



## **Birds of the Kaijende Highlands, Enga Province, Papua New Guinea**

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## Chapter 3

### Birds of the Kaijende Highlands, Enga Province, Papua New Guinea

Bruce M. Beehler and Robert Sine

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#### SUMMARY

Nineteen days of surveys at four sites between 2,117 m and 3,200 m elevation in the Kaijende Highlands of western Papua New Guinea detected 102 species of birds. The Long-bearded Melidectes (*Melidectes princeps*) was recorded for the first time west of the Mount Hagen massif. It presumably ranges westward at high elevations to the Strickland Gap. The Ribbon-tailed Astrapia (*Astrapia mayeri*) was common from 2,117 m at Lake Tawa to 3,200 m at Omyaka Camp. We did not encounter Stephanie's Astrapia (*Astrapia stephaniae*). Its westernmost range extension must lie east of Porgera valley in the north, although it extends west to the Doma Peaks/Tari Gap area in the south.

The Crested Bird of Paradise (*Cnemophilus macgregorii*) was not encountered on this survey, but one local informant at Omyaka Camp stated that it was present and it was collected during a 1989 survey (Kula 1989). It appears that this species is rare or absent between the Hagen/Giluwe area and the Star Mountains of Papua (Indonesia). This provides an intermediate-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. This could serve as a useful biodiversity offset for the Porgera mine operation.

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#### INTRODUCTION

Study of the geographic distribution of birds in Papua New Guinea has reached the phase where most field surveys provide fine-tuning of the elevational and geographic distribution of a few interesting species endemic to Papua New Guinea, while also confirming the excellent state of our knowledge of many of the more common and widespread species (Coates 2001). This rapid assessment of the bird fauna of the Kaijende Highlands produced some interesting distributional records that help to further clarify the pattern and process of differentiation of the montane forest birds of New Guinea.

Few surveys of the western highlands regions of Papua New Guinea have been undertaken, but most of these were individually comprehensive (see Frith and Beehler 1998, Appendix 2). To the southeast of our area of focus, the Mount Hagen massif was surveyed repeatedly for birds between 1938 and 1956 by Shaw Mayer, Blood, Gilliard, and Bulmer, and Mount Giluwe was worked between 1961 and 1973 by the Schoddes, Clissold, Sedlacek, and Mirza (in Frith and Beehler 1998, Appendix 2).

To the south and west of our area of focus, surveys were conducted as follows: The Tari Gap/Doma Peaks were surveyed between 1983 and 1991 by Mackay, the Friths, a PNG Department of Environment and Conservation (DEC) team, and Laska (in Frith and Beehler 1998, Appendix 2). The Victor Emanuel and Hindenburg Ranges were surveyed between 1954 and 1997 by Gilliard, Bell, Mirza, Wanga, Murray, and Gregory (in Frith and Beehler 1998, Appendix 2).

The Enga highlands of Kompiam (east of the Kaijende Highlands) were surveyed by Whiteside in 1994 (in Frith and Beehler 1998, Appendix 3), and the Kaijende Highlands above the Porgera mine were surveyed by a DEC team in the 1980s (G. Kula pers. comm.). Here we report the results of a brief but intensive survey of the Kaijende Highlands conducted at elevations between 2,117 m a.s.l. and 3,200 m a.s.l.

## METHODS AND STUDY SITES

### Field methods

Birds were surveyed during daily walking censuses and these data were supplemented by mist-netting (at Lake Tawa only) and through interviews with knowledgeable local naturalists who accompanied and assisted our field parties. 'Walking Censuses' were conducted by the senior author in the early morning, mid-morning, and again in the afternoon. Early morning surveys were typically three hours long and the later surveys were usually two hours long. During each survey the observer walked slowly and quietly through a selected habitat, and noted all birds heard and seen. An attempt was made to count individuals once per walk. The main objective of the surveys was to record all bird species present in each habitat, with a secondary objective being to obtain a general indication of relative species abundance.

Mist-netting at Lake Tawa followed standard procedures (Beehler and Mack 1999). Nets were set in places where high capture rates could be expected, including thickets, ridgecrests, and areas of regenerating low vegetation. They were operated and tended from dawn to dusk, and in some instances nets were opened at night to capture bats and night birds. Birds were weighed and measured and then marked by cutting the tip of an outer tail feather. Recaptured birds were released from the net without being measured again.

### Study sites

Intensive surveys were conducted at the four sites described below. Additional details on the vegetation and habitat characteristics of each site can be found in Chapter 1.

Omyaka Camp (5°31' 37" S, 143° 03' 23" E, 3,200 m elevation) was situated in the forested verge of an open grassland valley. The main walking track from Porgera to the Mount Kare mine traverses the center of the valley. A forest mosaic dominates the slopes and the bases of the slopes around the valley, whereas alpine tussock grass and scattered treeferns dominate the valley floor. The forest was low (typically no more than 12 m), closed-canopy upper montane/subalpine forest. Trees were moss-encrusted and trunks were twisted and irregular. The tree flora included broadleaf taxa (e.g., *Decaspermum*, *Eurya*, *Ilex*, *Prunus*, *Quintinia*, *Symplocos*, *Syzygium*, *Vaccinium*, *Xanthomyrtus*, *vide* Takeuchi, Chapter 1, this volume) and gymnosperms (e.g., *Libocedrus*, *Podocarpus*, *Phyllocladus*, *Dacrydium*, *vide* Takeuchi, Chapter 1, this volume). These gnarly elfin woodlands were edged by

a shrubland (with *Vaccinium*, *Melicope*, *Olearia*, *vide* Takeuchi, Chapter 1, this volume) that gave way to grasslands.

Lake Tawa Camp (5°35' 43" S, 142°50' 26" E, 2,117 m) was set in a remarkable closed montane basin whose catchment drained exclusively through one or more major sinkholes. The basin features several small inter-connected lakes, whose level rose and fell with the rainfall because of low drainage capacity of the sinkholes. A narrow band of lake-associated grassland encircled the lakes, and *Pandanus*-dominated forest bordered the grasslands. The forest interior was lower montane closed forest containing *Syzygium*, *Symplocos*, and *Lithocarpus* (*vide* Takeuchi, Chapter 1, this volume). Flat ridgetops that we visited exhibited a *Pandanus* scrub with scrambling ferns dominating the ground layer.

Paiela Road (5°30' 12" S, 143°5' 6" E, 2,800–2,900 m). We surveyed this road daily while based at the mine camp at Suyan. The road traverses the northeastern face of Mount Kumbepara, extending from the Waile Creek Road junction in a mainly north-westerly direction. It cuts through relatively undisturbed upper montane forest that afforded excellent conditions for bird survey.

Mine Environs and Suyan Forest (5°29' 12" S, 143° 9' E, 2,150 m). We observed birds in and around the Suyan mine camp, and on one full day we observed birds in the adjacent Suyan forest. Accessible habitats were a mix of open mid-montane valley habitats (gardens, grasslands, casuarinas groves, re-growth, remnant forest). The Suyan forest gave access to a lower montane bird fauna that was absent in other sites outlined above. We only imperfectly surveyed this elevational zone because our main focus was the more pristine uplands. We suggest that the zone below 2,200 m merits additional ornithological survey.

## RESULTS AND DISCUSSION

### Survey results

Nineteen days of surveys at four camps between 2,117 m and 3,200 m elevation in the Kaijende Highlands of western Papua New Guinea detected 2,378 individuals of 102 species of birds between 21 August and 9 September 2005. Sixty-two individuals of 26 species were mist-netted at Lake Tawa. Walking censuses at the three principal sites produced comparable numbers of individuals based on similar total search efforts, ranging from 23 to 36 individuals per hour. The summary results of the walking censuses are presented in Table 3.1, and the total numbers of individuals of each species on each census are presented in Appendix 3. Because of the random and fragmentary nature of the Mine/Suyan observations they are not comparable with those from the three primary survey sites, but these results are incorporated into the species list presented in Appendix 4. The discussion that follows focuses mainly on the results obtained from the three major survey sites.

Over the elevational span extending between 2,117 m and 3,200 m there is a linear decrease in species richness with

**Table 3.1.** Results of ‘walking censuses’ of birds in the Kaijende Highlands region, Papua New Guinea.

Location	Surveys/hours	Number of individuals	Number of individuals/hr	Number of Species
Omyaka Camp (3,200 m)	12 surveys/29 hrs	864	28	41
Paiela Road (~2,900 m)	7 surveys/22 hrs	785	36	48
Lake Tawa (2,117 m)	13 surveys/32 hrs	731	23	56

increasing elevation (Figure 3.1). This inverse relationship between elevation and species richness has been reported elsewhere in New Guinea (Diamond 1972, Beehler 1982). Although it is neither new nor counter-intuitive, this is a robust result that can be demonstrated with minimal field effort. It is one of the ornithological “laws” that governs the structuring of bird communities in montane New Guinea (Diamond 1972, Beehler 1982). Given our ability to demonstrate this with a low-investment survey methodology, we suggest the entire elevational range from sea level to 4,000+ m should be surveyed rapidly using walking surveys once there is a compendium of bird recordings for all species along the transect. Such a complete transect has never been attempted. Twenty-five hours at each elevational zone should be adequate to generate a robust dataset. This can then be used to tease out additional environmental patterns, especially the question regarding the putative “spike” in species richness in the hill forest zone, which is likely to be a sampling artifact (Kikkawa and Williams 1971).

#### Distributional notes

A series of notes on the distribution of lesser-known bird species, and those with particular distributional anomalies is presented below.

#### *Clytoceyx rex* (Shovel-billed Kingfisher)

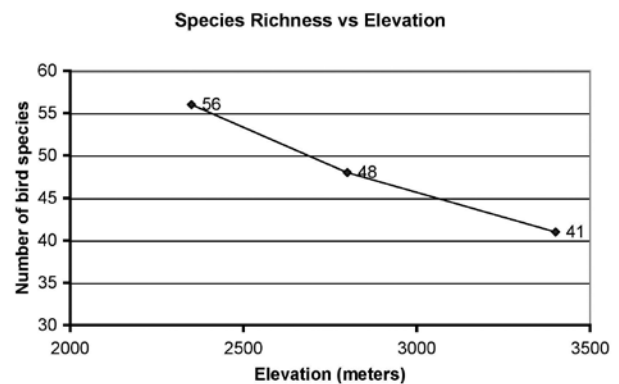
This widespread but rarely observed species was common and vocal at Lake Tawa. It was recorded on 8 of 13 surveys and several birds were heard singing at dawn every morning. We also heard individuals singing at dusk. It was observed at close range on several occasions. A high count of six individuals was made on 30 August.

#### *Petroica bivittata* (Mountain Robin)

This uncommon upper montane species was encountered on two surveys at Omyaka Camp and was also observed there during non-survey periods.

#### *Melidectes princeps* (Long-bearded Melidectes)

This rarely seen and striking high-elevation honeyeater was previously known only as far west as the Hagen Massif. It was observed on six surveys at Omyaka Camp, mainly foraging in shrubbery at the interface between forest and grassland where it was greatly outnumbered by the smaller but

**Figure 3.1.** Elevational trend in species richness of birds in the Kaijende Highlands.

similar Sooty Melidectes (*Melidectes fuscus*). On our 12 censuses we counted 11 Long-bearded Melidectes and 70 Sooty Melidectes. Our record of this species represents a north-westward range extension of 100 km. The Long-bearded Melidectes and Short-bearded Melidectes (*M. noubuysi*) are sister taxa and their relative ranges had stood out as peculiar until recently — with an unexplained gap of several hundred kilometers between the two species. The range of the Short-bearded Melidectes is currently known to extend from Papua Province into the Star Mountains of far-western Papua New Guinea (Gregory and Johnston 1993). Given the pattern exhibited by the ranges of other high cordilleran bird species (e.g., Chestnut Forest-Rail, Splendid *Astrapia*) the Short-bearded Melidectes presumably ranges eastward to the Strickland Gap. We suggest that the Long-bearded Melidectes ranges westward to that same lowland barrier. This species-pair is hypothesized to have speciated across this major barrier for montane birds.

#### *Melidectes rufocrissalis* (Yellow-browed Melidectes)

The lesser-known twin of the *Melidectes belfordii/rufocrissalis* species-pair was found on the grounds of the Suyan Camp, inhabiting wooded copses set among gardens. It occupies a lower elevational zone than does the more abundant and better-known Belford’s Melidectes, with which it read-

ily hybridizes in areas of contact (Gilliard 1959). Belford's *Melidectes* was abundant at Omyaka Camp (mean of 14 individuals per survey) and along the Paiela Road (mean of 16 per survey), and was common at Lake Tawa (mean of 9 per survey). This hybridizing species-pair has caused taxonomic consternation for generations (see Mayr and Gilliard 1952, Gilliard 1959, Diamond 1967, 1972) mainly because of the complex and patchy distribution of *M. rufocrissalis* in the central range of New Guinea, combined with the apparent hybrid ancestry of some populations. Unlike the *M. principis*/*M. nouhuysi* species pair, this one is presumably considerably older, making the unraveling of its history more difficult. It is particularly unusual that the lower-elevation form (*rufocrissalis*) is confined to central New Guinea, whereas the higher-elevation form (*belfordi*) ranges from the Weyland Mountains of the far west to the far southeast of the Owen Stanley Range. The rather straightforward north-west-southeast vicariance that typifies Diamond's "drop-out" model (Diamond 1972) cannot explain this species-pair's distribution. Diamond (1967) noted that most records for *rufocrissalis* were from the northern watershed, and that it is closely related to the morphologically similar *M. leucostephes* of the Bird's Head region of far western Papua Province and *M. foersteri* from the uplands of the Huon Peninsula. In fact *rufocrissalis* is well distributed in the southern watershed, the Tari and Porgera valley populations being two examples. Molecular analyses of component taxa will be required to more fully understand the evolution of this remarkable group. The *Melidectes belfordi*/*rufocrissalis* species-pair offers a wonderful and challenging speciation/hybridization phenomenon whose study will provide an important insight into the geographic differentiation of montane forest birds of New Guinea.

#### ***Cnemophilus macgregorii* (Crested Bird of Paradise)**

Although the *cnemophilines* are no longer considered to be birds of paradise (Cracraft and Feinstein 1999), they remain a fascinating New Guinean cordilleran lineage of uncertain provenance. In the absence of a new taxonomic disposition or group-name, for convenience we retain the original nomenclature in our discussion. The range of the Crested Bird of Paradise is unusual. Like the Blue Bird of Paradise (*Paradisaea rudolphi*) it is confined primarily to mainland New Guinea east of the Strickland Gap. However whereas the Blue Bird of Paradise is entirely confined to territory east of the Strickland, the Crested Bird of Paradise shows a less clear-cut range. It is only found regularly and commonly east of the Gap, but there are a few records from west of the Gap, ranging as far west as east-central Papua. Most strange of all, is that the range of *Cnemophilus macgregorii* exhibits a major hiatus between Mount Hagen/Doma Peaks and the Star Mountains of Papua (see Frith and Beehler 1998, page 184). We searched for this species in vain in the Kaijende uplands, but at least one of our informants reported the species to be present and Kula (1989) collected voucher specimens from the region in 1989. Thus the Crested Bird of Paradise is

common east of the Strickland Gap, but very rare or absent for several hundred kilometers west of the Gap. It then occurs in sparse numbers far west of the Strickland Gap, but apparently does not range as far west as the western terminus of the main cordillera (as does its sister form, Loria's Bird of Paradise). In sum, the species is common in the eastern two-fifths of the central cordillera, more or less absent in the central fifth of New Guinea, sparse in the west-central fifth of New Guinea, and absent from the westernmost fifth of the island.

Although the Strickland Gap seems to be important as a distributional barrier dividing young montane-dwelling species-pairs (e.g., Chestnut/Forbes' Forest-Rails, Splendid/Ribbon-tailed *Astrapias*, Short-bearded/Long-bearded *Melidectes*), most montane species (e.g., Loria's Bird of Paradise, Belford's *Melidectes*, Common Smoky Honeyeater, Red-collared *Myzomela*, Papuan Lorikeet, Great Wood-swallow, and many others) or species-pairs (*Astrapia*, *Melidectes*, *Parotia*) range from one end of the Cordillera to the other (Beehler et al. 1986, Frith and Beehler 1998).

The strange range of the Crested Bird of Paradise seems to exemplify an intermediate step in Diamond's "drop-out" phenomenon. Diamond invoked his "drop-out" model to explain how eastern and western sub-populations achieved geographic isolation along a continuous montane cordillera. The Crested Bird of Paradise seems to have achieved this range disjunction. The western population now has an opportunity to differentiate from the eastern population. This major range discontinuity is much as Diamond illustrated for the Papuan Treecreeper (Diamond 1972). One pressing question arises from the discontinuity of the Crested Bird of Paradise's range. What ecological or demographic process produces these discontinuities? Why is the species common in the east, very rare or absent in the middle of its range, and sparse in the west? Is it simply a stochastic process? Getting a clear answer to this question would provide an important insight into the mechanism of montane speciation in the birds of New Guinea.

The Crested Bird of Paradise's range offers some insight into the possible history of the currently truncated, east-New Guinea only range of the Blue Bird of Paradise. Indeed the range of the former species might closely resemble the Blue's current range if all of the western populations (already rare or very rare) become extinct. Both the Crested and the Blue Birds of Paradise appear to be "older" lineages (neither have extant close sister forms) and thus it is safe to assume that both, at some earlier time, occurred along the entire length of the central cordillera (as Loria's Bird of Paradise does today) but that the western segments of the population have declined — partially in the case of the Crested, and completely in the case of the Blue. These appear to be "senescent" ranges of aging lineages. A similar but reverse pattern can be found for the Yellow-breasted Bird of Paradise, a close relative of Loria's and Crested Birds of Paradise. In the case of the Yellow-breasted Bird of Paradise it is the far eastern

populations of its cordilleran range that have become extinct, leaving just the central and western components.

#### ***Astrapia mayeri* (Ribbon-tailed *Astrapia*)** (Photos 75, 77)

The Kaijende Highlands are the heartland of the circumscribed range of this remarkable species, the last of the birds of paradise to be described to science (Stonor 1939). We encountered no populations of this species' eastern sister form, Stephanie's *Astrapia* (*Astrapia stephaniae*) on our survey, and we were told by informants that the "black-tails" were not present in the area. We know from detailed species-mapping of these two species (Frith and Beehler 1998) that Stephanie's *Astrapia* occurs 165 km to the southeast (Wabag, Kompiam), and 45 km to the south-south-west (Doma Peaks, Ambua). These two *Astrapia* species hybridize freely where they come into contact, but *Astrapia mayeri* generally occupies higher elevations than *A. stephaniae*. At Lake Tawa *Astrapia mayeri* was common (9 of 13 walking surveys). This is the lowest documented elevation that the species has been recorded (2,117 m) although Coates (2001) mentions a record as low as 1,800 m. In the Ambua/Doma Peaks region, where both species are present, *Astrapia mayeri* is found to occupy higher elevations (above 2,500 m). The western terminus of the distribution of *A. mayeri* is unknown, but it is probably the Strickland Gap. The Splendid *Astrapia* (*Astrapia splendidissima*) inhabits the high ranges west of the Strickland Gap. It will be interesting to determine whether *A. mayeri* and *A. splendidissima* meet and hybridize north of the Gap along the central range, north or northwest of the eastward bend of the Strickland in Hewa country.

#### **CONSERVATION RECOMMENDATIONS**

The Kaijende Highlands are spectacular, with remarkable monumental features and wilderness qualities worth conserving. The bird fauna adds to the value of this resource. At least four species of birds of paradise (Brown Sicklebill, Ribbon-tailed *Astrapia*, King of Saxony Bird of Paradise, Short-tailed Paradigalla) inhabit the uplands, and additional species (Superb Bird of Paradise, Black Sicklebill) inhabit forests at lower elevations. The New Guinea Harpy Eagle and Shovel-billed Kingfisher also add biodiversity value to these environments. A community-delineated and managed reserve, focused on uninhabited traditional hunting lands, might be an appropriate vehicle for conserving these remarkable sub-alpine and upper montane environments and their wildlife.

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## 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
<b>FERNS AND LYCOPHYTES</b>			
<b>Adiantaceae</b>			
<i>Adiantum aneitense</i> Carr		P	
<i>Cheilanthes papuana</i> C. Chr.			P
<b>Aspleniaceae</b>			
<i>Asplenium acrobryum</i> Christ		P	
<i>Asplenium adiantoides</i> (L.) C. Chr.		P	
<i>Asplenium nutans</i> Rosenst.		P	P
<i>Asplenium steerei</i> Harrington		P	
<b>Athyriaceae</b>			
<i>Diplazium</i> sp. ?nov.		P	
<b>Blechnaceae</b>			
<i>Blechnum fluviatile</i> (R. Br.) Lowe ex Salomon	P		
<i>Blechnum hieronymi</i> Brause		P	
<i>Blechnum keyseri</i> Rosenst.		P	
<i>Blechnum revolutum</i> (Alderw.) C. Chr.	P		P
<i>Blechnum rosenstockii</i> Copel.			P
<b>Cyatheaceae</b>			
<i>Cyathea aeneifolia</i> (v.A.v.R.) Domin			P
<i>Cyathea atrospinosa</i> Holtt.		P	
<i>Cyathea atrox</i> C. Chr. var. <i>inermis</i> Holtt.	P		Pw
<i>Cyathea dicksonioides</i> Holtt.	P		Pw
<i>Cyathea hornei</i> (Baker) Copel.		P	
<i>Cyathea lepidoclada</i> (Christ) Domin	P		
<i>Cyathea magna</i> Copel.		P	
<i>Cyathea</i> (closest to) <i>magna</i> Copel.			P
<i>Cyathea microphylloides</i> Rosenst.		P	
<i>Cyathea perpeligera</i> v.A.v.R.		P	

*continued*

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

continued



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

continued

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

continued

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

continued

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

continued

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

continued

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

continued

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

continued

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

continued



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

continued

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

continued

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

continued

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

continued

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

continued

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

## 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.















## 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	<i>Casuarius bennetti</i>			X		
Black Kite	<i>Milvus migrans</i>	X				
Brahminy Kite	<i>Haliastur indus</i>	X	X		X	
Spotted Marsh Harrier	<i>Circus spilonotus</i>					X
Black-mantled Goshawk	<i>Accipiter melanochlamys</i>				X	
New Guinea Harpy-Eagle	<i>Harpyopsis novaeguineae</i>			X		
Long-tailed Buzzard	<i>Henicopernis longicauda</i>		X			
Salvadori's Teal	<i>Salvadorina waigiuenis</i>			X		
Grey Teal	<i>Anas gibberifrons</i>			X		
Pacific Black Duck	<i>Anas superciliosa</i>			X		
Brown Quail	<i>Coturnix australis</i>	X		X		X
Buff-banded Rail	<i>Gallirallus philippensis</i>	X				
Forbes' Forest-Rail(?)	<i>Rallacula forbesi</i>			X		
Brown Cuckoo-Dove	<i>Macropygia amboinensis</i>	X				
Black-billed Cuckoo-Dove	<i>Macropygia nigrirostris</i>	X		X	X	
Great Cuckoo-Dove	<i>Reinwardtoena reinwardtii</i>			X		
Bronze Ground-Dove	<i>Gallicolumba beccarii</i>			X		
Ornate Fruit-Dove	<i>Ptilinopus ornatus</i>	X				
White-breasted Fruit-Dove	<i>Ptilinopus rivoli</i>			X		
Papuan Mountain Pigeon	<i>Gymnophaps albertisii</i>			X	X	X
Goldie's Lorikeet	<i>Psitteuteles goldiei</i>	X		X		
Papuan Lorikeet	<i>Charmosyna papou</i>			X	X	X
Yellow-billed Lorikeet	<i>Neopsittacus musschenbroekii</i>		X			
Plum-faced Lorikeet	<i>Oreopsittacus arfaki</i>			X	X	X
Orange-billed Lorikeet	<i>Neopsittacus pullicauda</i>			X	X	X
Brehm's Tiger-Parrot	<i>Psittacella brehmii</i>			X	X	
Painted Tiger-Parrot	<i>Psittacella picta</i>					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	<i>Micropsitta bruijnii</i>		X			
Brush Cuckoo	<i>Cacomantis variolosus</i>	X				
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>			X	X	X
Rufous-throated Bronze-Cuckoo	<i>Chrysococcyx ruficollis</i>			X	X	
Sooty Owl	<i>Tyto tenebricosa</i>			X		
Feline Owlet-nightjar	<i>Aegotheles insignis</i>			X		
Mountain Nightjar	<i>Eurostopodus archboldi</i>			X	X	
Mountain Swiftlet	<i>Collocalia hirundinacea</i>	X	X	X	X	X
Glossy Swiftlet	<i>Collocalia esculenta</i>	X	X	X	X	X
Shovel-billed Kingfisher	<i>Clytoceyx rex</i>			X		
Sacred Kingfisher	<i>Todiramphus sanctus</i>	X				
Rainbow Bee-eater	<i>Merops ornatus</i>				X	
Pacific Swallow	<i>Hirundo tabitica</i>	X				
Alpine Pipit	<i>Anthus gutturalis</i>					X
Hooded Cuckoo-shrike	<i>Coracina longicauda</i>			X	X	
Black-bellied Cuckoo-shrike	<i>Coracina montana</i>			X		
Long-tailed Shrike	<i>Lanius schach</i>	X		X		
Pied Chat	<i>Saxicola caprata</i>	X				X
Island Thrush	<i>Turdus poliocephalus</i>				X	X
Lesser Melampitta	<i>Melampitta lugubris</i>			X	X	X
Blue-capped Ifrita	<i>Ifrita kowaldi</i>			X	X	X
Tawny Grassbird	<i>Megalurus timoriensis</i>	X		X	X	X
Island Leaf-Warbler	<i>Phylloscopus poliocephalus</i>		X			
Orange-crowned Fairy-wren	<i>Clytomyias insignis</i>					
Mountain Mouse-warbler	<i>Crateroscelis robusta</i>			X	X	X
Large Scrubwren	<i>Sericornis nouhuysi</i>			X	X	X
Papuan Scrubwren	<i>Sericornis papuensis</i>			X	X	X
Buff-faced Scrubwren	<i>Sericornis perspicillatus</i>		X			
New Guinea Thornbill	<i>Acanthiza murina</i>				X	X
Brown-breasted Gerygone	<i>Gerygone ruficollis</i>	X	X	X	X	X
Dimorphic Fantail	<i>Rhipidura brachyrhyncha</i>			X	X	X
Friendly Fantail	<i>Rhipidura albolimbata</i>		X	X	X	X
Black Fantail	<i>Rhipidura atra</i>		X	X		
Willie Wagtail	<i>Rhipidura leucophrys</i>	X				
Black Monarch	<i>Monarcha axillaris</i>			X		
Canary Flycatcher	<i>Microeca papuana</i>		X	X	X	
Garnet Robin	<i>Eugerygone rubra</i>				X	X
Mountain Robin	<i>Petroica bivittata</i>					X
Black-breasted Boatbill	<i>Machaerirhynchus nigripectus</i>			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	<i>Poecilodryas albonotata</i>				X		
Ashy Robin	<i>Poecilodryas albispectularis</i>			X			
“Greater Ground-Robin”?	<i>Amalocichla sclateriana</i>				X		
Lesser Ground-Robin	<i>Amalocichla incerta</i>			X			
White-winged Robin	<i>Peneothello sigillatus</i>				X	X	
Blue-grey Robin	<i>Peneothello cyanus</i>		X	X			
Sclater’s Whistler	<i>Pachycephala soror</i>			X			
Regent Whistler	<i>Pachycephala schlegelii</i>				X		
Brown-backed Whistler	<i>Pachycephala modesta</i>				X	X	
Rufous-naped Whistler	<i>Aleadryas rufinucha</i>			X	X	X	
Black Sittella	<i>Daphoenositta miranda</i>			X			
Papuan Flowerpecker	<i>Dicaeum pectorale</i>		X				
Fan-tailed Berrypecker	<i>Melanocharis versteri</i>			X	X	X	
Crested Berrypecker	<i>Paramythia montium</i>				X	X	
White-eye species	<i>Zosterops</i> sp.	X	X	X			
Olive Straightbill	<i>Timeliopsis fulvigula</i>			X			
Red-collared Myzomela	<i>Myzomela rosenbergii</i>		X		X	X	
Black-throated Honeyeater	<i>Lichenostomus subfrenatus</i>		X	X	X	X	
Rufous-backed Honeyeater	<i>Ptiloprora guisei</i>			X			
Grey-streaked Honeyeater	<i>Ptiloprora perstriata</i>				X	X	
Sooty Melidectes	<i>Melidectes fuscus</i>				X	X	
Long-bearded Melidectes	<i>Melidectes princeps</i>					X	
Belford’s Melidectes	<i>Melidectes belfordi</i>			X	X	X	
Yellow-browed Melidectes	<i>Melidectes rufocrissalis</i>	X	X				
Common Smoky Honeyeater	<i>Melipotes fumigatus</i>		X	X	X	X	
Blue-faced Parrot-Finch	<i>Erythrura trichroa</i>			X	X	X	
Hooded Mannikin	<i>Lonchura spectabilis</i>	X		X			
Mountain Firetail	<i>Oreostruthus fuliginosus</i>				X	X	
Great Wood-swallow	<i>Artamus maximus</i>	X					
Crested Bird of Paradise	<i>Cnemophilus macgregorii</i>					?	
Loria’s BoP	<i>Cnemophilus loriae</i>			X			
Short-tailed Paradigalla	<i>Paradigalla brevicauda</i>			X			
Brown Sicklebill	<i>Epimachus meyeri</i>			X	X		
Black Sicklebill	<i>Epimachus fastuosus</i>		X				
Ribbon-tailed Astrapia	<i>Astrapia mayeri</i>			X	X	X	
Superb Bird of Paradise	<i>Lophorina superba</i>	X					
King of Saxony Bird of Paradise	<i>Pteridophora alberti</i>			X	X		
<b>Total species</b>		<b>102</b>	<b>23</b>	<b>20</b>	<b>61</b>	<b>48</b>	<b>41</b>



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