

## Draft proposal for the amendment of Appendix II of CITES

**A. Proposal**

Inclusion of all species of the genus *Mantella* spp. in Appendix II of CITES in accordance with Article II 2(a) and resolution Conf. 9.24. The species *Mantella aurantiaca* is already listed in Appendix II of CITES.

**B. Proponents**

The Kingdom of the Netherlands and the United States of America.

**C. Supporting Statement****1. Taxonomy**

**1.1 Class** Amphibia

**1.2 Order** Anura

**1.3 Family** Ranidae

**Subfamily** Mantellinae

**1.4 Species** *Mantella baroni* Boulenger, 1922  
*Mantella bernhardi* Vences et al., 1994  
*Mantella betsileo* (Grandidier, 1872)  
*Mantella crocea* Pintak & Böhme, 1990  
*Mantella cowani* Boulenger, 1882  
*Mantella expectata* Busse & Böhme, 1992  
*Mantella haraldmeieri* Busse, 1981  
*Mantella laevigata* Methuen & Hewitt, 1913  
*Mantella madagascariensis* (Grandidier, 1872)  
*Mantella manery* Vences, Glaw & Böhme, 1999  
*Mantella milotympanum* Staniszewski, 1996  
*Mantella nigricans* Guibé, 1978  
*Mantella pulchra* Parker, 1925  
*Mantella* sp. 1 (still to be described) Nussbaum, Köhler & Vences  
*Mantella viridis* Pintak & Böhme, 1888

The nomenclature of the genus *Mantella* is rather complicated. In consultation with the Nomenclature Committee the list of species is chosen to follow a more recent taxonomy (Vences et al., 1999) than the standard reference as recommended in resolution Conf. 10.22, f): "Amphibian Species of the World: A Taxonomic and Geographic Reference (D.R. Frost, 1985, Allen Press and The Association of Systematics Collections) and Amphibian Species of the World: Additions and Corrections (W.E. Duellman, 1993, University of Kansas) for amphibian nomenclature until the second edition of the former reference has been published." A continuously updated version of this publication is available on internet. Possible adoption of this modernised version still has to be discussed by the Nomenclature Committee and the 11th Conference of Parties for adoption. Since the whole genus is proposed for inclusion in Appendix II, these taxonomic complications would as yet not interact with the proposed amendment of Appendix II.

**Note:**

The present proposal should be read keeping in mind the fact that at the moment new data on the species of *Mantella* are actively being gathered in the field. New data on distribution, collecting systems and impact on natural populations may modify the actual perception of the situation of the exploitation of *Mantella*'s. The main objective of this ongoing work is to make a proper management plan that will ensure at the local level that there will be no over exploitation.

**1.5 Scientific synonyms**

*Mantella aurantiaca* Mocquard, 1900; included *Mantella aurantiaca milotympanum* Staniszewski, 1996 (now considered a separate species); and *Mantella aurantiaca rubra* Staniszewski, 1996 (considered a full synonym of *M. aurantiaca*).

*Mantella baroni* Boulenger, 1888; includes *Phrynomantis maculatus* Thominot 1889 and was treated as a synonym of *M. madagascariensis* by Glaw & Vences (1994), but here again considered as a good taxon. Many specimens imported as *M. cowanii* are in fact *Mantella baroni* Staniszewski, 1998.

*Mantella betsileo* (Grandidier, 1872); includes *M. attemsi* Werner, 1901 and *Dendrobates ebenau*

Boettger, 1880.

*Mantella haraldmeieri* Busse, 1981; synonym *M. madagascariensis haraldmeieri*.

*Mantella madagascariensis* Grandidier, 1872; includes *Mantella loppei* Roux, 1935.

*Mantella nigricans* Guibé, 1978; synonym *M. madagascariensis nigricans* and *Mantella cowani nigricans*.

*Mantella pulchra* Parker, 1925; treated as a colour morph of *M. madagascariensis* by Duellman (1993).

Confusion reigns with this species, as most were imported as *Mantella cowani* before 1994.

(Staniszewski 1998).

**1.6 Common names** English: Malagasy poison frogs.

Dutch: gifkikkers van Madagaskar

French:

## 1.7 Code number

## 2. Biological Parameters

### 2.1 Distribution

All species of *Mantella* spp. are exclusively distributed on (parts of) Madagascar and its adjacent islets (Nosy Be, Nosy Komba, Nosy Boraha, Nosy Mangabe). Records of *Mantella* species on La Réunion (Thomot, 1889; Guibé, 1964) or the Seychelles (Staniszewski, 1977) are not corroborated by reliable voucher specimens, and must be considered as wrong.

*Mantella baroni*: occurs in the central Eastern Region, mainly at mid-altitude localities: Antsihanaka; Ankeniheny (ca. 1000 m attitude); An'Ala (ANDREONE, 1993; DALY et al., 1996; personal observation at ca. 840 m attitude); Analamazoatra; Anosibe (Anosibeana); Niagarakely; Marotamba (120 km S Moramanga; probably identical with Marolambo, which is situated about 100 km S Moramanga; see BLOMMERS-SCHLÖSSER & BLANC, 1993); Ambohimombo; Ikongo; Ruisseau d'Iorantjatsy; Forêt de Tsianovoha, Ranomafana National Park (ANDREONE, 1992; GARRAFFO et al., 1993; personal observation near Vohiparara, ca. 1000 m attitude); Mantady. Additional localities were published by Daly et al. (1996): Sahavondrona (near Ranomafana; ca. 1000 m altitude); 30-35 km south of Moramanga.

*Mantella bernhardi*: Until now, the species is only known from the type locality: forest near Ambohimanana (Tolongoina). This locality is corroborated by the observation of Andreone (personal communication) who, however, found only one single specimen in the dry season.

*Mantella betsileo*: Except the type locality "Pays des Betsileos", all known localities are located in lowlands (attitude between 0 and ca. 500 m), generally near the coast. Also, all east coast localities are in an area north of Betsileo (see DALY et al., 1996: 19). Confirmation of the type locality would therefore be important. The species is common along the east coast in the Maroantsetra region and on Nosy Boraha, and in the Sambirano region; it also occurs along the west coast.

*Mantella crocea*: The type locality (Andasibe) could not be confirmed by recent surveys. Also the Moramanga locality (ZFMK vouchers) seems rather dubious. The only reliable information of which we are aware is included in BEHRA et al. (1995), who confirmed the occurrence of the species in the Bakozetra area north of Andasibe (located immediately to the north of the known distribution area of *M. aurantiaca* in the Torotoro- fotsy swamps).

*Mantella cowani*: limited to surroundings of Antoetra, Antoetra east of Ambositra, furthermore, the original description of the species tells us the species is also supposed to occur in forests near Ambatolampy.

*Mantella expectata*: Known from the type locality, 20 km SE of Toliara; the area around Morondava, based on a picture made by a German development aid worker and published by Meier (1986); the Isalo massif (altitude ca. 800 m.), based on a personal communication of A. Peyrieras and on Daly et al. (1996). The locality Mandena in SE Madagascar, given by Glaw & Vences (1994), was based on an erroneous information of G. Hallmann and was corrected by Vences et al. (1996).

*Mantella haraldmeieri*: in extreme southeastern Madagascar in the forest reserve of Tsitongabarika (Manantantely and Manangotry), in the Marosohy near Ranomafana-Sud and in the Réserve naturelle intégrale d'Andohahela, (Lot number 1) (Netherlands, 1997). Museum Koenig, Bonn and Turin Museum specimens with a reliably known locality were collected near Nahampoana. A. PEYRIERAS (personal communication) found the species in Mahatalaha. MNHN vouchers demonstrate that the species is the only *Mantella* so far known in the Anosy mountain chain. Localities are Chaines Anosyennes, Ambana, Bekazaha, and Soavala.

*Mantella laevigata*: Type locality Folohy. Recent localities from the East and North-East are the small island Nosy Mangabe (100-300 m altitude); the Tsararano chain (700 m altitude); the Marojezy massif (300-700 m altitude) and at Masoala (Ambatoleolama surroundings) (Andreone & Randrianirina unpublished). Two additional localities from the northern part of the Eastern Region are found in DALY et al. (1996): Ambodimanga and Varary, both in the Mananara reserve (ca. 100 m altitude). The locality Maroantsetra (based on ZFMK 19298; see Busse, 1981) does almost certainly not refer to the town Maroantsetra itself but to a nearby locality (most probably Nosy Mangabe) and is therefore not accepted here.

*Mantella madagascariensis*: Type locality is Ambalavato near Ranomafana. Type locality of the junior synonym *M. loppei* is Marolambo (Vatomandry). ZFMK vouchers were collected at Niarakely. At Vohiparara (ca. 1000 m altitude; near Ranomafana), we found one specimen syntopic with *M. baroni*, confirmed by F. Andreone and Turin Museum voucher specimens. According to A. PEYRIERAS (personal communication), populations of the "variable morph", here included in *M.*

*madagascariensis*, occur near Beparasy.

*Mantella manery*: only known from the type locality: Marojezy massif, near Camp 1.

*Mantella milotympanum*: According to A. PEYRIERAS (personal communication in GLAW & VENCES, 1994) this species occurs in the Fiherenana valley, located about 50 km N Andasibe (not the Fiherenana valley in the South-Western region, near Toliara).

*Mantella nigricans*: Known from: the Marojezy massif (North-Eastern region; 300-700 m altitude); Hiaraka (Iaraka) (Masoala peninsula; PEYRIERAS, personal communication); Tsararano (700 m altitude); Anjanaharibe (1200 m altitude) (Raxworthy et al., 1998; Randrianirina, 1998; Andreone et al., in press) and at Ambatoleama surroundings, Masoala (Andreone & Randrianirina, pers. communication).

*Mantella pulchra*: Type locality is Antsibanaka. ANDREONE (1992) and DALY et al. (1996) collected the species near An'Ala (near Andasibe; ca. 850-1000 m altitude), and A. PEYRIERAS (pers. communication) in Andekaleka (Rogez). Further localities within the Mananara reserve (ca. 100-200 m altitude) were published by DALY et al. (1996). Specimens in the Transvaal Museum, Pretoria corroborate the occurrence in Folohy. Exact location of the type locality Antsibanaka is unknown; most probably, the name was used in the past for a forested region near Lake Alaotra (see VIETTE, 1991). BLOMMERS-SCHLÖSSER & BLANC (1991: map 4) locate Antsibanaka, probably erroneously, east of Andasibe. An'Ala is currently almost destroyed, and we ignore whether *M. pulchra* (and *M. baroni*) still occur there (Andreone pers.com.).

*Mantella* sp. 1 (new species to be described): Ankarana; Tongahybe; Morondava, Androatsalo (Androatsabo according to Blommers-Schlösser & Blanc, 1991); Mohambo (locality not traced). According to Nussbaum (personal communication; see also Clark 1994), large populations of this species occur in the spiny desert of the SW region.

*Mantella viridis*: Only known from the northern tip of Madagascar. The published type locality is south of Antsiranana. The only reliable localities known are 13 km south of Antsiranana (DALY et al., 1996); Montagne des Français (GLAW & VENCES, 1994; ca. 100-300 m altitude), south of Antsiranana. Specimens in Museum Koenig, Bonn with the locality "Antsiranana" were most probably collected in the Montagne des Français. ANDREONE (1992) showed pictures of *Mantella viridis* from "area of Montagne d'Ambre National Park", but previously stated that he had not observed the species in nature and that locality information was based on PINTAK & BÖHME (1988). Most probably the species is not present in the Montagne d'Ambre National Park since recent surveys failed to find it (RAXWORTHY & NUSSBAUM, 1994; GLAW & VENCES, 1994); Anketrabe-Antongombato, Ambra forests, especially at altitudes below 300 m., and in Ankarana.

## 2.2. Habitat availability

Most *Mantella* species inhabit areas of tropical rainforest, but at least three species (*M. expectata*, *M. betsileo* and *M. sp. 1*) are known from arid regions in western Madagascar. Although no reliable altitude data for most localities are available, it can be stated that they are mostly in between sea level and ca. 1000 m altitude. Only *M. cowani* is known to occur at much higher altitudes (Ambatodradama: 2000 m). *Mantella bernhardi* lives near swamps on secondary growth slopes.

*Mantella cowani* favours open or degraded areas after the destruction of its natural habitat (primary forest). It prefers the following habitats: fields and secondary growth, ground litter and fallen tree trunks, near grass clumps in associations of grasses and in eucalyptus forests, either on litter or under tree trunks.

*Mantella expectata*: unknown; Hallman (pers.com) found this frog near Mandena, outside the forest.

*Mantella haraldmeieri* hides in litter or under fallen trees near streams or in crevasses along larger streams.

*Mantella viridis* prefers dry forests and their immediate environment. During the winter, it gathers in small areas, especially in dried canals, of about 30 square metres.

### 2.3 Population status

For statements on vulnerability by excessive collecting or habitat destruction, and identification of conservation priorities, a comparative assessment of the status of all *Mantella* species is necessary. In the following five different factors which may influence the status of *Mantella* species are analysed.

(1) *Geographical distribution of the species.* - We estimated the extent of the distribution area and the density by which it is populated by a certain species by taking into account the total number of localities known and the largest distance in kilometres between two locality records attributed to the species. Species can be classified as follows: (a) common species with a large distribution area ([10 localities, and > 400 km distance between the most distant localities): *M. betsileo*, *M. baroni*; (b) more localised species with a large distribution area (5 localities, > 400 km distance). *M. sp. 1*; (c) relatively common species with a moderate distribution area ([5 localities, 100-400 km distance): *M. laevigata*, *M. madagascariensis*, *M. cowani*; (d) more localised species with a moderate distribution area (< 5 localities, 100-400 km distance): *M. expectata*, *M. pulchra*; (e) species with a small distribution area (3 localities, 50- 100 km distance): *M. nigricans*, *M. haraldmeieri*, *M. aurantiaca*; (f) localised species which are only known from one or two localities (distance < 50 km): *M. manery*, *M. viridis*, *M. bernhardi*, *M. crocea*, *M. milotympanum*. (2) *Number of nature reserves and protected areas in which a species is known to occur.* - At present, this is known to apply to the following species and localities: *M. betsileo*, Tsaratanana, Mananara, Masoala, Lokobe, Manongarivo, Tsingy de Bemaraha; *M. sp. 1*, Ankarana; *M. expectata*, Isalo; *M. manery*, Marojezy; *M. laevigata*, Mananara, Nosy Mangabe, Anjanaharibe-Sud, Marojezy; *M. baroni*, Analamazoatra, Mantady, Ranomafana, probably Zahamena; *M. aff. baroni*, Ivohibe; *M. nigricans*, Anjanaharibe-Sud, Marojezy, probably Masoala; *M. haraldmeieri*, possibly Andohahela; *M. madagascariensis*, Ranomafana; *M. pulchra*, Mananara; *M. aurantiaca*, not yet known from any protected area (would occur within the limits of Analamazoatra if this reserve was expanded as suggested by ZIMMERMANN, 1996b).

(3) *Restriction of the species to primary (forest) habitat.* - Field data are lacking or insufficient for most *Mantella* voucher specimens examined in the present study. However, some authors give reliable habitat data for *Mantella* species, which are here combined with observations by Vences & Glaw, referred to here as pers.obs. Species which are until now only found in primary rainforest are *Mantella laevigata* (localities Nosy Mangabe, Marojezy: personal observation; Anjanaharibe, Tsararano: personal communication of F. ANDREONE), *M. baroni* (several localities; ANDREONE, 1993; DALY et al., 1996; pers. obs.), *M. haraldmeieri* (pristine and degraded primary forest near Nahampoana, pers. obs.), *M. nigricans* (Marojezy, Tsararano, Anjanaharibe; pers. communication of F. ANDREONE and pers. obs.), *M. manery* (pers. obs.), *M. madagascariensis* (Ranomafana; pers. obs.), *M. pulchra* (several localities; ANDREONE, 1993, DALY et al., 1996, pers. obs.), *M. aurantiaca* (swamp forest near Andasibe; pers. obs., ZIMMERMANN et al., 1990), *M. crocea* (swamp forests; DALY et al. 1996), and *M. bernhardi* (a single specimen found in degraded primary forest rests near rice fields, pers. communication of F. ANDREONE). Species known from more arid forest are *M. viridis* (pers. obs. at Montagne des Français; see also DALY et al., 1996), *M. expectata* (Isalo; DALY et al., 1996) and *M. sp. 1* (Ankarana; pers. communication of J. KÖHLER). Only *M. betsileo* is known to occur regularly outside primary habitats (pers. obs. on Nosy Be, Nosy Komba, Nosy Boraha and near Maroantsetra). For the remaining species, no reliable field observations are available to us; however, it is to be expected that *M. milotympanum* is restricted, as *M. aurantiaca* is, to swamp forests. (4) *Extent of trade of the species.* - Although trade statistics do exist, a reliable comparison of numbers of traded specimens of different species is not possible due to taxonomic confusion in the past. In many cases, it is not possible to state which species actually was traded under a certain name. Therefore it is preferred to summarise our subjective impressions obtained between 1990 and 1997. In these years, Vences, Glaw & Boehme (1999) monitored several times the exhibitions of specialised pet dealers both in Germany and in Madagascar, and thus got some indications on extent of trade in certain species which are summarised in tab. 1. Their impressions agree relatively well with the data of GORZULA (1996), who reported the incidence of *Mantella* species among a sample of 69 European hobbyists: *M. aurantiaca*, 15.9 %; *M. madagascariensis* (probably partly referring to *M. baroni*) and *M. crocea*, 14.5 % each; *M. cowani* (possibly also largely referring to *M. baroni* or *M. madagascariensis*), 11.6 %; *M. pulchra*, 4.4 %; *M. viridis*, 2.9 %; *M. betsileo* and *M. haraldmeieri*, 1.5 %. Also the list of BEHRA (1990) of *Mantella* exported in 1990 from Madagascar does not contradict these observations: *M. aurantiaca*, 30.5%; *M.*

*viridis*, 14%; *M. betsileo*, 3%; *M. cowani* (probably largely referring to *M. baroni*), 29%; undetermined species, 23%.

(5) *Potential subjective attractiveness to hobbyists*, estimated by amount of colourful pattern and interest of breeding biology (in *M. laevigata*).

To summarise these data, Vences, Glaw & Boehme (1999) tried to assign status categories to *Mantella* species. They followed categories used in the European CITES regulations (ANONYMOUS, 1996), except the category CT ("commercially threatened") which was used in a modified way as specified below, and the abbreviation OK which was used for non-threatened species.

(1) OK (*not threatened*). - Not threatened at present is *M. betsileo*, which has a low attractiveness, a very large distribution area, and which also occurs outside primary forest.

(2) K (*insufficiently known*). - *M. manery* and *M. aff. baroni* are expected to belong to one of the categories below (probably R), but basic information is lacking. *M. sp. 1* does not seem to be threatened at the moment due to its low attractiveness and apparently large distribution area; this species, however, may be more locally restricted than *M. betsileo*, and more dependent on a threatened habitat type (dry forest). Also in this case, more data are needed.

(3) CT (*commercially threatened*). - This category is here used for species which may be locally and potentially effected by overcollecting due to their high attractiveness, but which are not yet threatened in their whole distribution area. Included in this category are *M. laevigata*, *M. nigricans*, *M. baroni*, *M. pulchra* and *M. madagascariensis*.

(4) R (*rare*). - Species with restricted distribution areas, which are not yet vulnerable or endangered, but are at risk. In this category, we include *M. viridis*, *M. expectata* and *M. cowani*

(5) V (*vulnerable*). - Species likely to become endangered by extinction soon if causal factors continue operating. At present, only *M. aurantiaca* and *M. bernhardi* are included in this category.

(6) I (*indeterminate*). - Species known to be endangered, vulnerable or rare, but for which at the moment there is not enough information to say which of the categories would be appropriate. *M. crocea* and *M. milotympanum* are included in this category.

**Table 1** - Conservation status and trade of *Mantella* species. For each species are given: the number of known localities; the maximum distance between the most distant known localities ( $\pm$  20km) measured on a 1:2,000,000 map (Carte routière, Foiben Taosarintanin'I Madagasikara [Institut National de Géodésie et Cartographie, Madagascar]) as a very rough estimate of the distribution area; the number of nature reserves in which the species is known to occur; its known restriction to primary forest habitat (+ restricted to primary forest; - not restricted to primary forest); the frequency in which it was seen in trade (only Vences, Glaw & Boehme's subjective impression between 1990-1997: - not exported in relevant numbers, + exported, ++ often exported); and the potential attractiveness for hobbyists and the pet trade (+ not very attractive, ++ attractive, +++ very attractive). Status is coded as follows: OK, not threatened; CT, commercially threatened (potential danger of overcollecting exists at least locally); R, rare; K, insufficiently known; I, indeterminate; V, vulnerable. Research needs are coded as follows: 1, distribution; 2, taxonomic status and validity; 3, variation; 4, habitat.

<i>Mantella</i> species	Number of localities	Maximum locality distance	Number of reserves	Restriction to primary forest	In trade	Attractiveness	Status	Research needs
<i>M. betsileo</i>	17(18)	840 (1220) km	6	-	+	+	OK	-
<i>M. sp. 1</i>	5	1260 km	1	(-)	-	+	K	2,3
<i>M. viridis</i>	2	< 20 km	0	(+)	++	++	R	1
<i>M. expectata</i>	3	340 km	1	(-)	+	+++	R	1,4
<i>M. manery</i>	1	0 km	1	+	-	++	K	1,2,3,4
<i>M. laevigata</i>	5	360 km	4	+	+	+++	CT	-
<i>M. nigricans</i>	4	80 km	3	+	-	++	CT	2
<i>M. haraldmeieri</i>	6	50 km	1?	+	-	+	R	2

<i>Mantella</i> species	Number of localities	Maximum locality distance	Number of reserves	Restriction to primary forest	In trade	Attractiveness	Status	Research needs
<i>M. baroni</i>	16(18)	420 km	3(4)	+	++	+++	CT	-
<i>M. aff. baroni</i>	1	0 km	1	?	-	+++	K	1,2,3,4
<i>M. cowani</i>	5	160 km	0	?	++	+++	R	1,2,3,4
<i>M. bernhardi</i>	1	0 km	0	+?	+	+	V	1,4
<i>M. pulchra</i>	5	320 km	1	+	+	++	CT	2,3
<i>M. madagascariensis</i>	5	260 km	1	+	++	+++	CT	3, 4
<i>M. crocea</i>	1?	0 km	0	+?	+	++	I	1,2,3,4
<i>M. aurantiaca</i>	4	60 km	0	+	++	+++	V	1,3
<i>M. milotympanum</i>	1	0 km	0	?	+	+++	I	1,2,3,4

We do not yet assign any known *Mantella* species to the "endangered" category (species facing a very high risk of extinction in the wild in the near future), but some species might move into this category within the next ten years.

Only the species *Mantella aurantiaca* is listed as VULNERABLE (A1cd) in the IUCN Red List of Threatened Animals, 1996.

## 2.4 Population trends

Studies by BIODÉV reveal considerable seasonal variation in species density. During the reproductive period, populations are found in abundance.

*Mantella baroni*: An'Ala is currently almost destroyed, and we ignore whether this species (and *M. pulchra*) still occur there (Andreone, pers. communication).

*Mantella bernhardi*: At Ambohimanana, the only known site where this species is found, the population was estimated to be 123 specimens per hectare. Because there have been no extensive studies, no reliable estimate can presently be made on the evolution of the populations of *Mantella bernhardi*. Recent field studies have, however, made it apparent that collecting constitutes a serious threat because the region is readily accessible. Unfortunately it is unlikely to be available for the pet trade for much longer due to its precarious position in the wild. (Staniszewski 1998).

*Mantella cowani*: During the reproduction period (the month of December), the BIODÉV-team counted 598 specimens per hectare in several existing ecological areas. At the end of reproduction period at the site studied the number of specimens had dropped to 48 per hectare after heavy collecting. Collectors reported that formerly 2,000 specimens of *M. cowani* could be collected in one day, compared to the current 100 to 150 specimens now comprising one day's harvest. It appears that the population around Antoetra is not stable.

*Mantella expectata*: this species might have its habitat also threatened by sapphire mining, which is rampant and uncontrolled all over the island.

*Mantella haraldmeieri*: During January 1996, this species was found at Manantantely in low valleys near a stream with a density of 760 specimens per hectare. At higher altitudes, numbers dropped to 50 individuals per hectare on the slopes and to zero at the summit. In the nature reserve at Andohahela where the population is well protected, an average density of 1450 specimens per hectare was found during this same period. At present, this population appears to be stable, but deforestation is beginning to cause negative effects. Its range is rather restricted.

*Mantella viridis*: Density varies greatly from one site to another. In the Montagne des Français, the density was 138 specimens per hectare in 1996; 94 specimens per hectare were counted at Antamotamo and 110-204 specimens per hectare were estimated at Analamanandro compared with 396 and 553 specimens per hectare at Analamanga where there was no collecting due to the nearness

of the village and the presence of a game warden. Similarly, 1,692 specimens per hectare were counted at Anketrabe-Antongombata in August 1994, but only 214 specimens per hectare were counted following exploitation of the area in March 1996. It seems that the population can not regenerate in a short period. After metamorphosis of tadpoles into froglets during April, densities of 1300 specimens have been observed on sample areas of 28 square meters, but this hardly can be taken as an indication for the normal population density of post-metamorphic and adult specimens. The surveys of BIODÉV did indicate that collecting of specimens for international trade constitutes a serious threat, primarily because the majority of collecting sites are readily accessible. These sites are under more intensive collecting pressure than more isolated locations. Distinct variations have been observed after collecting and these variations cause legitimate concerns, although the species range may be larger, and some populations of *Mantella*-species undoubtedly still will be discovered.

*Mantella pulchra*: An'Ala is currently almost destroyed, and we ignore whether *M. pulchra* (and *M. baroni*) still occur there (Andreone, pers. communication).

## 2.5 Geographic trends

In general it can be stated that all species are under distinct pressure because of loss of habitat throughout Madagascar. The number of isolated populations is increasing because of fragmentation of habitat. Thus, the total surface available to populations of *Mantella* is decreasing. It is to be expected that small isolated populations will disappear soon when collecting in small areas intensifies.

## 2.6 Role of the species in its ecosystem

All species of *Mantella* are small leaf litter predators, feeding on small insects. They themselves serve as prey species for snakes and may be some smaller carnivorous mammals and birds. The extent of protection provided by their warning colours and skin poisons against predators is not known. Tadpoles may be preyed upon by fishes, waterinsects and insect larvae.

## 2.7 Threats

Human pressure on *Mantella* populations and their habitat may be divided into two general groups by zones.

- The Southeast: The main threat to *Mantella* species prior to the increased demand for *Mantella*'s in international trade was the destruction of their habitat. Woodlands that were used as shelter against the strong sunshine during the hot season are being cut for wood used for construction and for producing charcoal. *Mantella* specimens have no tolerance for the sun. They die after exposure of several minutes to the sun. Andreone (1994) suggested that frogs which originally occurred in unaltered or primary forest but now survive in degraded habitats or along rivers may do so because microclimatic conditions (e.g., temperature and humidity) in those habitats may be relatively stable.

This was confirmed at Nahampoana where the typical habitat at Manantantaly has been totally destroyed. The Réserve d'Andohahela fortunately offers a relatively efficient protection.

- The high plateaux: The situation is quite different, and the forest does not seem essential for the *Mantella* because the climate is not so hot. More specimens were found in the grasslands than in the bamboo forest at Antoetra (190 specimens per hectare compared to 20 specimens per hectare). Raxworthy & Nussbaum (1996) found that montane secondary heathlands had a number of endemic species of herpetofauna, suggesting to them that montane secondary heathlands are of natural rather than artificial origin. Based on this information, Raxworthy & Nussbaum (1996) believed it might be possible to establish suitable dispersal corridors of climax sclerophyllous forests between isolated montane forests for this herpetofauna.

*M. viridis* appears to be less susceptible to the effects of deforestation because this species occupies decomposed forest litter; only complete deforestation is expected to lead to the extinction of *M. viridis* (IUCN/BIODÉV 1993). However, Andreone (1994) reported that terrestrial species strictly confined to the leaf litter appear to be less tolerant of habitat alteration and to have more specialised habitat requirements. During field studies, it was observed that deforestation is very slow in the areas where a gamewarden (APN) is present, such as at Anketrabo-Antongombato. At Montagne des Français, however, deforestation is more widespread throughout the area.

## 3. Utilisation and trade

All *Mantella* specimens collected in Madagascar are destined for international trade. In general, there is a

network of "primary" collectors, intermediaries and final exporters, both Madagascan nationals and expatriates.

### 3.1 National utilisation

No information is available concerning whether, and if so, in what manner *Mantella* species are used by the local population for its own purposes.

### 3.2 Legal international trade

Available information shows that during the first six months of 1990, 3090 specimens of *Mantella cowani* and 2004 specimens during the last three months of that year were exported from Madagascar. During the first six months of 1991, Madagascar exported 3045 specimens of *Mantella cowani* (Martin JENKINS, ANGAP report). There has probably been misidentification between *Mantella madagascariensis* and *Mantella cowani* and this figure might not reflect reality.

In 1995, 3732 specimens of *Mantella cowani* were reportedly exported as well as 290 specimens of *Mantella bernhardi* (study of DEF permits, BIODEV international document).

There is, however, no data on *Mantella haraldmeieri* probably because of the confusion of this species with *Mantella cowani*. The species was discovered in 1981 in the extreme southeast of the Madagascar and is rarely imported for the pet trade probably due to the lack of demand. (Staniszewski 1998).

Behra, 1991, reported that during the first half of 1990, 1470 specimens of *Mantella viridis* were legally exported from Madagascar. The number of specimens exported appears to have increased to more than 3000 specimens during the first six months of 1991 (BIODEV, unpublished). In 1995, apparently 2055 specimens were exported according to the numbers on the permits issued by the Malagasy CITES Management Authority (BIODEV, internal document). Data on the number of specimens exported during the following years are not yet available. Exports may have increased because of increased interest in several western countries for *Mantella* from Madagascar.

Although demand in the United States has increased and Japan has entered the market, the main importing countries of *Mantella* from Madagascar are Germany and the Netherlands (IUCN, 1993). In more recent years Belgium, U.K., Denmark, France and Spain also imported specimens.

In the United States, *M. bernhardi* and *M. cowani* are advertised for \$35.00 each and *M. viridis* for \$20.00 each. Similarly, *M. viridis* was offered for sale at the 1995 and 1997 National Breeders Expo for \$20.00 each.

*Mantella* spp. imported to the United States increased from 1,052 specimens in 1994 to 3,450 specimens in 1997. Table 2 shows the number of imports of *Mantella* spp. reported from 1994 through 1998. The only species for which there are very few trade data is *M. haraldmeieri*, possibly because it is similar in appearance to *M. cowani*. Note that *M. veronica* is not an existing species but a trade name without any taxonomic value.

**Table 2.** International trade in *Mantella* species as reported by some importing countries:

Species	Imports in USA in 1994	Imports in USA in 1995	Imports in USA in 1996	Imports in USA in 1997	Imports in EU (BE,DE) in 1997	Imports in EU (BE, DE, DK, ES, NL, UK) in 1998	TOTAL
<i>Mantella</i> spp.	1,052	1,844	4,900	3,450	230	1538	13,014
<i>Mantella aurantiaca</i>					400	1,405	1,805
<i>Mantella bernhardi</i>					30		30
<i>Mantella betsileo</i>					1,000	530	1,530
<i>Mantella cowani</i>						95	95
<i>Mantella crocea</i>						452	452
<i>Mantella expectata</i>					100	766	866
<i>Mantella haraldmeieri</i>						12	12

<i>Mantella laevigata</i>					100	520	620
<i>Mantella madagascariensis</i>					125	2,652	2,777
<i>Mantella pulchra</i>						809	809
<i>Mantella veronica</i> (?)					100	200	300
<i>Mantella viridis</i>					125	785	910
TOTAL	1,052	1,844	4,900	3,450	2,210	9,764	23,190

For *Mantella aurantiaca* the United States accounted for 60% of the imports in 1995 and 75% in 1996. Madagascar reported an export of 12,110 *Mantella aurantiaca* in 1995 and 16,767 *Mantella aurantiaca* in 1996.

### 3.3 Illegal trade

Given the existence of unlimited legal exportation and the relatively low price of each specimen, illegal trade of these frogs is apparently of minor importance. Accurate data, however, are not available. The fact that in the past it was tried regularly to import specimens from Madagascar as 'captive bred', where there was no supporting evidence that captive breeding occurred, might indicate that there is a parallel circuit of (illegal?) specimens which were tried to be kept outside the numbers of wild caught specimens. When imports of such so-called captive bred specimens into the EU were refused on the basis that these could not be captive bred specimens, new export permits stating the material was wild-caught were issued. This behaviour might have been caused by traders (falsely) assuming that importing countries would be more willing to issue import permits when they said the material was captive bred.

### 3.4 Actual or potential trade impacts

Collecting takes place mainly during the reproductive season. All ages and both sexes of *Mantella* are captured, even pregnant females. Some species of *Mantella* very probably are not threatened at all by the trade.

For several species it is likely that collecting is too intensive at the most frequented collecting sites.

Collecting may threaten some of the *Mantella* populations in the centre of Madagascar.

Collectors report that in previous years it was possible to easily find 2,000 specimens of *Mantella cowani* in one day, whereas today, 100 to 150 specimens are considered to be a good day's harvest.

*Mantella bernhardi*, *M. cowani* and *M. expectata* are commercially collected at three specific sites: Ambohimana (*M. bernhardi*), Ilakaka (*M. expectata*) and Antoetra region (*M. cowani*). These are all highly disturbed areas. There is no indication that these species are commercially harvested in more isolated undisturbed areas at all. The situation for *M. bernhardi* seems most critical since this species is only known from Ambohimana, the type locality, where it is also collected, although the species may occur in forests nearby as well.

During field studies, lower population densities were found at sites where recent collecting had taken place although it appears that some populations have good regeneration rates.

For example, 94 specimens per hectare of *Mantella viridis* were counted at Antamotamo and 110-204 specimens per hectare at Analamananandro compared to between 396 and 553 specimens per hectare at Analamanga where there was no collecting because of the nearness of the village and the presence of a game warden (Agent Protecteur de la Nature).

It is clear that, in general, the areas used for collecting and the more isolated areas do not suffer the same pressures.

One of the problems with this group of frogs is that base studies on populations and their dynamics (reproductive rate, maturation, natural mortality, life span) only have been done piecemeal, not on a long term basis. Nevertheless collecting for the pet trade has been going on for years in several places. From the few data available it seems that populations are definitely impacted in a negative way in the short term by collecting for the pet trade. Long term effects are not yet known. It is also difficult to determine accurately the overall importance of collecting in relation to exports, owing to insufficient information on the mortality of the frogs between collecting and exportation. Mortality may vary between 20 and 70 percent. DeVosjoli (pers. comm. 1998) reported that high mortality of collected specimens of *Mantella*

spp. occurs when specimens are maintained in crowded conditions without an adequate food source for extended periods of time prior to shipment. The percentage of mortality during international transport is not known.

### 3.5 Captive breeding for commercial purposes (outside country of region)

Gorzula (1996) studied *Mantella* in captivity and their reproduction. Several species have been bred in captivity by private terrariumkeepers in Europe and the USA, who may sell or exchange specimens at a small scale. No real commercial enterprises based on these frogs are known to exist.

## 4. Conservation and Management

Given the range of all species of *Mantella* and the pressure on their habitats, it is clear that careful management of the populations of all species would in the long run be the best choice for ensuring their survival in nature.

### 4.1 Legal status

#### 4.1.1 National

There is no specific national legislation protecting *Mantella* in Madagascar. *Mantella* in Madagascar benefits, however, from legal protection given to all species in protected reserves. A hunting license is required for collecting these frogs.

#### 4.1.2 International

Among the anurans of Madagascar, besides the tomato frogs (*Dyscophus antongili* and *D. guineti*), *Mantella* is certainly the group most attractive to the pet trade. According to BEHRA (1993), a total of 10597 *Mantella* specimens were legally exported from Madagascar in the first half of 1990. *Mantella* species have been the subject of discussions on trade restrictions and CITES inclusion for some time. The Netherlands proposed *Mantella aurantiaca* for inclusion in Appendix I at the 6th conference in 1987. The proposal was withdrawn at the understanding that Madagascar would list the species in Appendix III. The species was again proposed for inclusion in Appendix I by the Netherlands and for Appendix II by Germany at the 9th conference in 1994 and accepted for Appendix II, due to its restricted distribution and vulnerability. At the 10th conference in 1997, the Netherlands proposed the inclusion of several other species (*M. haraldmeieri*, *M. bernhardi*, *M. cowani* and *M. viridis*) in Appendix II. The proposal was withdrawn at the understanding that Madagascar would include these species in Appendix III. The Madagascar Government now has come to the conclusion that inclusion of the entire genus *Mantella* in Appendix II would be more efficient than placement in Appendix III.

The genus *Mantella* since 1 June 1997 has been included in Annex B of the European Council Regulation (EC) No 338/97 on the protection of species of wild fauna and flora by regulating the trade therein. As a consequence of that an import permit is required for all imports of *Mantella* in the 15 countries of the European Union. The Management Authority of the importing country only can issue an import permit after a positive non-detriment finding of the Scientific Authority of the importing country.

Imports of *Mantella aurantiaca* into the EU have been suspended since 23 June 1999.

Imports of *Mantella crocea*, *M. laevigata*, *M. madagascariensis*, *M. pulchra* and *M. viridis* have been suspended since 10 November 1999.

Most *Mantella* species qualify for listing in Appendix II on the basis of the following: (1) documented declines in the density of *Mantella* spp. in Madagascar following collecting for the international trade market; (2) a limited habitat base and species distribution; and (3) the continued threat of deforestation of suitable *Mantella* spp. habitat. The current status of the *Mantella* species meets the criteria of CITES Resolution 9.24 Annex a (A) and Annex a (B). The species meet criteria B(iv) listed in Annex 1: an observed, inferred, or projected decrease in the area or quality of habitat.

Some *Mantella* species like *M. betsileo* (status OK) and maybe also *Mantella* sp. 1 (Status K, more data needed) perhaps do not completely qualify to the criteria. However, for several reasons it is judged more cautious, and therefore recommended, to include the whole genus: 1) all *Mantella* species are in international trade which is increasing; 2) nomenclature of *Mantella* is still dynamic, with at least one new species still to be described; 3) there is a lot of colour variation, both intraspecific and interspecific, which makes identification for enforcement agencies difficult, although specialists with the proper literature and reference collections can identify all species; 4) excluding one or two species from CITES-controls would lead to confusion for traders, CITES authorities and enforcement agencies and could stimulate illegal trade under wrong names.

## 4.2 Species management

Collecting for trade requires a specific commercial hunting license, granted by the Direction des Eaux et Forêts to animal traders. Copies of this authorisation are given to the collectors in the field.

### 4.2.1 Population monitoring

To be undertaken by DGDRF (Direction de la Gestion Durable des Ressources Forestières = Directorate for the Sustainable management of Forestry Resources).

### 4.2.2 Habitat conservation

*Mantella* have been used as key species for the justification of expansion or implementation of natural reserves (e.g. ZIMMERMANN, 1-996).

### 4.2.3 Management measures

The management authority of Madagascar has recently set up a new adaptive management plan which suggests a total ban for collecting and exporting *Mantella bernhardi*, *M. cowani* and *M. expectata* (a zero quatum), and strict control of exports of all other *Mantella* species. The collecting of *Mantella aurantiaca* in the main collecting area of the marsh of Torotorofotsy will not be authorised any more. Collecting in other areas will be limited, and based on quota to be installed by DGDRF. Collecting in precisely defined collecting areas and export will require the authorisation of DGDRF. Numbered labels will be issued by DGDRF to collectors and exporters. Collected numbers of specimens will be registered and reported to evaluate the effect on the populations. A study about the impact of collecting on *Mantella aurantiaca* will be carried out.

## 4.3 Control measures

Although until now it has been difficult to enforce protection measures in force, officially the collecting season is limited to the hunting season between 1 May and the first Sunday in October.

### 4.3.1 International trade

Inclusion in Appendix II will contribute to the sustainable management of the *Mantella* species.

### 4.3.2 Domestic measures

Quota to be installed for collecting and export on a legal basis.

## 5. Information on similar species

Other colourful poison frogs are the unrelated genera *Dendrobates* and *Phylllobates* from Central and South America, which are also covered by CITES. They can easily be differentiated from *Mantella* by the presence of two dermal scutes on top of the discs of fingers and toes. The microhylid frog *Scaphiophryne gottlebei* Busse & Boehme, 1992 also is a colourful Madagascan frog, but it has large discs on the fingers without dermal scutes.

## 6. Other comments

Considering the lack of basic knowledge on distribution, variation, and taxonomic status of many *Mantella* species, and the apparent vulnerability of several of them (see tab. 2), the following research priorities are proposed:

- (1) Clarification of taxonomy and distribution of the species of the *M. aurantiaca* group by detailed mapping of colour morph occurrence and genetic studies along hybrid zones. Single voucher specimens from each recorded locality should be deposited in publicly available scientific collections.
- (2) Habitat descriptions and mapping of *M. expectata*, *M. cowani* and *M. bernhardi*.
- (3) Clarification of the taxonomic status of *M. aff. baroni* and of *M. baroni* from the Zahamena area.
- (4) Studies on variability in the *M. madagascariensis* group (status of *M. pulchra*, identity of the "variable morph(s)" of *M. madagascariensis*).
- (5) Formal description and naming of *M. sp. 1*.
- (6) Comparative studies on the microhabitat and ecology of all *Mantella* species.
- (7) Installation of protected areas, encompassing threatened populations of *Mantella* species.

## 7. Additional Remarks

- To assess the population status of the different species more properly further field research would be advisable.
- The need to install national export quota for all *Mantella* species to be monitored by the Animals Committee under the Significant Trade process (Res. Conf. 8.15).
- Nomenclature Committee to advise on the nomenclature of the species of this genus.

## 7A. Acknowledgements.

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