

AARK EX SITU MANAGEMENT GUIDELINES: *Mantella aurantiaca*

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Author(s): Craig Walker and Richard Gibson, ZSL; Devin Edmonds, Association Mitsinjo

BIOLOGY AND FIELD DATA

Taxonomy:

Order: ANURA
Family: Ranidae
Subfamily: Mantellinae
Genus: *Mantella*
Species: *aurantiaca*
Common names: Golden mantella

Golden frog

Some authors have suggested that the different colour forms may be separate species or sub-species but Henkel and Schmidt (1995) noted that various shades exist sympatrically and to date none have been elevated to species in their own right.

The type locality is the population found between Beforona and Moramanga (Mocquard, 1900). Staniszewski proposed that this latter form be elevated to sub-species status and in their 1999 paper, based on Staniszewski's description and photographs, Glaw, Vences and Bohme described this form as a valid sub-species naming it *M. aurantiaca rubra* (Staniszewski, 1996). However, since this description was published Staniszewski's "type" specimen was analysed by Vences using allozyme electrophoresis tests; the results of which showed no divergence between the orange, red/orange and yellow /orange types. The sub-species "*rubra*" is therefore currently considered synonymous with *aurantiaca*.

Another frog long considered to be a variant of *M. aurantiaca* was recently described as a separate species – *M. milotympanum* (Staniszewski 1996) – the black-eared mantella. This species is consistently smaller, has a dark tympanum and redder, more granular skin than *M. aurantiaca*. Although still considered a close relation of *M. aurantiaca*, this frog may be genetically closer to *M. crocea* (Vences, Glaw and Bohme, 1999). What appears to be a green form of this species has been discovered recently.

Description:

Size: Females 24-26mm, males 20 – 22mm (Staniszewski, 1998).

Coloration: The dorsal surface of adults is uniformly orange, the shade of which varies between individuals from almost yellow to nearly red. The ventral surface, including the throat, is paler. Mature males often have pale patches on the rear of their thighs, highlighting the femoral pads. The eyes are black and occasionally the iris is flecked with gold.

At metamorphosis, froglets may be various shades of pale brown with darker patterns on the head, back, legs, and sides. These dark marks fade over a period of several weeks as the colour changes to orange. It can take 10 or more months for juveniles to fully attain adult coloration.

Morphological characters: Although the skin of this species appears smooth and glossy it is, on closer inspection, finely granular. Warts are entirely absent.

Due to the presence of toxins such as lipophilic alkaloids in the skin secretions of mantellas, the colouration of some species, including *M. aurantiaca*, is considered to be aposematic - their flamboyant colours warning potential predators of their toxic qualities. However, no mantella is considered

dangerous to humans.

Males have a single sub-gular vocal sac.

The forelimbs have four digits and the rear five. In keeping with their largely terrestrial habits they have no webbing between the digits.

Longevity:

Skeletochronology showed wild *M. aurantiaca* to live no more than 2 years (Jovanovic & Vences, 2010). In captivity these frogs regularly live beyond five years and one kept by Staniszewski survived 12 years (Staniszewski, 2001).

Zoogeography/ecology:

Distribution: All known *M. aurantiaca* localities are centered in the remanant eastern rainforest corridor north and southwest of the city of Moramanga between 873 and 1,054 meters asl (Randriavelona et al., 2010a). Near Andasibe; between Beforona and Moramanga; Ambatoharanana; Beparasy region; Anosibe An'Ala (Glaw and Vences, 1994); Menalamba; Antaniditra; Torotorofotsy Wetland (Zimmerman and Hetz, 1992).

Habitat: Humid mid-altitude tropical forests surrounding small marshy depressions with ephemeral pools which are used for breeding (Randriavelona et al., 2010b). The frogs forage actively for prey among dense vegetation, in loose soil and leaf-litter and have been found 40cm deep in the litter (Henkel and Schmidt, 1995).

Population: Rabemananjara et al. (2008) found 836-1317 individuals per hectare during three brief mark-recapture studies in 2004 and 2007, though they also note that estimating population sizes from these data which were collected during peak breeding season is not of great value (Randriavelona et al., 2010a)

Status: This species listed as Critically Endangered (Cr) in the IUCN Red List of Threatened Species (www.globalamphibians.org).

As a result of international trade, the species is listed on Appendix II of CITES.

Ironically it has been suggested that the increased interest in the collection of mantellas for the pet industry came as a direct result of the listing of all South American *Dendrobates* and *Phyllobates* species on App. II in 1987. Because of this regulation of the trade, the market turned its attention to the then unprotected mantellas.

Due to the continuing threat to their already restricted natural range the exploitation of *M. aurantiaca* "may be a very significant threat" (Zimmerman and Zimmerman, 1994; Raxworthy and Nausbaum, 2000).

Despite their inclusion on Appendix II of CITES the trade in *M. aurantiaca* continues to grow (UNEP World Conservation Monitoring Centre, 1998), with the United States being responsible for 75% of exports (>12,500 animals/yr).

Diet:

The small size of these amphibians restricts the size of their potential prey to that of small invertebrates. In the field this mainly takes the form of ants and termites for which the frogs actively forage (Glaw and Vences, 1994). Analysis of 65 adult *M. aurantiaca* at Torotorofotsy Wetland found the stomach contents to mainly be composed of mites, collembolans, ants, and flies (Woodhead et al. 2007)

Reproduction:

Sexual maturity/age at first breeding: Sexual maturity is attained at 12-15 months (noted from captive observations) (Staniszewski, 1998).

Seasonality: In the wild this species has a period of relative inactivity during the Madagascan upland winter from May to October. At this time feeding, mating, and general activity become greatly reduced as the temperature drops and the air becomes less humid (Staniszewski, 1998). In the spring and summer from November to April, temperatures rise, rainfall and therefore humidity increases, and so does the activity, feeding, and breeding of the frogs.

Eggs/oviposition/clutch size/ incubation: Eggs are white and have a diameter of 1.5–2mm. They are deposited terrestrially in a mass of jelly near a water source and undercover of leaf litter or similar. Many objects are cited as laying cover in the literature including pieces of wood, bark, coconut shells and even plastic film containers (Henkel and Schmidt, 1995). Clutch sizes of 20 to to more than 100 eggs have been reported.

Embryogenesis may last 14 days (Blommers-Schlosser, 1979) and the tadpoles are washed into the surrounding ephemeral pools as water levels rise. Metamorphosis follows in around 70 or more days though studies on larval development in the wild are lacking.

Activity and other notable behaviour:

Mantellas are diurnal and highly active. They are said to be ‘bold’ in as much as they move around clear of ground cover while searching for prey, engaging rivals in “combat” or attracting potential mates. The high altitude species, including *M. aurantiaca* are reported to spend time sitting in pools of sunlight and males have been observed vocalising from such areas (Staniszewski, 2001).

MAINTENANCE IN CAPTIVITY

Accommodation

Adult animals:

Enclosure design: Depending on whether a “natural” looking set up is required, as would be likely for a public exhibit, or a “laboratory” one, for ease of maintenance in an off-show breeding set up, many different materials can be utilised:

“Natural” method

Substrate: Due to the humidity levels required the substrate should be able to drain freely. To this end a layer of pea gravel at least several centimetres deep should be placed directly onto the bottom of the enclosure. Any very large rocks or logs used as furnishings should be placed in position first to avoid “shifting”. With the gravel in place, the accumulated water can be removed either through a drainage hole/pipe or can be pumped out using an aquarium pump (if the water is at a constant level above the height of the pump).

A soil substrate can then be placed on top of the gravel. This can be “coir” coconut compost or peat and can be mixed with sand to improve drainage. Again, several centimetres of this should be sufficient unless landscaping demands slopes.

Furnishings: As this species climbs well, the use of aerial branching is an ideal method of increasing the area available to the frogs. Live plants can be used and there are many ideal species available commercially. Some, such as bromeliads, will be used for cover by the frogs. Water can simply be presented in an easily removable ceramic or plastic bowl, or in a pond with running water. Small electric pumps are available commercially which are placed into the pool and circulate the water or send it over waterfalls etc. It is important to prevent the possibility of the frogs being drawn into the pump. One method is to have the pump (or just the inlet) covered with a mesh cage, another is to cover the pump with gravel.

“Laboratory” method

Substrate: Kitchen towels, sponge matting or similar non-toxic materials can be used to cover the floor of a laboratory-type set up. This provides a certain ease of maintenance, allowing easy and frequent removal and replacing (in the case of the towels) or cleaning (in the case of the sponge), thereby preventing a build up of faecal material.

Furnishings: In this method also, potted live or artificial plants, rocks and pieces of wood can be used to break up the monotony of the landscape, allowing the frogs to establish territories, thereby encouraging breeding behaviour.

Enclosure dimensions: Depending on the size of the colony to be housed, a range of sizes of enclosures can be used. A vivarium measuring about 30x30x30cm will house a group of 3-4 individuals and one of 90x80x60cm would be suitable for a colony of up to 20 animals. These are *guidelines* and the use of furnishings and provision of streams and pools will affect the numbers that can be kept together successfully.

This species should be provided with sufficient space to develop and defend territories, however as immature animals display little territorial behaviour they can be housed at higher densities than adults.

Temperature regime: Because *M.aurantiaca* lives at altitudes of around 900m temperatures should not exceed 24°C for extended periods of time. Although captive bred specimens are said to be able to tolerate *slightly* higher temperatures, perhaps one or two degrees, this is not recommended.

A seasonal temperature range should reflect the weather patterns that the frogs experience in the natural range. Temperatures ~0.5 m above ground in shade within Analamazaotra Forestry Station (near *M.aurantiaca* habitat at Torotorofotsy) rarely exceed 28°C or fall below 11°C (Edmonds pers. obs.) In captivity, a recommended temperature range is:

Summer range; November – April 18-24°C

Winter range; May – October 15-20°C.

Humidity/rainfall: Summer humidity should range between 80 - 90%. To achieve this, the enclosure should be misted at least twice daily. A system of running and standing water in the vivarium will also help maintain a high humidity. During the cooler period humidity levels can be allowed to drop down to around 70% or lower. However as this is period of dormancy for the frogs it is essential to ensure that no part of

the enclosure is allowed to dry out completely. Because the environment provided is also ideal for potentially harmful bacteria and fungus, effective ventilation is a priority. A combination of air vents and low powered fans can be used for this purpose but a balance must be found between humidity, temperature and ventilation.

Photoperiod: A regime of 14hrs light and 10hrs dark in summer, switching to 10hrs light and 14hrs dark for winter should be effective.

NB: Seasonal changes in climatic conditions should initiate reproductive behaviour in mature specimens. It is recommended that rather than suddenly change from summer to winter ranges, the temperatures, humidity and photoperiod should all be gradually adjusted over a span of several weeks through October so that by the end of that month summer conditions are established and *vice versa* in April.

Recent metamorphs:

Recently metamorphosed and juvenile mantellas are best housed in simple accommodation, akin to the 'laboratory method' described above. However, owing to their small size they are particularly prone to dehydration and therefore shallow layer of damp compost and/or sphagnum moss is preferential to paper towels (which may dry quickly). Water bowls should be suitably shallow to allow ease of entry and exit.

It essential that sufficient retreats are made available for all froglets to hide but that these should be easy to move, clean and replace to monitor animals well being and maintain hygiene.

Larvae:

Tadpoles are best housed communally with their clutch mates. Simple glass or plastic aquaria with a few plastic plant leaves or broken pots for cover and a water depth of 3-5cm suffices. Substrate is not necessary but a shallow layer of typical aquarium gravel can facilitate trapping of faeces and detritus and therefore enhance water quality.

Life-support details:

Complex life support is not usually necessary unless very large numbers of larvae are being reared. In general, RO or rainwater (i.e. soft water), oxygenated with an air-stone, and receiving a 50% water change on regular basis is sufficient. See 'Care of eggs and larvae' below.

If a large number of larvae will be raised, and staff servicing time is limited, installing an internal or external mechanical and biological filter to the aquarium will significantly reduce the intensity of husbandry required.

Diet

Food items:

Adult: In captivity the staple diet is cricket nymphs of various species (*Acheta assimilis*, *Acheta domestica* and *Gryllus bimaculatus*) which are available commercially and fruit flies (*Drosophila melanogaster*). If care is taken with regards to the presence of pesticides and other potentially harmful substances, other small invertebrates such as aphids and springtails can be collected seasonally to vary and supplement the diet. The decision to use these collected foods will have to be weighed against the possibility of introducing parasites or even potential predators.

The prey is dusted with a multivitamin powder such as Nutrobal™ or Repton™ once or twice weekly for adults more often for juveniles and gravid females.

Recent metamorphs and juveniles: Springtails (*Collembola* spp) are essential for the successful rearing of the tiny mantella metamorphs. These should be raised on a good calcium rich diet and as soon as the frogs are large enough they should be 'weaned' onto the standard adult diet.

Larvae: Tadpoles can be fed on a mixture of tropical fish flake (Aquarian), spirulina algae tablets (*Acidophilus*) and cuttlefish bone, powdered and mixed in roughly equal parts.

Feeding method:

Adults: Once the frogs are familiar with their surroundings prey can be offered at "feeding stations", i.e. shallow dishes containing the food can be presented to the frogs regularly at the same location. This method of feeding gives the keeper the opportunity to regularly assess the condition and number of the animals and also, in the case of public exhibits, has the benefit of encouraging the animals to appear in areas where they can be observed with ease.

Larvae: The tadpole diet can be sprinkled on to the water surface, which is then agitated until the diet sinks to the bottom, where it is grazed by the larvae. Alternatively the powder can be mixed with distilled water to form a thick paste which sinks when dropped into the aquarium.

Reproduction

Social structure:

Although it is not unknown for pairs of *M. aurantiaca* to breed successfully, it is unusual and like many species of anurans it is thought that vocal and physical competition between males may be a trigger for female acceptance. For this reason the smallest recommended social structure is 2:1. In larger groups,

as long as several healthy adult males are present the actual sex ratio becomes less important.

Courtship and spawning:

Mature males (and to a lesser extent females) establish territories. In the case of males this is often around a prominent calling site such as a rock or a mound. When a female accepts a male she leads him to a nesting site which is usually hidden from view under leaf litter, in a crevice, under a rock, or similar dark and humid location.

At ZSL, frogs are housed in a natural type vivarium with bark, leaves and coconut shells provided as potential breeding sites. These have so far been ignored apart from use as a shelter. Instead the frogs have burrowed into the layers of cushion moss and laid eggs directly onto the underlying peat.

Amplexus is said to be brief, if it occurs at all, and the result is a clutch of eggs numbering from 20 to over 100. The female usually leaves soon after oviposition while the male stays to continue fertilising the eggs. It is reported that fertilisation can be delayed by up to 48 hours (Staniszewski, 1998).

Care of eggs and larvae:

Eggs: The eggs can be left *in situ* while they develop and then removed to a rearing tank prior to hatching. Alternatively the spawn can be removed by gently rolling the clump onto a plastic tea spoon. It is then transferred to the rearing accommodation and placed on a platform of wet moss above a body of shallow water (4 to 6mm is sufficient). Incubation lasts around 10-14 days or less at a temperature of 20-24°C.

At term, hatching can be induced by mimicking rainfall by gently pouring water over the egg mass. Once the first few tadpoles have emerged it is usually fine to immerse the mass in the water where the rest should wriggle free.

Larvae: The tadpoles can be kept in filtered and aged tap water, rain water, reverse-osmosis water or mineral water which should be gently aerated with a pump and airline to prevent the water stagnating. Entire clutches can be reared as a group as there appears to be no cannibalism, however there is notable differences in the growth rates of the larvae reared this way. If it is necessary to rear as many as possible from a particular clutch then it could be advantageous to split them into smaller groups or even keep them in individual containers, though this would undoubtedly be more time consuming. Daily siphoning to remove debris such as uneaten food and faeces is essential. The water thus removed should be replaced with fresh.

Development to metamorphosis can take from 56 days to more than 90. Small pieces of bark or rocks should be added as larvae grow their front legs and the froglets removed as they emerge. Alternatively, the entire aquarium can be placed on an incline with 60% water and 40% land area.

Other details:

Handling and transport:

Because of their small size, mantellas are delicate and should be handled only when absolutely necessary and then with great care and wet, gloved hands.

When being transported they should be packed into plastic cartons with sufficient air holes, the type used for invertebrate live food are ideal, and cushioned with damp moss or damp toxin free paper tissues. This is to prevent desiccation and injury during transport.

All transportation should conform to the Welfare of Animals during Transport Order 1994, and IATA regulations if being transported by air. An 'Animal Transport Certificate' should accompany the animals during their journey and their containers should in no way compromise their welfare.

All movements across international borders will require CITES permits and health certificates

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