

Endemic Fruit Bats and Conservation Education: New Initiatives in Madagascar and Papua New Guinea

Terry O'Connor, Woodland Park Zoo
Peter Riger, Houston Zoo
and Richard Jenkins, University of Aberdeen/Madagasikara Voakajy (Madagascar)

The AZA Bat Taxon Advisory Group (Bat TAG) has initiated a series of collaborative conservation education programs to support ongoing educational efforts in Madagascar and Papua New Guinea. Each of these countries has dwindling endemic wildlife populations due to human encroachment, habitat loss or degradation, unsustainable hunting, and other environmental concerns. Both Madagascar and Papua New Guinea have organizations working within them to develop long term conservation and education programs that utilize their unique “flagship” charismatic species. These represent collaborations between in-country and international conservationists, and frequently involve working with local communities. By joining with these proven and established programs, the Bat TAG has been able to promote an often-overlooked group of animals to the forefront of conservation initiatives through *in situ* community education programs.

In 2002-2003, the Bat TAG began planning and development of collaborative education programs in Madagascar, focusing on Parc Ivoloina in Tamatave, which is overseen by the Madagascar Fauna Group (MFG). Through a partnership established with the Tree Kangaroo Conservation Program, the Bat TAG also began a bat education program on the Huon Peninsula in Papua New Guinea. In this paper, we will describe each of those initiatives and draw conclusions about the role of launching new education initiatives on neglected species, such as fruit bats, in large countries that have already received major efforts to conserve their larger mammals.

Madagascar's Fruit Bats and the Current Cause for Concern

Madagascar is home to at least 30 different species of bats—27 are small, microchiropteran insect-eating bats and the remaining three are larger, fruit-eating bats. Eighteen of Madagascar's bat species, including all three fruit bats, are endemic to the island. The three megachiropteran fruit bat species found in Malagasy forests are the Madagascar flying fox (*Pteropus rufus*), the Madagascar straw-colored fruit bat (*Eidolon dupreanum*), and the Madagascar rousette (*Rousettus madagascariensis*). All three species are important pollinators and seed dispersers for the island's endemic plants in fragmented landscapes where movements of other frugivores and nectarivores are more constrained by habitat barriers. Populations of both Madagascar flying foxes and Madagascar straw-colored fruit bats are diminishing due to heavy and sustained hunting for the bushmeat trade and local consumption. In addition, the Madagascar flying fox is also threatened by the loss of roost sites that result from deforestation.

Although lemurs have been the focus of many education and conservation programs on Madagascar and are incorporated into formal lessons in schools near protected areas, little has been done to promote the welfare and conservation of endemic bat species on the island. Yet during their regular and unique long-distance foraging flights these fruit bats pollinate plants and disperse their seeds over a broad area. They therefore play a crucial ecological role in the survival of Madagascar's flora and fauna. Two of the three endemic fruit bats, The Madagascar flying fox and the Madagascar straw-colored fruit bat are known to feed on at least fifty different plant species, many of these endemic to Madagascar. The Madagascar straw-colored fruit bat also visits the rare baobab (*Adansonia suarezensis*), listed as IUCN endangered, and is likely its main pollinator (Baum, 1995).

It has become clear that the loss of roost sites, combined with hunting pressures, are reducing the overall populations of these species. The Madagascar flying fox has recently become a species of concern for the IUCN/SSC Chiroptera Specialist Group and in 2004, was moved from near threatened to vulnerable on the IUCN Red List. At the current rate of loss, this species is facing extirpations across its range. Conservationists cannot rely on protected areas or wildlife law to protect Malagasy fruit bats – most roosts

are found outside of reserves, and fruit bats are classified as game species. Conservation action is urgently needed for fruit bats in Madagascar to address the anomaly of having endemic, threatened mammals as species that can be legally hunted for food, sport or crop protection.

The AZA Bat TAG believes that initiating a local conservation education program on Madagascar now, while there are viable populations of fruit bats still left in the wild, may be the only solution to bridging the gap between legal exploitation under existing wildlife law and the need to conserve the remaining populations of The Madagascar flying fox and the Madagascar straw-colored fruit bat. This program may be the prelude to bringing these species into captivity in the next five years for breeding programs in Madagascar and in the U.S.; however, at this time the priority is to increase the awareness of the local Malagasy people on the important ecological role bats play as key to the future survival of Madagascar's forests, especially in the communities living near to large, existing roosts.

Partnership Facilitates Bat Conservation Education

The Bat TAG initiated discussions with the Madagascar Fauna Group (MFG) and we agreed on the need for stronger educational initiatives focusing on vertebrate species other than lemurs. Through the MFG, the Bat TAG developed a relationship with Parc Ivoloïna in Tamatave, where MFG staff Andrea Katz, and Charlie Welch welcomed the idea of a collaborative effort between the Bat TAG and the MFG team on bat education. There currently are no bats on exhibit at Parc Ivoloïna; however, we determined that the project would consist of two elements: interpretive graphic panels for the Parc, and an educational kit and curriculum for use in Parc education programs for schools and other children's groups. We developed the following program goals, objectives and expected outcomes:

Conservation Goals

1. To educate public visitors and school groups to Parc Ivoloïna about the ecological significance of their endemic species of fruit bats, especially the Madagascar flying fox and the Madagascar straw-colored fruit bat as key to the future survival of Madagascar's forests.
2. To increase awareness of why populations of these species of fruit bats are declining in Madagascar and the need for their conservation.
3. To encourage visitors to conserve bats by not eating them and by preserving forest habitat.

Objectives

- Produce one graphic panel about Madagascar's bats, which will be installed at Parc Ivoloïna
- Develop a curriculum about bats for teachers and school children to include grade level-appropriate activities developed according to Madagascar's school curriculum guidelines
- Create a kit of materials about bats that can be used by Parc Ivoloïna staff in interactive programs for students and family visitors.

Outcomes (student outcomes would be developed according to curriculum guidelines). Program participants and park visitors will:

- Understand that these fruit bats are wildlife treasures unique to Madagascar
- Identify bats as key pollinators and seed dispersers of endemic plants, including some plants that are economically important
- Recognize that the key to saving Madagascar's declining forests is to conserve the bats that are necessary to the survival of plants
- Name two ways that people can help save bats: by not eating them and by protecting their forest habitat

Program Development

Endorsed by the Madagascar Fauna Group, the Bat TAG applied for, and received, a grant award from the Sophie Danforth Conservation Biology Fund at the Roger Williams Park Zoo, which funded the initial

implementation of the project. Parc Ivoloïna has an annual attendance of 15,000 visitors per year, 85% of whom are native Malagasy. The remaining visitors are international tourists. We began the project by asking Parc Ivoloïna staff to survey a small group of young Parc visitors to assess their attitudes and knowledge about bats. From the responses made by the seven groups of children ages 12-14 years from the Lycee Francais of Tamatave, more than 50% knew nothing or very little about bats and nothing about these bats' existence in Madagascar. Most knew nothing about bats' ecological role in pollination and seed dispersal, which confirmed the Bat TAG's previous experience when working with school children on the island of Rodrigues. Following the success of the bat education kit and curriculum the Bat TAG developed for Rodrigues fruit bats, we developed a similar program for Madagascar fruit bats.

Vickie B. Smith, a bat educator from Eufaula, Alabama and advisor to the Bat TAG, created a bat costume, bat facemasks, and games. These were added to a kit also containing books, plastic replicas of bat diet items, bat photos, and a "pollination simulator" consisting of cream-colored, large silk flowers, talcum powder and plush bat puppets. Terry O'Connor adapted the lesson plans from the Rodrigues curriculum, and prepared a new curriculum packet specific to Madagascar's endemic fruit bats and conservation initiatives. Madagascar bat researchers Emma Long and Richard Jenkins provided valuable comments based on their thorough and thoughtful review of the curriculum draft. The written material was eventually translated into French and will be translated into Malagasy by Parc Ivoloïna staff (since we hadn't budgeted in the original grant for French translation, this delayed the implementation).

Karen Freeman became the new Director of Parc Ivoloïna when Andrea Katz and Charlie Welch left Madagascar, and Karen also enthusiastically supported the bat education initiative in progress. Karen reviewed the text for the two requested interpretive graphic panels, and MFG Education Officer Randriambelona translated the French text for the graphic panels into Malagasy. Peter Riger worked with Steve Stratakos of the Texas Department of Fish & Wildlife, who offered his graphic design skills to the project. Using photographic images donated by Nick Garbutt, Steve created the two interpretive panels with bilingual text. They were prepared as laminated panels that could easily be rolled for transport.

Implementing Bat Conservation Education in Madagascar

As the bat education kit and curriculum were being created, Richard Jenkins of the University of Aberdeen requested that a second duplicate kit be developed. As director of Madagasikara Voakajy, the new Malagasy NGO that specializes in bat conservation and is active in sites across the island, Richard felt that the kit could be valuable for a project near Moramanga, in eastern Madagascar. This area still holds significant numbers of Madagascar flying foxes but their roost sites are unprotected and are under severe threat from human activities. Building on the momentum from his project in 17 rural primary schools that increased the awareness about fruit bats to children and teachers, Richard and his partners in Moramanga (ACCE) visited Parc Ivoloïna in November 2004 with Co-chair of the IUCN Chiroptera Specialist Group Professor Paul Racey to discuss MFG's new bat education display. During the visit it became clear that, like the majority of Madagascar's conservation professionals, the MFG staff were lacking background and context about fruit bat ecology and conservation, having for so long educated visitors about general environmental education issues. It was also evident that the Madagasikara Voakajy and ACCE teams lacked significant teaching experience and could learn a lot from the MFG education team. A workshop was therefore planned for an exchange of information, ideas and experiences and to discuss ways of using the bat education kit in Madagascar and of integrating the conservation message into formal teaching in primary schools.

The Houston Zoo provided funding to support the development of the second bat education kit, which was created by Vicky B. Smith and Terry O'Connor. The contents and print materials from both kits were packed into small, sturdy duffel bags for shipment, along with the rolled graphic panels for installation at Parc Ivoloïna. Thanks to Ingrid Porton and the MFG, the Saint Louis Zoo transported one of the kits to Madagascar. Our thanks also go to Conservation International, whose staff agreed to carry the second kit and graphic panels.

The two graphic panels were installed at Parc Ivoloina, where follow-up work will include having Parc staff survey visitors to gauge their understanding of the panels' messages about importance of Madagascar's fruit bats, why their populations are diminishing, and what people can do to protect them.

The bat workshop was funded by the Disney Wildlife Conservation Fund, Conservation International, BP Conservation Programme and the Darwin Initiative. The workshop was held from 25 to 28 April 2005 and the number of participants steadily increased during the planning phase as more and more people wanted to become involved. Thirty-six people attended the event that was opened by the Member of Parliament for Moramanga. In addition to representatives from Madagasikara Voakajy, ACCE and MFG, other participants included ANGAP (National Parks Service), CISCO (Education Authority) and DIREF (Ministry of the Environment, Water & Forests). Three members of Action Comoros, an NGO from Comoros Islands dedicated to *Pteropus* conservation, also attended.

The morning of day one consisted of presentations by Madagasikara Voakajy and ACCE on the diversity, ecology and conservation of Malagasy fruit bats. The participants divided into groups in the afternoon to discuss the particular sections of the education kit (i.e. bat biology, bat ecology and bat conservation) and the application of the kits to primary school teaching. On the morning of the second day, children from a local school fruit bat club (Club Fanihy) joined the workshop and experimented with the games and demonstrations in the bat education kit. This was followed-up by a plenary session to bring together ideas on the bat education kit and to develop a strategy for integrating bat conservation into primary school teaching.

The main recommendations from the workshop were to:

- 1- Implement a pilot project based on the format below in eight primary schools to test the suitability of bat conservation information for uptake across Madagascar
- 2- Produce a guide to 'Bats and their Conservation' for educators in Madagascar
- 3- Establish a network of conservation groups in Madagascar and other islands in western Indian Ocean to share experience and ideas
- 4- Educate more conservation professionals in Madagascar about bats
- 5- Mass produce the graphic panels as small color posters for schools

Pilot Project

1. Collaboration between biologists, teachers and education authorities
2. Choose eight schools from an area with important flying fox roosts
3. Provide each school teacher with a copy of the proposed 'Bats and their Conservation' booklet that identifies parts of the curriculum where bats can be included
4. Conduct a teacher training workshop to bring all educators from the eight schools together
5. Insert bat examples into the existing curriculum lessons on basic mammal biology and the biology of pollination (currently examples used in Malagasy schools for mammal biology are cows and insects for pollination)
6. Encourage teachers to use the new materials and examples in everyday school lessons during two terms
7. Conduct a follow-up meeting with all educators to evaluate the project and make any necessary alterations
8. Provide recommendations to the government based on the pilot project to expand the initiative

On the last day of the workshop the participants visited a Madagascar flying fox roost that ACCE and Madagasikara Voakajy are actively trying to protect. Practical ways of conserving the bats and their roosting habitats were discussed. This was a very helpful exercise because it highlighted the similarities and differences with other conservation projects. For example, the forests used by Madagascar flying foxes for roosting are small and low in biodiversity value; a sharp contrast to the primary rainforests used by *Pteropus livingstonii* in the Comoros. The field visit also gave MFG educators a valuable opportunity to observe the behavior of Madagascar flying foxes. Staff from the Peregrine Fund shared their experiences about community management of important conservation sites that lie outside of the protected area

network and this approach was generally agreed to have significant potential for fruit bat roosts. The workshop was closed by the MP, who pledged to take the case of *P. rufus* to the national assembly to consider changing its status from a game species to a protected species.

Of the two bat education kits in Madagascar, the MFG is using one to educate the visitors to Parc Ivoloina and will also be used in schools near the Betampona Reserve. The kit has already been piloted in July 2005 (with great success) with a group of students from villages surrounding the zoo, who spent an entire day learning about the threats to bats in the local area. Following their introduction at the workshop to the plight of bats MFG agents Arsene Razanadahy and Celestin Razafy undertook a two-day hike out to the nearest known fruit bat roost to Betampona Reserve. They were successful in finding a colony using four tree roosts (probably Madagascar flying foxes judging by the roost choice) and spoke with local villagers to try to discern the status of the colony. It was apparent that the colony had diminished greatly in recent years and that the bats were still persecuted due to their consumption of local fruit crops. They plan to return later in 2005 with the bat education kits to work with local school children in order to promote the conservation of these animals before they disappear completely. Other sites will be investigated as work commitments allow.

The other bat kit will also have a mobile role, being taken into schools situated near to roosts, and will impact a large number of children from different sites. For example, Madagasikara Voakajy will use the kit in December 2005 in the Sainte Luce forest, located in the southeastern tip of the island, where the remaining three flying fox roosts are threatened by hunting and habitat loss. The kit will also be used in September 2005 at three schools near to Maromiza Forest following requests from workshop attendees for us to help conserve a Madagascar rousette roost.

Richard Jenkins, Professor Paul Racey, Karen Freeman and Lubee Bat Conservancy Director Allyson Walsh have discussed the potential of a *Pteropus rufus* exhibit at Parc Ivoloina for display and education purposes. This would provide a wonderful opportunity for community visitors and school children to learn about bats and their amazing adaptations, and to discover the ecological importance of these bats to Madagascar.

Fruit Bats of Papua New Guinea

In addition to its rich diversity of cultures, Papua New Guinea has some of the most biologically diverse ecosystems in the world. The forests of Papua New Guinea (mostly at lower elevations) are home to 91 different species of bats—55 of them are small, primarily insect-eating bats and 34 species are larger, fruit-eating bats. Nineteen of Papua New Guinea's bat species are endemic and eleven of these are fruit bats. Unlike many areas of the world, Papua New Guinea still retains most of its original forest; however, half of its people rely on the forest for subsistence (Bonaccorso, 1998) and there are pressures from logging, mining and petroleum exploration. While several of the insect-eating bats are widespread in Papua New Guinea, other bat species are considered vulnerable. The 34 large fruit bat species include the endangered Bulmer's fruit bat (*Aproteles bulmerae*). Deforestation for commercial agriculture and mining, and over-hunting of the bats for food are the primary reasons why populations of some of Papua New Guinea's fruit bats, such as Bulmer's fruit bat, have declined. Papua New Guinea's fruit bats are therefore species of concern for the Bat TAG.

While these bats are not recommended for captive management, we wanted to promote awareness and inspire efforts to protect fruit bats in Papua New Guinea, through an education initiative. Our past experience as well as that of other field conservation and education programs has shown that the success of an *in situ* program is dependent upon a stable in-country presence to ensure that the program is more than a one-time event, and will remain a part of the curriculum.

What do Fruit Bats have to do with Tree Kangaroos?

In 2003 we began exploring the idea of a conservation education program for Papua New Guinea bats with Dr. Lisa Dabek, Director of the Tree Kangaroo Conservation Program (TKCP). The TKCP is a community-based conservation program that is helping to establish a 150,000-acre Conservation Area on

the Yupna-Urawe-Som (YUS) watersheds of the central and western Huon Peninsula in Papua New Guinea, and area that includes 13 villages. Along with conservation outreach, habitat protection and research, this program has a strong and well-established education component. The TKCP supports teacher training workshops and programs for school children, which includes an international art exchange with schools in Australia and the U.S. Dr. Dabek was interested in expanding the focus of the education program to other species and had already begun working with Woodland Park Zoo's Bug Club. Her support for bat education in Papua New Guinea enabled the Bat TAG to pursue this initiative, and in 2004 the Bat TAG was awarded a grant from the Riverbanks Zoo & Garden to create a bat education kit and curriculum for school children in Papua New Guinea.

We agreed to pilot the bat education kit during the TKCP annual teacher workshop in November 2004. This was a significant opportunity for the Bat TAG to test a new kit and curriculum and get teacher reactions to the materials before the curriculum was finally completed. Chris Doyle, Conservation Education Coordinator for the TKCP provided tremendous insight and support to this bat education project, and her experience in Papua New Guinea was invaluable to the preparation of the curriculum. The TKCP had also previously conducted a wildlife survey, which enabled us to determine which bat species inhabited the area, and which might be sighted by village inhabitants.

Creating the Bat Education Kit

For children ages eight and older, we developed the following learning outcomes: through their exposure to the lessons and educational activities contained in this kit, children will:

- Understand that bats are mammals with many special adaptations for survival
- Learn that there are about 1,000 different kinds of bats in the world that vary in size, appearance, habits and feeding strategies
- Examine people's attitudes about bats and learn that bats are our friends
- Discover how fruit bats are adapted to eat fruit, nectar and pollen, and that they are important pollinators and seed dispersers of tropical plants
- Be able to name some of the fruits we eat and other plant products we use that depend on bats
- Understand that bats play important roles in their environment and that their survival affects the whole community of wildlife
- Realize that some species of bats in Papua New Guinea are found no where else on Earth, and be encouraged to take pride in their unique wildlife heritage
- Learn why some bats are endangered
- Discover ways that students can be involved in protecting habitat for wildlife

Just as we had with the Madagascar project, we developed a similar kit of materials for Papua New Guinea, with the costume, masks and games once again created by Vicky B. Smith. Terry O'Connor wrote a curriculum relevant to Papua New Guinea's bat species and conservation issues, incorporating the same lesson plans used in other bat education projects. Papua New Guineans speak Pidgin, but are taught English in school, so the curriculum was prepared in English. We shipped all materials to Roger Williams Park Zoo, where Chris Doyle assembled the kit into a backpack for transport to Papua New Guinea. Villages in the TKCP study site are in mountainous areas, separated by long hiking distances, and the portability and water-resistance of the kit were important considerations.

Teacher Workshop and School Visits

In September 2004 Chris Doyle was accompanied to Papua New Guinea by educators Anne Warner, Mark Wanner (Saint Louis Zoo), Australian artist/naturalist Robin Wingrave and educator Sharyn Wingrave. They joined TKCP Field Scientist Joel Glick and In-County Education Coordinator, Danny Samandingke. The team conducted the Second Annual Teacher training Workshop for Primary School Teachers (of grades 3-8) in Dinangat Village. Seventeen teachers participated, along with teacher trainers from the Research and Conservation Foundation (RCF) an NGO based in Garoka. While the primary focus of the workshop was on cultures, the TKCP team also piloted the bat education kit and

curriculum, and found that the teachers enjoyed using the kit materials and participating in the hands-on activities. Teachers learned new information about bats' anatomy and physiology. As fruit bats eat, they crush fruit, ingesting the juice and spitting out the tough, fibrous parts. Teachers who had seen this behavior thought that bats defecated from their mouths. Prior to their unit on bats in the workshop, the teachers had no understanding of bats' roles as pollinators and seed dispersers.

While the bat education kit was well received, the great distances between remote village schools makes it impractical for the kit to be circulated among schools and used in classrooms. Instead, teachers recommended that we create a much simplified version, with tools and patterns so that the teachers could create their own "bush kits," with costumes, masks and games made from locally-available tapa cloth and natural materials such as bark, moss and other vegetation. Using their recommendations, the Bat TAG will now be working to create these "bush kits" for teachers for the November 2005 TKCP workshop. Thanks to these teachers' ingenuity, more teachers and schools can use the bat education kits, at a lower cost. This approach will also influence the Bat TAG's development of future education materials for new areas.

The TKCP also visited five YUS villages during September of 2004, where the bat education kit was piloted in several classes in which approximately 160 children ages 8 and older participated. The team also gave two community presentations, attended by people of all ages. After completing their seasonal work in Papua New Guinea, the team returned to Queensland Australia, where they collaborated with Australian environmental educators and classroom teachers at the Herberton State School in the Atherton Tablelands. In October 2004, they piloted the bat education kit to two fifth-grade classes. Bat rehabilitator Jenny Maclean of the Tolga Bat Hospital gave a presentation with orphaned spectacled flying foxes (*Pteropus conspicillatus*) and a northern free-tailed bat (*Chaerephon jobensis*). Because Papua New Guinea and Australia have many of the same bat species, the kit was effective in connecting Australian students with their local wildlife as well as the wildlife of Papua New Guinea.

The TKCP left the bat education kit with Jenny Maclean for use with bat education presentations in Queensland. Since the bat education kit was intended for use in Papua New Guinea, this fall, Chris Doyle will return the kit to Papua New Guinea, where it will be left with the Research and Conservation Foundation (RCF) in Goroka, where it can be used to train additional teachers. The Australian team can then duplicate the contents of the bat education kit for their own use, and the Bat TAG will provide an electronic copy of the curriculum that can be adapted for Australian bat species. The TKCP will take the new patterns, templates, books and supplies to the YUS area on the Huon Peninsula, so that teachers participating in the 2005 workshop can create their own bat bush kits.

Conclusion

Development of programs such as these in regions that are difficult to access from North America are not without their challenges. Although technology has made communication easier, translation of programs into native languages; transportation and delivery of materials; and collaboration among numerous organizations, NGO's and individuals adds complexity and time. Measuring outcomes from these programs also means that conservation education efforts are long-term projects. Forging relationships among groups with similar interests has taken us a long way towards the completion of our education initiatives in both Madagascar and Papua New Guinea. Further collaborations with the Madagascar Fauna Group, Parc Ivoloina, Madagasikara Voakajy, and the Tree Kangaroo SSP will help the AZA Bat TAG to continue our conservation education role in these regions as well as utilize the successes of these programs as a template for future projects.

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