijende Highlands RAP survey.

Site	Coordinates	Elevation (m)	Dates (2005)	# Days survey effort
Suyan Camp & vicinity	05°29'09" S, 143°08'07" E	2,200	19 August & other brief visits	~ 1
Omyaka Camp	05°31'37" S, 143°03'23" E	3,200	20–25 August	5
Lake Tawa	05°35'43" S, 142°50'26" E	2,117–2,400	26 August–3 September	7
Paiela Rd & Waile Creek	Various (see Appendix 1)	2,800–3,200	4–9 September	6

Figure 3. Aerial view of Lake Tawa showing A) bivouac; B) sinkholes in photo 23; C) limestone outcrops; D) photographic station for photo 24; E) *Pandanus* savanna to the north and northeast of camp (see photo 29, color plates).

Other species of conservation concern that occur in the Kaijende Highlands include the echidna *Zaglossus bartoni* and the tree-kangaroo *Dendrolagus dorianus*.

CONSERVATION RECOMMENDATIONS

Protection of important habitats

The *Cyathea* savanna that dominates the Kaijende upper montane zone at elevations between 3,000 m and at least 3,400 m is unique to the island of New Guinea. These upper montane habitats and vegetation formations are not protected by existing conservation initiatives in Papua New Guinea. Because island endemism is higher in Upper Montane Forest and subalpine environments than in the low elevation habitats typically covered by many conservation areas in Papua New Guinea, protection of the Kaijende Highlands will provide security for a number of endemic taxa presently excluded from conservation consideration. This survey has identified a suite of plants, frogs and mammals that appear to be dependent on these subalpine environments. The high-altitude tree fern savanna, tussock grassland, and adjacent upper montane (elfin) forests also support a poorly known assemblage of mammal species that have become rare or disappeared from many other montane sites in New Guinea.

Another habitat that may require specific targeting for conservation action is limestone outcrops. Three new plant species were associated with karst formations during the 2005 RAP survey and additional surveys are required to determine whether these localized habitats harbor a substantial endemic plant or animal biota.

The Kaijende Highlands not only harbor a large number of poorly known and significant species and habitats, but the landscapes of the region are scenic and visually stunning. The aesthetic beauty of the Kaijende Highlands provides a further compelling argument for protection of these montane habitats. The *Cyathea* grassland panoramas at Omyaka and Waile Creek and the lakeside vistas at Lake Tawa are among the most spectacular ever encountered by the RAP team, and the dramatic limestone pinnacles emerging from dense mid-montane forest near Porgera are breathtaking.

Our results strongly vindicate the current efforts to establish a Wildlife Conservation Area in the Kaijende Highlands. Conservation International, the PNG Department of Environment and Conservation and PJV are working with local communities to develop a sustainable, long-term conservation plan for the proposed Conservation Area. We hope that the results of our survey will be used to promote interest in the Kaijende Highlands among local communities, and among decision makers in Local, Provincial and National Governments. Particular attention should be placed on educating local landowners about the significance of their unique biota on a global scale, about the importance of adopting sustainable hunting practices to ensure the long-term survival of many bird and larger mammal species that are becoming scarce in the mountains of New Guinea, and about the benefits of protecting their montane forests and grasslands from increasingly frequent fires and other destructive human activities. With the interest and support of the local communities, the Kaijende Highlands could become a model protected area in Papua New Guinea.

Species-specific recommendations

Studies are needed to assess in greater detail the distribution, abundance, and threats faced by wallabies, tree-kangaroos, and echidnas in the Kaijende Highlands. These large mammals have disappeared from most areas with high human population density throughout New Guinea. Although *Zaglossus* and at least three different kangaroo species (*Dendrolagus dorianus, Dorcopsulus vanheurni,* and *Thylogale calabyi*) still persist in the vicinity of Porgera, the 2005 RAP team did not encounter living animals of these species. They were documented solely based on information from informants or from trophy jaws. Clearly there is at least some hunting pressure on these animals. Obtaining information about abundance, hunting pressure, and microdistribution of large mammals in the region is a high priority if these species are to be conserved in the long term. These studies will require the assistance and knowledge of local communities, and might prove to be a straightforward and manageable project, perhaps one that can be undertaken by a sponsored student or a PJV Environmental Officer.

Future Research

The cost and logistical challenges of working in New Guinea's remote high-montane environments are a major impediment to research. As a result, most upper montane habitats on the island remain very poorly documented. The success of our Kaijende survey was due in large part to the logistical support provided by the Porgera mine, and also to the infrastructure, including roads, that has been established in the surrounding district. Few areas in Papua New Guinea offer such advantages for an ongoing program of conservation assessments and biological studies.

Long-term monitoring programs

The upper montane habitats of the Kaijende Highlands provide an opportunity to monitor long-term floristic change caused by global warming. Upper Montane Forest is acutely responsive to temperature shifts induced by climatic change, as demonstrated by palynological evidence from Holocene sediments. Baseline studies should be established that not only document subsequent shifts in upper montane forest composition and distribution, but also examine concurrent changes in abundance and assemblage structure of animal taxa associated exclusively or primarily with these habitats. Fauna identified as high priorities for monitoring programs include a new genus and species of frog known only from grasslands at Omyaka, and a number of large mammal species that may already be under threat from over-hunting.

Biodiversity surveys

The results of the short Kaijende Highlands RAP survey were spectacular and it is clear that additional biodiversity surveys

targeting habitats and elevations not covered during the 2005 RAP survey will document numerous additional species in the proposed Mt. Kaijende Conservation Area. Additional surveys will also be critical for assessing the distribution and conservation status of a number of threatened or significant species encountered or otherwise documented during the 2005 RAP survey (e.g. *Thylogale calabyi*, *Zaglossus bartoni* and *Dendrolagus dorianus*, three new species of microhylid frogs, several new plant species). Inasmuch as the flora and vertebrate fauna of the Upper Montane Forests are highly significant from a conservation perspective but relatively depauperate in terms of species richness, a series of targeted surveys could provide the most comprehensive biodiversity assessment of Upper Montane Forest and grasslands for any area in New Guinea to date.

All participants in the Kaijende RAP survey noted that extending biodiversity survey activities to areas below 2,000 m elevation would dramatically increase the variety of biota documented. With support from PJV a trans-watershed biodiversity survey transect extending from the Kaijende Highlands to the lowlands along the Strickland River would be an ambitious project that would put the Kaijende Highlands fauna and flora in a broad biological and biogeographic context. In addition, with community support any future extension of the boundaries of the Conservation Area to accommodate contiguous habitats below 2,000 m elevation would substantially increase the biodiversity values of the Conservation Area.

Ecotourism potential

Tourism is a small but potentially lucrative business for Papua New Guinea. Few areas in the country can boast the combination of spectacular scenery and established infrastructure of the Kaijende Highlands region. Properly marketed, the Kaijende Highlands could attract visitors from elsewhere in PNG and from overseas. Formal designation of the Kaijende Highlands as a Conservation Area will increase the area's attractiveness as a travel destination. However it should be recognized that the tourism market is small. Studies to assess the potential of specialised eco-tours, or the promotion of research-based 'tourism' should be conducted as a matter of priority.

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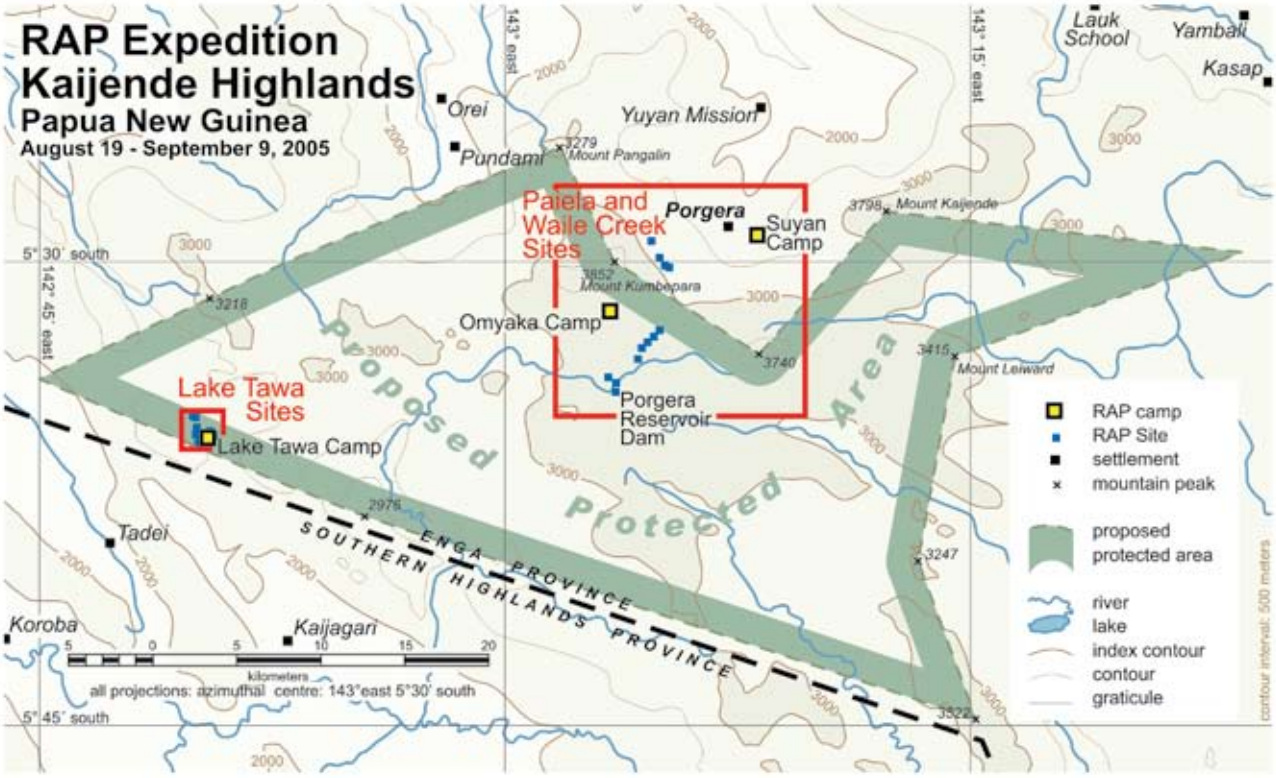
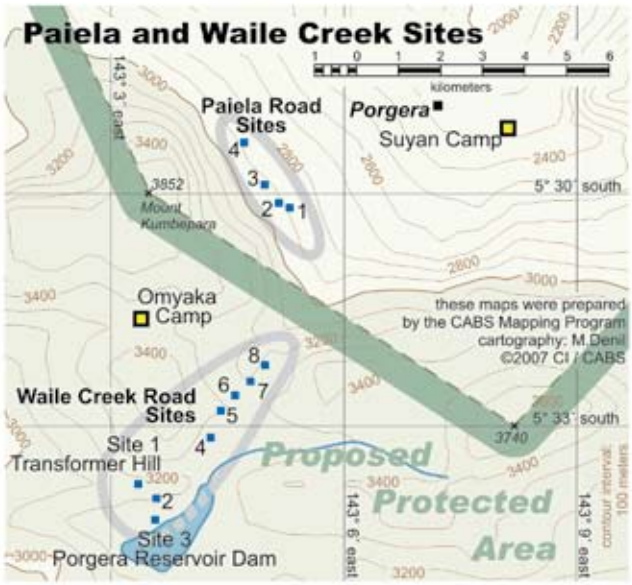




Numbers in brackets refer to specimen vouchers (plants only). Photos 1–27, 29–61 by Wayne Takeuchi. Photos 28, 62–84 by Stephen Richards.

1. *Decaspermum alpinum* is a perfume-flowered species easily seen in upper montane forests of the Porgera district. (20147).

2. *Ilex archboldiana*. The retuse leaves are usually provided with a minute apiculum in the sinus. (19754).

3. *Quintinia kuborensis* is a frequency dominant at high elevations, often forming monospecific patches in the upper canopy. (19712).

4. *Vaccinium apiculatum*. A common arborescent species of subalpine shrubberies. (19574).

5. *Vaccinium apiculatum*. Raceme detail. The narrowly urceolate corolla is initially green or white, turning pinkish-red at anthesis. (19574).

6. *Xanthomyrtus compacta*. A dominant nanophyllous species in the upper montane zone, vegetatively distinguishable from other small-leaved associates by the verrucose branchlets. (19752).

7. *Drimys piperita* entity *coriacea*. (20319).

8. *Drimys piperita* entity *montis-wilhelmi*. (19713).

9. *Vaccinium schoddei* is a terrestrial shrub with long arching stems (horizontal branchlets in photo) and cordate-amplexicaul leaves. The flowers are whitish-pink in bud and dark purple when mature. (19592).

10. *Vaccinium striicaule* var. *adenodes*. A common subarborescent on forest edges at Omyaka. The calyx lobes are occasionally furnished with a distinct apical gland. (19751).

11. *Chionochloa archboldii* in the subalpine grassland. The culms are generally 1.5–2.0 m tall. (19655).

12. *Hypericum* shrub association at Waile Creek, dominated by *H. macgregorii* and *H. papuanum*.

Numbers in brackets refer to specimen vouchers (plants only). Photos 1–27, 29–61 by Wayne Takeuchi. Photos 28, 62–84 by Stephen Richards.

13. *Coprosma papuensis* ssp. *discolor* occurs as ascending shrubs (shown) or subscandent plants with trailing branches. (19598). *Libocedrus papuana* var. *papuana* is a large tree in the background. (19594).

14. Flowering branch of *Coprosma papuensis* ssp. *discolor*. The setose stipules have a large central lobe. (19598). Although unrecorded by the RAP survey, *C. divergens* is probably present at Kaijende and will be easily recognized by its opposite leaves (3-whorled in *C. papuensis*; see Gardner 2002).

15. *Styphelia suaveolens* is widely distributed from Western Malesia to the Solomon Islands. The species can be found as erect shrubs, as small prostrate subshrubs, or even as dwarfed 20 cm tall monoaxial plants in montane bogs. (19599).

16. *Ischnea elachoglossa* is a caespitose bog herb (pictured in water pools) with pentamerous disk florets. The species is known mainly from specimens originating in Indonesian Papua, and has been infrequently found in PNG. The only previous record for the Highlands was from Mt Giluwe in Southern Highlands Province. (19718).

17. *Keysseria radicans* (closest to) ssp. *radicans*. A suffrutex with vinelike branches, shown in cushion bogs at Omyaka. The 30 mm wide heads are the largest recorded for any *Keysseria*. (19681). This genus of 10 species is known from Borneo, Sulawesi, New Guinea, and Hawaii (Koster 1975).

18. *Potentilla foersteriana* var. *foersteriana* is a common rosulate herb in bogs and subalpine grassland at Omyaka. The inconspicuous inflorescence consists of small yellow flowers. (19629).

19. *Potentilla papuana*. The long-peduncled inflorescence immediately distinguishes this species from the sympatric *P. foersteriana*. Vegetative parts are densely sericeous. (19627).

20. *Vaccinium amblyandrum* var. *pungens* growing as miniature 20 cm plants. (20260).

21. *Vaccinium amblyandrum* var. *pungens*. Flowers are solitary with white or pale pink corollas. (20260).

22. Lake Tawa. Aerial view of the catchment lakes and surrounding vegetation.

23. Lake Tawa. The southeastern end of the basin is a limestone zone with numerous sinkholes (Australian Survey Corps 1979).

24. Wide-field view of the scenic surroundings at Lake Tawa. Pollen stratigraphies from nearby swamps should be informative.

Numbers in brackets refer to specimen vouchers (plants only). Photos 1–27, 29–61 by Wayne Takeuchi. Photos 28, 62–84 by Stephen Richards.

25. Lake Tawa riparian community. The plants shown are primarily *Polygonum*, *Hypericum*, and *Hydrocotyle*.

26. *Hydrocotyle sibthorpioides*, a dominant repent herb on the Tawa lakefront.

27. Small ascending stems of *Hypericum* cf. *papuanum,* intermingling with *Hydrocotyle* at Lake Tawa.

28. Aerial view of the *Pandanus* savanna, north of the Lake Tawa camp-site.

29. *Pandanus* savanna at Lake Tawa. Anthropogenic influence is an unlikely explanation for the presence and distribution of this unusual vegetation, whose occurrence is probably related to poor soil conditions. There are no indications of former burning at the site.

30. *Saurauia* sp. nov. The deliquescent shrubs have the smallest leaves (<20 mm long) of any Papuasian congener. (20310).

31. *Saurauia* sp. nov. Closer view of the inflorescence. The calyces are reddish-purple, petals white. There are 4–5 styles. (20310).

32. *Polyscias ledermannii*, an arborescent species related to *P. belensis* but distinguished from the latter by crenate leaflets (entire in *P. belensis*). (19974).

33. *Dimorphanthera* sp. nov. A common scandent species on forest margins at Omyaka. Corollas are white, cupular, and pubescent. The presence of 10 isomorphous stamens indicates a relationship to Sleumer's section *Pachyantha*. (19571).

34. *Macaranga* sp. nov. Forest trees 15–20 m tall on limestone. The leaves are thickly coriaceous, rugose, and white beneath. (19931).

35. *Palmeria clemensae.* The foliar indument is dimorphic, with small fulvous-stellate hairs on undersurfaces, and much longer hyaline hairs along veins. (19981).

36. *Syzygium* sp. nov. The new species is very common in the *Pandanus* fringe around Lake Tawa. Calyces are smooth and entire in fresh flowers, but are deeply channelled after drying. (19987B).

Numbers in brackets refer to specimen vouchers (plants only). Photos 1–27, 29–61 by Wayne Takeuchi. Photos 28, 62–84 by Stephen Richards.

37. *Jasminum* sp. nov. Savanna plants (shown) are typically low-growing subshrubs 20–30 cm tall with horizontally spreading branches. Internodes are contracted in comparison to forest congeners. (20298).

38. *Jasminum* sp. nov. The salverform corolla has a pinkish-red tube and white limb. (20298).

39. *Rubus* sp., '*diclinus-trigonus*' facies. Prostrate floricanes with a dense orange-brown indument on stems and abaxial leaf surfaces. (20093A).

40. *Rubus* sp., '*diclinus-trigonus*' facies. Flowers are fragrant and large, with pink sepals 7 mm long and white petals 10–12 mm long. (20225).

41. *Acronychia richards-beehlerii.* Subcanopy trees with yellow flowers and fruits. The drupes are conspicuously fissured and rugose. (20119).

42. *Pilea* sp. nov. A common species resembling a *Pipturus pullei* in architecture and habit. Leaves are decussate and congested. The bright red nutlets are arranged in axillary glomerules. (20277).

43. *Gaultheria pullei* var. *pullei* is an aromatic shrub of forest margins, old mine workings, and cleared summits (Sleumer 1967). The genus is represented in New Guinea by six endemic species. (20304).

44. *Dimorphanthera keysseri*, the most common *Dimorphanthera* in the proposed WMA. (19575).

45. *Dimorphanthera keysseri*. The flowers have the characteristic androecium of the *Pachyantha* facies. (19575).

46. *Rhododendron beyerinckianum* hybrid. Hybridization with *R. phaeochitum* is suggested by the variegated red and white flowers, and by the corolla tubes with hairy interior surfaces. (20289).

47. *Rhododendron commonae*, flowering profusely at Omyaka in late August. (19670).

48. *Rhododendron inconspicuum*. In its broad circumscription (Royen 1982), the species can have red, pink, or white (shown) flowers. (20311).

Numbers in brackets refer to specimen vouchers (plants only). Photos 1–27, 29–61 by Wayne Takeuchi. Photos 28, 62–84 by Stephen Richards.

49. *Rhododendron macgregoriae* var. *macgregoriae* is possibly the most common vireya in PNG. Corollas in Omyaka-Waile Creek populations can be yellow (shown), light orange, or yellow with orange-red lobes. (19796).

50. [top] Treefern savanna. The Waile Creek savanna is the only formation of its kind with drive-through accessibility.

51. [bottom] Fire-induced dieback from the 1998 El Niño event near Omyaka (3,450 m). Widespread effects were recorded in PNG forests during the last climatic disturbance, including environments from sea level to the high montane zone (Takeuchi 2003). If El Niño occurrences increase in frequency as a result of global warming, large-scale conversions of UMF to subalpine grassland can be expected in the Kaijende region. This will involve an expansion of areas presently coded as Ga and Gi (treefern savanna in part). The changes will probably be accompanied by corresponding increases in scrub vegetation (Sc) as taller forest is converted to open woody growth. Unless future climatic disturbances are of exceptional intensity, biodiversity losses should not be particularly severe. Upper montane forests are floristically depauperate and many of their elements also occur in the open scrub. Since the epiphytic flora is species-poor, losses in that component will be similarly small. El Niño impacts to the LMF and the lower elevation flora could be of far greater consequence.

52. *Passiflora mollissima* is a naturalized vine in montane Malesian environments (de Wilde 1972) and other insular ecosystems (e.g. HDOA 1992).

Alien species near Porgera are concentrated along service roads and adjacent areas, showing that the transport network is unintentionally facilitating the dispersal of unwanted plants. Future introductions of weedy species are likely to spread using existing roadways as conduits. Construction of new facilities in the conservation zone should be considered against the likelihood of such impacts.

53. *Lupinus* cv *Russell* hybrid. This legume is common in New Zealand and has been reported within PNG from the Eastern Highlands (Verdcourt 1979).

54. *Olearia durifolia* Koster, or aff. (20255). *Olearia* collections are generally difficult to identify. The existing treatments (Koster 1966, Royen 1982) rely primarily on the microscopic morphology of the leaf hairs, characters which are not easily determined. Even when a specimen is carefully keyed out, the result often will not match the assigned name. The variation in certain species is either much wider than presently recognized, or there are more taxa in need of formal description.

55. *Olearia pallida* Koster. Forest margin shrubs at Waile Creek. The abaxial indument consists of long-stipitate stellate hairs with acicular arms radiating in all directions. (20307).

56. *Olearia platyphylla* var. *cinerea* as compact shrubs on rock rubble. (20299).

57. *Olearia platyphylla* var. *cinerea*. Closer view of the inflorescence: involucre 7 mm long; ligule 7 mm long, white; disk yellow, 7–8 florets. (20299).

58. *Olearia rufa* is a regrowth shrub in forest clearings at Waile Creek. Leaves are opposite, abaxially orange-brown tomentose, and with stellate 5–8-rayed hairs. (20279).

59. *Olearia rufa*. The large panicles are composed of heads with 4–6 disk florets. (20279).

60. *Saurauia giluwensis* is a common species on forest margins near Porgera Reservoir. Leaves are densely and abaxially orange-brown furfuraceous. The flowers have 4–5 styles. (20259).

Photos 1–27, 29–61 by Wayne Takeuchi. Photos 28, 62–84 by Stephen Richards.

61. *Muehlenbeckia monticola* occurs as prostrate vines or climbers from sea level to over 3,000 m elevation. The species is present at Porgera mainly in disturbed areas such as road embankments, landslides, construction sites, and forest regrowth.

62. Pinnacle limestone between Porgera and Lake Tawa.

63. The vast expanse of near-uninhabited montane forest and grassland in the Kaijende Highlands between Porgera and Lake Tawa.

64. Cyathea grasslands above 3000 m elevation at Waile Creek near the Porgera Reservoir.

65. Interior of the low stature Upper Montane Forest around Omyaka and Waile Creek.

66. Montane Bog at about 3,200 m elevation on a small ridge adjacent to the Omyaka Camp.

67. Local landowner at Omyaka Camp. The landowners have tremendous knowledge about the plants and animals on their land.

68. The sheer cliffs of Mt. Kumbepara dominate the skyline along the Paiela Road. Dense forest along the base of the mountain adjacent to Paiela Road contained a number of new and interesting plant and animal taxa.

69. Lake Tawa in early morning mist. This picturesque lake is surrounded by extremely biodiverse rainforest.

70. This small, undescribed microhylid frog of the genus *Albericus* was common at Lake Tawa and Paiela Road.

71. An undescribed species of *Cophixalus* that called from deep at the base of moss clumps at Omyaka and Paiela Road. Males called only during the afternoon, and two were found guarding egg masses deep within humus in the alpine meadow adjacent to Omyaka Camp.

72. This beautiful treefrog of the genus *Litoria* was collected by local assistants at Suyan Village.

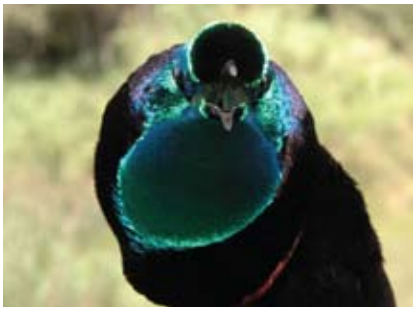
Photos 1–27, 29–61 by Wayne Takeuchi. Photos 28, 62–84 by Stephen Richards.

73. Microhylid frogs dominate the upper-montane habitats of the Kaijende Highlands. This bizarre species probably represents a new genus and species. It was found only in the montane grasslands adjacent to Omyaka Camp at around 3,200 m elevation.

74. Few reptiles were documented during the Kaijende RAP survey. This small skink may be undescribed. It was collected from the Camp's Pit-toilet on the final day at Lake Tawa by SJR. No one else volunteered.

75. Ornithologist Bruce Beehler with a male Ribbon-tailed Astrapia (*Astrapia mayeri*). This spectacular species was common at Lake Tawa.

76. Sclaters Whistler (*Pachycephala soror*) is a beautiful species that is widespread at mid-elevations in the central mountains. This bird was collected in mist-nets from forest adjacent to Lake Tawa.



77. A male Ribbon-tailed Astrapia (*Astrapia mayeri*) at Lake Tawa. This species, the last of the Birds of Paradise to be described, has a very small range that fortunately includes the proposed Mt. Kaijende Conservation Area.

78. A Wattled Ploughbill (*Eulacestoma nigropectus*). This bizarre bird was captured in a net at Lake Tawa.

79. Kris Helgen and local assistants with a Mountain Cuscus (*Phalanger carmelitae*) at Lake Tawa. Local hunters are extremely skilled at detecting and capturing possums and other larger mammals.

80. Collecting mammal bones from an owl pellet deposit in a rock outcrop near the Porgera Reservoir revealed jaws of at least eight small mammal species.

81. Live traps were set for small mammals along track-ways in the grasslands and forest around Lake Tawa.

82. *Rattus giluwensis*. This poorly-known rat was previously known only from the vicinity of Mt. Giluwe in Southern Highlands Province.

83. The Sugar Glider (*Petaurus breviceps*) is a common and widespread species throughout lowland and montane New Guinea. This animal was found in the forest at Lake Tawa.

84. The attractive Eastern Striped Bandicoot (*Microperoryctes ornata*) is a common species in forest at moderately high elevations across the central mountains of New Guinea. A single specimen was collected in an Elliott Trap at Lake Tawa.

Appendix 1

Gazetteer of sites surveyed in the Kaijende Highlands and a brief description of their major vegetation characteristics

Wayne Takeuchi

Site	Coordinates	Elevation (m)	Habitat Description
Suyan Camp, Porgera	05°29'09" S, 143°08'07" E	2,200	Anthropogenic – gardens and regrowth
Omyaka Camp, Helipad adjacent Bivouac	05°31'37" S, 143°03'23" E	3,200	margin of mossy montane forest
Omyaka Site 1	05°31'35" S, 143°03'16" E	3,185	Sphagnum-*Oreobolus* bog with numerous *Rhododendron* shrubs, surrounded by low-stature mossy montane forest
Omyaka Site 2	05°31'32" S, 143°03'16" E	3,209	Sphagnum-*Oreobolus* bog complex with pools of standing water, surrounded by low-stature mossy montane forest
Omyaka Site 3	05°31'28" S, 143°03'12" E	3,218	Sphagnum-*Oreobolus* bog complex surrounded by forest burn from the 1998 El Nino
Omyaka Site 4	05°31'31" S, 143°03'22" E	3,225	mossy montane forest on ridge next to bivouac
Omyaka Site 5	05°31'31" S, 143°03'13" E	3,236	low-stature mossy montane forest on margin of Sphagnum-*Oreobolus* bog complex
Lake Tawa Camp Bivouac	05°35'43" S, 142°50'26" E	2,117	margin of mossy montane forest at bivoauc
Lake Tawa Site 1	05°35'43" S, 142°50'26" E	2,192	mossy montane forest along footpath to Mt. Kare
Lake Tawa Site 2	05°35'38" S, 142°50'31" E	2,225	low-stature mossy montane forest midway from helipad to *Pandanus* savanna)
Lake Tawa Site 3	05°35'40" S, 142°50'35" E	2,264	margin of *Pandanus-Dicranopteris* savanna community
Lake Tawa Site 4	05°35'38" S, 142°50'37" E	2,290	*Pandanus-Dicranopteris* community
Lake Tawa Site 5	05°35'36" S, 142°50'07" E	2,198	margin of second lake below bivoauc, along footpath to Porgera
Lake Tawa Site 6	05°35'36" S, 142°50'02" E	2,275	advanced forest regrowth in *Pandanus* fringe zone, second lake below bivouac
Lake Tawa Site 7	05°35'37" S, 142°50'15" E	2,238	herbaceous community along second lake below bivouac
Lake Tawa Site 8	05°35'45" S, 142°50'23" E	2,192	edge of natural growth montane forest directly opposite bivouac
Lake Tawa Site 9	05°35'49" S, 142°50'21" E	2,210	grassy slopes of sinkholes near bivouac
Lake Tawa Site 10	05°35'53" S, 142°50'16" E	2,230	*Pandanus* margin of mossy montane forest on lower slopes of limestone ridge
Lake Tawa Site 11	05°35'54" S, 142°50'07" E	2,340	mossy montane forest about halfway to summit of limestone ridge near bivouac
Lake Tawa Site 12	05°35'56" S, 142°50'07" E	2,400	mossy montane forest, subcrest of limestone ridge near bivouac,
Lake Tawa Site 13	05°35'23" S, 142°50'05" E	2,207	herbaceous lakeside community along second lake below bivouac

continued

Site	Coordinates	Elevation (m)	Habitat Description
Lake Tawa Site 14	05°35'03" S, 142°50'02" E	2,240	sandstone gorge at end of lake below bivouac
Lake Tawa Site 15	05°35'00" S, 142°49'57" E	2,243	river flowing into lakes below bivouac
Lake Tawa Site 16	05°35'32" S, 142°50'28" E	2,249	mossy montane forest at top of waterfall
Lake Tawa Site 17	05°35'30" S, 142°50'30" E	2,275	forest clearing around abandoned bush hut
Lake Tawa Site 18	05°35'48" S, 142°50'15" E	2,232	mossy montane forest at top of small ridge near bivouac
Lake Tawa Site 19	05°35'39" S, 142°50'11" E	2,237	*Pandanus* margin of mossy montane forest
Paiela Road Site 1	05°30'11" S, 143°04'52" E	2,875	mossy montane forest, near junction of Paiela Road and Quarry Road
Paiela Road Site 2	05°30'07" S, 143°04'44" E	2,908	stream in mossy montane forest
Paiela Road Site 3	05°29'53" S, 143°04'33" E	2,850	margin of mossy montane forest near base of limestone escarpment
Paiela Road Site 4	05°29'20" S, 143°04'17" E	2,898	margin of mossy montane forest near end of limestone escarpments
Waile Creek Road Site 1 (Transformer Hill)	05°33'45" S, 143°03'21" E	3,076	mosaic of alpine grassland and patches of low-stature mossy montane forest
Waile Creek Road Site 2	05°33'56" S, 143°03'35" E	3,010	alpine grassland, junction of Waile Creek Road and Tari Track, near Porgera Reservoir
Waile Creek Road Site 3 (Porgera Reservoir Dam and Spillway)	05°34'13" S, 143°03'34" E	3,010	alpine grassland and anthropogenic communities
Waile Creek Road Site 4	05°33'09" S, 143°04'17" E	3,108	alpine grassland, near 2 km mark along pipeline
Waile Creek Road Site 5	05°32'48" S, 143°04'25" E	3,134	herbaceous regrowth in grassy clearings and quarry rock near water-tank
Waile Creek Road Site 6	05°32'36" S, 143°04'36" E	3,081	margin of mossy montane forest below the Pass
Waile Creek Road Site 7	05°32'25" S, 143°04'48" E	3,054	patches of mossy forest in alpine grassland at 4 km mark on pipeline
Waile Creek Road Site 8	05°32'13" S, 143°04'59" E	3,027	mixed community mosaic of mossy forest interspersed with regrowth from anthropogenic activities nr 4.5 km mark on pipeline

Appendix 2

Plant species recorded in the Kaijende Highlands

Wayne Takeuchi

Species recorded 19 August– 9 September 2005.
P = present, documented by collection(s) and Pw = present, but without collection.

Taxon	Omyaka	Lake Tawa	Paiela Road + Waile Creek
FERNS AND LYCOPHYTES			
Adiantaceae			
Adiantum aneitense Carr		P	
Cheilanthes papuana C. Chr.			P
Aspleniaceae			
Asplenium acrobryum Christ		P	
Asplenium adiantoides (L.) C. Chr.		P	
Asplenium nutans Rosenst.		P	P
Asplenium steerei Harrington		P	
Athyriaceae			
Diplazium sp. ?nov.		P	
Blechnaceae			
Blechnum fluviatile (R. Br.) Lowe ex Salomon	P		
Blechnum hieronymi Brause		P	
Blechnum keysseri Rosenst.		P	
Blechnum revolutum (Alderw.) C. Chr.	P		P
Blechnum rosenstockii Copel.			P
Cyatheaceae			
Cyathea aeneifolia (v.A.v.R.) Domin			P
Cyathea atrospinosa Holtt.		P	
Cyathea atrox C. Chr. var. *inermis* Holtt.	P		Pw
Cyathea dicksonioides Holtt.	P		Pw
Cyathea hornei (Baker) Copel.		P	
Cyathea lepidoclada (Christ) Domin	P		
Cyathea magna Copel.		P	
Cyathea (closest to) *magna* Copel.			P
Cyathea microphylloides Rosenst.		P	
Cyathea perpelvigera v.A.v.R.		P	

continued

Taxon	Omyaka	Lake Tawa	Paiela Road + Waile Creek
Cyathea physolepidota Alston		P	
Dicksonia hieronymi Brause		P	
Davalliaceae			
Davallia repens (L.f.) Kuhn	Pw		P
Davallodes novoguineense (Rosenst.) Copel.		P	
Rumohra adiantiformis (Forst.) Ching			P
Dennstaedtiaceae			
Dennstaedtia magnifica Copel.			P
Dennstaedtia cf. *penicillifera* v.A.v.R.		P	
Dennstaedtia scandens (Bl.) Moore		P	
Histiopteris squamulata Holtt.	P		P
Hypolepis alpina (Bl.) Hook.	P	P	Pw
Pteridium aquilinum (L.) Kuhn		P	
Dipteridaceae			
Dipteris conjugata Reinw.		P	
Dryopteridaceae			
Dryopteris sparsa (Ham.) O. Kuntze		P	
Dryopteris subarborea (Baker) C. Chr.			P
var. *quadripinnata* Rosenst.			
Dryopteris wallichiana (Spreng.) Hyl.			P
Polystichum alpinum Rosenst.			P
Polystichum hooglandii Nakaike			P
Polystichum keysserianum Rosenst.		P	
Polystichum pullenii Nakaike			P
Polystichum takakii Nakaike			P
Stenolepia tristis (Bl.) v.A.v.R.	P		P
Equisetaceae			
Equisetum ramosissimum Desf. ssp. *debile* (Vauch.) Hauke	Pw		Pw
Gleicheniaceae			
Dicranopteris linearis (Burm. f.) Underw. var. *linearis*	Pw	P	Pw
Gleichenia bolanica Rosenst.	P		
Gleichenia brassii C. Chr.		P	
Gleichenia erecta C. Chr.	P		
Gleichenia vulcanica Bl.	P		
Grammitidaceae			
Calymmodon atrichus Copel.	P		
Ctenopteris bipinnatifida (Baker) Copel.	P		
Ctenopteris brassii Copel.	P		
Ctenopteris integripaleata Copel.		P	
Ctenopteris subsecundodissecta (Zoll.) Copel.		P	
Ctenopteris venulosoides Copel.		P	P
Ctenopteris s.l.; *Prosaptia contigua* (Forst.) Presl	P		
Ctenopteris s.l.; *Prosaptia davalliacea* (F.v.M. & Baker) Copel.	P		

continued

Taxon	Omyaka	Lake Tawa	Paiela Road + Waile Creek
Grammitis padangensis (Baker) Copel.	P		
Grammitis scabristipes (Baker) Copel.	P	P	
Grammitis sumatrana (Baker) Copel.		P	
Hymenophyllaceae			
Hymenophyllum geluense Rosenst.	P		
Hymenophyllum imbricatum Bl.		P	
Hymenophyllum s.l.; *Amphipterum humatoides* Copel.	P		
Hymenophyllum s.l.; *Mecodium bismarckianum* (Christ) Copel.		P	
Hymenophyllum s.l.; *Mecodium reinwardtii* (v.d.B.) Copel.			P
Hymenophyllum s.l.; *Myriodon brassii* (C. Chr.) Copel.	P		
Trichomanes pallidum Bl. (*Pleuromanes*)		P	
Lindsaea Group			
Lindsaea pulchella (J.J. Sm.) Mett. ex Kuhn var. *blanda* (Mett. ex Kuhn) Kramer		P	
Sphenomeris chinensis (L.) Maxon (close to) var. *divaricata* (Christ) Kramer		P	
Lomariopsidaceae			
Elaphoglossum angustifrons Holtt.		P	
Elaphoglossum sclerophyllum v.A.v.R.	P	P	
Lycopodiaceae			
Huperzia aff. *serrata* (Thunb.) Trevisan			P
Lycopodium clavatum L.	P		
Lycopodium divaricatum Grev. & Hook.; (*L. clavatum* L., s.l.)	P		
Lycopodium scariosum G. Forst.	P		P
Lycopodium volubile G. Forst.		P	
Lycopodium wightianum Grev. & Hook.	P		
Palhinhaea cernua (L.) Vasc. & Franco; =*Lycopodiella*		P	Pw
Marattiaceae			
Marattia cf. *coronata* Copel.		P	
Oleandraceae			
Nephrolepis cordifolia (L.) Presl		P	
Oleandra sibbaldii Grev.		P	
Ophioglossaceae			
Ophioglossum pendulum L.		Pw	
Plagiogyriaceae			
Plagiogyria egenolfioides (Baker) Copel. var. *decrescens* (C. Chr.) Zhang & Noot.	P		Pw
Polypodiaceae			
Belvisia mucronata (Fee) Copel. var. *mucronata*		P	P
Belvisia novoguineensis (Rosenst.) Copel.		P	
Belvisia validinervis (Kunze) Copel. var. *longissima* (Holtt.) Hovenkamp & Franken		P	
Belvisia validinervis (Kunze) Copel. var. *validinervis*	P		P
Goniophlebium demersum (Brause) Rödl-Linder		P	

continued

Taxon	Omyaka	Lake Tawa	Paiela Road + Waile Creek
Microsorum papuanum (Baker) Parris		P	
Selliguea albidosquamata (Bl.) Parris		P	
Selliguea costulata (Ces.) Wagner & Grether		P	
Selliguea (close to) *costulata* (Ces.) Wagner & Grether		P	
Selliguea enervis (Cav.) Ching	P		P
Selliguea enervis (Cav.) Ching the gramineous *'lamprophyllus'* form		P	P
Selliguea enervis (Cav.) Ching the dimorphic *'senescens-spathulatus'* form		P	
Selliguea plantaginea Brackenr.	P		Pw
Pteridaceae			
Pteris blumeana Agardh		P	
Pteris brassii C. Chr.	P		
Pteris wallichiana Agardh		P	P
Tectaria Group			
Ctenitis s.l.		P	P
Lastreopsis novoguineensis Holtt.			P
Thelypteridaceae			
Coryphopteris klossii (Ridl.) Holtt.		P	
Parathelypteris beddomei (Baker) Ching		P	
Plesioneuron dryopteroideum (Brause) Holtt. (closest to) var. *dryopteroideum*			P
Plesioneuron marattioides (Alston) Holtt.		P	
Pneumatopteris petrophila (Copel.) Holtt., or aff.		P	
Pneumatopteris superba (Brause) Holtt.		P	
Pneumatopteris sp. nov.		P	
Pronephrium womersleyi Holtt.		P	
Pseudophegopteris aurita (Hook.) Ching			P
Sphaerostephanos acrostichoides (Desv.) Holtt.		P	
Sphaerostephanos archboldii (C. Chr.) Holtt.		P	
Sphaerostephanos sp.			P
Vittariaceae			
Loxogramme paltonioides Copel.		P	
Loxogramme (closest to) *paltonioides* Copel.		P	P
Loxogramme subselliguea (Baker) Alston	P		
Vittaria elongata Sw. var. *angustifolia* Holtt.		P	
GYMNOSPERMS			
Cupressaceae			
Libocedrus papuana F.v.M. var. *papuana*	P		Pw
Pinaceae			
Pinus caribaea Morelet			P
Podocarpaceae			
Dacrydium imbricatus (Bl.) de Laub. var. *robustus* de Laub.		P	Pw

continued

Taxon	Omyaka	Lake Tawa	Paiela Road + Waile Creek
Phyllocladus hypophyllus Hook. f.	Pw	P	Pw
Podocarpus (closest to) *crassigemmis* de Laub.			P
Podocarpus pseudobracteatus de Laub.		P	
MONOCOTS			
Araceae			
Alocasia macrorrhizos (L.) G. Don		Pw	
Alocasia nicolsonii Hay			Pw
Colocasia esculenta (L.) Schott		Pw	
Cyperaceae			
Carex cruciata Wahl. var. *rafflesiana* (Boot) Noot.		P	P
Carex michauxiana Boeck. var. *asiatica* (Hulten) Ohwi	P		
Carex oedorrhampha Nelmes		P	
Gahnia javanica Zoll. & Mor. ex Mor.	P		
Scirpus crassiusculus (Hook.) Benth.	P		
Scirpus mucronatus L. ssp. *clemensiae* Kukenth.	P		
Scirpus subtilissimus (Boeck.) S.T. Blake	P		
Eriocaulaceae			
Eriocaulon hookerianum Stapf		P	
Hemerocallidaceae			
Geitonoplesium cymosum A. Cunn.		P	
Iridaceae			
Sisyrinchium pulchellum (R. Br.) F.v.M.	P		Pw
Juncaceae			
Juncus effusus L.	P		P
Juncus prismatocarpus R. Br.	P		
Laxmanniaceae			
Cordyline fruticosa (L.) A. Chev.		Pw	
Liliaceae			
Astelia alpina R. Br.	P		
Orchidaceae (dets. by N. Howcroft)			
Agrostophyllum earinoides Schltr.		P	
Bulbophyllum sp., sect. *Peltopus*	P		
Cadetia aprinoides (J.J. Sm.) A.D. Hawkes		P	
Cadetia sp., sect. *Ptero-Cadetia*		P	
Ceratostylis cf. *flavescens* Schltr.	P		
Ceratostylis sp.		P	
Dendrobium alaticaulinum Royen		P	
Dendrobium brevicaule Rolfe ssp. *calcarium* (J.J. Sm.) Reeve & Woods	P		
Dendrobium cuthbertsonii F.v.M.		P	
Dendrobium dichroma Schltr.	P		
Dendrobium masarangense Schltr. var. *theionanthum* (Schltr.) Reeve & Woods		P	

continued

Taxon	Omyaka	Lake Tawa	Paiela Road + Waile Creek
Dendrobium nardoides Schltr.			P
Dendrobium prostheciglossum Schltr.		P	
Dendrobium vexillarius J.J. Sm. var. *albiviride* (Royen) Reeve & Woods		P	
Epiblastus cf. *montihageni* Royen		P	
Epiblastus pulchellus Schltr.		P	
Epiblastus sp.		P	
Glomera aurea Schltr., or aff.		P	
Glossorhyncha sp. nov. A		P	
Glossorhyncha sp. nov. B			P
Liparis sp., sect. *Distichon*		P	
Mediocalcar aff. *crenulatum* J.J. Sm.		P	
Microtatorchis clavicalcarata J.J. Sm.			P
Oberonia sp.		P	
Phreatia aff. *quadrata* Schltr.		P	
Phreatia sp. A, sect. *Bulbophreatia*		P	
Phreatia sp. B, sect. *Bulbophreatia*		P	
Spathoglottis parviflora Krzl.			P
Pandanaceae			
Freycinetia sp.		P	
Pandanus sp., sect. *Intraobtutus*		P	
Poaceae			
Agrostis avenacea Gmelin			P
Arundinella furva Chase	P		
Chionochloa archboldii (Hitchc.) Conert	P		P
Danthonia oreoboloides (F.v.M.) Stapf	P		
Deschampsia klossii Ridl.	P		
Eulalia leptostachys (Pilg.) Henrard			P
Imperata conferta (Presl) Ohwi			P
Isachne pauciflora Hack.		P	
Isachne villosa (Hitchc.) Reeder		P	
Mischanthus floridulus (Labill.) Warb.		Pw	P
Nastus productus (Pilg.) Holtt.	Pw		Pw
Oplismenus hirtellus (L.) P. Beauv.		P	
Poa annua L.			P
Poa keysseri Pilg. (closest to) ssp. *keysseri*			P
Sacciolepis indica (L.) Chase		P	
Setaria roemerii Jansen		P	
Typhaceae			
Typha angustifolia L.		P	
Zingiberaceae			
Alpinia albipurpurea (Royen) R.M. Smith, or aff.	P		
Riedelia geluensis Laut.		P	

continued

Taxon	Omyaka	Lake Tawa	Paiela Road + Waile Creek
Riedelia sp., aff. *geluensis* Laut.		P	
Riedelia subalpina Royen	P		
DICOTS			
Actinidiaceae			
Saurauia cf. *achyrantha* Diels		P	
Saurauia altiterra Royen			P
Saurauia bifida Warb.		P	
Saurauia giluwensis Royen			P
Saurauia aff. *naumannii* Diels		P	P
Saurauia aff. *occulta* A.C. Smith			P
Saurauia (closest to) *scaberrima* Laut.	P		
Saurauia trugul Royen			P
Saurauia sp., ser. *Setosae*, *holotricha* facies		P	
Saurauia sp. nov., ser. *Setosae*		P	P
Anacardiaceae			
Rhus caudata Laut.		P	
Apiaceae			
Hydrocotyle sibthorpioides Lamarck	P	P	P
Oenanthe javanica DC.		P	
Apocynaceae			
Alyxia cacuminum Markgr.		P	
Alyxia subalpina Markgr.		P	
Hoya sp.		P	
Parsonsia sanguinea (Wernh.) Markgr.		P	
Aquifoliaceae			
Ilex archboldiana Merr. & Perry	P	P	P
Ilex spicata Bl.		P	
Araliaceae			
Harmsiopanax harmsii K. Schum. ex K. Schum. & Laut.	P		P
Polyscias belensis Philipson		P	
Polyscias ledermannii Harms		P	
Polyscias royenii Philipson		P	
'Schefflera' dentata Frodin		P	P
'Schefflera' setulosa Harms		P	
'Schefflera' simbuensis Frodin, or aff.	P		P
Asteraceae			
Adenostemma hirsutum (Bl.) DC.		P	
Adenostemma lavenia (L.) Kuntze		Pw	
Ageratum conyzoides L.		Pw	
Anaphalis lorentzii Laut. form *lorentzii*	P		
Anaphalis mariae F.v.M. form *alba* Koster	P		
Anaphalis mariae F.v.M. form *mariae*			P
Arrhenechthites novoguinensis (S. Moore) Mattf. ssp. *novoguinensis*		P	P

continued

Taxon	Omyaka	Lake Tawa	Paiela Road + Waile Creek
Bidens pilosa L.			Pw
Blumea arnakidophora Mattf.		P	
Blumea papuana S. Moore			P
Blumea sylvatica (Bl.) DC. cf. var. *macrophylla* (Bl.) Randeria			P
Cirsium vulgare (Savi) Ten.			P
Crassocephalum crepidioides (Benth.) S. Moore		Pw	
Erigeron sumatrensis Retz			P
Erigeron sp., *Senecio* facies			P
Gnaphalium involucratum Forst.			P
Helichrysum bracteatum (Vent.) Andrews	P		
Ischnea elachoglossa F.v.M.	P		
Keysseria radicans (F.v.M.) Mattf.	P		
Lactuca laevigata (Bl.) DC. var. *laevigata*	Pw		P
Myriactis cabrerae Koster	P		
Olearia durifolia Koster	P		
Olearia durifolia Koster, or aff. (deviant)	P		P
Olearia pallida Koster, or aff.	P		P
Olearia platyphylla Mattf. var. *cinerea* (Mattf.) Koster		P	P
Olearia rufa Koster			P
Olearia spectabilis Koster	P		
Olearia sp., *lepidota-platyphylla* facies, closer to *platyphylla*	P		
Papuacalia kukul (Royen) Veldkamp			P
Senecio brassii Belcher	P		
Senecio papuanus (Laut.) Belcher	P		
Sonchus asper (L.) Hill form *hydrophilus* (Boulos) Koster	Pw		P
Tetramolopium ciliatum Mattf.			P
Tetramolopium macrum (F.v.M.) Mattf. var. *glabrescens* Koster	P		
Vernonia cuneata Less.		P	
Begoniaceae			
Begonia kaniensis Irmscher		P	
Bignoniaceae			
Tecomanthe volubilis Gibbs		P	
Boraginaceae			
Cynoglossum hellwigii Brand			P
Brassicaceae			
Brassica oleracea L.			P
Cardamine keysseri Schulze		P	
Rorippa nasturtium-aquaticum (L.) Hayek	P		P
Caprifoliaceae			
Sambucus canadensis L.			P
Caryophyllaceae			
Cerastium papuanum Schltr. ssp. *phaenops* Mattf.	P		P

continued

Taxon	Omyaka	Lake Tawa	Paiela Road + Waile Creek
Sagina papuana Warb.	P		P
indet.		P	
Chloranthaceae			
Chloranthus erectus (Buch.-Ham.) Verdcourt		P	
Clusiaceae			
Garcinia archboldiana A.C. Smith, or aff.		P	
Garcinia assugu Laut., or aff.		P	
Coriariaceae			
Coriaria papuana Warb.			P
Cucurbitaceae			
Gynostemma pentaphylla (Thunb.) Makino			P
Urceodiscus belensis (Merr. & Perry) de Wilde & Duyfjes		P	
Cunoniaceae			
Spiraeopsis papuana (Pulle) Perry		P	
Daphniphyllaceae			
Daphniphyllum gracile Gage var. *gracile*			P
Daphniphyllum papuanum Hallier f. var. *tuberculatum* (T.C. Huang) T.C. Huang		P	
Droseraceae			
Drosera peltata Thunb. ssp. *peltata*	P		
Elaeocarpaceae			
Aceratium ledermannii Schltr.		P	
Dubouzetia novoguineensis A.C. Smith		P	
Elaeocarpus polydactylus Schltr., Coode group 1		P	
Elaeocarpus polydactylus Schltr., Coode group 3			P
Elaeocarpus ptilanthus Schltr.		P	
Elaeocarpus sayeri F.v.M. var. *altigenus* (Schltr.) Weibel		P	
Sericolea gaultheria (F.v.M.) Schltr. var. *gaultheria*	P		
Sericolea pullei (Laut.) Schltr.		P	
Epacridaceae			
Styphelia suaveolens (Hook. f.) Warb.	P		Pw
Trochocarpa dekockii (J.J. Sm.) H.J. Lam	Pw		P
Ericaceae			
Dimorphanthera alpina J.J. Sm. var. *alpina*	P		
Dimorphanthera anchorifera J.J. Sm.		P	
Dimorphanthera cornuta J.J. Sm. var. *cornuta*	Pw		P
Dimorphanthera dekockii J.J. Sm. var. *dekockii*		P	
Dimorphanthera keysseri (Diels) Stevens	P		P
Dimorphanthera sp. nov., aff. *ingens* (Sleum.) Stevens	P		P
Diplycosia morobeensis Sleum. var. *morobeensis*		P	
Diplycosia rupicola Sleum.	P		
Diplycosia sp. nov., aff. *lamii* J.J. Sm.		P	
Gaultheria mundula F.v.M. var. *mundula*	P		

continued

Taxon	Omyaka	Lake Tawa	Paiela Road + Waile Creek
Gaultheria pullei J.J. Sm. var. *pullei*			P
Rhododendron beyerinckianum Koord.		P	P
Rhododendron commonae Foerster	P		P
Rhododendron herzogii Warb.			P
Rhododendron inconspicuum J.J. Sm.			P
Rhododendron macgregoriae F.v.M. var. *macgregoriae*		P	P
Rhododendron prostratum Sleum.			P
Rhododendron rarum Schltr.			P
Rhododendron scabridibracteum Sleum.		P	
Vaccinium amblyandrum F.v.M. var. *pungens* Sleum.	P		P
Vaccinium apiculatum Sleum.	P		
Vaccinium auriculifolium Sleum.		P	
Vaccinium finisterrae Schltr.			P
Vaccinium reticulato-venosum Sleum.		P	
Vaccinium schoddei Sleum.	P		P
Vaccinium stellae-montis Sleum.	P		
Vaccinium striicaule Sleum. var. *adenodes* Sleum.	P	P	
Euphorbiaceae s.l.			
Breynia collaris Airy Shaw		P	
Claoxylon nubicola Airy Shaw			P
Glochidion macrocarpum Bl. ssp. *orientale* Airy Shaw		P	
Glochidion (closest to) *nobile* Airy Shaw		P	
Glochidion sp. nov., aff. *dumicola-oogynum* facies		P	
Macaranga albescens Perry		P	
Macaranga carrii Perry var. *leonardii* (Perry) Whitm.			P
Macaranga sp. nov., aff. *papuana* (J.J. Sm.) Pax & Hoffm.		P	
Omalanthus arfakiensis Hutch.			P
Omalanthus nervosus J.J. Sm.		P	P
Fabaceae			
Lupinus cv Russell hybrid			P
Trifolium dubium Sibth.			P
Trifolium repens L.			P
Trifolium rueppellianum Fres.			P
Fagaceae			
Lithocarpus rufovillosus (Markgr.) Rehd.		Pw	
Gentianaceae			
Gentiana ettingshausenii F.v.M.	P		
Swertia papuana Diels	P		P
Geraniaceae			
Geranium niuginense Veldkamp	Pw		P
Gesneriaceae			
Aeschynanthus sp. A		P	
Aeschynanthus sp. B			P

continued

Taxon	Omyaka	Lake Tawa	Paiela Road + Waile Creek
Aeschynanthus sp. C			P
Cyrtandra arfakensis Schltr.		P	
Cyrtandra aff. *aundensis* Royen		P	P
Cyrtandra sp., sect. *Axillanthe*		P	
Goodeniaceae			
Scaevola oppositifolia R. Br.		P	
Gunneraceae			
Gunnera macrophylla Bl.		P	P
Haloragaceae			
Gonocarpus halconensis (Merr.) Orchard			Pw
Hypericaceae			
Hypericum macgregorii F.v.M.	P		
Hypericum papuanum Ridl.	P		
Hypericum cf. *papuanum* Ridl. (deviant)		P	
Lamiaceae			
Plectranthus scutellarioides (L.) R. Br.		P	
Lauraceae			
Litsea sp.		P	
Loranthaceae			
Decaisnina cf. *hollrungii* (K. Schum.) Barlow		P	
Melastomataceae			
Astronia ledermannii Mansf.		P	
Beccarianthus aff. *acutifolius* (Mansf.) Maxw.		P	
Medinilla interiacens Bodegom		P	
Medinilla rubiginosa Cogn.		P	
Poikilogyne cordifolia (Cogn.) Mansf.		P	
Monimiaceae			
Levieria nitens Perkins		P	
Levieria squarrosa Perkins			P
Palmeria arfakiana Becc.		P	P
Palmeria clemensae Philipson		P	
Palmeria schoddei Philipson			P
Steganthera hirsuta (Warb.) Perkins		P	
Steganthera ilicifolia A.C. Smith			P
Moraceae			
Ficus erythrosperma Miq.		P	
Streblus glaber (Merr.) Corner		P	
Streblus urophyllus Diels var. *urophyllus*			P
Myrsinaceae			
Embelia cotinoides (S. Moore) Merr.			P
Maesa bismarckiana Mez			P
Maesa haplobotrys F.v.M.		P	

continued

Taxon	Omyaka	Lake Tawa	Paiela Road + Waile Creek
Rapanea involucrata Mez		P	
Rapanea leucantha K. Schum.		P	
Rapanea papuana (Hemsl.) Mez	P		
Rapanea rhombata Royen			P
Rapanea sp. nov., aff. *cacuminum-leucantha* facies			P
Myrtaceae			
Decaspermum alpinum Royen	Pw		P
Decaspermum forbesii Baker	Pw		P
Kania eugenioides Schltr.		P	
Metrosideros ramiflora Laut., or aff.		P	
Octamyrtus behrmannii Diels		P	
Octamyrtus pleiopetala Diels		P	
Syzygium alatum (Laut.) Diels	P		Pw
Syzygium effusum (A. Gray) C. Muell.		P	
Syzygium fastigiatum (Bl.) Merr. & Perry		P	
Syzygium sp. nov., aff. *goniocalyx* (Laut.) Merr. & Perry		P	
Syzygium sp. nov., aff. *womersleyi-malaccense* facies		P	
Xanthomyrtus compacta (Ridl.) Diels	P		Pw
Xanthomyrtus papuana Merr. & Perry		P	
Ochnaceae			
Schuurmansia henningsii K. Schum.		Pw	
Oleaceae			
Chionanthus brassii (Kobuski) Kiew		P	
Jasminum domatiigerum Lingelsh.		P	
Jasminum sp. nov., aff. *domatiigerum* Lingelsh.	P		P
Onagraceae			
Epilobium detznerianum Schltr. ex Diels	P		
Epilobium hooglandii Raven	P		
Epilobium keysseri Diels	P		P
Epilobium prostratum Warb.			P
Oxalidaceae			
Oxalis corniculata L. var. *sericea* Knuth		P	P
Passifloraceae			
Passiflora mollissima (H.B.K.) Bailey			P
Piperaceae			
Piper abbreviatum Opiz			P
Piper bolanicum Schltr. ex R.O. Gardner	P		P
Piper gibbilimbum C. DC.		P	P
Piper macropiper Pennant		P	
Piper novoguineense Warb.		P	P
Piper triangulare Chew		P	
Pittosporaceae			
Pittosporum pullifolium Burk. ssp. *pullifolium* var. *pullifolium*	P	P	

continued

Taxon	Omyaka	Lake Tawa	Paiela Road + Waile Creek
Pittosporum ramiflorum (Zoll. & Mor.) Miq. var. *ramiflorum*		P	P
Plantaginaceae			
Plantago major L.			P
Polygonaceae			
Muehlenbeckia monticola Pulle			P
Polygonum longisetum DeBr.		P	
Polygonum nepalense Meissn.			P
Polygonum runcinatum D. Don		P	
Polygonum strigosum R. Br.		P	
Rumex brownii Campd.			P
Rumex crispus L.			P
Polyosmaceae			
Polyosma sp. nov., aff. *occulta* Reeder			P
Proteaceae			
Helicia cf. *commutata* Sleum.		P	
Ranunculaceae			
Clematis phanerophlebia Merr. & Perry		P	P
Ranunculus schoddei Eichler			P
Ranunculus uncostigma Merr. & Perry, or aff.			P
Ranunculus wahgiensis Eichler	P		P
Rhamnaceae			
Alphitonia ferruginea Merr. & Perry		Pw	
Rhamnus nipalensis (Wall.) Lawson ex Hook.			P
Rosaceae			
Acaena anserinifolia (Forst.) Druce	P		
Potentilla foersteriana Laut. var. *foersteriana*	P		
Potentilla papuana Focke	P		
Potentilla parvula Hook. ex Stapf	P		P
Prunus costata (Hemsl.) Kalkm.	P		
Prunus pullei (Koehne) Kalkm.	P		
Rubus archboldianus Merr. & Perry			P
Rubus ferdinandi-muelleri Focke		P	
Rubus lorentzianus Pulle	P		
Rubus moluccanus L. var. *moluccanus*	Pw		P
Rubus montiswilhelmi Royen	P		
Rubus papuanus Schltr. ex Diels			P
Rubus royenii Kalkm. var. *hispidus* Kalkm.	P		P
Rubus sp., *'diclinus-trigonus'* facies	Pw		P
Rousseaceae			
Carpodetus arboreus (K. Schum. & Laut.) Schltr.			P
Rubiaceae			
Argostemma aff. *bryophilum* K. Schum.	P		

continued

Taxon	Omyaka	Lake Tawa	Paiela Road + Waile Creek
Coprosma nertera F.v.M. var. *papuana* (Val.) Heads	P		
Coprosma papuensis Oliv. ssp. *discolor* (Royen) R.O. Gardner	P		P
Galium subtrifidum Reinw. ex Bl.			P
Gardenia pallens Merr. & Perry		P	
Hedyotis aff. *verticillata* (L.) Lamk		P	
Mussaenda cf. *ferruginea* K. Schum.			P
Psychotria chrysantha Merr. & Perry			P
Psychotria coodei Sohmer ined.			P
Psychotria dieniensis Merr. & Perry			P
Psychotria leucococca Laut.		P	
Psychotria lorentzii Val.			P
Psychotria sphaerothyrsa Val.		P	
Psychotria sp., aff. *dieniensis* Merr. & Perry		P	
Psychotria sp. (vining)		P	
Timonius avenis Val. var. *avenis*		P	
Timonius belensis Merr. & Perry		P	
Rutaceae			
Acronychia emarginata Laut.		P	
Acronychia foveata Hartley		P	
Acronychia richards-beehlerii			P
Melicope brassii Hartley			P
Melicope mucronata Merr. & Perry	P	P	
Melicope robbinsii Hartley	P	P	
Melicope rubra (Laut. & K. Schum.) Hartley		P	P
Sabiaceae			
Meliosma pinnata (Roxb.) Maxim. ssp. *macrophylla* (Merr.) Beus.			P
Salicaceae			
Casearia ripicola Sleum.		P	
Santalaceae			
Cladomyza cuneata Danser		P	
Cladomyza sp., *'dubia-cuneata'* facies	P		
Sapindaceae			
Dodonaea viscosa (L.) Royen		P	
Saxifragaceae			
Astilbe cf. *rivularis* D. Don		P	
Scrophulariaceae			
Buddleja asiatica Lour.			P
indet.			P
Solanaceae			
Physalis peruviana L.			P
Solanum nolense Symon		P	
Sphenostemonaceae			
Quintinia brassii Reeder			P

continued

Taxon	Omyaka	Lake Tawa	Paiela Road + Waile Creek
Quintinia kuborensis Royen	P		P
Sphenostemon papuanus (Laut.) Steen. & Erdtman		P	Pw
Symplocaceae			
Symplocos cochinchinensis (Lour.) S. Moore ssp. *leptophylla* (Brand) Noot. var. *leptophylla*		P	
Symplocos cochinchinensis (Lour.) S. Moore ssp. *leptophylla* (Brand) Noot. var. *monticola* Noot.		P	
Symplocos cochinchinensis (Lour.) S. Moore ssp. *leptophylla* (Brand) Noot. var. *orbicularis* (Hemsl.) Noot.	P		P
Theaceae			
Eurya brassii Kobuski ssp. *apiculata* Barker	P		
Eurya brassii Kobuski ssp. *brassii*	P		
Eurya fragilis Barker	P		
Eurya tigang K. Schum. & Laut.			P
Ternstroemia britteniana F.v.M.		P	
Thymelaeaceae			
Drapetes ericoides Hook.	P		
Wikstroemia androsaemifolia Decne		P	
Trimeniaceae			
Trimenia papuana Ridl.		P	
Urticaceae			
Cypholophus pachycarpus Winkler			P
Elatostema aff. *serra* Winkler		P	
Nothocnide mollissima (Bl.) Chew			Pw
Pilea cuneata Winkler		P	
Pilea melastomoides (Poir.) Bl.		P	P
Pilea papuana Winkler		P	
Pilea rubiacea Ridl. var. *latifolia* (Winkler) Winkler	P		P
Pilea sp. nov., aff. *zaranensis* Royen			P
Pipturus montanus Royen			P
Pipturus pullei Winkler		P	P
Pouzolzia pentandra (Roxb.) Benn. & Br.		P	
Procris grueningii (Winkler) Johns		P	P
Violaceae			
Viola arcuata Bl.		P	
Viola kjellbergii Melchior	P		P
Vitaceae			
Cayratia sp.		P	
Winteraceae			
Drimys piperita Hook. f. entity *coriacea*			P
Drimys piperita Hook. f. entity *heteromera*	P		P
Drimys piperita Hook. f. entity *montis-wilhelmi*	P		
Zygogynum calothyrsum (Diels) Vink			P
Zygogynum cf. *idenburgensis* A.C. Smith		P	

continued

Taxon	Omyaka	Lake Tawa	Paiela Road + Waile Creek
INDETERMINABLE COLLECTIONS			
sp. 1 (Lamiales)		P	
sp. 2		P	
sp. 3		P	
sp. 4			P
Total	**141**	**257**	**202**

Appendix 3

Total number of birds counted on 'Walking Censuses' in the Kaijende Highlands

Bruce M. Beehler

See Appendix 4 for scientific names and distributional records of all bird species within the study area.

See next page for Appendix 3.

	OMYAKA CAMP 3,200 m												LAKE TAWA 2,120m												Paiela Road 2,900 m							
Transect Details	21Aug:0600-0900 Omyaka	21Aug:1400-1600 Omyaka	22Aug:0600-0900 Omyaka	22Aug:1030-1230 Omyaka	22Aug:1600-1800 Omyaka	23Aug:0600-0900 Omyaka	23Aug:1000-1200 Omyaka	23Aug:1400-1600 Omyaka	24Aug:0600-0900 Omyaka	24Aug:1045-1245 Omyaka	24Aug:1450-1650 Omyaka	25Aug:0600-0900 Omyaka	26Aug:1600-1800 Tawa	27Aug:0600-0900 Tawa	27Aug:1350-1550 Tawa	27Aug:1700-1800 Tawa	28Aug:0600-0900 Tawa	28Aug:1618-1918 Tawa	29Aug:0600-0900 Tawa	29Aug:1300-1500 Tawa	30Aug:0610-0910 Tawa	30Aug:1240-1440 Tawa	31Aug:0615-0915 Tawa	31Aug:1651-1851 Tawa	1Sep:0615-0915 Tawa	4Sep:0937-1237 Paiela Rd	5Sep:0713-1013 Paiala Rd	5Sep:1024-1224 Paiela Rd	6Sep:0614-1014 Paiela Rd	7Sep:0629-0929 Paiela Rd	8Sep:0600-0900 Paiela Rd	10Sep:0600-0900 Paiela Rd	9Sep:0800-1400 Suyan Forest, 2,200 m
Dwarf Cassowary													1																			
Black Kite																																
Brahminy Kite																														1	1		1
Spotted Marsh Harrier					1																											
Black-mantled Goshawk																												1				
New Guinea Harpy-Eagle																					1		1									
Long-tailed Buzzard																																1
Salvadori's Teal																		1			1	1										
Grey Teal																				4												
Pacific Black Duck													1	8	2	3		5		6	12			2								
Brown Quail			5		2	2		1				1	1		1																	
Buff-banded Rail																																
Forbes' Forest-Rail(?)															1																	
Brown Cuckoo-Dove																																
Black-billed Cuckoo-Dove																	1		1			1									1	
Great Cuckoo-Dove																	1				1	1										
Bronze Ground-Dove																	1															

continued

	OMYAKA CAMP 3,200 m												LAKE TAWA 2,120m												Paiela Road 2,900 m							
Transect Details	21Aug:0600-0900 Omyaka	21Aug:1400-1600 Omyaka	22Aug:0600-0900 Omyaka	22Aug:1030-1230 Omyaka	22Aug:1600-1800 Omyaka	23Aug:0600-0900 Omyaka	23Aug:1000-1200 Omyaka	23Aug:1400-1600 Omyaka	24Aug:0600-0900 Omyaka	24Aug:1045-1245 Omyaka	24Aug:1450-1650 Omyaka	25Aug:0600-0900 Omyaka	26Aug:1600-1800 Tawa	27Aug:0600-0900 Tawa	27Aug:1350-1550 Tawa	27Aug:1700-1800 Tawa	28Aug:0600-0900 Tawa	28Aug:1618-1918 Tawa	29Aug:0600-0900 Tawa	29Aug:1300-1500 Tawa	30Aug:0610-0910 Tawa	30Aug:1240-1440 Tawa	31Aug:0615-0915 Tawa	31Aug:1651-1851 Tawa	1Sep:0615-0915 Tawa	4Sep:0937-1237 Paiela Rd	5Sep:0713-1013 Paiela Rd	5Sep:1024-1224 Paiela Rd	6Sep:0614-1014 Paiela Rd	7Sep:0629-0929 Paiela Rd	8Sep:0600-0900 Paiela Rd	10Sep:0600-0900 Paiela Rd	9Sep:0800-1400 Suyan Forest, 2,200 m
Ornate Fruit-Dove																																
White-breasted Fruit-Dove													1	2		1	1		1		2	3	1	1								
Papuan Mountain Pigeon	5					4											1				1						1		2	2	1	3	
Goldie's Lorikeet													14	3		8	4	7	3	3	3	2		10	1								
Papuan Lorikeet	6		2	1		5	2		8			1	1	1	3		3	1	1	1	1	1	4	2	2	2		3			4		
Yellow-billed Lorikeet																																2
Plum-faced Lorikeet	15	7	9	8	6	5	3	7	12	2	12	2					1									2	5	9	3	1	14	3	
Orange-billed Lorikeet		2				2	5				2			2	1	2	1	4			5	2						2	2			3	
Brehm's Tiger-Parrot																								1			2				1	
Painted Tiger-Parrot				2			1	1																								
Red-breasted Pygmy-Parrot																																3
Brush Cuckoo																																
Fan-tailed Cuckoo					1												1	1			1				1		1		1		1	
Rufous-throated Bronze-Cuckoo														1			1		1		1						2	1	1	2	2	1	
Sooty Owl																																
Feline Owlet-nightjar																																

continued

	OMYAKA CAMP 3,200 m												LAKE TAWA 2,120m												Paiela Road 2,900 m							
Transect Details	21Aug:0600-0900 Omyaka	21Aug:1400-1600 Omyaka	22Aug:0600-0900 Omyaka	22Aug:1030-1230 Omyaka	22Aug:1600-1800 Omyaka	23Aug:0600-0900 Omyaka	23Aug:1000-1200 Omyaka	23Aug:1400-1600 Omyaka	24Aug:0600-0900 Omyaka	24Aug:1045-1245 Omyaka	24Aug:1450-1650 Omyaka	25Aug:0600-0900 Omyaka	26Aug:1600-1800 Tawa	27Aug:0600-0900 Tawa	27Aug:1350-1550 Tawa	27Aug:1700-1800 Tawa	28Aug:0600-0900 Tawa	28Aug:1618-1918 Tawa	29Aug:0600-0900 Tawa	29Aug:1300-1500 Tawa	30Aug:0610-0910 Tawa	30Aug:1240-1440 Tawa	31Aug:0615-0915 Tawa	31Aug:1651-1851 Tawa	1Sep:0615-0915 Tawa	4Sep:0937-1237 Paiela Rd	5Sep:0713-1013 Paiala Rd	5Sep:1024-1224 Paiela Rd	6Sep:0614-1014 Paiela Rd	7Sep:0629-0929 Paiela Rd	8Sep:0600-0900 Paiela Rd	10Sep:0600-0900 Paiela Rd	9Sep:0800-1400 Suyan Forest, 2,200 m
Mountain Nightjar																								1							1		
Mountain Swiftlet	2	2		1	1	1	3	2		1	1		1	11	3	5	2	1	4	2	2	2	1	7	2	3		1	1	7	2	1	1
Glossy Swiftlet	1		2		2	2		4	2	1	2	1					1	2			2				1	9	9	8	12	8	9	8	2
Shovel-billed Kingfisher													1	3			4	2	3		6		3		4							
Sacred Kingfisher																																
Rainbow Bee-eater																												20				
Pacific Swallow																																
Alpine Pipit						2	2																									
Hooded Cuckoo-shrike														1																1		
Black-bellied Cuckoo-shrike													3	1	2		2		2			2	2		1							
Long-tailed Shrike																					1											
Pied Chat	1		3				1	1			1																				1	1
Island Thrush	15	2	2		3	3			1	2	1	1														1				2	4	
Lesser Melampitta			2		1	1		2	3		1	1	1		1								1		2	1	2		2	2	3	2	
Blue-capped Ifrita						2	1		1			1					3			1	2		1		2				3	2	2	1	
Tawny Grassbird	10	1	9	1	6	6	2	1	1	1	1	3	1	3	2	2	4	2	3	1	4	2	1		4	2	3	4	3	4	2	2	1
Island Leaf-Warbler																																3
Orange-crowned Fairy-wren																																
Mountain Mouse-warbler	2	1	2	1		1	1	1	1		1	1		1	1		2		3		2		2	1	2		5	3	2	1	3	3	
Large Scrubwren					3	1	1	4	6					2	5		3	1		4	4		5	2		1		4	2	1	4	4	

continued

	OMYAKA CAMP 3,200 m												LAKE TAWA 2,120m												Paiela Road 2,900 m							
Transect Details	21Aug:0600-0900 Omyaka	21Aug:1400-1600 Omyaka	22Aug:0600-0900 Omyaka	22Aug:1030-1230 Omyaka	22Aug:1600-1800 Omyaka	23Aug:0600-0900 Omyaka	23Aug:1000-1200 Omyaka	23Aug:1400-1600 Omyaka	24Aug:0600-0900 Omyaka	24Aug:1045-1245 Omyaka	24Aug:1450-1650 Omyaka	25Aug:0600-0900 Omyaka	26Aug:1600-1800 Tawa	27Aug:0600-0900 Tawa	27Aug:1350-1550 Tawa	27Aug:1700-1800 Tawa	28Aug:0600-0900 Tawa	28Aug:1618-1918 Tawa	29Aug:0600-0900 Tawa	29Aug:1300-1500 Tawa	30Aug:0610-0910 Tawa	30Aug:1240-1440 Tawa	31Aug:0615-0915 Tawa	31Aug:1651-1851 Tawa	1Sep:0615-0915 Tawa	4Sep:0937-1237 Paiela Rd	5Sep:0713-1013 Paiala Rd	5Sep:1024-1224 Paiela Rd	6Sep:0614-1014 Paiela Rd	7Sep:0629-0929 Paiela Rd	8Sep:0600-0900 Paiela Rd	10Sep:0600-0900 Paiela Rd	9Sep:0800-1400 Suyan Forest, 2,200 m
Papuan Scrubwren									2			1							3		4					5	5	3	6	7	5	6	
Buff-faced Scrubwren																																4
New Guinea Thornbill							3																						1	3	1	5	
Brown-breasted Gerygone	1		4				1			1	1	1		4											1	1		1	1		1		4
Dimorphic Fantail	1	1	2	4	1	2	1		2	1	1	2	1				5	3	1	1	1		1		1	1	2		1	3	2	1	
Friendly Fantail	3		1	1		2	2	1	1	1		1			1		1			4	1	1	3	1		1	3	1	2	1	2	3	1
Black Fantail																	2	1			1	1		1	1								1
Willie Wagtail																																	2
Black Monarch																						1		1									
Canary Flycatcher															1						2			3			1	1	1	2	2	1	2
Garnet Robin									2																				1	1	1	1	
Mountain Robin		2								2																							
Black-breasted Boatbill							2	1	2				1	1	1	1	1	3	1		3	1	2	1			1	2		2	2		
Black-throated Robin																											1		2	1	2		
Ashy Robin																			2														
"Greater Ground-Robin"?																													1	2	1		
Lesser Ground-Robin																	1		1	1	2			1	1								
White-winged Robin	1		6	3	1	3	3	1	4		2	1																		1	1	3	
Blue-grey Robin																				1		1	1	1									1

continued

	OMYAKA CAMP 3,200 m												LAKE TAWA 2,120m												Paiela Road 2,900 m							
Transect Details	21Aug:0600-0900 Omyaka	21Aug:1400-1600 Omyaka	22Aug:0600-0900 Omyaka	22Aug:1030-1230 Omyaka	22Aug:1600-1800 Omyaka	23Aug:0600-0900 Omyaka	23Aug:1000-1200 Omyaka	23Aug:1400-1600 Omyaka	24Aug:0600-0900 Omyaka	24Aug:1045-1245 Omyaka	24Aug:1450-1650 Omyaka	25Aug:0600-0900 Omyaka	26Aug:1600-1800 Tawa	27Aug:0600-0900 Tawa	27Aug:1350-1550 Tawa	27Aug:1700-1800 Tawa	28Aug:0600-0900 Tawa	28Aug:1618-1918 Tawa	29Aug:0600-0900 Tawa	29Aug:1300-1500 Tawa	30Aug:0610-0910 Tawa	30Aug:1240-1440 Tawa	31Aug:0615-0915 Tawa	31Aug:1651-1851 Tawa	1Sep:0615-0915 Tawa	4Sep:0937-1237 Paiela Rd	5Sep:0713-1013 Paiala Rd	5Sep:1024-1224 Paiela Rd	6Sep:0614-1014 Paiela Rd	7Sep:0629-0929 Paiela Rd	8Sep:0600-0900 Paiela Rd	10Sep:0600-0900 Paiela Rd	9Sep:0800-1400 Suyan Forest, 2,200 m
Sclater's Whistler																	1								1								
Regent Whistler																															1	4	
Brown-backed Whistler	1	1				1	2	1	2	1	1																1	1		1	1	4	1	
Rufous-naped Whistler	1	3	1	1	6	1			1	1	1	1	2	2			1							1	1			1	1	1	3	3	3	
Black Sittella																																	
Papuan Flowerpecker																																	1
Fan-tailed Berrypecker	1		4	1		1	2	1	2		2			1	2		1							2	1	1	4	1	1	1	4	5	1	
Crested Berrypecker	3	1	5	5	2	1	7	6	5			3																			3		2	
White-eye species																	6																	10
Olive Straightbill																																	
Red-collared Myzomela	1	1				2		2																			17	11	12	9	10	15	6	2
Black-throated Honeyeater	4	1	6	4	2	7	1		4	1	2	3	2	3	2	3	8	2	4		4	1		4	2	5	5		1	1	1	1	1	
Rufous-backed Honeyeater													1	1	1		1	4	5	1	2	2	6	3	7								
Grey-streaked Honeyeater	3	1	2	3	5		3	2	3	1	4	2															7	8	5	8	6	5	5	
Sooty Melidectes	10	4	5	5	4	6	5	3	8	6	3	6															1	5	3		2	2		
Long-bearded Melidectes	1		2		3	2	2		1																								
Belford's Melidectes	20	15	21	13	10	18	9	9	27	7	11	13	3	6	5	6	13	10	11	8	10	6	9	10	15	14	17	11	17	20	17	13	

continued

	OMYAKA CAMP 3,200 m												LAKE TAWA 2,120m													Paiela Road 2,900 m							
Transect Details	21Aug:0600-0900 Omyaka	21Aug:1400-1600 Omyaka	22Aug:0600-0900 Omyaka	22Aug:1030-1230 Omyaka	22Aug:1600-1800 Omyaka	23Aug:0600-0900 Omyaka	23Aug:1000-1200 Omyaka	23Aug:1400-1600 Omyaka	24Aug:0600-0900 Omyaka	24Aug:1045-1245 Omyaka	24Aug:1450-1650 Omyaka	25Aug:0600-0900 Omyaka	26Aug:1600-1800 Tawa	27Aug:0600-0900 Tawa	27Aug:1350-1550 Tawa	27Aug:1700-1800 Tawa	28Aug:0600-0900 Tawa	28Aug:1618-1918 Tawa	29Aug:0600-0900 Tawa	29Aug:1300-1500 Tawa	30Aug:0610-0910 Tawa	30Aug:1240-1440 Tawa	31Aug:0615-0915 Tawa	31Aug:1651-1851 Tawa	1Sep:0615-0915 Tawa	4Sep:0937-1237 Paiela Rd	5Sep:0713-1013 Paiela Rd	5Sep:1024-1224 Paiela Rd	6Sep:0614-1014 Paiela Rd	7Sep:0629-0929 Paiela Rd	8Sep:0600-0900 Paiela Rd	10Sep:0600-0900 Paiela Rd	9Sep:0800-1400 Suyan Forest, 2,200 m
Yellow-browed Melidectes																																10
Common Smoky Honeyeater	10	5	6	6	6	4	5	5	10	2	2	1	5			4	5	2			2	5	6	6	3	6	13	5	1	7	10	4	2
Blue-faced Parrot-Finch	2		1														1									1	3	1			1		1
Hooded Mannikin																	4	3	3													
Mountain Firetail			1		1		1																			1	2		2	4	3	1	
Great Wood-swallow																																
Crested Bird of Paradise				?																												
Loria's BoP																						1			1							
Short-tailed Paradigalla														1							1				1							
Brown Sicklebill																	2	1	4				1	1	1		2		2		2	1	
Black Sicklebill																																
Ribbon-tailed Astrapia	1		1			1	3		1		1	1	2	3		1	1			1	1	4	1		1	1	9	1	1	1	6	3	
Superb Bird of Paradise																																
King of Saxony Bird of Paradise															1		2	1	2			1	1	1	1		4	1	1	1	2	2	
Total individuals during censuses	**121**	**50**	**104**	**60**	**67**	**88**	**74**	**56**	**112**	**31**	**53**	**48**	**43**	**61**	**36**	**36**	**93**	**57**	**59**	**39**	**86**	**42**	**55**	**63**	**61**	**87**	**125**	**105**	**95**	**118**	**148**	**105**	**57**
Total no. species = 102																								**Grand total number of individuals**								**2,435**	

Appendix 4

Bird species documented at four sites in the Kaijende Highlands of Enga Province, Papua New Guinea

Bruce M. Beehler and Robert Sine

Species		Mine & Campus (2,200 m)	Suyan Forest (2,200 m)	Lake Tawa (2,100–2,300 m)	Paiela Road (2,900 m)	Omyaka Camp (3,200 m)
Dwarf Cassowary	*Casuarius bennetti*			X		
Black Kite	*Milvus migrans*	X				
Brahminy Kite	*Haliastur indus*	X	X		X	
Spotted Marsh Harrier	*Circus spilonotus*					X
Black-mantled Goshawk	*Accipiter melanochlamys*				X	
New Guinea Harpy-Eagle	*Harpyopsis novaeguineae*			X		
Long-tailed Buzzard	*Henicopernis longicauda*		X			
Salvadori's Teal	*Salvadorina waigiuensis*			X		
Grey Teal	*Anas gibberifrons*			X		
Pacific Black Duck	*Anas superciliosa*			X		
Brown Quail	*Coturnix australis*	X		X		X
Buff-banded Rail	*Gallirallus philippensis*	X				
Forbes' Forest-Rail(?)	*Rallicula forbesi*			X		
Brown Cuckoo-Dove	*Macropygia amboinensis*	X				
Black-billed Cuckoo-Dove	*Macropygia nigrirostris*	X		X	X	
Great Cuckoo-Dove	*Reinwardtoena reinwardtii*			X		
Bronze Ground-Dove	*Gallicolumba beccarii*			X		
Ornate Fruit-Dove	*Ptilinopus ornatus*	X				
White-breasted Fruit-Dove	*Ptilinopus rivoli*			X		
Papuan Mountain Pigeon	*Gymnophaps albertisii*			X	X	X
Goldie's Lorikeet	*Psitteuteles goldiei*	X		X		
Papuan Lorikeet	*Charmosyna papou*			X	X	X
Yellow-billed Lorikeet	*Neopsittacus musschenbroekii*		X			
Plum-faced Lorikeet	*Oreopsittacus arfaki*			X	X	X
Orange-billed Lorikeet	*Neopsittacus pullicauda*			X	X	X
Brehm's Tiger-Parrot	*Psittacella brehmii*			X	X	
Painted Tiger-Parrot	*Psittacella picta*					X

continued

Species		Mine & Campus (2,200 m)	Suyan Forest (2,200 m)	Lake Tawa (2,100–2,300 m)	Paiela Road (2,900 m)	Omyaka Camp (3,200 m)
Red-breasted Pygmy-Parrot	*Micropsitta bruijnii*		X			
Brush Cuckoo	*Cacomantis variolosus*	X				
Fan-tailed Cuckoo	*Cacomantis flabelliformis*			X	X	X
Rufous-throated Bronze-Cuckoo	*Chrysococcyx ruficollis*			X	X	
Sooty Owl	*Tyto tenebricosa*			X		
Feline Owlet-nightjar	*Aegotheles insignis*			X		
Mountain Nightjar	*Eurostopodus archboldi*			X	X	
Mountain Swiftlet	*Collocalia hirundinacea*	X	X	X	X	X
Glossy Swiftlet	*Collocalia esculenta*	X	X	X	X	X
Shovel-billed Kingfisher	*Clytoceyx rex*			X		
Sacred Kingfisher	*Todiramphus sanctus*	X				
Rainbow Bee-eater	*Merops ornatus*				X	
Pacific Swallow	*Hirundo tahitica*	X				
Alpine Pipit	*Anthus gutturalis*					X
Hooded Cuckoo-shrike	*Coracina longicauda*			X	X	
Black-bellied Cuckoo-shrike	*Coracina montana*			X		
Long-tailed Shrike	*Lanius schach*	X		X		
Pied Chat	*Saxicola caprata*	X				X
Island Thrush	*Turdus poliocephalus*				X	X
Lesser Melampitta	*Melampitta lugubris*			X	X	X
Blue-capped Ifrita	*Ifrita kowaldi*			X	X	X
Tawny Grassbird	*Megalurus timoriensis*	X		X	X	X
Island Leaf-Warbler	*Phylloscopus poliocephalus*		X			
Orange-crowned Fairy-wren	*Clytomyias insignis*					
Mountain Mouse-warbler	*Crateroscelis robusta*			X	X	X
Large Scrubwren	*Sericornis nouhuysi*			X	X	X
Papuan Scrubwren	*Sericornis papuensis*			X	X	X
Buff-faced Scrubwren	*Sericornis perspicillatus*		X			
New Guinea Thornbill	*Acanthiza murina*				X	X
Brown-breasted Gerygone	*Gerygone ruficollis*	X	X	X	X	X
Dimorphic Fantail	*Rhipidura brachyrhyncha*			X	X	X
Friendly Fantail	*Rhipidura albolimbata*		X	X	X	X
Black Fantail	*Rhipidura atra*		X	X		
Willie Wagtail	*Rhipidura leucophrys*	X				
Black Monarch	*Monarcha axillaris*			X		
Canary Flycatcher	*Microeca papuana*		X	X	X	
Garnet Robin	*Eugerygone rubra*				X	X
Mountain Robin	*Petroica bivittata*					X
Black-breasted Boatbill	*Machaerirhynchus nigripectus*			X	X	X

continued

Species		Mine & Campus (2,200 m)	Suyan Forest (2,200 m)	Lake Tawa (2,100–2,300 m)	Paiela Road (2,900 m)	Omyaka Camp (3,200 m)
Black-throated Robin	*Poecilodryas albonotata*				X	
Ashy Robin	*Poecilodryas albispecularis*			X		
"Greater Ground-Robin"?	*Amalocichla sclateriana*				X	
Lesser Ground-Robin	*Amalocichla incerta*			X		
White-winged Robin	*Peneothello sigillatus*				X	X
Blue-grey Robin	*Peneothello cyanus*		X	X		
Sclater's Whistler	*Pachycephala soror*			X		
Regent Whistler	*Pachycephala schlegelii*				X	
Brown-backed Whistler	*Pachycephala modesta*				X	X
Rufous-naped Whistler	*Aleadryas rufinucha*			X	X	X
Black Sittella	*Daphoenositta miranda*			X		
Papuan Flowerpecker	*Dicaeum pectorale*		X			
Fan-tailed Berrypecker	*Melanocharis versteri*			X	X	X
Crested Berrypecker	*Paramythia montium*				X	X
White-eye species	*Zosterops* sp.	X	X	X		
Olive Straightbill	*Timeliopsis fulvigula*			X		
Red-collared Myzomela	*Myzomela rosenbergii*		X		X	X
Black-throated Honeyeater	*Lichenostomus subfrenatus*		X	X	X	X
Rufous-backed Honeyeater	*Ptiloprora guisei*			X		
Grey-streaked Honeyeater	*Ptiloprora perstriata*				X	X
Sooty Melidectes	*Melidectes fuscus*				X	X
Long-bearded Melidectes	*Melidectes princeps*					X
Belford's Melidectes	*Melidectes belfordi*			X	X	X
Yellow-browed Melidectes	*Melidectes rufocrissalis*	X	X			
Common Smoky Honeyeater	*Melipotes fumigatus*		X	X	X	X
Blue-faced Parrot-Finch	*Erythrura trichroa*			X	X	X
Hooded Mannikin	*Lonchura spectabilis*	X		X		
Mountain Firetail	*Oreostruthus fuliginosus*				X	X
Great Wood-swallow	*Artamus maximus*	X				
Crested Bird of Paradise	*Cnemophilus macgregorii*					?
Loria's BoP	*Cnemophilus loriae*			X		
Short-tailed Paradigalla	*Paradigalla brevicauda*			X		
Brown Sicklebill	*Epimachus meyeri*			X	X	
Black Sicklebill	*Epimachus fastuosus*		X			
Ribbon-tailed Astrapia	*Astrapia mayeri*			X	X	X
Superb Bird of Paradise	*Lophorina superba*	X				
King of Saxony Bird of Paradise	*Pteridophora alberti*			X	X	
	Total species 102	**23**	**20**	**61**	**48**	**41**

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Central America

† Belize: Columbia River Forest Reserve. Parker, T.A. III. (ed.). 1993. A Biological Assessment of the Columbia River Forest Reserve, Toledo District, Belize. RAP Working Papers 3. Conservation International, Washington, DC.

* Guatemala: Laguna del Tigre National Park. Bestelmeyer, B. and L.E. Alonso (eds.). 2000. A Biological Assessment of Laguna del Tigre National Park, Petén, Guatemala. RAP Bulletin of Biological Assessment 16. Conservation International, Washington, DC.

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* Indonesia: Togean and Banggai Islands. Allen, G.R., and S.A. McKenna (eds.). 2001. A Marine Rapid Assessment of the Togean and Banggai Islands, Sulawesi, Indonesia. RAP Bulletin of Biological Assessment 20. Conservation International, Washington, DC.

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