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The History and Mystery of the Mountain Tarsier, *Tarsius pumilus*

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Abstract: *Tarsius pumilus* is one of two tarsier taxa listed as Data Deficient. Known by only three museum specimens collected over the course of the past ninety years, it is one of the most mysterious primate species. Inferences drawn from these specimens are that it is a small tarsier adapted for life in the mossy montane forests of Sulawesi at elevations of 1,800–2,200 m. To this I add the further inference from unsuccessful field surveys that is unlikely that this species duets as do other tarsiers from Sulawesi. This raises the possibility that it is not closely-related to other Sulawesian tarsiers, all of which duet, and the phylogenetic position of this species becomes highly interesting. Fossil and biogeographic evidence are consistent with the hypothesis that *T. pumilus* is the sister-taxon to all other extant tarsier species. If this is verified, then the small size of *T. pumilus* is likely to be primitive, and other extant tarsiers, small as they are, might be island giants. I argue that "mountain tarsier" is a more apt common name than "pygmy tarsier".

Key words: Conservation, biogeography, tarsier, *Tarsius*, montane endemic, primate evolution

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Wright (2003) identified the need to remedy the categorization of Data Deficient (DD), then attributed to all the species of tarsiers, as a critical step for their conservation. Subsequent to the Global Mammal Assessment workshop in the Philippines (Puerto Princesa City, Palawan, Philippines, April 2006) and the Asian Primates Red List Workshop held in Cambodia (Phnom Penh, Cambodia, September 2006), the DD status has been removed from all but two of the tarsier taxa: the recently described Palu tarsier *Tarsius lariang* Merker and Groves, 2006, and the pygmy or mountain tarsier *Tarsius pumilus* Miller and Hollister, 1921, one of the world's most mysterious primates. Is *Tarsius pumilus* a developmental aberration unworthy of taxonomic separation, or is it perhaps the grandfather of all extant tarsiers, a sort of Rosetta stone that will unlock the mysteries of the historical biogeography of extant tarsiers? This paper focuses on what we know and what can be inferred about this mysterious primate, and what mysteries may yet be revealed.

Of more than 240 taxa of primates in *The Pictorial Guide to the Living Primates* (Rowe 1996) *Tarsius pumilus* is unique in that, not only has this animal never been photographed, there is no evidence that it has even been seen alive by a scientist who recognized it for what it was. Until the new millennium, this species was known by only two specimens, one collected on New Year's Eve 1917 by American Henry Raven, and the second collected on 17 June 1930 by German Dr. G. Heinrich (Musser and Dagosto 1987). After a gap of nearly seventy years, a third specimen was found in May 2000.

The history of work on *T. pumilus* contains some complexities that warrant clarification. It was described as a small, or pygmy, tarsier based on one of three tarsier specimens collected in 1917 from central Sulawesi by Raven (Miller and Hollister 1921): one was from Rano Rano and the other two from Gimpu. Subsequent analysis of dental eruption revealed that the specimens from Gimpu were juveniles of the ordinary lowland tarsier (Musser and Dagosto 1987), and this population was subsequently taxonomically separated from *T. tarsier* and named *Tarsius lariang* Merker and Groves 2006. The third specimen, the holotype, was an adult, however, and it showed some peculiarities for tarsiers.

First, the collection locality, Rano Rano, was listed as 1,800 m above sea level. Very few other tarsier specimens, from Sulawesi or elsewhere, have been collected above 1,100 m (Gorog and Sinaga 2008). Tarsiers in museum collections from Sulawesi go from sea level up to 1,100 m (the highest of these being a series of tarsiers in the American Museum of Natural History (AMNH) from Lombasang, on

the southwest peninsula, east of Makasar). There is a skin in the AMNH from Wawo, on the southeastern peninsula of Sulawesi, from 1,500 m above sea level. MacKinnon and MacKinnon (1980) reported hearing tarsier duet calls in Tangkoko Nature Reserve, on the extreme northern tip of Sulawesi, from sea level to the top of the mountain, an elevation of 1,149 m. Prior to 2000, the only tarsier specimens collected above 1,500 m were the holotype of *T. pumilus*, and the specimen mentioned earlier that was collected by Heinrich in 1930, which was at 2,200 m on the flanks of Mount Rantemario, at the junction where the southwestern peninsula meets the central core of Sulawesi.

Musser and Dagosto (1987) noted several morphological peculiarities shared by the specimens from Rano Rano and from Rantemario. Most obviously, both specimens were quite small, although clearly adult. Linear measurements averaged about 75% of those seen in other Eastern tarsiers (those from the Sulawesi biogeographic region). Other oddities included the keeled, claw-like nails on the fingers and toes, very long and extending beyond the digital pad. The central lower incisors were relatively long, and scanning electron microscopy revealed fine striations, consistent with their having been used to comb their fur. The mountain tarsiers from Rano Rano and Rantemario were different from all others in having rather longer, silkier fur. Additionally, both exhibited enlarged auditory bullae.

The montane habitat of Sulawesi at 1,800–2,200 m above sea level is characterized by cool moss forests. Musser and Dagosto (1987) interpreted the distinctive morphology of the Rano Rano and Rantemario specimens as adaptations for this habitat: the long fur was an adaptation for the colder climate; the elongated incisors helped to groom the fur, as evidenced by the wear pattern seen in the microscopy; the claws were valuable for gripping surfaces in the moss forest, the forest at this elevation being virtually bereft of the smooth surfaces that necessitated the disk-like gripping pads on the digits of lowland tarsiers; and the enlarged bullae reflected auditory adaptations, as this mossy covering deadens sound. Thus, by conducting a detailed morphometric analysis of numerous museum specimens, Musser and Dagosto (1987) were able to identify *T. pumilus* as a montane endemic tarsier adapted to the unique characteristics of the moss forest.

Virtually every tarsier biologist who has worked on Sulawesi has attempted to locate this tarsier, but without success, particularly subsequent to Musser and Dagosto's seminal work on the species. Niemitz (1984) searched near Gimpu, photographing and making field recordings of tarsiers there that he understandably assumed were *T. pumilus*, but which, as was mentioned above, were tarsiers of the *T. tarsier*-complex and are currently classified as *T. lariang*. Mike Tremble and Yopie Muskita (Y. Muskita pers. comm.) spent a month near the type locality, Rano Rano, in the early 1990s before giving up and focusing, instead, on what was then a newly described species, *Tarsius dianae*, which Niemitz *et al*. (1991) had described from Kamarora, a village at about 600–700 m above sea level that lies some 20–30 km west of Rano Rano (see Tremble *et al.* 1993). Subsequently, evidence from the distribution of duet calls that were diagnostic of *T. dianae* indicated that it was a junior synonym of *T. dentatus* Miller and Hollister 1921 (Brandon-Jones *et al*. 2004). Alexandra Nietsch, Stefan Merker, and myself made unsuccessful attempts to locate *T. pumilus* in the highlands around Kamarora in the 1990s (A. Nietsch and S. Merker pers. comm.). During the same period Sharon Gursky searched unsuccessfully for *T. pumilus* in the highlands of Morowali National Park (pers. comm.). In no instance was the tell-tale sign of the Eastern tarsier's duet call encountered, leading some field biologists to privately speculate that the two museum specimens were either aberrant individuals of the *T. tarsier*-complex that develop differently in cold high-altitude environments, or, perhaps, that *T. pumilus* had gone extinct. This second hypothesis seemed particularly unlikely since the montane forests of Sulawesi were little disturbed relative to the lowland forests, where large populations of tarsiers of the *T. tarsier*-complex persist. If anything, the mystery of the mountain tarsier had deepened during the 1990s.

With the dawn of the new millennium new light was suddenly and unexpectedly shed on this mystery. In May 2000, a field assistant working for a small mammal survey of Lore Lindu National Park sponsored by The Nature Conservancy inadvertently trapped and killed the third known specimen of *T. pumilus* in a "Victor"-style snap trap at 2,200 m above sea level on the flank of Mt. Rorekatimbu (Maryanto and Yani 2004). The great irony of this capture is that it occurred very close to areas that were independently surveyed by Nietsch, Merker, and myself. Indeed, both Merker and myself returned to the very site of the third capture and, again, failed to locate definitive evidence of tarsiers. The facts that *T. pumilus* was proven to exist in an area where a number of experienced tarsier field biologists had failed to locate tarsiers, and that experienced tarsier field biologists could not locate tarsiers at a site proven to have them, provided a hint that, perhaps, *T. pumilus* exhibited marked behavioral differences from other Eastern tarsiers. Specifically, it seemed possible that *T. pumilus* did not duet, or produce other vocalizations that are common to Eastern tarsiers and that are well-known to tarsier field biologists experienced in Sulawesi.

Thus, one of the most fundamental questions about *Tarsius pumilus*—does it even exist?—has been answered conclusively with the discovery of the third specimen. The montane habitat of *T. pumilus* is relatively less disturbed compared with its lowland relatives, and from this we can predict that populations of *T. pumilus* should be under relatively less threat of extinction.

Is *T. pumilus* simply an aberrant lowland tarsier, and will we find tarsiers that share this suite of traits wherever lowland tarsiers are pushed into montane habitats? This seems less likely, although a definitive answer to this question will probably require more information, such as observations in the wild or genetic data. But this raises the question about the phylogenetic relationship of *T. pumilus* with other tarsiers: is *T. pumilus* the sister-taxon of some lowland tarsier

population (i.e., nested within other Eastern tarsiers), or the sister taxon of all other Eastern tarsiers, or, perhaps, the sister taxon of all other tarsiers? This intriguing possibility — that *T. pumilus* could be the primitive sister-species of all extant tarsiers — is not mere speculation.

While the polarity of character states among tarsiers is not clearly understood, assuming global polarity, *T. pumilus* is primitive in having the furriest tail (Shekelle *et al.* 2008, unpubl. data) and, presumably, no duet call. Furthermore, the small size of *T. pumilus* may well be primitive, as all known fossils of the family Tarsiidae are smaller than extant lowland tarsiers, including *Tarsius eocaenus* and *Xanthorhysis tabrumi* from the Eocene of China (Beard *et al.* 1994; Beard 1998), the disputed *Afrotarsius chatrathi* from the Oligocene of Africa (Simons and Bown 1985), and the last known fossil tarsier, *Tarsius thailandicus*, from Miocene deposits in Thailand (Ginsburg and Mein 1987; see Simons 2003 for a review of the fossil history of tarsiers). This last fossil is very well-placed in space and time to facilitate the dispersal of tarsiers from mainland Asia to Sulawesi in the middle Miocene, according to models of geologic and genetic evolution (Shekelle 2008). Finally, biological evidence indicates that Sulawesi has experienced multiple waves of immigration dating back to the early or middle Miocene, with dispersal from Thailand in the middle Miocene being considered the most likely route (Hall 2001). Although these immigration events are not yet thoroughly understood, one pattern that has emerged from the rodents is that the oldest immigrants are today distributed as montane endemics (J. C. Morales pers. comm.). A small tissue sample suitable for analysis of mitochondrial DNA should be able to answer this question definitively. Unfortunately, the third specimen was placed in formalin before a tissue sample was taken, and subsequent attempts to sequence the formalin-preserved tissue have been unsuccessful (unpubl. data).

The phylogenetic position of *T. pumilus* bears directly on one more assumption about its nature: that it is a pygmy tarsier. If it turns out that *T. pumilus* is, indeed, the sister-species of other extant tarsiers, then being small is quite likely the primitive state (see Beard 2001). Furthermore, if small size is the primitive state for tarsiers, and if *T. pumilus* retains the primitive state, then all other extant tarsiers, small as they are, are actually island giants, following Foster's "island rule" (Foster 1964; MacArthur and Wilson 1967). Thus, an answer to the question of the phylogenetic relationships of *T. pumilus* could have great impact on our understanding of the historical biogeography of extant tarsiers.

As a postscript, given that we are now reasonably certain that *T. pumilus* is a montane tarsier with a known distribution of 1,800–2,200 m above sea level, and given that its status as a pygmy form is unresolved, perhaps it is more apt to think of this animal as the mountain tarsier, and refer to it by that name.

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Editor's Note: As this article was being finalized for online publication, MSNBC reported that *Tarsius pumilus* had been rediscovered. According to the report, *T. pumilus* does not duet, as was predicted in this article.

Boyle. A. 2008. [Science editor msnbc.com]. Real-life Furbys rediscovered: Some experts feared that Indonesia's pygmy tarsier was extinct. Website: <http://www.msnbc.msn.com/id/27786771/from/ET>. Posted 2:01 p.m. ET, 18 November 2008. Accessed 18 November 2008.