

Leaf-Tailed Geckos of Madagascar's Central Highlands: *Rediscovering Candidate Species 8*



Aerial view of Ambohitantely Special Reserve, the last remnant of central highland rainforest.

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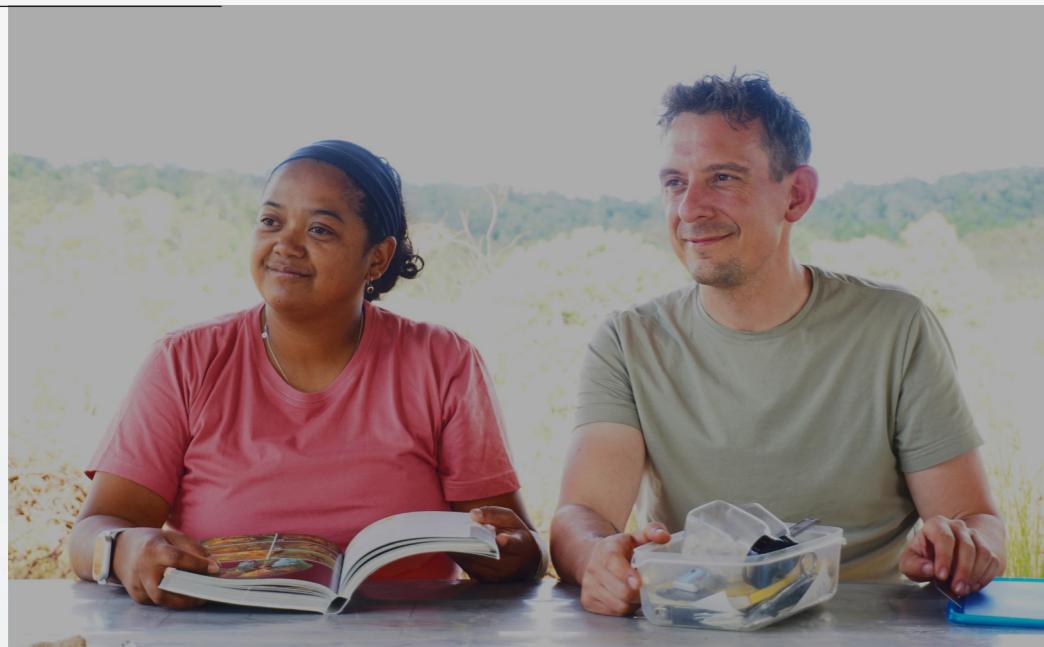
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*All photos are provided by the authors.

Ambohitantely Special Reserve stands as a critical and isolated habitat, safeguarding the final large fragment of mid-altitude central highland rainforest in Madagascar. This relict forest harbors a distinct biodiversity, including a highly differentiated population of leaf-tailed geckos (*Uroplatus*),

known as candidate species **Number 8** (*U. cf. ebenaui Ca8*). This report details an expedition into the reserve to investigate this enigmatic lineage, clarifying its status within the *Uroplatus* genus and highlighting the urgent conservation threats facing this invaluable ecosystem.



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View on the Ambohitantely Special Reserve.

Leaf-tailed geckos of the genus *Uroplatus* Dumeril, 1806 are particularly enigmatic fauna of the island of Madagascar. Although they were mentioned and described very early on in scientific literature, the actual species diversity was only truly comprehensively recorded within the last 15 years. This was due to the intensification of fieldwork and the introduction of molecular methods in combination with comparative morphological studies.

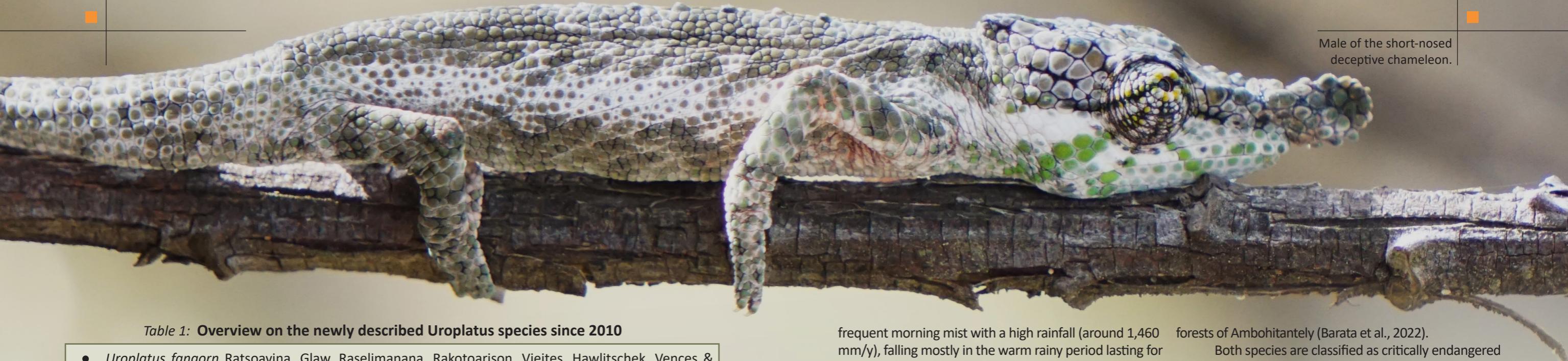
Since then, nine new species (see Table 1) have been described, almost doubling the number of species within the genus, which currently comprises 22 valid species (Glaw et al. 2023).

A particularly high proportion of cryptic species diversity was found within the *Uroplatus ebenaui* species complex, which includes smaller, leaf-mimicking species. Almost all the initially identified candidate species have now been formally described, and the species inventory is almost

complete (Ratsoavina et al., 2020, Glaw et al., 2023).

Only a few identified genetic lines are still marked with question marks, where it remains unclear whether they are deep genetic lineages of an already known species or an independent evolutionary lineage that might also be differentiated morphologically and thus represents a previously undescribed species. One such open question is candidate species number 8 (*U. cf. ebenaui* Ca8).

In the study by Ratsoavina et al. (2015), two genetic samples from the last primary forest area of the central highlands in Ambohitantely showed relatively high genetic divergence (up to 4.5%) from its sister species *U. fiera* from the central east coast of Madagascar. Little was known about this isolated population, and only a few photos of its morphology were available, so the taxonomic status of this population must be considered as unclear (Ratsoavina et al., 2015, Gehring 2020).



Male of the short-nosed deceptive chameleon.

Table 1: Overview on the newly described *Uroplatus* species since 2010

• <i>Uroplatus fangorn</i> Ratsoavina, Glaw, Raselimanana, Rakotoarison, Vieites, Hawlitschek, Vences & Scherz, 2020
• <i>Uroplatus fetsy</i> Ratsoavina, Scherz, Tolley, Raselimanana, Glaw & Vences, 2019
• <i>Uroplatus fiera</i> Ratsoavina, Ranjanaharisoa, Glaw, Raselimanana, Miralles & Vences, 2015
• <i>Uroplatus finaritra</i> Ratsoavina, Raselimanana, Scherz, Rakotoarison, Razafindraibe, Glaw & Vences, 2019
• <i>Uroplatus finiavana</i> Ratsoavina, Louis Jr., Crottini, Randrianaaina, Glaw & Vences, 2011
• <i>Uroplatus fivehy</i> Ratsoavina, Glaw, Raselimanana, Rakotoarison, Vieites, Hawlitschek, Vences & Scherz, 2020
• <i>Uroplatus fotsivava</i> Ratsoavina, Gehring, Scherz, Vieites, Glaw & Vences, 2017
• <i>Uroplatus garamaso</i> Glaw, Köhler, Ratsoavina, Raselimanana, Crottini, Gehring, Böhme, Scherz & Vences, 2023
• <i>Uroplatus kelirambo</i> Ratsoavina, Gehring, Scherz, Vieites, Glaw & Vences, 2017

In April 2025, an expedition was undertaken to Ambohitantely with the aim of finding this candidate species of leaf-tailed gecko and collecting data on the morphology and biology of the animals.

The study site—the Ambohitantely Special Reserve

About 140 km northwest of Antananarivo lies the Ambohitantely Special Reserve in the district of Ankazobe. The name Ambohitantely means "the place with honey," as wild honey used to be collected in the forests of this reserve. Access to the reserve is via the village of Firarazana, located about 30 km north of Ankazobe along the RN4.

It requires a four-wheel drive vehicle and leads from Firarazana about 12 km east to the local

administration of Madagascar National Parks. Visitors will find a small camp with shelter, kitchen, sanitary facilities, and several marked hiking trails with viewpoints over the forest and surrounding savannah.

The forest of Ambohitantely (consisting of nearly 42 fragments that vary in shape and size) encompasses the very last larger fragment of medium altitude moist evergreen forest in the central highlands of Madagascar (Goodman et al. 2018).

The reserve covers 5,600 hectares, of which about 1800 hectares are primary forest and 3,800 hectares are grassland savannah at altitudes between 1300 and 1650 meters (Goodman et al., 2018). The vegetation is conditioned by a cool climate (mean temperatures range from +11.9 °C to +17.9 °C (53.42-64.22 °F)), a six-month dry season, and

frequent morning mist with a high rainfall (around 1,460 mm/y), falling mostly in the warm rainy period lasting for about half a year from October–November to March–April (Langrand, 2003; Goodman et al., 2018).

High Plateau forests are considered relict, nonetheless grassland is also a naturally occurring vegetation type of the Central Plateau of Madagascar but nowadays is highly degraded. Ambohitantely seems like a forest island in a vast sea of grass around since the ecotone between the protected forest and grassland is most often sharp. Though, relatively narrow intermediate zones of secondary shrubby vegetation are also present in some parts of the Reserve.

The trails in the protected area lead through primary forest, which, due to the altitude and exposure to strong winds, has a relatively low canopy height of 6–12 m on average (maximum 20 m). Below this are one or two further layers of dense undergrowth consisting of trees with a small diameter and stands of *Pandanus* (Pandanaceae) (Goodman et al. 2018).

On wind-protected slopes and especially in valleys the vegetation becomes more luxuriant with a canopy height of 18 m (single emergent rising to 25 m) with a dense middle layer of shrubs and lianas and a herbaceous stratum (Goodman et al., 2018).

This forest serves as a habitat for various mostly endemic species. Documented plant species include: *Asteropeia amblyocarpa* Tul., *Schizolaena tampoketsana* Lowry, G.E.Schatz, J.-F.Leroy & A.-E. Wolf, and the endangered palm species *Dypsis onilahensis* (Jum. & H.Perrier) Beentje & J.Dransf., *Dypsis decipiens* (Becc.) Beentje & J.Dransf., and *Dypsis oropediumis* Beentje (Goodman et al. 2018).

Populations of the microhylid frogs *Anodonthyla vallani* Vences, Glaw, Köhler & Wollenberg, 2010 and *Anilany heleneae* Vallan, 2000 still exist in the fragmented

forests of Ambohitantely (Barata et al., 2022).

Both species are classified as critically endangered and are considered EDGE species (Evolutionarily Distinct and Globally Endangered). Their occurrence is limited exclusively to Ambohitantely (and surrounding fragments), which is why the area has been designated an "Alliance for Zero Extinction" site. Such areas are considered important locations for endangered or critically endangered species, as they represent their last remaining habitats.

Because of its importance for the conservation of biodiversity, the Ambohitantely Special Reserve is managed by Madagascar National Parks (MNP). Like all protected areas managed by MNP, the management of the Ambohitantely Special Reserve is also based on collaborative co-management with the participation of members of local communities in conservation and development activities. They are organized into the Local Park Committee (CLP) and the Protected Areas Orientation and Support Committee (COSAP).

Threats to the protected area

The primary pressure at this site is wildfires, which move through the secondary grasslands and can extend into the remaining forest fragments (Goodman et al., 2018). This issue has resulted in observable reductions in forest cover over recent decades and the loss of several areas of natural forest (Goodman et al., 2018).

Traditionally, fires have been started for pasture renewal at the end of the dry season for zebu herds and for clearing agricultural land before planting. Other causes of ongoing secondary grassland burning are varied and include lightning strikes, accidental sources such as discarded cigarettes, and deliberate acts with differing motivations such as anarchistic acts against the state (Goodman et al., 2018).

Subadult female of the mossy leaf-tailed gecko.



To reduce the problem of fire entering the main forest parcel, it is now surrounded by a 60 km firebreak and there are immediate plans to extend its coverage. Some additional conservation issues in the protected area include unauthorized harvesting of forest trees, particularly hardwoods, as well as extraction of semi-precious stones such as quartz and beryl (Goodman et al. 2018).

These resources are generally not used locally but are likely transported to Antananarivo for sale. There is also a collection of forest animals for bushmeat. Another source of significant resource extraction has come from a military camp near Ambohitantely, involving activities such as hunting lemurs, harvesting forest trees, and producing charcoal (Goodman et al. 2018).

Searching for leaf-tailed Geckos

Almost 15 years have passed since we searched together for leaf-tailed geckos in the wild in Madagascar, so we were really looking forward to this joint tour. We planned four nights in the reserve to search for the geckos.

In mid-April, we could still expect increased activity from the animals, as the cooler winter season has not yet begun. Nevertheless, even in April, temperatures dropped to +12 °C (53.6 °F) in the early morning hours. During the day and especially

at night, we used the trail system in the reserve to search for leaf-tailed geckos.

Also, for other reptile groups, the Ambohitantely reserve promises to contain undiscovered genetic lines, perhaps even species.

In particular, an incredible variety of cryptic species has been discovered recently within the *Calumma nasutum* complex (Gehring et al., 2012; Prötz et al., 2020), but the population in Ambohitantely has not yet been studied neither genetically nor morphologically. It was therefore very interesting to examine these species in more detail.

Based on their external appearance and the altitude in Ambohitantely, we suspect that the specimens found belong to *Calumma fallax* (Mocquard, 1900), which is also known from Anjozorobe (clade H in Prötz et al., 2020). However, the females had two large white spots on the tip of the nasal process and in the middle between the two eyes, which we had not yet observed with such clarity in *C. fallax*.

More detailed findings will certainly be revealed by the pending analyses of the genetic samples. Not only for the chameleons but generally, we expected that the species composition of the herpetofauna of Ambohitantely would show



the most similarities with the rainforests of the central east coast at medium altitudes, such as those in the regions of Andasibe, Fierenana (Moramanga), and Anjozorobe, which have been relatively well studied and documented.

On the other hand, Ambohitantely, with an altitude of 1300–1600 m a.s.l., is significantly higher than, for example, the forests of Andasibe and Fierenana, which are located at an altitude of about 900–1200 m a.s.l., which in turn suggested some differences in the species assemblage.

Originally, the forest of Ambohitantely in the central highlands must have been seamlessly connected to the rainforests of Madagascar's east coast, as evidenced by the presence of various forest-dwelling amphibian and reptile species found in Ambohitantely, Anjozorobe, Mandraka, Fierenana, and down to Andasibe (such as *Boophis madagascariensis* (Peters, 1874), *Platypelis grandis* (Boulenger, 1889), *Calumma crypticum* Raxworthy & Nussbaum, 2006, and *Calumma gastrotaenia* (Boulenger, 1888)).

Therefore, the presence of the leaf-tailed gecko species *Uroplatus sikorae* Boettger, 1913 in Ambohitantely was not surprising. This species is widespread along almost the entire east coast at altitudes of around 300 m (in the southern populations) to 1550 m above sea level in Ambohitantely, which represents the highest locality for the species (Gehring et al., 2023).

Genetically this population represents the sister group to the populations from Andasibe, Fierenana, and Anjozorobe, which are distributed

along the central east coast at altitudes of around 900 m a.s.l. (Gehring et al., 2023).

Maybe because of their isolated location and the significant difference in altitude between their distribution areas the *U. sikorae* population from Ambohitantely represents an own recognizable evolutionary lineage (sik 8 in Gehring et al., 2023).

However, it nests deeply within *U. sikorae* (sensu stricto), leaving no doubt about its systematic affiliation. Also morphological, the specimens of *U. sikorae* that we found in Ambohitantely were clearly recognizable as such. Their coloration showed the typical variable pattern of green, gray, and brownish tones, mimicking the coloration and irregular patterns of tree trunks covered with moss and lichen in their habitat.

The animals' oral mucosa was deep black in color. We found two specimens in Ambohitantely that were actively foraging for food at night in the forest's shrub layer in ca. 3 m height.

One was an adult female, and the other was a subadult female, which we estimated to be about 6–9 months old.

Although these findings were very interesting and exciting for us, we were unable to find any specimens of our target species, *U. cf. ebenaui* (Ca8), during the first two nights, even though we searched intensively and late into the night.

It was not until the third night that the first specimens of these sought after leaf-tailed geckos appeared in the light of our headlamps. A truly magical moment!

All the intensive preparation and planning for this expedition paid off. We had finally found them. First, we found a juvenile male and an adult female in the shrub layer of the primary forest at a height of about 1 m.

One night later, we found two adult males in the shrub layer and one in a pandanus tree at a height of up to 3 m. The geckos were clearly recognizable as members of the *Uroplatus ebenaui* (Boettger, 1879)—species group based on their external appearance, due to its triangular head with supraocular spines, a laterally compressed body, and

short, spear-like tail. The dorsal colour pattern was highly variable. One male showed a rather strong pattern including isolated small dark brown patches on the entire back from the snout until the tail base and an irregularly mottling ventrally.

Other specimens such as the adult female were dorsally almost uniform pale brown and ventrally with very limited or no mottling at all. The oral mucosa was unpigmented, an important distinguishing feature within this group of leaf-tailed geckos, which, depending on the species, can be either unpigmented, black, or can even contain red and yellow elements, as is the case with *Uroplatus phantasticus* (Boulenger, 1888), for example.

Except for the juvenile male, the adult males had a snout-vent length of up to 65.12 mm (2.56 in), while the adult females measured up to 69.10 mm (2.72 in). The tail length of males was up to 20.08 mm, with a maximum width of 4.37 mm (0.17 in). The tails of females were up to 19.13 mm (0.75 in) long, with a maximum width of 4.01 mm (0.15 in).

Overall, the external appearance was very similar to *U. fiera* and the morphometric data collected in the field also fall within the range of variation of *U. fiera* (compare Ratsoavina et al. 2015).

The presence of *U. fiera* here in Ambohitantely can also be



Female of the candidate species *Uroplatus cf. ebenaui* (Ca8).



Male of the candidate species *Uroplatus* cf. *ebenaui* (Ca8).

explained biogeographically, as the rainforests at medium altitudes on the east coast, which are the terra typica of *U. fiera*, were once more or less continuously connected to Ambohitantely.

The only surprising thing is that *U. fiera* has not yet been found in the forests of Anjozorobe, which lie roughly between Ambohitantely and Fierenana.

Since more detailed investigations, such as counting the rows of scales around the mouth, the number of adhesive lamellae under the toes, or, of course, comprehensive genetic analyses, were not possible in the field, we cannot definitively answer the question of whether candidate species number 8 is actually a separate evolutionary lineage (and species) or as a highly differentiated population of the species *U. fiera*.

For this, we must wait for the subsequent laboratory results, for which we were able to take appropriate samples. We therefore ask for your patience until the relevant publication can be arranged.

However, populations of the *U. ebenaui* complex (and *U. sikorae* complex) from almost every remaining rainforest block in Madagascar show substantial genetic divergence. Even if this may not be indicative of cryptic taxonomically relevant diversity, it still exemplifies how further loss of primary rainforest habitat in Madagascar will inevitably lead to a loss of hitherto unknown and undescribed species and intraspecific genetic diversity and calls for caution when assembling captive populations for conservation breeding from specimens of unknown provenance.



Typical habitat of *U. cf. ebenaui* (Ca8) in Ambohitantely Special Reserve.

Future perspectives for the leaf-tailed geckos of Ambohitantely

Both *Uroplatus* species (*U. sikorae* and *U. cf. ebenaui* Ca8) are known to live in only a very restricted number of larger forest fragments within the Ambohitantely Special Reserve. It is unknown whether these species can survive in the smaller forest fragments within or outside the Reserve, given the different microhabitats and microclimates these smaller fragments probably have.

For example, bigger trees with a larger trunk diameter are important resting sites for *U. sikorae*, may be absent in heavily logged forest fragments. The reproduction of both species also relies on humidity, which could be lower in smaller forest fragments that are more affected by edge effects (Hending et al., 2023).

The impact of forest fragmentation and degradation on amphibian populations in Madagascar has been investigated an increasing number of studies (e.g. Vallan 2000, Riemann et al., 2015, Monteiro et al., 2025), but the effects on the reptile communities are largely unknown.

However, it can be assumed that these are quite similar, especially for strict forest-dwelling species such as leaf-tailed geckos and that species vulnerability increases by reducing the heterogeneity of the microhabitats available to those reptiles. In addition, very little is known about the required habitat size for the long-term survival of these taxa. Accordingly, conservation initiatives should prioritise preventing further habitat degradation and loss, as well as promoting forest regeneration near boundaries (Pareliussen et al., 2006).



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