

# **Rainforest Reserves for Critically Endangered Comorian Fruit Bats**

The “Comoros Forest Reserves Project”

## **Final Report**

BP Conservation Programme Gold Award

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# Rainforest Reserves for Critically Endangered Comorian Fruit Bats

## Abstract

Rainforests of the Union of the Comoros represent a global biodiversity hotspot, harboring a diverse array of endemic species. However, the Comoros face the highest rate of deforestation in the world, and its forests are completely unprotected. The loss of these forests will also mean the loss of endemic species such as Livingstone's flying fox *Pteropus livingstonii*, a critically endangered species of fruit bat found only on the islands of Anjouan and Mohéli. Based on recommendations from the national *Conservation Action Plan for Livingstone's Flying Fox*, we proposed to lay the groundwork for establishing the first forest reserves in the country, centered on the critical roosting habitat of Livingstone's flying fox. The overall aim of this project, therefore, was *to use a participatory approach to develop specific plans for reserves that will be beneficial to bat and forest conservation, sustainable, and have broad local and governmental support*. We used a novel approach, combining social science and ecological methods to develop these reserve plans and to determine priorities for follow-up conservation action at the project scale. Our project had a heavy emphasis on local participation, outreach, and capacity building.

Our project was able to meet the overall aim and goals it identified at the outset. Our *Comoros Community Forest Reserves Plan* highlights key information about sites, stakeholders, local conservation actors, and potential conservation partners. It also presents a conservation approach and a set of priority actions tailored to each locality, along with maps of land ownership and proposed boundaries of potential forest reserves at the site. In addition, we also identified priorities for follow-up conservation action, and shared results with local, national, and scientific audiences. Finally, we emphasized community participation and capacity development throughout the project, and these elements have resulted in strong support for our conservation proposals and a skilled network of Comorian personnel ready to engage in follow-up conservation efforts. Our conservation planning effort presents strong opportunities for follow-up conservation action to benefit a critically endangered species and the highly diverse and threatened Comorian rainforest.

## **Introduction**

The rainforests of the Union of the Comoros, a small African island nation in the Western Indian Ocean, are extremely rich in endemic species (BirdLife International 2003; Caldecott et al. 1996), but also face an annual deforestation rate of 5.8%, one of the highest rates in the world (Moulaert 1998; UNDP 2000). Conservation action is urgently needed to protect the highly diverse Comorian rainforests. Conservation of these forests is a key priority of the Union of the Comoros' *National Biodiversity Strategy and Action Plan* (Roby & Dossar 2000), BirdLife International's Important Bird Area programme (BirdLife International 2003), and Conservation International's biodiversity hotspot program (Mittermeier et al. 1998), which labels it, along with other western Indian Ocean islands, as one of the five most important biodiversity areas in the world for endemic species and threatened habitat (Myers et al. 2000). The Comorian rainforests are a central global conservation priority, yet unfortunately, these forests remain completely unprotected.

The shrinking Comorian rainforests are also the only habitat of the Livingstone's flying fox (*Pteropus livingstonii*), a critically endangered (IUCN 2004) endemic fruit bat that is both a flagship for rainforest conservation (IUCN 1994; Sewall & Granek 2000; Sewall et al. 2007; Trehwella et al. 2005; UNDP 1998) and a global priority for fruit bat conservation (Mickleburgh et al. 1992). Recent censuses indicate that only 1200-1500 of these bats remain (Action Comores, pers. comm.) on the Comorian islands of Anjouan and Mohéli. Livingstone's flying fox is critical to pollination and seed dispersal of canopy trees (Cox et al. 1991; Fujita & Tuttle 1991; Sewall 2002a; Trehwella et al. 2001), and thus to the maintenance and regeneration of the Comorian rainforest ecosystem that harbors a diversity of other endemic and threatened plant and animal species.

Between 2001 and 2004, a collaborative effort between the Comorian NGO Action Comores-Anjouan, the conservation program Projet Biodiversité (organized by UNDP, GEF, IUCN, and the Comorian Environment Ministry), international conservation groups, a panel of ecologists, local village authorities, and village stakeholders developed the Union of the Comoros' national *Conservation Action Plan for Livingstone's flying fox* (Sewall et al. 2007). The *Action Plan* identified seven widely dispersed colonies on the islands of Anjouan and Moheli which contain more than half the remaining bat population, and recommended that these

colonies' critical habitat be protected. In this project, we proposed to directly address this recommendation, by laying the groundwork for the establishment of the first terrestrial protected areas in the Union of the Comoros: small community-managed forest reserves for Livingstone's flying fox and the Comorian rainforest.

No terrestrial protected areas have been established in the Union of the Comoros. For conservation efforts in the Comoros, this meant not only that the critically endangered Livingstone's flying fox and its highly threatened rainforest habitat were completely unprotected, but also that there was no model for terrestrial habitat protection. The *Conservation Action Plan for Livingstone's flying fox* (Sewall et al. 2007) therefore recommended in-depth conservation planning as a necessary first step to establishing bat and forest reserves.

Any effort to establish protected areas within the Comoros would face several challenges. First, due to a lack of scientific study in the Comoros, potential reserve sites were poorly known, and the extent of human impact to critical habitat of Livingstone's flying fox was unclear. Second, all forested land was claimed not only by one or more local villagers (IS and DA, pers. obs.), but also, due to a complicated legal history and recent devolution of power, by both island and national governments (M. Dossar, pers. comm.). Third, farmers in the Union of the Comoros were among the world's poorest (UNDP 2004), and they rely on agricultural land and exploitation of forest products for subsistence. In such situations, collaborative efforts and the sharing of power and responsibilities (co-management) between local villagers, the government, and NGOs are most effective (Borgerhoff Mulder & Coppolillo 2005). To protect critical bat habitat, therefore, we identified needs for better understanding the status of Livingstone's flying fox habitat, addressing conflicting land claims, clarifying the roles of each actor in reserve establishment, and developing methods to encourage broad participation and support for terrestrial conservation.

Our overall aim in this project was *to use a participatory approach to develop specific plans for reserves that will be beneficial to bat and forest conservation, sustainable, and have broad local and governmental support*. Our specific objectives were to (1) identify potential reserve sites for each of the seven key Livingstone's flying fox colonies, (2) propose boundaries and rules-for-use for reserves that are acceptable to local communities and beneficial to fruit bat and forest conservation, (3) identify key stakeholders, obstacles to reserve creation, and potential solutions to overcome these obstacles, (4) identify priorities for future conservation action, and

(5) clearly communicate results to local people, government officials, and international conservation organizations.

## **Methods**

We used a novel conservation planning methodology to guide the development of the forest reserves plan and to identify conservation priorities. Our approach combined ecological methods to evaluate biodiversity at forest sites, social science methods to determine local perspectives on conservation in neighboring villages, consultation with key conservation actors, and capacity development of Comorian project personnel and villagers.

With the assistance of village teams that we trained, we conducted ecological surveys at forest sites and social surveys in neighboring villages. The ecological surveys were designed to identify potential reserve sites that are most critical as roosting habitat for Livingstone's flying fox and as habitat for broader Comorian biodiversity, especially threatened species. These covered an array of ecological variables, measuring such variables as bat colony size, bird diversity, and invasive plant species. Our social surveys were designed to measure local environmental understanding and attitudes toward conservation. These covered an array of social variables, measuring such variables as understanding of fruit bat ecology, views of forest importance, and perspectives on forest conservation. We further conducted site visits with local stakeholders, and consulted with representatives of government agencies and conservation groups. These procedures enabled us to gather and integrate a diverse set of information, which was essential for evaluating the relative conservation value, threat, and feasibility of reserve establishment at each of the seven sites. The procedures further enabled us to develop feasible and broadly supported plans for establishing forest reserves and to clarify rules of use and access to these reserves.

We focused on the seven forest sites harboring critical habitat identified in the *Conservation Action Plan for Livingstone's Flying Fox* (Sewall et al. 2007), and on the ten villages neighboring these sites (Table 1). We used standardized procedures in each site to ensure comparability of the data, and to ensure all information needed for conservation planning was gathered. We then entered and conducted a preliminary analysis of our data, compiled results and developed a draft plan for establishing small community-managed forest reserves in the Comoros. To ensure the validity of our conclusions, we engaged in a process of feedback

and further consultation with key conservation actors. Part of this process was a return visit to all villages to discuss the draft plan with conservation actors. These return visits enabled us to further seek local perspectives on potential obstacles to conservation success and means to surmount such obstacles. We compiled results from our biodiversity prioritization process into a scientific manuscript and a series of scientific presentations. We compiled all results of our conservation planning process in a new plan for bat and forest conservation in the Comoros, the *Comoros Community Forest Reserves Plan*.

We also emphasized capacity development of Comorian personnel at each stage of the process. One major element of this emphasis was on training of our Comorian team members. We conducted trainings for our Comorian team members in grant writing, project planning, accounting, field techniques for ecological studies, survey techniques for studies of village perspectives, and in ecology and natural history. In addition, we developed the capacities of our Comorian team members by gradually transferring responsibilities related to project activities, and leadership of the project, from the American team members to the Comorian team members. This transition enabled us to ensure quality in project execution from the beginning, while also ensuring that, by the end, the Comorian members had developed sufficient capacity to effectively lead all elements of the project.

In addition to developing the capacities of our Comorian team members, we also worked extensively to train Comorians who lived in the focal villages of our study. In each village, we identified and trained a village member to assist in biodiversity surveys and a village member to assist in community organization and social surveys (Table 2). One or both of these two village team members took part in all project activities. They learned all the field techniques we employed, and assisted us in planning and tailoring our work to the specific situation in each village. Finally, they assisted us with the interpretation of our results to ensure we had accurately understood the local situation.

## **Results**

Based on the ecological and social data collected, we evaluated the seven forest sites based on conservation value, threats from human encroachment, and the feasibility of establishing reserve sites. These data, combined with our investigation of land tenure issues, local Comorians' attitudes toward reserve establishment, and perspectives of government

officials and conservation professionals, provided tremendous insight into strategies for reserve implementation on Anjouan and Mohéli.

#### *Conservation Value of Sites*

Each site harbored irreplaceable biodiversity, but the sites varied in their conservation value relative to each other. For example, at each site a number of rare and threatened species of plants and trees were observed. Species like the critically endangered Anjouan and Mohéli Scops-owls (*Otus capnodes* and *Otus moheliensis*) were present at each site. The relative number of rare and threatened species at each site varied, however. Specific results are presented in the *Comoros Community Forest Reserves Plan* (Sewall et al. 2009), and in our scientific manuscript on the topic (Sewall et al. in prep). Overall, however, the site of Yiméré near Lingoni, Anjouan had the highest relative conservation value across all variables measured, followed closely by the site of Hassera-Ndrenge near Ouallah-Miréreni, Mohéli.

#### *Threat Faced by Sites*

Each site faced severe and imminent threats from human encroachment, but the sites varied in the relative degree of threat each faced. For example, human disturbance had reached within 150 meters of each of the seven roost sites for Livingstone's flying fox; this suggests that deforestation threatens all important roosting habitat for the bat species. The relative threat faced by each site now and in the future varied, however. Specific results are presented in the *Comoros Community Forest Reserves Plan* (Sewall et al. 2009), and in our scientific manuscript on the topic (Sewall et al. in prep). Overall, however, the site of Hamoigne-Pagna, near Bazmini, Anjouan had the highest relative threat across all variables measured. The second-most threatened site was Kidogo-Basse, near Ouallah-Miréreni, Mohéli.

#### *Feasibility of Reserve Establishment at Sites*

Conservation action at each site would be beneficial for biodiversity, though the sites varied in the relative feasibility with which a forest reserve could be established there. For example, in all neighboring villages, in every village group that we interviewed, Comorian residents indicated that they would look favorably upon reserve creation, as long as certain conditions were met. The number and type of conditions named, however, varied by site, and

this suggests relative differences in the feasibility of establishing a reserve at the site. Specific results are presented in the *Comoros Community Forest Reserves Plan* (Sewall et al. 2009), and in our scientific manuscript on the topic (Sewall et al. in prep). Overall, however, the site of Hassera-Ndrengé, near Ouallah-Miréreni, Mohéli, had the highest relative feasibility across all variables measured, followed closely by the site of Yiméré near Lingoni, Anjouan.

### *Biodiversity Prioritization at the Project Scale*

Our measures of relative conservation value, threat, and feasibility enabled us to identify priority sites for conservation intervention. The data suggest that the sites of Yiméré near Lingoni, Anjouan and Hassera-Ndrengé, near Ouallah-Miréreni, Mohéli are overall priorities based on all three criteria. Clearly, though, given the important biodiversity found at each site, the imminent threats each faced, and the opportunities for conservation at each site, conservation efforts are needed and can be successful at all sites.

### *Feedback*

To ensure that the *Comoros Community Forest Reserves Plan* (Sewall et al. 2009) met the needs of local people, the requirements of the country's government, and the expectations of the international conservation community, we solicited a diverse set of feedback on the proposal, through a process which involved a return to each of the villages neighboring proposed protected areas, return visits to government ministries on the islands of Anjouan and Moheli, and discussion and correspondence with international partners. The thoughtful comments and discussion that this process generated enabled us to better interpret our results and further develop our proposed conservation strategy. This process guided our preparation of the final plan, and enabled us to tailor recommendations specifically to each locality, taking into account village perspectives and ecological data.

### *Comoros Community Forest Reserves Plan*

In the *Comoros Community Forest Reserves Plan* (Sewall et al. 2009), we provided an overview of the Comoros social context, highlighted findings from past research, explained the complex land tenure system in the Comoros Islands, and provided important background information on forest sites and neighboring villages. We also presented our results from



ecological and social surveys, discussions with village authorities, governmental officials, and representatives of conservation organizations. We also presented a conservation strategy for the target forest sites based on these results. This strategy also took into account past conservation interventions, ongoing village-level efforts, and potential or proposed future conservation interventions.

Although we ranked the seven sites in terms of relative conservation value, threat, and feasibility of forest reserve creation, enabling prioritization of activities and sites, each of the seven sites is nonetheless a critical site for Livingstone's flying fox conservation. Each site also retains significant biodiversity, and is facing severe and imminent threats. In each case, conservation interventions could have important outcomes for biodiversity. Thus in the conservation strategy we outline in the *Plan*, we recommended conservation action for each site, though the approach and priority actions differ in each case.

We propose a strategy in the *Plan* for conservation action in habitat that is critical to the continued persistence of Livingstone's flying fox and other key Comorian threatened species. We first present specific social and ecological data relevant to forest conservation at each site, and recommend a conservation approach and a set of priority actions tailored to each locality. We highlight important conservation actors, potential conservation partners, and key stakeholders. We provide maps of land ownership and proposed boundaries of potential forest reserves at the site. We also identify priority actions for conservation at each site. These site-specific plans outline a clear process for conservation at each site that will be sustainable, broadly supported, and beneficial to bat and forest conservation.

### *Capacity Development*

An increase in Comorian capacity was an important outcome of this project. An early benefit of the project came courtesy of the BP Conservation Programme, which invited our team member Nassuri Toilibou to its training for project teams. This was a tremendous experience for him, providing him with enormous pride and motivation for conservation. He also gained concrete skills on a variety of topics, ranging from project management to the use of GIS software, that proved useful throughout our project, and will benefit future conservation efforts in the Comoros.

The American members of our project team, Brent Sewall and Amy Freestone, also conducted trainings on a variety of topics, including grant writing, project planning, accounting, field techniques for ecological studies, survey techniques for studies of village perspectives, and in ecology and natural history. In addition, we gradually transferred project responsibilities and leadership opportunities to Comorian personnel over the course of the project, and the Comorian team members excelled at project leadership. The combination of these trainings and transfer of responsibility for the project to the Comorian personnel was very effective; Comorian team members are fully capable of leading a similar project in the future on their own.

Village team members were also an integral part of our conservation process. Working with them allowed us to more efficiently and effectively conduct our studies, and improved our understanding of forest sites and village attitudes. Our village team members benefitted tremendously from the experience of working with the project. It was the first time most had been invited to participate in a project, and they were clearly excited by the opportunity to learn field techniques, assist in local project planning, and tailoring our work to their local village. While we only were able to work with each village team while we were present in their locality, these personnel clearly represent potentially important local actors for future conservation work. Our project therefore had the result of developing a network of local actors interested in participating in and facilitating conservation action.

#### *Other Results*

We had a few other important results from this project. First, after receiving the BPCP Gold Award, our project attracted additional support from the international conservation community. Conservation International-Madagascar committed significant additional funding to support our capacity building and awareness raising efforts during the project fieldwork. This additional funding enabled additional training of Comorian team members during the field work, and enabled us to deepen the participation of people living near the proposed protected areas. Action Comores International provided support for field equipment useful for the ecological surveys. And we received important in-kind support from Durrell Wildlife Conservation Trust and Action Comores Anjouan to assist with logistics for the project.

Second, during the forest surveys, our team discovered a new roost site for Livingstone's flying fox, and confirmed the existence of another. This brings to 23 the total number of known

roost sites for this fruit bat species. These unexpected discoveries are important results of the project, since the bats are highly faithful to and dependent upon roost sites. Livingstone's flying fox colonies are known to roost in one location for decades, and they rarely change locations. Each site is critical to the continued persistence of this species, whose population is thought to number only 1200-1500 individuals.

Third, soon after completing our initial round of forest and village visits, our team had the opportunity to participate in an international conference in the Comoros to set the agenda for future conservation efforts for the critically endangered Livingstone's flying fox. Our team leader, Brent Sewall, presented the keynote presentation at this conference (Sewall 2006a). Our team also presented preliminary results of this project to a range of government officials, community leaders, and representatives of international conservation groups, and received valuable feedback that helped us improve our forest reserves plan.

Fourth, our team leader, Brent Sewall presented results of the project on behalf of the team to conservation biologists and conservation practitioners at major national and international scientific conferences, including annual meetings of the American Society of Mammalogists (Sewall 2006b, Sewall et al. 2007), the Ecological Society of America (Sewall et al. 2008b), and the Society for Conservation Biology (Sewall et al. 2006, 2008a). At the Conservation Biology conference in 2008, the presentation won a Society for Conservation Biology Student Award in the student competition.

Finally, our team believes that the ideas we have developed, the approach we used, and the results we have found can be valuable to conservation biologists and conservation practitioners working on similar projects elsewhere. We therefore have written a manuscript presenting the novel approach we used and the results of the project. This manuscript is in the final stages of being readied for submission to a scientific journal (Sewall et al. in prep).

## **Discussion**

Our work in this project enabled us to (1) identify potential reserve sites for each of the seven key Livingstone's flying fox colonies, (2) propose boundaries and rules-for-use for reserves that are acceptable to local communities and beneficial to fruit bat and forest conservation, (3) identify key stakeholders, obstacles to reserve creation, and potential solutions to overcome these obstacles, (4) identify priorities for future conservation action, and (5) clearly

communicate results to local people, government officials, and international conservation organizations. As a result, we were able to meet our overall aim in the project, which was to use a participatory approach to develop specific plans for reserves that will be beneficial to bat and forest conservation, sustainable, and have broad local and governmental support.

### *Follow-up Conservation Action*

While we have met the goals and overall aim we set out to accomplish, we recognize that the development of a conservation plan is not an ending point in the conservation process. The work we have accomplished has enabled us to identify conservation actors in each locality, prioritize conservation actions to undertake, and identify partners for the implementation of the plan. The Forest Reserves project and the planning process we have undertaken have built a solid foundation for the targeted conservation of a critically endangered species and its highly diverse rainforest habitat. In addition, the training, opportunities, and experiences received by Comorian personnel have developed their capacity to manage conservation projects in the future. This project and its forest reserve plan therefore present a strong opportunity for follow-up conservation action to benefit a critically endangered species, the highly diverse and threatened Comorian rainforest, and the people who live in nearby areas. We are currently seeking funding and partners for follow-up work to implement the recommendations we have identified in the *Comoros Community Forest Reserves Plan*.

### *Conclusions*

There is a vital need for conservation action to protect the critically endangered Livingstone's flying fox and Comorian biodiversity, which face extensive human encroachment. Since no model exists for establishing terrestrial protected areas in the Comoros, an in-depth planning process was required. Following up on previous planning efforts, we collected social and ecological data and worked in a participative manner with residents of villages neighboring key forest sites, non-governmental organizations, and government officials to identify priorities for conservation and develop detailed plans for reserve establishment. Our work resulted in the *Comoros Community Forest Reserves Plan* (Sewall et al. 2009), which highlights important background information, key stakeholders, dynamic conservation actors, and potential conservation partners. It also presents a conservation approach and a set of priority actions

tailored to each locality, along with maps of land ownership and proposed boundaries of potential forest reserves at the site. In addition to this *Plan*, we also have developed several scientific products, including an award-winning presentation and a scientific manuscript which present our novel approach to conservation and highlight the Comoros priority conservation sites. Finally, we emphasized community participation and capacity development throughout the project, and these elements have resulted in strong support for our conservation proposals and a skilled network of Comorian personnel ready to engage in follow-up conservation efforts.

**Table 1.** Seven forest sites and ten neighboring villages that were the focus of this study. Sites were selected on the basis of their importance to the critically endangered Livingstone's flying fox, as noted in the *Conservation Action Plan for Livingstone's Flying Fox*. Note that the village of Ouallah-Miréreni neighbors two forest sites. The village claiming ownership of land at the site is also noted.

Island and forest site	Villages with access to forest site	Village claiming forest site
Anjouan		
Yiméré	Lingoni	Lingoni
Matulabé	Nindri & Kowet	Nindri & Kowet
Moihadjou	Ouzini	Ouzini
Hamoigne-Pagna	Bazmini	Bazmini
Massakini	Mpagé & Bwedza	Mpagé
Mohéli		
Hassera-Ndrenyé	Ouallah-Miréreni & Miringoni	Ouallah-Miréreni
Kidogo-Basse	Ouallah-Miréreni & Ouallah 2	Ouallah-Miréreni

**Table 2.** Village teams included a roost monitor and a community organizer.

	Anjouan						Mohéli			
	Yiméré	Matulabé	Moihadjou	Hamoigne-Pagna	Massakini	Hassera-Ndrenge	Kidogo-Basse			
Forest location										
Closest village(s)	Lingoni	Nindri-Kowet	Ouzini	Bazmini	Mpagé	Bwedza	Miringoni	Ouallah-Miréreni		Ouallah 2
Village roost monitor	Mohamed Attoumane	Hamidoune Oussene	Saindou Moussa Toumani	Nassuri Ali Mari	Ali Djaha		Cheikh Moussa Iboura			Mohamed Fahare
Village community organizer	Soidaenti Saïd	Nahiyati Kaambi	Zalfa Baydhoine	Daouria Saïd Oussene	Anrafat Youssof Ben Ali	Hadidja Abdou Halidi	Natidjati Maoulida Soeuf	Naskati Avilaza		Dhourai Siyaka

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## Annex 1: Project Timeline

<u>Dates</u>	<u>Activity</u>																																				
<i>Preparation and Planning</i>																																					
July-Aug 2005	Planning Meetings																																				
Sept-Dec 2005	Preparation and Training																																				
<i>Field Work, Consultation, and Analysis</i>																																					
Dec 2005-Feb 2006	Field Surveys (Social and Ecological)																																				
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## **Annex 2: Project Budget**

All amounts in U.S. dollars

### Amounts Received

BP Conservation Programme Gold Award	\$ 17500
Conservation International	\$ 9449
Action Comores International	\$ 1000
Donations	<u>\$ 309</u>
Total Received	\$ 28258

### In Kind Donations

Durrell Wildlife Conservation Trust - translation services  
Action Comores Anjouan - office space, office equipment, lodging

### Expenditures

Travel	
International flights	\$ 8169
Domestic flights and ground transportation	\$ 2705
Room and board	
Lodging	\$ 906
Food	\$ 3680
Personnel	\$ 7267
Equipment and Supplies	\$ 3929
Miscellaneous	
Postage and Shipping	\$ 430
Photocopies	\$ 256
Internet and Phone	\$ 393
Insurance & Medical	<u>\$ 524</u>
Total Spent	\$ 28259

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