REPOBLIKAN'I MADAGASIKARA
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Species Conservation Strategy for *Mantella aurantiaca* (The golden mantella frog) 2017-2021

MINISTERE DE L'ENVIRONNEMENT, DE L'ECOLOGIE ET DES FORETS

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Cover photo: *Mantella aurantiaca* female in the Ambananin'i Ranomena forest, Mangabe-Ranomena-Sahasarotra protected area, Ambohibary commune, Moramanga district (by Eddie F. Rakotondrasoa, 2015).

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FOREWORD

Madagascar est reconnu mondialement par sa richesse en termes de biodiversité et par son taux d'endémicité élevé et parfois localisé. Il existe actuellement plus de 250 espèces d'amphibiens dont 99% sont endémiques. Malheureusement, la plupart de cette faune endémique est menacée d'extinction due à la destruction de leur habitat par la pratique de la culture sur brulis, l'exploitation forestière et l'assèchement des zones humides. Les conséquences de ces menaces restent encore à déterminer mais des mesures sont déployées pour minimiser l'impact sur notre biodiversité dont la mise en œuvre de la Convention sur la Diversité Biologique, de la Convention RAMSAR et de la Convention sur le Commerce des Espèces Menacées (CITES).

Le **sahona mena** ou ***Mantella aurantiaca*** est parmi ces espèces et se trouve uniquement dans le District de Moramanga. Il est actuellement l'emblème du district de Moramanga. Cette espèce est classée « En danger Critique d'Extinction » dans la Liste Rouge de l'Union Internationale pour la Conservation de Nature (IUCN). En outre, cette espèce est aussi classée dans l'Annexe II de la CITES disposant d'un quota annuel régulier depuis 2015.

Une première stratégie de gestion et de conservation de ***Mantella aurantiaca*** a été développée en 2010 avec toutes les parties prenantes et un atelier d'évaluation a été effectué en 2016. Cette évaluation a permis de développer cette nouvelle stratégie qui est une mise à jour pour les cinq années à venir (2017-2021). Par ailleurs, lors de la dixième conférence de la Convention sur la Diversité Biologique à Nagoya, un des défis défini était que l'extinction des espèces menacées, y compris ***Mantella. aurantiaca***, serait évitée en 2020, et que leurs status seraient améliorés et maintenus durablement.

Le Ministère de l'Environnement, de l'Ecologie et des Forêts félicite tous les acteurs ayant mis en œuvre la première Stratégie de Conservation de ***Mantella aurantiaca*** et le développement de cette nouvelle Stratégie pour 2017-2021, aussi bien à Madagascar qu'à l'étranger. Ce document est le nouvel outil de travail et d'orientation dans l'exécution des activités de conservation et de la gestion de l'espèce.

La contribution de toutes les parties prenantes dans la mise en œuvre des activités définit d'un commun accord est important pour servir de modèle et de références pour les initiatives visant à concilier la conservation et le développement humain à Madagascar pour les autres espèces menacées.

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ACKNOWLEDGMENT

La Direction Générale de l'Environnement et des Forêts (DGEF) et ses équipes tiennent à remercier vivement les différentes parties prenantes qui ont apporté leur contribution dans le processus d'élaboration de cette mise à jour de la stratégie de conservation de l'amphibien *Mantella aurantiaca* pour les cinq années à venir. *Mantella aurantiaca* est une espèce endémique régionale et En Danger Critique d' Extinction selon la classification de l'UICN.

Nous remercions l'association Madagasikara Voakajy et ses équipes pour leurs initiative et dévouement dans le processus d'élaboration de cette nouvelle stratégie de conservation.

Nous tenons aussi à présenter notre gratitude aux autorités Régionale et celles du district de Moramanga, en particulier le Chef District de Moramanga ; les Maires des communes rurales Ambohibary, Mangarivotra, Andasibe et Morarano ; la Direction Régionale de l'Environnement de l'Ecologie et des Forêts (DREEF) Alaotra Mangoro ; le Chef de la Circonscription de l'Environnement de l'Ecologie et des Forêt (CIREEF) Moramanga ; le Chef Cantonnement ; les Chefs Fokontany Antsily, Ampahatra, pour leur participation active dans l'élaboration et la mise en œuvre local de cette stratégie.

Nos vifs remerciements aux différentes institutions œuvrant dans la conservation et dans le domaine communautaire qui ont participés activement à cette stratégie de conservation à savoir, l'Amphibian Specialist Group (UICN/SSC), Amphibian Project Lead (APL), Le Département Environnement Mine Ambatovy Minerals S.A., Association Mitsinjo, ONG ASITY Madagasikara, Madagascar National Parks , Plate-forme pour la gestion du Corridor Ankeniheny Zahamena (PLACAZ), Office Régionale du Tourisme Alaotra Mangoro (ORTALMA), l'associations des exportateurs et aux collecteurs locaux ; VOI (Vondron'Olona Ifotony), Hafasahona Mangabe, VOI Faniry Ambodirotra, VOI Soamanantsara Manakana-Est, VOI Fanazava Andranomandry, VOI Soamiafara Ampahatra, VOI Fitahiana PK 33, VOI Ezaka Tantsaha Avolo, VOI Miavotena Lakambato, VOI Tsaradia pk 27 et Association Fivoarana pk 21.

Nous adressons notre reconnaissance à Chester Zoo pour leur contribution financière remarquable le long du processus d'élaboration et surtout à la mise en œuvre de cette stratégie.

Enfin, nous tenons également à témoigner notre gratitude à toutes les personnes physiques et morales non citées, et qui ont contribué de près ou de loin à la réalisation de cette stratégie. Nous espérons que votre contribution soit effective dans les cinq prochaines années.

ACRONYMES

ACNP : Avis de Commerce Non Préjudiciable

ACSAM : A Conservation Strategic of the Amphibian in Madagascar

CDB : Convention sur la Diversité Biologique

CEEF : Cantonnement l'Environnement, l'Ecologie et des Forêts

CFAM : Corridor Forestier Analamay-Mantadia

CIREEF : Circonscription Régional de l'Environnement, l'Ecologie et des Forêts

CITES : "Convention on International Trade in Endangered Species"

CTD: Collectivités Territoriales Décentralisées

DREEF : Direction Régional de l'Environnement, l'Ecologie et des Forêts

DVRF : Direction de Valorisation des Ressources Forestières

DSAP : Direction du Système des Aires Protégées

EDGE : Evolutionarily Distinct and Globally Endangered species

MV : Madagasikara Voakajy

AP : Aire Protégée

PAG : Plan de l'Aménagement et de Gestion

STD: Services Techniques Déconcentrés

TGRN : Transfert de Gestion des Ressources Naturelles

UICN : Union Internationale pour la Conservation de la Nature

VOI : Vondron'Olona Ifotony

ABSTRACT

The first conservation strategy for *Mantella aurantiaca* was published in 2010 and implemented between 2011 and 2015. The final evaluation was carried out in October 2016 to measure the achievements against the set objectives. This assessment will allow the update of the conservation strategy to be released for the next five years (2017-2021). The new strategy contains updates on the status of the species, including conservation management and threat analysis. This strategy also contains new guidelines for conservation. *Mantella aurantiaca* is an Amphibian species classified as Critically Endangered by the IUCN Red List, but it is also a species important for international trade as the export of this magnificent species is still open according to the convention of CITES (Appendix II), with an annual quota of 280 individuals (2015 quota). Apart from their presence in the Analamay-Ambatovy mining site, *Mantella aurantiaca* is a conservation target for the two protected areas (Mangabe-Ranomena-Sahasarotra and Torotorofotsy) in the Moramanga district. The Mitsinjo captive breeding center also harbours populations from the Analamay-Ambatovy mine site. Approximately 239 ponds are identified today which are distributed in the South (Mangabe) and the North (Analamay-Ambatovy and Torotorofotsy). The major threat to this species is the destruction of its natural habitat of anthropogenic origin, namely rice fields, fire, “Tavy”, artisanal and industrial mining. This strategy has a vision with five goals and nine main objectives. In each objective there are actions to be carried out with specific indicators of achievement.

INTRODUCTION

The establishment of a species conservation strategy is a framework for monitoring the effective management of biodiversity. The Golden Mantella is a very threatened species of amphibian endemic to Madagascar. The development of the first conservation strategy for a five-year period was carried out in 2009, was published in 2010 and implemented between 2010 and 2015. This enabled usto identify a list of priority activities in line with the situation of the species at the time. Participating in this strategy demonstrates its effectiveness in mobilizing the various partners to undertake relevant and effective actions. A mid-term evaluation was carried out in 2013 in order to measure the results and impacts of the actions undertaken, and to identify further efforts required. The strategy itself ended in 2015, and a final assessment is required to determine the impacts of the strategy on the conservation of the species, and also to identify any problems which were encountered. *Mantella aurantiaca* is an endemic amphibian species of Madagascar known only in the Moramanga district, Alaotra-Mangoro Region, in the Central East part of the Island. It is classified as Critically Endangered (CR) in the Red List of Threatened Species since 2012 (IUCN, 2012). Since 1995, the species is listed in CITES ANNEX II and its export in international trade is based on an annual quota system sanctioned by this Convention. In 2010, the export of *Mantella aurantiaca* was suspended by CITES due to insufficient data to justify its quota. CITES calls on Madagascan authorities to produce a document called non-detriment findings which must contain all available information on: biology, ecology, management mode and collection sites of *Mantella aurantiaca* before accept its export quota. The existence of this first conservation strategy is one of the key factors within the document that was handed over to CITES in 2013. Subsequently, the suspension was lifted with the reopening of its export, and the quota was 250 Individuals for the year 2014 and then 280 individuals from 2015. Since 2008 the Madagasikara Voakajy team has carried out several research and conservation activities on this highly endangered species in collaboration with the various stakeholders in the conservation of biodiversity in Madagascar, in order to ensure the sustainable management of this species. As the validity period of the first strategy has expired, we conducted the final evaluation always adopting the same methods and participants during its development to measure achievement against objectives. This assessment will make it possible to update the status of the species and to develop new actions necessary for its conservation.

A. STATUS REVIEW

1. Species description

1.1 Classification

Kingdom: Animalia

Phylum: Chordata

Subphylum: Vertebrata

Class: Amphibia

Order: Anura

Family: Mantellidae

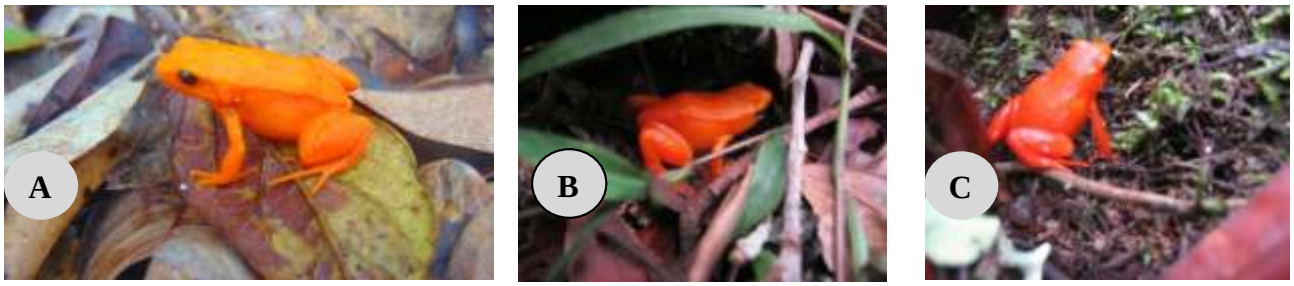
SubFamily: Mantellinae

Genre: *Mantella*

Species: *aurantiaca*

Vernacular name: Golden Mantella (English), Mantelle Doré (French), Sahona mena (Malagasy).

1.2 Photographs of the species



Mantella aurantiaca ((A), (B) d'Eddie R., (C) de Pierre R.)

1.3 Status of the species

The status of the species in the IUCN Red List, its CITES category, its classification at the EDGE level and its status in the national legislation have not changed since the implementation of the strategy in 2010.

- UICN: Critical Endangered, B2ab (iii, v)
- CITES: Annexe II with quota
- EDGE: 141 among les 4 339 threatened.
- Nationale Legislation: Catégory I, Class I, according to national legislation: Decree No 2006-400 in 13 June 2006 to classify wildlife species.

1.4 Discovery

The information collected on the reproduction of the species in the wild is limited except for its use of the ponds between October and April. Both sexes aggregate at the ponds before the fall of the rain, usually from the beginning of November. Females are observed at the ponds only between November and February (Randrianavelona et al., 2010). They then climb gradually into the adjacent forest as soon as the ponds are flooded. The males also perform this same dynamism, but their number in the vicinity of the pond decreases from April.

In captivity, in the case of Mitsinjo center, the eggs are deposited on the leaf litter or in pots provided outside the water. The duration of egg incubation is about 10 days, transformation into free swimming tadpole varies from 3 to 5 days. The tadpole life cycle lasts between 70 - 90 days at an average temperature of 24 ° C. The breeding period recorded in the terrarium extends from July to August, to resume in October. A pregnant female can lay 45 to 90 eggs in each pond. The diet of *Mantella aurantiaca* in captivity is of higher quantity and quality when compared to what the species experiences in the wild. The use of locusts, *Drosophila* and *Collembola* with added vitamins is favorable to reproduction.

1.5 Description

1.5.1 Morphology

Mantella aurantiaca is an attractive little frog with a bright colouring varying between bright orange, yellow and red (Vences et al., 1999). The body length is usually between 17-29 mm, but sometimes large females reach 31 mm (Glaw and Vences. 2007). The species does not really show any sexual dimorphism, but males are known by the existence of the femoral glands and its small size compared to the female. The colour of the juvenile is brown.

1.5.2 Genetics

Molecular studies of *Mantella aurantiaca* previously demonstrated that they are distinct from *Mantella milotympanum* and *Mantella crocea* with some putative hybrids with *Mantella crocea* for the population of Southern *Mantella aurantiaca* in Andranomandry and Andranomena area (Chiari et al., 2004, Rabemananjara et al., 2008). These studies also show that there are two subpopulations including the northern group (Analamay-Torotorofotsy) and the southern group (Andranomandry-

Andranomena- Besariaka) with hybrids with the pond of Menalamba. These two groups are separated by the national road N ° 2 (RN2). Adaptations in captivity reduce the physical condition of frogs and are one of many reasons for the low success rate of reintroductions. According to a recent study (Passos et al., 2017) on the response of females to the call of the male, there is a difference between female behavior in captivity and in the wild. The response is shorter for individuals in the wild. This difference could be detrimental to the reproduction of Mantella after reintroduction of individuals caught in the wild. Another publication (Passos et al., 2017) dictates that it is necessary to test and compare a significant behavioral response in captive and wild individuals of the same species. "Thanatosis" is an anti-predator strategy that reduces the risk of death by predation, which is a common behavioral response in frogs.

1.5.3 Habitat

It is strictly a terrestrial species of primary and secondary tropical forest, and is usually found in wet and swampy areas. Within their habitat aquatic plants and emergent plants present a quality of refuges ideal for adult *Mantella aurantiaca* as well as tadpoles. In the Ambatovy zone, these plants are often composed of *Osmunda regalis, Medinil aff parvifolia Baker, Pandanus, Stellatus Marteli, Sphaerostephanos unitus, Dianella ensifolia, Ethulia conyzoides* and *Cyperus prolifer, Bazzania decrescens, Pyrrhobryum spiniform* and *Rhodobryum oil*. Other species may be added to the list but they always provide a microclimate (Humidity, Temperature, UV and Lux) favorable to the terrestrial amphibian.

1.5.4 Value of Species and Function

M. aurantiaca is a predator of litter and mite fauna, Amphipods, *Collembola, Formicidae* (non-winged), *Diptera*, *Thysanoptera* and *Isopoda*.

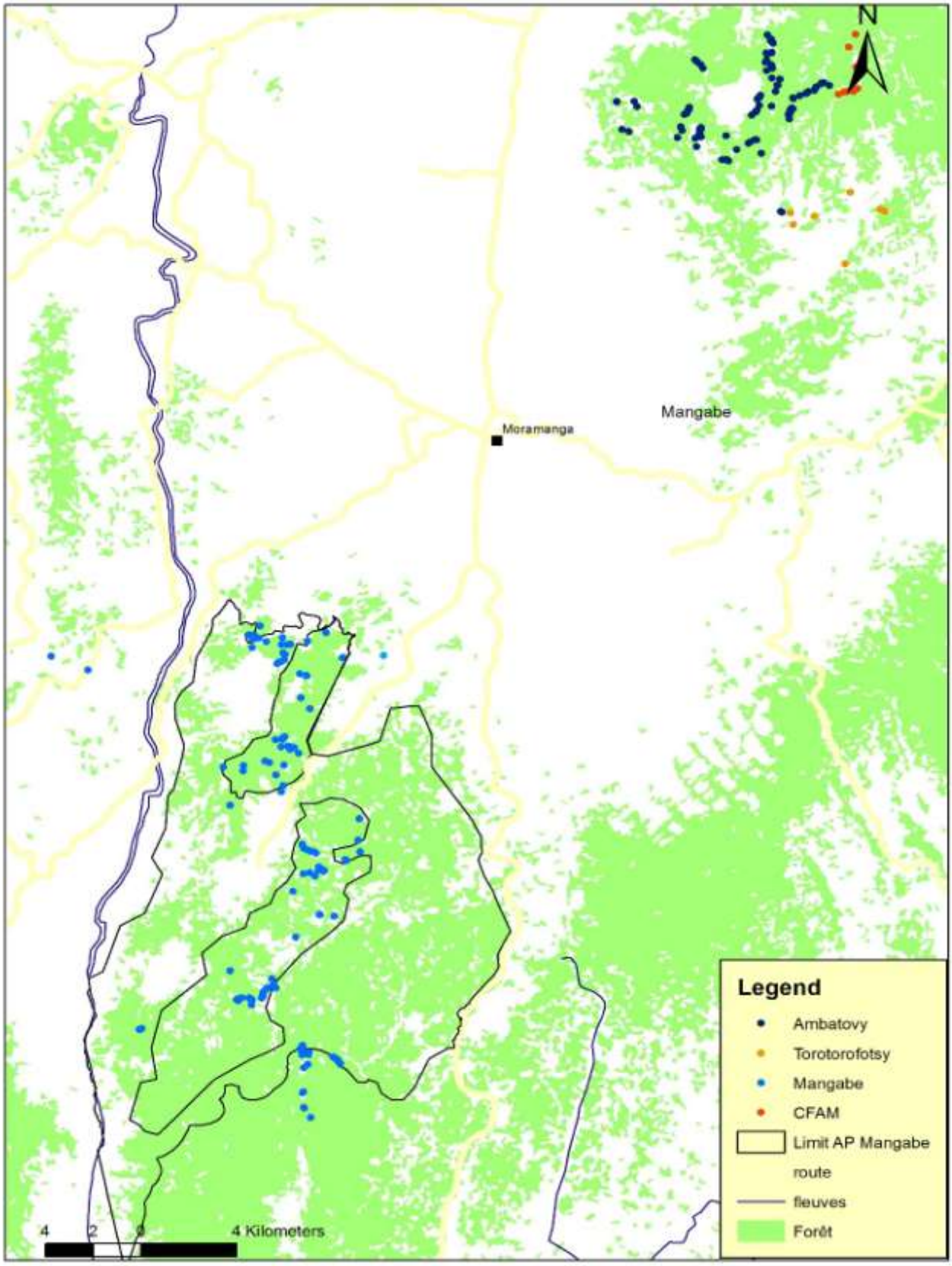
2. Conservation Management

At the end of the research and conservation activities carried out since 2010, new sites have been identified and new management and management plans have been put in place; Among them, the final creation of the AP Mangabe-Ranomena-Sahasarotra under Decree No. 725 of July 23, 2015 and the AP Torotorofotsy under Decree No. 808 of May 05, 2015, the program of rescue by release in the zone

Conservation of Analamay-Ambatovy as well as the captive breeding of *Mantella aurantiaca* in Andasibe in the Mitsinjo Center.

2.1 Current distribution

Two hundred and thirty-nine (239) ponds of *Mantella aurantiaca* are currently identified, including one hundred and thirty-three (133) at Mangabe, ninety-two (92) at Ambatovy, seven (7) at Torotorofotsy and seven (7) in the Analamay-Mantadia Forest Corridor (CFAM).



Map: Localisation and distribution of the *Mantella aurantiaca* ponds in the Moramanga district

2.2 Identifying populations

Mantella aurantiaca is currently composed of two separated populations that are found in four sites:

- One is south of the town of Moramanga and closely associated with the Ranomena and Sahamarirana Rivers.
- The other is located in the north of Moramanga such as Ambatovy, Torotorofotsy and the Analamay-Mantadia Forest Corridor and is associated with the Sakalava, Mahatakatra, Marinjo, Antsampandrano and Menalamba rivers.

Mangabe*:* (133 ponds: 82 in the strict conservation zone, 29 in the buffer zone, and 22 in the peripheral zone).

The Mangabe forest, with its surface area of 27,346 ha, is the only forest that crosses the boundary between Moramanga and Anosibe An'Ala. The northern part of this massif is included in the commune of Mangarivotra and that of Ambohibary, while its southern part is limited by the administrative boundary of the district of Moramanga and Anosibe An'Ala. Two ponds are to the west of Mangoro (Fatakana, commune Vodiriana).

Ambatovy*:* (92 ponds: 53 in the strict conservation zone, 17 in the mining footprint zone, 10 in the lease zone, 17 in the Analamay-Mantadia Forest Corridor “CFAM” and two in Torotorofotsy).

The ponds in Ambatovy are divided between three communes Ambohibary, Morarano and Andasibe.

Torotorofotsy*:* seven ponds.

The site of Torotorofotsy, the Ramsar site since 02 February 2005, is a new protected area of which Asity Madagascar is the delegated manager. Stretching over an area of 9776 ha, the Torotorofotsy marsh is located in the Fokontany of Menalamba, Rural Commune of Andasibe, District of Moramanga, Province of Toamasina, Madagascar. Torotorofotsy contains seven ponds of *Mantella aurantiaca*, including the famous site of Menalamba.

Analamay-Mantadia Forest Corridor “CFAM” (seven ponds)

CFAM covers an area of 140.26 km² of which 68.23 km² is constituted by a conservation pond. This Forest Corridor links the ponds of the Analamay-Ambatovy

Conservation pond, the Northwest, North and Northeast parts of the Torotorofotsy Ramsar Site and the Mantadia National Park. The management effort of this forest area is supported by Ambatovy Mining Company in partnership with local stakeholders. With the exception of the *Mantella aurantiaca* pond in Antsampandrano, the six other ponds are now being inventoried after 2010. The translocation pond for rescue of individuals from two MP7 and MP8 sites in the Ambatovy mining footprint are part of this population, 2,839 individuals of *Mantella aurantiaca* were saved there.

3. Threats Analysis

The emigration of the human population in search of fields for cultivation has become a remarkable threat in recent years. Some have settled permanently and converted the ponds into rice fields (Torotorofotsy pond). In the case of Mangabe, after periods of sensitization and repression, the amount of emigration decreases, AP Mangabe obtained the decree of creation definitive is this supposed to mean obtained protection?. A Dina is sanctioned by the court of Moramanga, Madagasikara Voakajy obtained the management delegation in 2017.

3.1 Tavy ou culture sur brulis

No-resident farmers practiced “tavy” by converting ponds into rice fields or cultivated fields (the case of the Mangabe AP). In most cases, they are not officially registered as inhabitants in the area administration, and do not respect the established management plan.

Figure: Tavy in Avolo *(by Eddie R., 2015)*

3.2 Rice field

The transformation of the nesting marshes of *Mantella aurantiaca* into rice fields reduces their breeding site. The clearing of the rainforest over the watershed upstream of their nesting site destroys their hibernation and refuge.

3.3 Fire and Charcoal

The fire seriously alters the structure of the vegetation of the humid forest in the forests occupied by *Mantella aurantiaca*. The burning of litter and dead wood reduces the quality of habitat.

Figure: Fire in Ranomena (A, B) and Charcoal in pk 21(C, D) *(by Eddie R., 2015)*

3.4 Gold mining

Since 2010, the sites of *Mantella aurantiaca* are threatened by artisanal and illegal gold mining. These activities lead to the degradation of the aquatic habitat of *Mantella aurantiaca* due to the displacement of the river bed, backfilling and increased turbidity of the water. This phenomenon concerns populations of the species in Mangabe, Torotorofotsy, CFAM and CAZ. In Mangabe, *Mantella aurantiaca* ponds have also been affected by this threat. Periodic patrol missions by Patrollers, forestry and policy improved the situation. Since 2012, restorations of these sites are carried out annually. In 2016, a study on the impact of gold mining was carried out. The objective of this study was to determine the impacts of gold mining on the quality and quantity of water and also on the life history of the local population (recruitment, health and relationship).

Figure: Photo gold mining in Andasindrainidonaka- Mangabe *(by Eddie R., 2015)*

3.5 Industrial mine

Some *Mantella aurantiaca* ponds in Analamay-Ambatovy will disappear due to clearing activities carried out by the Ambatovy project for the extraction of nickel and cobalt minerals. Rescue measures have been implemented since September 2011, according to the Mantella management plan of the mining company, and a Rescue Procedure Manual has been developed with the scientific teams. This activity is carried out in collaboration with the specialized agencies, and the mitigation measure continues until all species threatened with extinction in the mine footprint are transferred to the receptor sites located in the conservation area.

3.6 Use of the biological resource

Mangabe and Torotorofotsy have been the traditional collection sites of *Mantella aurantiaca*, according to surveys of villagers, to satisfy international trade. The impacts of this collection on natural populations are not exactly known but considered minimal (Andreone et al., 2005). It is evident that the exploitation could have negative impacts on the survival of *Mantella aurantiaca* when combined with the destruction of the habitat. Since 2012, a project to set up a collection pond for *Mantella aurantiaca* has been established. By 2015, *Mantella aurantiaca* has a quota of 280 individuals. The defined sites are all in the buffer zone of the Mangabe-Ranomena-Sahasarotra Protected Area.

3.7 Climate change

The impact of climate change on biodiversity focuses on at least seven strategic factors, such as changes in population structure, changes in range, changes in biological rhythms, invasive species proliferation and changes in the structure of surrounding environment. For the case of *Mantella aurantiaca*, a preliminary modelling analysis of its distribution using the projection of the climate for 2050 indicates a decrease in the zone with high probability of sheltering the species, but also a displacement of the viable zone probable for the species to occur in the East. The effect of climate change can be more severe by adding the rate of degradation of the surrounding environment because *Mantella aurantiaca* depends on a specific habitat.

B. DECLARATION OF VISION

Our vision of *Mantella aurantiaca* is that the population and its habitats be conserved, restored and equitably managed in a legal sustainable and manner through the services and participation of all stakeholders.

C. GOALS

Goal 1: All habitats of *Mantella aurantiaca* are effectively conserved within protected areas.

Goal 2: The populations of *Mantella aurantiaca* which are doomed to destruction are saved and replaced; the destroyed habitats are restored to maintain genetic diversity, viable population size and ecological function.

Goal 3: The sites of *Mantella aurantiaca* are protected from diseases and invasive species.

Goal 4: The rational and legal exploitation of *Mantella aurantiaca* and its habitat will be managed equitably.

Goal 5: Have effective collaboration and effective and efficient sharing among all stakeholders to ensure sound management.

D. GOAL, OBJECTIVES AND ACTIVITES

Goal 1: All habitats of *Mantella aurantiaca* are effectively conserved in protected areas.

Objective 1. Involve local populations in all procedures and implementation of the management plan for each site and / or conservation area, within the next five years

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
1.1. Standardise all management tools (Protected Areas, VOIs and their transfer of management, “Dina”)	1.1.1. Create three VOIs Torotorofotsy, three VOIs for Mangabe, Orientation of the VOI in CFAM on conservation de	Number of VOIs create	CIREEF, CEEF, Site Managers, CTD, Local communities	Years 1 and 2
	1.1.2. Formalization of all VOIs through ritualization	The VOIs create are Active and legal by the end of the year 3rd	CIREEF, CEEF, Site Managers, CTD, Local communities	Years 1 and 3
	1.1.3. Update the management plan of *Mantella aurantiaca* by Ambatovy (established in 2014)	Management plan published by Ambatovy with all stakeholders	Ambatovy	Year 1
	1.1.4. Elaboration and Implementation of the PAG of the Torotorofotsy protected areas	PAG is set up for the site by 2017	Asity	Year 1
	1.1.5. Monitoring and evaluation of the 7 VOIs of the Mangabe PA	Evaluation report	MV	Year 3
	1.1.6. Implementation of the “Dina” for Torotorofotsy and CFAM	“Dina” homologated	Asity, Ambatovy, CTD, Tribunal, Local communities, CIREEF, CEEF	Years 1 to 5
	1.1.7. Implementation et Capacity building for the “Dina” Application Committees	Number of committees created and the number of training courses given	CIREEF, CEEF, Site Managers, CTD, Local communities	Annual
	1.1.8. Awareness of and follow-up of the application of the Dina in the Protected Areas	Amount of public awareness carried out	CIREEF, CEEF, Site Managers, CTD, Local communities	Annual

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
1.2. Set up the management tools for each area to be conserved and materialize them physically	1.2.1. Delimitation and materialization of the different zonings of Torotorofotsy PA	Field report and photos of the plates	Asity, STD, CIREEF,	Years 1 and 2
	1.2.2. Plot inventory for registration of PAs (Mangabe and Torotorofotsy)	Owners of areas identified	Asity, MV	Annual
	1.2.3. Media coverage of the Mangabe and Torotorofotsy Protected Areas	Mangabe and Torotorofotsy are publicly recognized on the local media (Moramanga)	MEEF, Asity, MV,	Years 1 and 2
	1.2.4. Continue materialization of the buffer zones of Mangabe PA		MV	Years 1 and 2
	1.2.5. Maintain and renew paints and road signs in their Protected Areas and Ambatovy zone		MV, Asity, Ambatovy	Annual

Objective 2: Strengthen capacity of the local population's for the conservation management in the protected area (PA) and the Income Generating Activities Management System (AGR)

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
2.1. Organize various technical training related to Protected Areas management	2.1.1. Implementation of Patrollers for all Protected Areas	Patrollers are active by the end of Year 2	MV, Asity, VOIs	Years 1 and 2
	2.1.2. Continue capacity building of VOIs and local authorities on the management of the PA	VOIs training module updated every 2 years	MV,Asity, CIREEF,CEEF	Years 1,3 and 5
	2.1.3. Development of guides and practical manuals as training materials	Guides and manuals put in place and practicable	STD concerned	Year 1

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
2.2. Consider the feasibility of AGRs and create them according to the reality on the field	2.2.1. Identify and collect AGRs according to community needs	- Guides and manuals put in place and practicable - Number of AGRs identified for each PA	MV,Asity	Years 1,3 and 5
	2.2.2.Continue training of local communities on improved farming and livestock practices (see Standard PSSE)	Good collaboration with STD to train local communities	MV, Asity, STD concerned	Years 1,3 and 5
	2.2.3. Monitoring and evaluation of completed projects	Project Monitoring and Evaluation Report	MV, Asity	Years 2 and 4
	2.2.4. Provide training and materials useful carry out of each project	Have the financing to buy these materials	MV, Asity	Years 1,3 and 5

Goal 2: The populations of *Mantella aurantiaca* who are doomed to destruction are saved and replaced; this destroyed habitats are restored maintain genetic diversity, viable population size and ecological functio

Objective 3: The population of *Mantella aurantiaca* is rescued and conserved in their natural environment

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
3.1. Have a research plan to study the biology and ecology of *Mantella aurantiaca*	3.1.1. Establishment of a research plan based on the bibliography	Document of the map	MV, Asity, ASG,DGF	Year 1 and 2
	3.1.2. Research and monitoring of *Mantella aurantiaca* to strengthen for the working group	Field report	MV, Asity, ASG, Searcher	Annual

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
3.1. Have a research plan to study the biology and ecology of *Mantella aurantiaca*	3.1.3. Search for new distribution areas of *Mantella aurantiaca*	Field report and update of the species distribution map	MV,Asity	Annual
	3.1.4. Research of ponds that may exist in each PA and in Ambatovy	Field report and GPS coordinate	MV, Asity, Ambatovy	Year 1 to 3
	3.1.5. Determination of abundance and estimation of population size of *Mantella aurantiaca* in each site	Research report and / or scientific publication	MV, Searcher	Year 1 to 3
	3.1.6. Conduct studies on the biology, genetics and habitat characteristic of *Mantella aurantiaca*	Research report and / or scientific publication	MV, ASG, Association Mitsinjo,	Year 1 to 3
	3.1.7. Studies of the impact of climate change on *Mantella aurantiaca*	Research report and / or scientific publication	MV, ASG, Searcher	Year 1 to 3
3.2. Transfer the *Mantella aurantiaca* into the clearing zone to the Ambatovy Conservation Area	3.2.1. Rescue of all existing *Mantella aurantiaca* in Ambatovy mining footprint	Field report, Number of Mantella saved in Ambatovy	Ambatovy, MV	Year 1 to 3
	3.2.2. Use of the parameters resulting from the habitat study of *Mantella aurantiaca* for identification receiving ponds	Document standard and updated for all searches on Mantella	Ambatovy, MV	Year 1 to 3
	3.2.3. Marking of all Mantella transferred using VIE	All transferred individuals are marked before release	MV	Year 1 to 3
	3.2.4. Bi-monthly monitoring of all ponds in the conservation area, clearing area and receiving ponds at Ambatovy	Up-to-date monitoring database	Ambatovy	Annual

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
3.2. Transfer the *Mantella aurantiaca* into the clearing zone to the Ambatovy Conservation Area	3.2.5 Search potential sites for pond receptor	Number new receiving pond identified	MV, Ambatovy	Year 1 to 3
	3.2.6. Enrichment and maintenance in the receiving pond of Aboriginal plants	All the receiving ponds found are in good condition to receive *Mantella aurantiaca*	MV, Ambatovy	Year 1 to 3
3.3. Reintroduction of *Mantella aurantiaca* into the sustainable habitat	3.3.1. Feasibility study for reintroduction	Field study and reference document for reintroduction	Ambatovy, ASG, DGF, Association, Mitsinjo	Year 1
	3.3.2. Replanting of *Mantella aurantiaca* from the "Tobin-tsahona" to the natural environments	Number of Mantella released and follow-up report of individuals released	ASG, Association Mitsinjo, Ambatovy	Year 2 to 4
	3.3.3. Conduct a test for captive breeding at a pilot site for future export and sustainable funding	Reference document with study cost and Advantage	ASG, DGF, Partenaires	Year 2 to 5
3.4. Update the status of the species in IUCN, ARKIVE, EDGE, National legislation	3.4.1. Capitalization of required information	Updated statute of *Mantella aurantiaca* by the end of Year 3	ASG, MV, Asity, Researchers, DGF	Year 1 and 3
	3.4.2. Classification in national legislation	Updated statute of *Mantella aurantiaca* by the end of Year 3	ASG, MV, Asity, Researchers, DGF	Year 1 and 3
3.5. Impliquer les populations locales sur les suivi et résultats de recherches	3.5.1. Bimonthly follow-up of the patrollers of the *Mantella aurantiaca* ponds	Conducting participation of ecological monitoring data	VOIs, MV,Asity	Year 1 to 5

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
3.5. Impliquer les populations locales sur les suivi et résultats de recherches	3.5.2. Return Community-level research findings to improve conservation management at Mantella	Annual restitution meeting with local communities	MV, Ambatovy, Asity, COBAs	Annual

Objective 4: Restore all ponds affected by threats to keep the state viable for *Mantella aurantiaca*

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
4.1. Restore disturbed ponds to initial state	4.1.1. Re-joining illegal gold mining sites	Number of ponds affected by goldmining each year	MV, VOIs	Annual
	4.1.2. Elaboration of a standard plan of restoration for all sites	Reference Document of the Restoration Plan	MV, Asity, CEEF	Year 1
	4.1.3. Installation of nurseries for indigenous and characteristic plants of the ponds of *Mantella aurantiaca*	A pilot nursery installed and could be visited by all VOIs	MV, Asity	Year 1 and 2
4.2. Maintain the restored ponds	4.2.1. Removal of invasive plants and planting of native plants	Field report with photos	MV, VOIs	Annual
	4.2.2. *Mantella aurantiaca* repopulation in restored ponds	Number of ponds selected and number of Mantella transfered	MV	Year 4 to 5

Goal 3: The sites of *Mantella aurantiaca* are protected from diseases and invasive species.

Objective 5: The spread of Chytrid is limited and safety measures are put in place

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
5.1. Effect of chytrid control activities	5.1.1. Maintenance of the national monitoring plan for chytrid fungous	Annual monitoring report	ACSAM, DBA, MV, Ambatovy, Asity, Searcher on amphibians	Annual
	5.1.2. Have the standardized pre-printed data sheet for chytrid sampling and monitoring.	Datasheet created and disseminated to all organizations implementing a monitoring plan by the end of year 2	ACSAM, DBA, MV, Ambatovy, Asity	Year 1 and 2
	5.1.3. Carrying out chytrid studies on site.	Annual reports on chytrid studies	ACSAM, DBA, MV, Ambatovy, Asity	Annual
	5.1.4. Using the identified chytrid line and the virulent strain most susceptible to invasion to initialize susceptibility tests on the	Reports on susceptibility testing by year 4	ACSAM	Year 3 and 4
	5.1.5. Reduce the risk of disease transmission in development and implementation of an emergency response strategy in the event of mass extinction or signs of a rapid decline in population.	Emergency response strategy in place within CEC of the government by the end of year 2	ACSAM	Year 2

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
5.1. Effect of chytrid control activities	5.1.6. Dissemination of biosecurity and hygiene protocols on chytrid and other diseases to all researchers and other key groups, tourists and exporters who work or are visiting.	All research and exploration permits issued include hygiene protocols by the end of Year 2 Protocol and material disseminated by the end of Year 2	ACSAM, MV, Ambatovy	Year 2
	5.1.7. Updating Biosecurity Protocols for Diseases	Protocol updated every two years	ACSAM, MV, Ambatovy	Year 1,3 and 5
5.2. Putting all stakeholders on the same level of information	5.2.1. Integration of follow-up data with national chytrid data and online maps	-Existing data integrated into online maps during Year 2 - Made annual updates	All stakeholders	Annual
	5.2.2. Annual chytride updates to all protected area managers	Annual updates communicated to other protected area managers, eg. The DCSBAP (record Meetings)	All stakeholders	Annual
	5.2.3. Collaboration with amphibian exporters to participate in disease control efforts in Madagascar	Amphibian Exporters members of CEC by Year 2 Agreements signed in place by Year 4	All stakeholders	Year 2 and 4

Goal 4: The rational and legal exploitation of *Mantella aurantiaca* and its habitat will be managed equitably.

Objective 6: Improve the management system, sustainable and rational use of *Mantella aurantiaca* and its habitat for better benefit among all stakeholders.

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
6.1. Establish a collection system known and validated by all stakeholders	6.1.1. Revision of the quota as well as collection sites	Report for the propositions of quota	All stakeholders	Annual
	6.1.2. Establishment of a collection procedure	Collection procedure signed by the stakeholders	MV, VOIs, OG, Operator	Year 1 to 2
	6.1.3. Inform all parties concerned of the existence of the collection procedure	FP and PV of the information meeting	All stakeholders	Year 1 to 2
	6.1.4. Making a translation into Malagasy of the collection mandate	Mandate of collection in Malagasy	OG	Year 1 to 5
	6.1.5. Follow the application of the collection procedures	Number of mandate of collection signed by all the entities concerned	OG, Operator	Year 1 to 5
	6.1.6. Monitor the impact of collection	Monitor report	MV, ASG	Annual
	6.1.7. Capacity building and equipment donations for the control system (GPS, camera, holding, badge, ...)	List of materials given	MV	Year 1 to 5

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
6.2. Share equitably the benefits of collecting *Mantella aurantiaca*	6.2.1. Identification of socio-economic projects in the conservation sites of *Mantella aurantiaca* in collaboration with operators)	List of projects identified	OG, Operator, ASG, Asity, MV	Year 1 to 5
	6.2.2. Implementation traceability (collection price to be set)		MV, OG, Operator	Year 1 to 2
	6.2.3. Search for a means of sharing fees for collection for the benefit of local communities (drawback and royalties)		OG, MV, Operator, CTD	Year 1 to 5
	6.2.4. Conduct feasibility studies for the procurement center		OG, Operator	Year 1 to 5

Objective 7: Promote ecotourism for equitable benefit.

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
7.1. To study the implementation of the promotion of ecotourism in sites with *Mantella aurantiaca*	7.1.1. Elaboration of framework document for ecotourism	Have a document conforming to the norm of ecotourism in Madagascar	MV, Asity, Min Tourism	Year 1 to 2
	7.1.2. Determination of priority areas for ecotourism	Areas are well defined in the zoning of each Protected Area	MV, Asity, VOIs	Year 1
	7.1.3. Fixing of entry fees in the sites concerned	Fixed amounts for each PA	MV, Asity, Min Tourism	Year 1 to 5

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
7.1. To study the implementation of the promotion of ecotourism in sites with *Mantella aurantiaca*	7.1.4. Strengthening the permanent control system at the site level, Monitoring payments of royalties and rebates	A receipt in accordance with the payment of royalties and drawbacks and which	MV, Asity, Min Tourism	Annual
	7.1.5. Implementation of Workbooks Of VOIs	The workbook is part of a document for the VOI delegation contract	MV, Asity	Year 1 to 3
	7.1.6. Implementation of materials to facilitate control	Design and installation of panels, verifiable by taking photos.	MV, Asity	Year 1 to 3
7.2. To study the cost, benefit and deficit for the economic, social and maintenance of biodiversity	7.2.1. Conduct cost and benefit studies and economic evaluation of the sector (based on Torotorofotsy, Mangabe, Ambatovy and Andasibe areas)	Document on the economic advantage of the sector	All stakeholders	Year 1 to 3
	7.2.2. Conduct assessments on compensation for loss of biodiversity and ecological functions due to economic activities in each area (Torotorofotsy, Mangabe, Ambatovy, Andasibe)	Same document but based on ecological importance	OG, MV, Asity, ,STD,CTD	Year 2 to 4

Objective 8: Develop accessible communication tools; easy to manipulate and use for habitat conservation in *Mantella aurantiaca* and support IEC initiatives (current, new) of stakeholders.

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
8.1. Promote the development of environmental education programs that support the community's standard of living and the conservation of *Mantella aurantiaca*	8.1.1. Conduct awareness-raising and environmental education sessions in primary schools	At least two sessions per year	MV, Asity, CISCO	Annual
	8.1.2. Ensures the education of the students selected for the conservation of *Mantella aurantiaca* within the Association Mitsinjo	At least one sessions per year	Association Mitsinjo	Annual
	8.1.3. Make known the conservation of *Mantella aurantiaca* and its habitats at the village.	At least one session per year	MV, Asity, Ambatovy, CISCO, Min Youth and Sport	Annual
8.2. Provide the necessary tools to raise awareness	8.2.1. Concepts of sensitization tools: brochure, poster, flyer, film ...	At least 3 new tools each year	MV, Asity, Ambatovy	Year 2 to 4
	8.2.2. Evaluation and updating of the old tools used for awareness-raising	The old tools are up-to-date every year	MV, Asity, Ambatovy	Annual
8.3. Decrease pressures and threats on *Mantella aurantiaca* and its natural habitat	8.3.1. Strengthening awareness of the PA and related laws, application of regulatory texts (local communities, local authorities, STD, CTD, etc.)	Number of outreach meetings conducted	MV, Asity, CIREEF, CEEF	Year 1 to 3
	8.3.2. Continuation of control and repression missions	Number of control and repression missions carried out	MV, Asity, Gendarmerie, CIREEF, CEEF	Annual
8.4. To make known the importance of *Mantella aurantiaca* to the local…	8.4.1. Organization of the regional celebration days for the *Mantella aurantiaca* on sites		All stakeholders	Year 2 and 4

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
8.4….. regional and international	8.4.2. Organization of activities promoting the transfer of knowledge for the benefit of biodiversity through *Mantella aurantiaca* (JME and JMZH participation)		All stakeholders	Annual

Goal 5: Have effective collaboration and effective and efficient sharing among all stakeholders to ensure sound management

Objective 9: Encourage close collaboration between stakeholders for good governance and serving as a decision-making tool for the protection and conservation of *Mantella aurantiaca*.

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
9.1. Implement an information sharing system for all stakeholders	9.1.1. Organization of periodic meetings for the exchange of information of the Committee	PV of meeting	OG, ASG, AS, Partenaires	2 sessions per year
	9.1.2. Creation of a multi-stakeholder committee	List of members	All Stakeholders	Annual
	9.1.3. Strengthen collaboration with local authorities	PV meeting with COBA	OG, ASG, AS, Partenaires, Autorités locales	Annual
	9.1.4. Conduct communication sessions on COAP by MEEF	COAP Acquired by All Stakeholders	All Stakeholders	Year 1 to 2
	9.1.5. Make exchanges between site managers, technicians and student researchers	PV meeting or training or field report	Site Managers, Etudiants chercheurs, Techniciens	Year 2 to 4

SPECIFIC OBJECTIVE	ACTIVITES	Indicator	Responsible	Time Frame
9.2. Putting a database of data accessible for all to facilitate decision-making	9.2.1. Update the databases within the Department and compare them	Updated and usable database every year	Site Managers, MEEF, ASG	Annual
	9.2.2. Updating databases at Rebioma		Site Managers	Annual
	9.2.3. Increase in the number of players involved in the implementation of the strategy		MEEF, Site Managers	Annual
9.3. Look for a sustainable financing system to provide tangible alternatives to the destruction of resources and for an equitable sharing of the benefits of conservation	9.3.1. search International funding	Number of donor obtained	MEEF, Site Managers	Year 1 to 3
	9.3.2. Research information on carbon project selection criteria		DGF, TPF	Year 1 to 3
	9.3.3. Search for sustainable financing, especially carbon sequestration projects allowing effective participation of local people in PAs		DGF, TPF	Year 1 to 3

E. List of participants during the final evaluation workshop of the conservation strategy of *Mantella aurantiaca* (2011-2015) in Moramanga.

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