



Expedition Report: “In Search of Ghosts”

An expedition to rediscover the Wondiwai Tree Kangaroo

**Sir Charles Blois Award for Science and Adventure 2021
Scientific Expedition Society**

Wondiwai Mountains, West Papua, July 2024

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Acknowledgements

I would like to express my sincere gratitude to Sir Charles Blois for his generous support in providing the initial financing for this expedition. His belief in this project was instrumental in making it possible.

I would also like to extend my heartfelt thanks to Oxford University, the Oak Foundation, and my dedicated expedition team members for their invaluable contributions and support throughout this endeavor.

OVERVIEW:

The outlying mountain ranges of Indonesian New Guinea are some of the least explored in the world, constituting a last frontier for scientific discovery. One such range is the Wondiwoi Mountains, situated on the Wandammen Peninsula in West Papua, Indonesia. Characterized by steep slopes, high ridges, plunging valleys, and narrow-walled gorges, the rugged topography of this range makes it a challenge to survey – that is, if you can even get to the range itself. The mountain range is currently a protected reserve and requires permission to enter from local authorities in Wasior, the coastal village on the west side of the range.

The montane zone of the Wondiwoi Mountains is particularly understudied, having only been surveyed several times cursorily by Western scientists. Jared Diamond, one of few to have ever surveyed the range, noted that he found them “exceptionally wet, cold, and steep, even by the standards of New Guinea mountains.” While our expedition was planned during the “drier” season, this region of West Papua still receives a substantial amount of rain throughout the year. Manokwari averages 315 rainy days annually with 1786 mm of accumulation; the montane zone of the Wondiwois, which is in the cloud forest, likely averages more. That being said, our expedition was graced by relatively benign weather, with only occasional rain that occurred mostly at night.

New Guinea is a biodiversity hotspot. In addition to a rich array of fauna, the island is the most floristically diverse in the world, with 68% of all flora species being endemic. New Guinea’s outlying mountain ranges – microcosms of the aforementioned island biogeography – also exhibit high rates of endemism given that they are isolated “islands” of montane habitat. Thus, they are of particular conservation concern. The Wondiwoi Mountains, which reach a maximum elevation of 2,187 m, are isolated from the mountainous Vogelkop region of the Bird’s Head and the Central Cordillera by hundreds of kilometers of lowland and hill forest. Thus, we focused our efforts on the cloud forest of the Wondiwoi Mountains, which is likely to support a large assemblage of endemic species.

BACKGROUND AND CONTEXT:

The phenomenon of ‘lost species’ is a recurring trend in conservation circles that continues to attract significant public attention, especially when the individual in question is a charismatic species. Several large conservation organisations have high profile campaigns to ‘rediscover’ lost species backed by a high profile celebrity (Watson & Davis, 2017). Within the context of the Anthropocene these programmes provide a quick win for biodiversity scientists to gain public and thus political attention for conservation (Liordos et al, 2017).

Whilst there has been some criticism (Watson & Davis 2017) of the potential ‘wild goose chase’ in searching for extinct or ‘lost’ species, research suggests it is not always in vain. Over 351 mammals, birds and amphibians have been confirmed extant since 1889 with increasing frequency. (Scheffers, 2011).

Of course, the romanticism of species rediscovery masks a real and urgent problem in biodiversity conservation. The shortfalls, in particular Linean and Wallacien, of knowledge in biogeography, act as real barriers in how best to protect the world's biodiversity (Ladle & Whittaker, 2011). 44,000 species remain categorised as data deficient on the IUCN red list (IUCN, 2020) hindering our ability to take effective conservation action.

PURPOSE:

The primary purpose of the expedition was to document the continued existence of the Wondiwoi tree kangaroo (*Dendrolagus mayri*). This enigmatic species is considered lost to science, having last been conclusively documented when Ernst Mayr obtained the holotype in 1928. IUCN lists it as “critically endangered, possibly extinct.” However, in 2018, a British botanist obtained a poor photograph of what may be a Wondiwoi tree-kangaroo, generating considerable interest in the media. As noted by Re:wild, “in 2018, a tourist in West Papua took low-quality photos of a species that could possibly be the Wondiwoi Tree Kangaroo. It is imperative that conservation measures are put in place to protect the species once the rediscovery is confirmed through scientific techniques.” This 2018 potential sighting, combined with promising information we received from our local guide Eky beforehand, prompted us to mount an expedition to conclusively document this cloud forest denizen and then initiate conservation efforts to protect what few individuals remained.

An additional objective pursued primarily by Jack and Ryan Bushong, who are experienced ornithologists, was to conduct a thorough survey of the Wondiwoi mountains’ montane birdlife. Only two individuals had ever conducted bird surveys in the Wondiwois – Ernst Mayr in 1928 and Jared Diamond in 1983 – and in private correspondence, Jared Diamond indicated that the Wondiwois were of top priority for future ornithological research in New Guinea. Jared Diamond sent a comprehensive list of bird species that had not previously been recorded from the Wondiwois but were likely to occur. We documented a number of these new species and made other significant discoveries detailed below. We believe the ornithological data generated from this expedition is an important contribution to the existing knowledge of this chronically understudied region.

METHODS:

This expedition was a culmination of several years of rigorous planning, preparation, and unwavering interest in uncovering the secrets of one of the world's most enigmatic and unexplored regions. Given that the primary goal of the expedition was to document the Wondiwoi tree kangaroo, our field procedures revolved around achieving that end. Each day, we spent a considerable amount of time in the field traversing new territory and staking out promising locations. We also frequently made forays at night in search of the tree kangaroo.

The following is a day-by-day summary of our expedition, beginning the day we departed Wasior for the mountains and ending when we returned to Wasior. This summary is meant to impart an understanding of our procedure in searching for the tree kangaroo, and how that varied by day in accordance with what we were finding, the recommendations of our porters and guide, and our own convictions:

Day 1 (June 30):

We departed Eky's house (who graciously accommodated us the night before) around 1 pm just as the rain was beginning to pick up. We soon left the village and entered second growth forest composed primarily of thick stands of bamboo. The rain was coming down in thick sheets through the canopy. The trail was incredibly steep and muddy, and it took us close to an hour to travel less than a kilometer up the trail as we grabbed onto vines, roots, and anything else to gain purchase.

Having ascended this initial steep stretch, we then descended a similarly steep trail that in places dropped precipitously hundreds of feet down. We were in primary rainforest now, and the jungle was tall and dense. We soon reached a clear, fast-flowing river with deep pools, and spent the next hour crisscrossing it somewhere between 10 and 15 times. During one of the crossings, a porter lost his footing and was almost swept downriver over a rapid.

We then began a steep muddy ascent on the opposite side of the river. It was still raining and the jungle was exceptionally humid. We reached base camp 1 at an elevation of 625m late in the day during a brief break in the rain. We hastily set up our hammocks and had a much-needed meal under the tarp-and-wood shelter that the porters and our guide slept in.

Day 2 (July 1):

We left camp around 10 am as it had rained during the early morning and it took us longer than expected to disassemble our hammocks, which were up on a muddy slope above camp. We slowly ascended through towering primary rainforest, at times traversing a high ridgeline that

was no wider than 20 meters and that plunged down hundreds of meters on either side. The higher elevations of these mountains are only possible to reach by traversing high ridgelines.

We arrived at base camp 2 at an elevation of 1220 m around 1:30 pm. From there, we decided to push on to base camp 3 given favorable weather conditions. We arrived at base camp 3 at an elevation of 1550 m just before dusk. The camp is situated on a small flat stretch on an otherwise steep slope. A small, swift spring runs through camp.

Day 3 (July 2):

We awoke early and spent the first hour walking the trail that ran due west from camp searching for signs of the tree kangaroo. There was a bit of rain the night prior but it was clear throughout the morning. We then ascended the nearby ridge to the first saddle where several porters had found fresh signs of tree kangaroo, including scratch marks on a moss-covered tree from earlier that morning. The elevation (1670 m) far exceeded the known elevational limit of the Vogelkop tree kangaroo (*Dendrolagus ursinus*) and nicely fit the expected elevational range of the Wondiwoi tree kangaroo.

We spent a while searching this area and then ascended the ridge further to 1860m where we encountered more recent scratch marks from a tree kangaroo. This is notably higher than the expected elevational range of even the Wondiwoi tree kangaroo.

We returned to camp that evening. Around 9 pm, Ryan and Jack went out with Eky to search for the tree kangaroo and other nocturnal fauna. They ascended the first steep section of the trail and then bushwhacked a loop through the forest, encountering and photographing an interesting ringtail species (see “results” section). No additional sign of tree kangaroo.

Day 4 (July 3):

We began hiking from camp in the late morning to revisit the sites with the claw marks from the day before and to ascend higher in search of more fresh tree kangaroo sign. The trail became very steep and treacherous beginning at 1870m, a near vertical ascent up the ridge’s muddy spine. The ridge was 5-10m wide with a drop of several hundred meters on either side. The ridge was well-forested with a thick understory that made travel difficult, as the trail was not well-worn. We stopped frequently to hack at the vegetation with machetes.

We reached a maximum elevation of 1965m at 2 pm and then turned around. Jack and Ryan, accompanied by several porters, returned to one of the spots with the fresh tree kangaroo sign in the late evening. They waited silently for one hour until it was mostly dark, and then

bushwhacked a long loop back to camp, encountering several more trees with older tree kangaroo claw marks.

Day 5 (July 4):

We spent the morning searching the trails around camp. Our groups split up around 11 am to cover more ground. Jack and Ryan, accompanied by several porters, began hiking the ridge with the intent of getting as high as possible. Meanwhile, Jody, Alex, and Eky bushwhacked a long loop through primary forest on the opposite side of the ridge where there were lots of recent sign.

Jack and Ryan reached an elevation of 2100m before being forced to turn around as the trail had become impassable, and the porters were trying to cut their way through a dense bamboo thicket to little avail. They encountered no new tree kangaroo sign. Jody and Alex found some old sign of arboreal vegetation on the forest floor that had been partially consumed by a tree kangaroo. The two teams reconnected late in the afternoon and then returned to camp.

Day 6 (July 5):

We awoke before dawn and ascended to the area where we had first encountered fresh tree kangaroo sign on Day 2. We then split into three groups, each group setting out in a different direction. Several hours later, right when we were about to reconvene, the group with Jody, Alex, and Eky detected very fresh tree kangaroo sign about 100m downslope of the claw marks from Day 2. The sign included recently-consumed vegetation from the canopy and a strong odor of urine that Eky said must have been from earlier that morning. We spent the next hour right around this site, searching all surrounding trees to no avail. We then returned to camp and made periodic forays out on the surrounding trails during the late morning and afternoon.

Around 5pm, Jack, Ryan, and two porters returned to the site from earlier in the morning and staked it out for one hour at dusk. They then met up with Jody, Alex, Eky, and the rest of the group who had been slowly ascending the first slope with their flashlights. We continued to search for the tree kangaroo well into the night, but still no sign.

Day 7 (July 6): We awoke early around 7 am. Alex and Jody left camp to descend to Wasior, reaching town late in the afternoon. Jack and Ryan remained at base camp 3 until late morning searching for birds, and then slowly descended to base camp 1 where they spent the night.

Day 8 (July 7): Jack and Ryan awoke early and spent the morning conducting bird surveys around base camp 1 before returning to Wasior where they arrived around 2 pm.

RESULTS:

Birds:

The following is a description of the most significant ornithological finds, including several significant geographic range extensions (“new species for the Wondiwois”), extensions to the known elevational range of certain species, and other observations of interest. The undescribed scrubwren taxa and (potentially) undescribed bird-of-paradise are the two most significant ornithological discoveries, and were entirely unexpected given modest historical coverage of this mountain range by several experienced ornithologists (most notably, Jared Diammond and Ernst Mayr). More comprehensive notes on the avifauna observed can be made available upon request.

Putative Undescribed Forms:

- Wondiwoi Scrubwren (undescribed form; *Aethomyias* sp.): On Day 5, Jack observed and photographed two scrubwrens of an undescribed form 100 yards from basecamp at roughly 5100 ft of elevation. He initially observed a single bird perched on a branch 10-15 ft off the ground in a well-vegetated gully. While observing this bird, a second individual of the same taxa flew in and fed the first bird before departing again. Given this behavior, there was likely an adult and juvenile present, or potentially two adults, but certainly not two juveniles.

The birds most closely resemble *Ae. rufescens* or *Ae. perspiculatus*, but with several differences, including the combination of pale underparts, a bold eyering, grayish head, and strong reddish-brown tones to the wings and tail.

Thane Pratt, who is currently revising the Birds of New Guinea field guide, had the following to say about the scrubwrens:

“[it] looks to me like a new, undescribed form of scrubwren, characterized by the gray head, white eye-ring, and reddish brown wings. The fact that you photographed two individuals suggests it is not some sort of aberrant plumage. It doesn’t fit any of the known scrubwrens, and it sure looks like a new form, either a new species or subspecies... It appears to be allied to either *Ae. rufescens* or *Ae. perspiculatus*, but it’s different enough that I’d hesitate to assign it to one species or the other.”

- Wondiwoi Bird-of-Paradise (hybrid/undescribed form; possibly an *Astrapia*): This is an utterly perplexing bird with no consensus around what it is, other than that it is an unknown bird-of-paradise taxa. In the field, it was initially identified as an immature male Arfak *Astrapia* (*Astrapia nigra*) given its blackish plumage and stupendously long graduated tail, but the bill shape does not appear consistent with *Astrapia*. It has also been suggested as a Long-tailed Paradigalla (*Paradigalla carunculata*), but the bill shape and tail length are also inconsistent with that species. Some have proposed it is a

manucode species, but again, certain inconsistencies arise. The fact that it appears to be a juvenile (likely a male) further complicates the situation, as juvenile males tend to be much less distinctive than elaborately-adorned adult male birds-of-paradise. Jared Diamond, one of the only ornithologists who has ever been to the Wondiwoi (Wandammen) mountains:

“My recommendation is that, in reporting your results, you say that you observed a probable *Astrapia* population for which there are no previous reports from Wandammen; and that your sighting agrees better with *A. nigra* of the Vogelkop than with *A. splendidissima* of the Central Range. [This observation] is potentially your most important discovery...you observe[d] a possible Wandammen *Astrapia* that Mayr, Shaw Mayer, and Pratt all failed to collect, and that I failed to observe. If your bird was indeed an *Astrapia*, it was probably an immature male, not an adult female, because you saw none of the barring on the belly visible in female *splendidissima*, and present but obscure in female *nigra*. Young male *astropias* resemble adult females and gradually lose female plumage features and acquire male plumage features. But *Astrapia nigra* is the least known bird of paradise, and we have only about six specimens of immature males that would permit reconstructing its changes in male plumage with age. Regardless of what stage of immature male your bird was, or even if it was a female, it is more likely to be the Vogelkop allospecies *A. nigra* than the western Central Range allospecies *A. splendidissima* — because the latter has white proximally in the tail in both females and adult males (hence presumably also in immature males). That white is lacking in *nigra*. You don’t mention seeing white, and no white appears in the two of your three photos that show the proximal tail. If Wandammen does have an *Astrapia*, it makes biogeographic sense that it would be *nigra* rather than *splendidissima*, because in four other superspecies the Wandammen population belongs to the Vogelkop allospecies rather than to the central range allospecies: *Parotia sefilata*, *Lophorina superba*, *Amblyornis inornatus*, and *Melipotes gymnops*.”

However, Thane Pratt offered notably different comments:

“Candidly, this bird does not look at all like an *astropia* to me. The shape is too lanky and the neck too long and thin. My first impression was manucode, but the bill doesn’t look right. The tapered tail suggests Long-tailed Paradigalla (not known from Wondiwoi Mts), but on the face there are no wattles showing...Could it be a hybrid bird of paradise? The odds are so small, but many hybrids have been documented over the years...In any case, no, I can’t put a name to this bird, and for that I apologize as it’s disappointing to not shed light on such an interesting find!”

New species for the Wondiwois:

- White-breasted Fruit-Dove (*Ptilinopus rivoli bellus*):¹ We heard, observed, and photographed a single male around our base camp at 5100 ft every day. The song was a series of “hoo” notes that rapidly decelerated. On our last full day, we encountered at least five birds on our descent from base camp 3 to base camp 1. One was at 5100 ft, two were at 4800 ft, and two were at 4680 ft.
- Black-breasted Boatbill (*Machaerirhynchus nigripectus*):¹ Ad male seen very well and heard vocalizing at 5850 ft while we were ascending the ridge.
- Torrent Flyrobin (*Monachella muelleriana*): Seen flycatching from a tree overhanging a fast-flowing creek at ~1500 ft during both the ascent and descent.
- Red-collared Myzomela (*Myzomela rosenbergii*):¹ Flock of five observed at an elevation of ~5300ft. They were present in the same stand of flowering/fruited trees the entire time we were at base camp 3. We also had several higher up on the ridge in a mixed flock.
- Red Myzomela (*Myzomela cruentata*): New for the Wondiwois? Mixed flock of Red and Papuan Black Myzomela in a flowering tree viewed through a gap in the forest at 2830 ft.
- Friendly Fantail (*Rhipidura albolimbata*):¹ One seen while ascending the ridge at 5969 ft and two seen the following day on the same ridge at ~5900 ft and 6850 ft.
- Black Berrypecker (*Melanocharis nigra nigra*): Male, M. n. nigra from the Vogelkop rather than M. n. unicolor from N, E, and SE NG based on drab gray underparts contrasting with glossy blue upperparts. The white pectoral tuft looks significantly more prominent than depictions in guides.
- Gray-green Scrubwren (*Aethomyias arfakianus*):¹ Observed frequently at an elevational range from 5000 ft to 6200 ft, and exceptionally to 6700 ft. It occasionally foraged as high as 50 ft in the canopy.
- Fairly Lorikeet (*Charmosynopsis pulchella*): We observed a small flock in the same stand of flowering/fruited trees as the Red-collared Myzomelas, at an elevation of 5300 ft on the slope above base camp 3.

Notable elevational records:

- Yellow-bellied Longbill (*Toxorhamphus novaeguineae*): Birds of the World lists its elevational range as being from sea level to 500 m, and rarely to 750 m. This bird was at ~1550 m. Initially seen right at the edge of base camp 3 in a mixed flock, and then observed what was presumably the same bird a few hours later on a steep slope a few hundred feet down from camp.

¹ Species that are not shown to occur in either the Pratt and Beehler (2015)'s comprehensive guide to the Birds of New Guinea or the Birds of the World database, but were reportedly observed by Jared Diamond on his expedition. This incongruence is still being worked out.

- Blyth's Hornbill (*Rhyticeros plicatus*): Highest was at 4700 ft; Pratt and Beehler (2015) describe its elevational range as being from 0 to 1400 m (~4590 ft).
- Palm Cockatoo (*Probosciger aterrimus*): Heard well at 5250 ft and identified as such by a local guide. Pratt & Beehler (2015) on the species' elevational affinities: "0-750m, locally to 1350m." This bird was at 1600m, so perhaps the species occasionally ranges far upslope when food is scarce lower down.

Other observations of note:

- Black Sicklebill (*Epimachus fastosus*): male advertisement call different from what is described in Pratt and Beehler (2015) and Birds of the World. It is a rapid sequence of five "whip" notes. We heard this call many times while hiking on the ridge between 5300 ft and 6800 ft.
- Bowers of Vogelkop Bowerbird (*Amblyornis inornata*) became progressively smaller and less ornamented the higher up on the ridge we ascended. This makes intrinsic sense but is not something I've read in the literature. Impressive maypole bower at about 5250 ft, by far the largest and most elaborately ornamented of the six bowers we encountered on the expedition (also worth noting is that VOBO constructs the largest bower of any bowerbird sp in NG). It was also at the lowest elevation of any of the bowers and was the only one located on a mountain flank rather than a narrow ridgeline; is there a correlation between the size/elaborateness of the bower and these other two variables? Could be the topic of an interesting paper. The bower was likely around 1m tall (unfortunately we neglected to measure this precisely in the field). It was a thatched roof, but interestingly, didn't seem to be constructed around a central pole like the others we saw. Base of bower was decorated with discrete piles of a bluish fruit, some sort of black fungus, red-and-black feathers from Pesquet's Parrot (of which there is a pair in the area), blackish seeds, and several pieces of trash that may have been collected from base camp 3 left by porters. Eky tied a plastic blue ribbon (which he later retrieved and took with him) and the bowerbird promptly flew in, untied the blue ribbon from a nearby sapling, and placed it on the floor of the bower.



White-breasted Fruit Dove



“Wondiwoi Bird-of-Paradise”



Bower of Vogelkop Bowerbird “Wondiwoi Scrubwren” (top) and Y.-b. Longbill (bottom) Blyth’s Hornbill



Friendly Fantail



Fairy Lorikeet



Spotted Jewel-Babbler

Herpetofauna:

Stephen Richards, an Honorary Research Associate at the South Australian Museum and the Regional Chair for Melanesia of the IUCN's Amphibian Specialist Group, was our primary point of contact in assisting with the identification of the herpetofauna we photographed. His commentary on the following four frog species and one snake species are as follows:

Platyplectrum platyceps (Arfak cannibal frog), 1615 m:

"Your *Platyplectrum* (*Lechriodus*) is almost certainly *platyceps*, and your record fills a large gap in their distribution."

"*Austrochaperina*" sp., 625 m:

"I am not convinced that your '*Austrochaperina*' is that genus...It wouldn't surprise me if it's a new species."

"*Oreophryne* 1", 1550 m:

"Arboreal Microhylidae...Members of this genus are very difficult to identify without calls (there's lots of similar-looking species) and at that altitude there's probably a bunch of completely new species. The body form of most *Oreophryne* is fairly conservative, and colour patterns are often highly variable within species. There's a high diversity of small *Oreophryne* species in the mountains of New Guinea and characters to distinguish them (apart from genetics obviously) include some important internal anatomical features, but also things like presence/absence of webbing between the toes, relative lengths of toes, and of course the calls which are vital; and none of these features are available for consideration for your specimens. Species 1 is simply impossible to tell - there's lots of *Oreophryne* species that look like that. Having said that, given that the frog fauna above 1,000 m asl in the Wondiwoi Mtns is so poorly documented I think there's a good chance that they are both new."

"*Oreophryne* 2", 1570 m:

S. R.: "Species 2 is really distinct (and while I think it is an *Oreophryne* it could be something else) and I do suspect that it is new to science but can't be sure."

Tropidonophis montanus, 1830 m:

S. R.: "It is a *Tropidonophis* (Keelback) species, and is most probably *T. montanus*, which is known from high altitudes in the Wondiwois."

Stephen Richards also contacted German herpetologist Rainer Günther who has visited lower elevations of the Wondiwoi Mountains, and added the following:

"Like me, Rainer is bamboozled by the '*Austrochaperina*' sp. He is not even convinced that it is an *Austrochaperina*...Rainer thinks that one of the species that I identified as an *Oreophryne* is a *Cophixalus* species. Those two microhylid genera are hard to distinguish externally (internal

anatomy is important) but there's few arboreal *Cophixalus* that far west (though there's a couple). I also considered that the tubercular one may be a *Cophixalus* and defer to Rainer's greater knowledge. In sum quite possibly/probably all three of those frogs are new to science.

Rainer, commenting on the “*Austrochaperina*” and the two “*Oreophrynes*,” remarked:

“The specimen with broad white dorsal stripe is similar to *Oreophryne clamata* but shows some differences in colouration. The second ‘*Oreophryne*’ specimen seems to me an unknown *Cophixalus* and ‘your unknown *Austrochaperina*’ seems not to belong to this genus, but its true allocation remains enigmatic.”



Top left: “*Austrochaperina*” sp

Top right: “*Oreophryne* 1”

Bottom left: Arfak cannibal frog

Bottom right: “*Oreophryne* 2”

Mammals:

Striped Possum (*Dactylopsila trivirgata*), 625 m in the trees right above base camp 1.

1 New Guinea Ringtail (*Pseudochirulus schlegeli*; probable), seen on a night outing at around 1615 m on the slope above base camp 3. This observation represents one of if not the most significant discovery on the expedition. Notes from Kris Helgen, the Chief Scientist and Director of the Australian Museum Research Institute:

“Under the current framework of New Guinea mammal taxonomy, the animal in the picture would be referred to as *Pseudochirulus schlegeli*. But: there is a bit more to it than that, which is I think why everyone gets confused with these western New Guinea ringtail pictures. I have quite a bit of confusion myself between *Pseudochirulus schlegeli* and specimens that have been referred to as *Pseudochirulus [forbesi] lewisi* in the past. Though these are considered synonyms right now, I think they might be different species that co-occur in the Vogelkop region, with *P. schlegeli* having more orange overall body color and with less elaborate facial ornamentation, and *P. lewisi* having more brown overall body color and more elaborate facial contrasting.

The animals in the Wondiwoi/Wandammen picture are more like the *lewisi* morph. Further work is needed to see if *schlegeli* and *lewisi* really represent one variable species or are two different taxa. But this animal pictured looks like the *lewisi* morph currently classified within *P. schlegeli*. It is a fantastic geographic record! The possum could indeed be something new [a new species] but would need some specimens to work that out.”



Top left: Striped Possum

Top and bottom right: New Guinea ringtail (probable)

Signs of Wondiwoi tree kangaroo:

While we did not observe the Wondiwoi tree kangaroo itself, we found substantial evidence to suggest that the species continues to persist at high elevations in the Wondiwoi Mountains.

Our local guide, Eky, as well as several porters informed us that they had only ever observed the Wondiwoi tree kangaroo once, around seven years ago. This roughly coincides with the photograph of a possible Wondiwoi tree kangaroo by Michael Smith in 2018.

We encountered claw marks that Eky and the porters consistently identified as being that of a Wondiwoi tree kangaroo between 1540 m and 1890 m (5050-6200 ft). The claw marks averaged 3-5 cm in length and were typically positioned vertically on the tree trunk. Claw marks were found primarily on small, straight trees (diameter ~30 cm) without much moss. The larger trees that the tree kangaroos presumably also scaled to consume arboreal vegetation did not show visible claw marks because the bark was coarser and adorned in thick layers of moss. Claw marks were concentrated at an elevational range between 1550 m and 1670 m.

We also frequently encountered signs of epiphytic plants that tree kangaroos had been consuming in the canopy of large trees. The tree kangaroos appeared to be consuming the pale whitish stem of the otherwise green plant. Per Eky and the porters, no other arboreal mammal (e.g., cuscus) would be consuming this plant. We encountered these partially-consumed plants on the forest floor between 1550 m and 1670 m.

On Day 4 (July 3), we detected a strong musky odor while descending the ridge at 1830 m. Eky and the porters quickly identified this scent as being that of a tree kangaroo. Eky was convinced it was in a tall tree about 50 m off the trail, so we spent nearly an hour canvassing the area to no avail. It is possible that the smell came from somewhere downslope that was not visible; the Wondiwoi cloud forest is very thick and draped in moss, limiting visibility.

On Day 6 (July 5), we detected a strong urine smell that Eky also identified as coming from a tree kangaroo at 1615 m. At the same location, we found freshly consumed epiphytic plants of the same variety described above. We failed to locate the tree kangaroo, despite spending another few hours at the location.

Given our observations, we believe there is at least one tree kangaroo still in the vicinity of the third base camp. It was likely wary of our presence, and may have been deterred by the sound of our voices at camp or the sound of the generator, which was turned on occasionally at night. Its favored elevational range appears to be from 1550 m to 1670 m, although it can range as high as 1890 m.

PRIORITIES FOR FUTURE RESEARCH

While this expedition provided data that strongly suggest the occurrence of multiple (if not many) undescribed species in the Wondiwai mountains, our inability to obtain specimens is inhibitive to formally describing new species to science. Thus, it is imperative that any return expedition to the Wondiwai mountains have the necessary permits to collect specimens.

Of particular importance are specimens of the following:

- Vogelkop ringtail possum (*Pseudochirulus schlegeli*)
- “*Austrochaperina sp.*” and any frogs observed above 1000m where the frog fauna is exceptionally poorly documented, including “*Oreophryne 1*” and “*Oreophryne 2*”
- “Wondiwai Bird-of-Paradise,” preferably an adult male which would be more phenotypically distinct than females or immatures
- Scrubwrens from 1400m and higher
- All insect species encountered above 1000m, particularly moths and butterflies

For future ornithological work, the priority should be to conduct extensive mist-netting from 1500m to 2000m around base camp 3 and elsewhere.

For the Wondiwai tree kangaroo, a concerted effort must be made to locate the species using trail cameras. Ideally, this would involve setting up 25-50 trail cameras in the appropriate elevational range in the vicinity of recent signs, such as that which we encountered on this expedition. It should also be a priority to survey new areas of suitable habitat for signs of tree kangaroo, which would involve ascending the mountains via a different route.

CONCLUDING THOUGHTS:

As we descend from the mountains, the weight of our journey settles upon us. The days of trekking through fog-wreathed forests and up treacherous ridgelines may have ended, but the memories linger. Each step echoes with the thrill of discovery and the realization that despite being privy to the mountains' secrets for an entire week, there is so much yet to uncover.

Our search for the Wondiwoi tree kangaroo was a journey into the unknown – not just the mountains we traversed, but exploring the delicate boundary between what is irrecoverably lost and what still remains. We did not observe the tree kangaroo itself, but the signs we uncovered – claw marks etched into the moss-covered bark, scattered remnants of its meals, its lingering odor in the cool mountain air – comfort us with the knowledge that it lives on. There is a profound beauty in knowing that some mysteries remain unsolved, at least through the bifocals of Western science. The Wondiwois continue to guard their secrets. Perhaps that is for the best.

As we reflect on our time here, we are filled with a deep sense of gratitude. To Eky, our guide, whose knowledge was indispensable and whose commitment to protecting the forests is admirable; to the porters who accompanied us; and to the people of Wasior, who welcomed us with open arms – we owe our deepest thanks.

Thank you as well to the Oak Foundation, Oxford University and Scientific Expedition Society for their financial contributions which were instrumental to the expedition's success. Fundraising for conservation is hard. Thank you for believing in us. We also want to express gratitude to Jared Diamond and Bruce Beehler for their assistance in the planning stages of the expedition, and to Jared Diamond, Roberto Portela Míguez, Steve Richards, Kris Helgen, and Thane Pratt for their assistance with the identification of various species post-expedition.

The tree kangaroo evaded us but we made other discoveries of perhaps greater significance: bird species that had never been recorded before in the mountain range, several of which constitute undescribed taxa; a significant range expansion of a very poorly-known mammal; and three frog species that are likely new to science. Above all else, we return home with a renewed sense of wonder, a commitment to continue the work we have begun, and the knowledge that the Wondiwois, in all their mysterious splendor, will continue to thrive in their quiet, ghostly way.

TEAM:

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