

The status of *Mantella milotympanum* in the Ankeniheny-Zahamena Corridor, eastern Madagascar

Bertrand Razafimahatratra^{1,2}, Nandinanjakana Fatroandrianjafinonjasolomiovazo¹,
Raphali Andriantsimanarilafy¹ and Richard Jenkins^{1,3,4*}

Abstract. *Mantella milotympanum* is an endemic Malagasy amphibian that is threatened by habitat degradation. We surveyed areas around Fierenena to identify the sites and habitats used by this species. We found *M. milotympanum* at 20 new locations, extending its known range both to the north and to the east, occupying an estimated area of 52 km². All but four localities were within the Ankeniheny-Zahamena Corridor new protected area. This species is threatened mainly by conversion of its habitats into agriculture and conservation resources should be targeted at preserving the remaining humid forest along the Ivohitra River, which is also important for ecosystem services in the catchment.

Keywords. Amphibian, *Mantella*, status, threats.

Introduction

Mantella milotympanum Staniszewski, 1996 is a small brightly coloured Malagasy amphibian that is restricted to a few humid forest sites in the east of Madagascar (Bora et al., 2008). It is listed as Critically Endangered on the IUCN Red List of Threatened Species because it occupies a small area of habitat and is threatened by the loss and degradation of its habitat (Vences and Nussbaum, 2008). This species has been legally exported from Madagascar under Appendix II of the Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES) and 5,825 were exported between 2000 and 2003 (Rabemananjara et al., 2008). Although there is no compelling evidence that collection of *Mantella* frogs for international trade has reduced population persistence in the wild (Andreone et al., 2005), the removal of so many individuals from a species like *M. milotympanum* that has such a small geographical range is of potential concern (Anonymous, 2009a). In a recent review of the impact of trade on

Mantella frogs it was concluded that the annual quota of 1,000 *M. milotympanum* was of possible concern and the quota was reduced in 2009 to zero based on a recommendation by the CITES authorities in Madagascar. This in turn led a CITES working group to recommend to the Animals Committee that *M. milotympanum* should be removed from the significant trade review (Anonymous, 2009b).

Rabemananjara et al. (2008) noted that the ongoing expansion of the protected area system in Madagascar could provide an opportunity to improve the existing system for the commercial collection of frogs to provide wider benefits to the national and local economies. Significant progress is being made towards conserving large tracts of humid forest in eastern Madagascar and many important sites for amphibians will receive improved protection (Kremen et al., 2008; Rakotobe et al., 2008). The most recent assessment of *M. milotympanum* indicates that it is endemic to a small area of forest that lies on the edge of a new protected area, called the Ankeniheny-Zahamena Corridor, in the Alaotra Mangoro Region (Bora et al., 2008). The geographical distribution of this species is poorly known however and new information is required to feed into conservation planning in the new protected area. We therefore conducted a survey of *M. milotympanum* that aimed to provide a more detailed account of its distribution in forest to the east of Fierenana and determine how many sites were within the proposed boundaries of the new protected area.

1 Madagasikara Voakajy, B.P. 5181, Antananarivo, Madagascar;
e-mail: rkbjenkins@gmail.com

2 Département de Biologie d'Animale, Faculté des Science, Université d'Antananarivo, Madagascar;

3 School of Biological Sciences, University of Aberdeen, Aberdeen, UK;

4 Durrell Institute of Conservation and Ecology, University of Kent, Canterbury, UK.

* corresponding author email

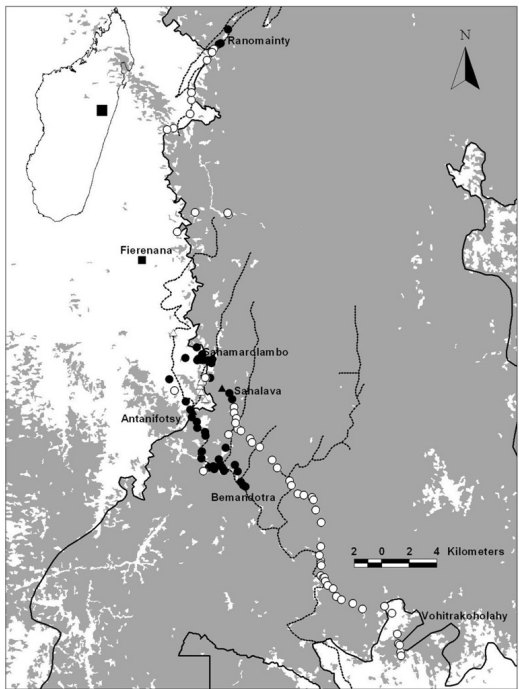


Figure 1. A map of the *Mantella milotympanum* survey area in eastern Madagascar showing new records (●) and sites from where the species was not observed (○). Previously published localities where we found *M. milotympanum* (▲) and where the species was not observed (Δ) are also shown. The limit of the Zahamena-Ankeniheny Corridor new protected area (—) and major rivers (---).

Materials and Methods

The surveys were conducted in the Commune of Fierenena, Moramanga District, Alaotra Mangoro Region, in eastern Madagascar. Information on the current and historic distribution of *M. milotympanum* was obtained through discussions with local farmers and frog collectors. We made rapid searches of suitable habitats on arrival at each site. At localities with *M. milotympanum* we conducted transects to determine its relative abundance. A transect line, 50 m long, was placed parallel to the nearest lentic habitat, and two more lines of the same length were set parallel at approximately 250 m and 500 m from the water. At each 10 m interval along the transect line a 2 m x 2 m (4 m²) quadrat was searched for *M. milotympanum* by three people. We recorded the duration of each quadrat search, the geographic position at zero metres of the first transect line and the maximum length and width of the lentic body. We also measured the snout-vent length (mm) and body mass (g) of the *M. milotympanum* that were temporarily detained during the search. We cleaned fieldwork equipment and clothing following recommended procedures to reduce the risk of transferring bacteria or pathogens between sites (Dejean *et al.*, 2007).

Results

In total we searched for *Mantella* frogs in six different areas and found evidence of *M. milotympanum* in 24 locations (Table 1; Fig. 1). An additional five sites that we visited were reported to be former commercial collection localities for *M. milotympanum* but no frogs or suitable habitat was found. We also found 10 individuals, from five different localities, of *Mantella*



Figure 2. Typical example of the green form of *Mantella milotympanum* encountered during the survey.



Figure 3. Typical example of the red form of *Mantella milotympanum* encountered during the survey.

cf. *milotympanum* (as described in Bora et al., 2008) that had distinctive black ear drums and nostrils but were green in coloration (Fig. 2). In all cases these intermediary forms were sympatric with the red forms but were never more than 25% of the frogs sampled at a site (Table 1).

Distribution

We confirmed the presence of *M. milotympanum* that phenologically resembled the holotype in 20 locations that were not previously described in the herpetological literature (Table 1; Fig. 3). Fourteen of these sites were within the proposed boundaries of the Zahamena-Ankeniheny Protected Area (Fig. 1). We superimposed a grid with 4 km² squares over the survey areas and found *M. milotympanum* present in 14, giving an estimated area of occupancy of 56 km².

Relative abundance

In total, we conducted transect surveys at 20 locations. We found a total of 652 *M. milotympanum* individuals which ranged between 2 and 135 at each site (mean 32.6 individuals \pm 7.1 SE). Transect length was standard across sites but search effort varied between 42 and 66 minutes (mean 53 minutes per site). The modal frequency was 1-10 frogs per site and at only one locality was an excess of 63 individuals encountered (Fig. 4).

Habitat associations

Mantella milotympanum was present in sites that were vegetated by mid-altitude humid forest. There were lentic habitats present in all sites where we found *M. milotympanum*. The relative abundance of *M. milotympanum* was highest in transects alongside standing water, and decreased with increasing distance

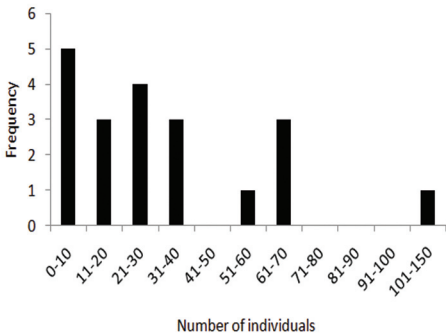


Figure 4. A frequency distribution graph of *Mantella milotympanum* from abundance counts at 20 different sites.

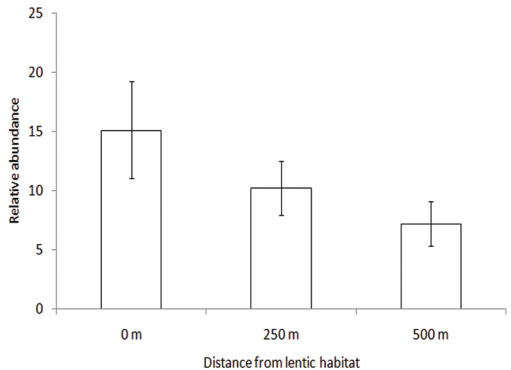


Figure 5. The relative abundance of *Mantella milotympanum* (mean \pm SE) in quadrats along transects at increasing distance from the presumed breeding ponds at 20 different sites.

Table 1. The sites visited during our survey where we confirmed the presence of *Mantella milotympanum*. At 20 localities we counted frogs in quadrats set along transects (see method) and this relative abundance is expressed as: the number of frogs found in all quadrats per locality / 150 m total transect length x 100. Information on the coloration of *M. milotympanum* at each locality is also given. CAZ is the name of the new protected area (Corridor de Ankeniheny-Zahamena). Previously published localities are annotated, Randrianirina (2005)¹, Vieites *et al.* (2005)², Bora *et al.* (2008)³

Locality	Latitude	Longitude	Altitude (m)	Frogs 100m ⁻¹	Red body	Green body
Ambalakadera (1)	18.57172	48.43797	965	Presence only	100%	0%
Ambalakadera (2)	18.56636	48.43475	953	Presence only	100%	0%
Ambalakadera (3)	18.55208	48.42319	926	Presence only	100%	0%
Ranomainty	18.33369	48.45589	1079	Presence only	100%	0%
Sahamarolambo (1) ^{2,3}	18.53811	48.44547	951	7.33	89%	11%
Sahamarolambo (2) ^{2,3}	18.53856	48.44272	948	22.67	100%	0%
Mandrevoamboa	18.53939	48.44961	935	23.33	100%	0%
Anjandina	18.55092	48.45125	944	14.67	100%	0%
Sahalava ¹	18.56072	48.46456	945	1.33	100%	0%
Amoron'i Vohitra (1)	18.60940	48.45460	931	8.00	89%	11%
Amoron'i Vohitra (2)	18.60999	48.45472	917	7.33	75%	25%
Bemandotra ¹	18.61153	48.47064	928	45.33	96%	4%
Marotaolana	18.60735	48.46872	922	90.00	100%	0%
Ambodimanga	18.61114	48.46144	950	19.33	82%	18%
Andranomangatsiaka	18.60750	48.45867	926	4.67	100%	0%
Sahanambolena	18.62031	48.47456	948	34.00	88%	12%
Ankazotoho	18.59611	48.46250	930	2.00	100%	0%
Mankary	18.61000	48.45472	917	20.00	83%	17%
Ambinanibe	18.60328	48.44572	947	4.00	100%	0%
Marosalazana	18.59881	48.44597	963	40.67	100%	0%
Befototanana	18.60367	48.45778	887	3.33	100%	0%
Nantiray	18.60931	48.45076	945	24.67	100%	0%
Andranomahitsy	18.58347	48.44278	920	20.00	100%	0%
Antanifotsy ¹	18.58614	48.44811	892	42.00	100%	0%

from the aquatic habitats (Fig. 5), although the difference was not statistically significant (Kruskal Wallis $H = 4.2$, $DF = 2$, $P = 0.12$). Ponds that were attributed to breeding habitats varied in surface area between 173 m² and 48,000 m² (mean = 5,124.4 m ± 2,470 SE), but this did

not significantly correlate with the relative abundance of *M. milotympanum* encountered (Spearman correlation $r_{20} = 0.01$, ns). Eight of the ponds were waterless at the time of the survey, whilst the remainder varied in depth between 5 cm and 50 cm (mean = 20.6 cm ± 3.40 SE).



Figure 6. Threats to *Mantella milotympanum* recorded inside the Zahamena-Ankeniheny Corridor new protected area: slash and burn.

Threats

We observed active slash and burn clearing at 50% of localities (Fig. 6), timber harvesting at 56% (Fig. 7) and conversion of riparian wetlands in agriculture at 33% (Fig. 8). The aquatic and terrestrial habitats of *Mantella milotympanum* are therefore threatened and five former sites have undergone complete removal of forest vegetation.

Discussion

Mantella milotympanum with uniformly red or orange coloration and black eardrum and nostril was previously known from four localities and we extended the range of this taxon north and east during the survey reported herein. The majority of localities were south-east of Fierenana and located alongside the Ivohitra River, but it was also discovered 18 km to the north around Ranomainity, although it was absent from an extensive area of degraded habitats between these locations. Although it is likely that undiscovered sites remain within its geographic range, the periphery appears to be set by the presence of intermediary forms with *M. crocea* to the north and south (Chiari et al., 2004; Bora



Figure 7. Threats to *Mantella milotympanum* recorded inside the Zahamena-Ankeniheny Corridor new protected area: logging.



Figure 8. Threats to *Mantella milotympanum* recorded inside the Zahamena-Ankeniheny Corridor new protected area: wetland conversion.

et al. 2008), whilst little forest exists to the west and to the east the habitat becomes progressively unsuitable because of lower elevations.

There is considerable genetic similarity between *M. milotympanum* and *M. crocea* and the specific status of the former is questionable (Chiari et al., 2004; Vieites et al., 2009). A number of intermediate forms are reported in the literature and which have, until now, circled the distribution of *M. milotympanum*. Bora et al. (2008) found populations of *Mantella* cf. *milotympanum*, characterized by greenish dorsal coloration and black eardrums, in locations to the north and south of where the classic red/orange *M. milotympanum* occurs. Although we did not visit these localities (Ambatombolana, Andriambe, Andaingo, Mandrevo Amboa and Savakoanina) we found individuals with this coloration in the same localities as the red form alongside the Ivohitra River, to the south-east of Fierenena.

The relative abundance of *M. milotympanum* decreased gradually with increasing distance from the aquatic habitats. This serves to highlight the importance of terrestrial habitat conservation for *M. milotympanum* because these areas are probably

important for feeding and over-wintering adults but are threatened by expanding agriculture and logging. The wetland habitats used by *M. milotympanum* are also threatened by conversion in to rice fields. The terrestrial protected area system of Madagascar is being expanded and part of the range of *M. milotympanum* is now included within a temporary protected area called the Ankeniheny-Zahamena Corridor. Work in progress is developing the various land use zones with local communities in a process that will lead to the site becoming a formal protected area. Consideration needs to be given to whether *M. milotympanum* breeding sites are designated as strictly protected or sustainable use areas; the former will afford the greatest protection to key habitats but the latter will permit sustainable collection. Given the relentless conversion of forest and wetland into agriculture in the area it would be wise to provide strict and effective protection to as many of the *M. milotympanum* localities as possible.

Mantella frogs do not command high prices internationally and during our survey the local collectors reported that reptile species, such as *Uroplatus pietschmani* and *Paroedura masobe*, were the most

profitable. We suggest therefore that whilst sustainable collection of *M. milotympanum* could be achieved in the new protected area it is more prudent at this stage to focus on conserving the forest and wetlands for the benefit of the frogs and the wider ecosystem.

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