



Mauritius Fruit Bat Research Strategy Workshop

9-10 May 2018, Mauritius

Hosted by the Ministry of Agro-Industry and Food Security, National Parks and Conservation Services



Background

Following a successful first stakeholder workshop on netting and management of fruit bat damage to orchards in Mauritius hosted in August 2017 by the Food and Agricultural Research Extension Institute (FAREI), the National Parks and Conservation Service (NPCS) of the Ministry of Agro-Industry and Food Security hosted a research strategy workshop in May 2018. This workshop was prepared and planned jointly by NPCS, the IUCN SSC Human-Wildlife Conflict Task Force, the IUCN SSC Bat Specialist Group, the Mauritian Wildlife Foundation (MWF) and Chester Zoo. Mauritian and international experts from a range of disciplines gathered to assess the state of knowledge on the human-bat conflict topic and discussed aspects including bat ecology, behaviour and conservation, as well as the social, political, agronomic and economic components of this issue. Participants worked together to identify current knowledge gaps and future research opportunities concerning the

Mauritius fruit bat. Participants included Mauritian professionals representing NGOs, academics, governmental departments and invited experts from overseas who have extensive, international knowledge. Through a combination of presentations and facilitated working groups, the workshop participants learned about current research initiatives and jointly identified priority research questions. It is anticipated that this workshop will provide a mechanism for continued exchange of expertise and ideas beyond the event itself and ultimately lead to the production of a national research strategy.

Objectives

- 1) To bring together stakeholders representing a range of scientific and research disciplines from Mauritius and overseas in order to share information and to contribute to the initial stages of producing a research strategy.
- 2) Exchange current knowledge concerning fruit bats globally from the social, economic and natural sciences perspectives.
- 3) Learn about current, ongoing and planned research projects encompassing all aspects of Mauritius fruit bats, their aims, objectives, schedules and intended outputs.
- 4) Identify priority research questions and areas for focussed study, and collate this towards an outline of a national research strategy on Mauritius fruit bats and their conservation and management.

Participants

The workshop was opened by the Permanent Secretary of the Ministry of Agro-Industry and Food Security who welcomed approximately 30 participants representing a number of NGOs, government institutions, and universities. These included the National Parks and Conservation Services (NPCS) of Mauritius, the Food and Agriculture Research Extension Institute (FAREI), the Mauritian Wildlife Foundation (MWF), the University of Mauritius, Ecosystem Restoration Alliance (ERA), the Small Planters Association and animal welfare groups. In addition to the Mauritian participants, international experts from the relevant IUCN specialist groups, the University of Oxford and Chester Zoo also participated. See Appendix I for a full list of participants.

Workshop Summary

The Fruit Bat Research Strategy Workshop was hosted by the National Parks and Conservation Service from 9th to 10th of May 2018 at Pearle Beach Hotel, Mauritius. The aim of the workshop was to provide an interactive platform to share knowledge and to propose new research avenues that would harmonise the issue of human-bat conflict. The first day of the workshop consisted of a series of presentations that showcased the variety of research being conducted across Mauritius. On day two participants were arranged into small working groups in order to discuss knowledge gaps and identify priority research questions that should be addressed in order to make progress towards finding non-lethal solutions to the issue.

Day 1 - Presentations

After the welcome address from the Acting Director of NPCS Mr Kevin Ruhomaun, the Permanent Secretary, Mr Boyramboli Nizam Jurawon delivered his speech and officially opened the workshop. Alexandra Zimmermann outlined the overall aims and context of the workshop and the progress of the initiative to date.

Session 1. Introduction and background to conflict and population assessment – Chaired by Kevin Ruhomaun

Dr. Tigga Kingston (IUCN SSC Bat Specialist Group) opened the first session by providing an update on the recent IUCN Red List assessment for the Mauritius fruit bat. Tigga informed participants that the status for the fruit bat will be up-listed to 'Endangered' from 'Vulnerable' in July 2018. She focussed her talk on the importance of fruit bats on islands for ecological functions such as seed dispersal and highlighted that *Pteropus* spp are globally threatened by multiple, interacting processes including climate change, land-use change, invasive species and persecution.

Dr. Vikash Tatayah (MWF) gave a historic account of the relationship between people and bats in Mauritius and noted that although a low-level of hunting was widespread, the current 'conflict' is quite recent and that negative perceptions are reinforced by the national press. Vikash presented data on the number of major tropical cyclones (and strong cyclones with gusts of over 200 km/hr) to affect Mauritius in recent decades, pointing out that although there had been an increasing number of strong cyclones in recent decades since the 1940s, there have been none since 2002. Several factors are fuelling the 'conflict' to various degrees.

Ms. Houshna Naujeer (NPCS) presented the most recent results from the Mauritius fruit bat survey carried out across Mauritius by the NPCS in October 2017. A total of 62,937 individuals were counted from 84 roosts after the cull of 7,280 individuals in December 2016. The Scientific Officer from NPCS explained that the objectives of the survey were: (a) to carry out an estimate of fruit bat population size in Mauritius using standardised methodologies (Evening Dispersal Count and Direct Count), (b) to monitor fruit bat colonies at different roosting sites and their spatial distribution, and (c) to enhance the sustainable conservation management of the species. The survey was limited to a short time period (9th to 31st Oct 2017) and provides robust primary data on the existing roost locations, the numbers occupying them and the migratory nature of this species.

The fruit bat count concluded that the majority of bats converged in the Northern region of the Island correlating with abundant food availability (lychee orchards) in this area. This observation was also confirmed by the cyclic movement pattern demonstrated in the navigation study of fruit bats conducted by Dr. Ryzsard Oleksy. The presentation also gave a brief overview of the ongoing research on fruit bats which includes experiments on fruit bat deterrents and a cognitive study on fruit bats that aims to study the movement of young bats tagged with GPS trackers.

Session 2. Damage caused by fruit bats in Mauritius – Chaired by Vikash Tatayah

Mr. Lauren Ayady (ERA) presented the findings of an orchard damage assessment carried out in 2014/15 that revealed an average level of damage to mango and lychee trees caused by bats of around 10%. He stressed that other causes of damage included over-ripening, birds and weather. Bat damage is more prevalent among trees higher than 2 metres.

Dr. Simon Tollington (Chester Zoo) presented the results of a 2016/17 study that investigated the levels of damage caused to backyard lychee trees. He highlighted the difficulty of assigning damage to a single taxon when there are many different factors that may cause imperfections in fruit (pathogens, nutrient imbalance, etc). Imperfections may then encourage secondary depredation by birds or bats. He estimated that on average, ~33% of lychees are lost to birds, bats and rats each year and that bats are responsible for ~42% of damaged fruit recovered from the ground. This is potentially worth Rs6.6m per year across Mauritius.

Mr. Dooblad (FAREI) presented research estimating that the damage caused by bats to fruit in backyards is 30 – 50% and that by installing nets the problem can be shifted to backyards where nets are not employed. The damage in orchards is estimated at 10-35% and depending on market price and levels of depredation the cost of this damage can amount to Rs180m annually. In the last eight years (2010 to date) Rs75m has been spent on the netting subsidy scheme. More than 42,000 tonnes of fruit are produced annually from 3000 Ha in Mauritius with lychees contributing 1000 – 4000. An estimated 200- 330 tonnes of lychees worth Rs45-50m are exported annually.

Session 3. Bats in a wider socioeconomic context - Chaired by Alexandra Zimmermann

Dr. Alexandra Zimmermann (Chester Zoo and IUCN SSC Human-Wildlife Conflict Task Force) presented a brief results summary of a public perceptions questionnaire survey that was conducted in Mauritius in March 2017. Approximately 360 people were interviewed at markets and supermarkets across Mauritius. A pattern emerged showing that people associated bats with noise and mess illustrating that perceptions are not just driven by fruit damage. Furthermore, of ~130 people who identified themselves as fruit growers approximately 66% did not use nets, nearly 50% had not heard of the government subsidy and only 14% of people claimed that nets worked as a deterrent against damage by bats.

Dr. Vikash Tatayah (MWF) gave an overview of the public dissemination and awareness raising activities of the Mauritian Wildlife Foundation related to bats in Mauritius going back to at least 2002.

Dr. Ewan Macdonald (Oxford University and Chester Zoo) addressed the question of “How can we use tools from the world of marketing to promote public enthusiasm for under-appreciated mammal species?” In his presentation, Ewan gave an overview of some of his past work that investigated which species people care about for conservation and why. He showed how big cats are almost universally popular but also how Australians have a unique preference for their own indigenous species. Ewan discussed how tools from the world of

marketing might be applied to improve Mauritian perceptions of bats, and expressed hope that Mauritians might one day feel a similar pride in their own native species as Australians do.

Session 4. Landscape-scale ecology - Chaired by Tigga Kingston

Dr. Vincent Florens (University of Mauritius) presented the results of a study that highlighted the importance of fruit bats as a keystone species in native forest restoration and regeneration. He estimated that a quarter of all native woody species, representing 63% of total forest biomass, are potentially distributed by fruit bats and that around half of those rely exclusively on bats for seed dissemination. Bats are the only extant native species capable of distributing larger seeds and a decrease in native forest is associated with a decrease in native dispersers and an increase in invasive alien species. Bats are also important pollinators of at least 18 native species. Vincent noted that fruit production had not increased after the culls.

Ms. Gabby Krivek (University of Mauritius) presented her MSc research that focussed on forest quality and levels of fruit depredation by bats and monkeys. Native fruit production was up to 3.7 times higher in forest plots that were weeded and evidence of bat foraging was 4.4 times higher in these areas when compared to non-weeded plots. The presence of monkeys in an area appeared to discourage foraging by bats. Bats prefer ripe fruit whilst monkeys will consume unripe fruits.

Mr. Raphael Reinegger (ERA and University of Bristol) introduced his MSc research work that focuses on the competition between bats and monkeys and the effects of wild boar and deer exclusion on seedling establishment.

Ms Houshna Naujeer (NPCS) presented the findings of the navigation study on Mauritius fruit bats from 2014 and 2016. She elaborated on the cyclic movement pattern of bats migrating from the south to the north in summer and vice versa as observed from data collected on bats movement through GPS tags (provided by Microwave Telemetry USA to MWF). Houshna further stated that there are other research projects in the pipeline that would study the cognitive behaviour of this endemic mammal. The study will be conducted by Dr. Ryszard Oleksy and coordinated by the NPCS using new GPS tracking devices (University of Tel Aviv) that will record positions much more frequently. Such study would provide more robust details on the movement and behaviour of young bats in the wild and also indicate on the cognitive abilities of young pups.



Figure 1 Workshop participants identifying priority research questions

Identification of knowledge gaps and research questions

The rest of the workshop was facilitated by Dr. Claire Raisin of Chester Zoo and for the remainder of the first day participants were asked to identify potential knowledge gaps and areas of research interest. These suggestions were collated and subsequently grouped under four broad themes in order to better facilitate the collective identification of specific research questions:

- 1) Biology and ecology
- 2) Economics
- 3) Social/human dimensions
- 4) Damage

Day 2 – Formulating and prioritising themed research questions

Morning session

Participants were randomly divided into three working groups of 6-8 people, tasked with identifying specific research questions based on the ideas and broad themes identified during the first day. Groups were asked to spend 45 minutes considering each of the four themes and to formulate specific questions associated with them. This resulted in three lists of questions for each research topic. These lists were then combined in order to remove any duplication and the questions were reworded in order to capture variation among the groups.

Afternoon session

Participants were asked to comment on the newly worded questions and these were edited and refined accordingly. In order to prioritise the questions in each theme, participants were given two votes and given the opportunity to collectively vote for the questions they perceived to be the most important. The three questions from each research theme that scored the highest number of votes were selected to represent a combined priority list. Once again, any duplication was removed (some questions appeared in more than one theme) and a final list was produced (Table 1). A complete list of questions identified can be found in Appendix II.

Table 1. Priority research questions

How does the availability of both exotic and native fruit drive dietary preferences of Mauritius fruit bats?

To include studies on temporal patterns of diet, phenology, the impact of forest restoration and a nutritional assessment of food types.

How does weather and climate affect the bats' diet and food availability?

What are the impacts of controlling macaques on native fruit production and fauna?

What is the level of 'offtake' of Mauritius fruit bats?

To include studies on deaths caused by persecution, electrocution, illegal hunting and entanglement in nets.

How does pruning and fruit tree management affect yield and income?

What lessons can we learn by creating a 'model' orchard?

How do we characterise and change stakeholder perceptions of fruit bats in Mauritius?

To include social marketing methodology to assess/improve perceptions/values

To include embracing/working with the media to generate positive news

What are the political interactions that influence the process/decision making?

How does netting and other deterrents affect the movement of Mauritius fruit bats?

What is the economic value of ecosystem services provided by Mauritius fruit bats?

What is the potential for green-labelling/certification of Mauritius fruit bat friendly products?

To include an evaluation of export markets and growth potential.

Visit to bat roost

To sum up the two day workshop, a field visit was organised by NPCS to visit a bat roost located at Mare aux Songes pilgrims in the Lower Black River Gorges National Park. Participants had the opportunity to see first-hand, a large roost numbering ~1000 bats as they began their evening foraging trips. This was a valuable exercise and demonstrated to the group the difficulty of counting bats. The closing remarks were delivered by Deputy Director Mr. Kevin Ruhomaun to participants gathered at the visitor centre in the Lower Black River Gorges after discussion on the observation of the bats in the roosting site at BRGNP. The Deputy Director also invited participants for a light evening meal as vote of thanks to participants.

Next steps

The next step in this process is to produce a comprehensive and interdisciplinary national research strategy that outlines these key research topics and priorities areas whilst placing them into the context of national biodiversity and agricultural strategies and policies.

Meanwhile, a third stakeholder meeting is planned for early 2019, in which the aim will be to bring together a further cross-section of the Mauritian population, this time to focus on the general public, the tourism sector, the media, and others who are affected by, and influence, the discourse and decision-making around Mauritius fruit bats. It is recognised that the fruit bat 'problem' is not limited to orchards and there are very strong public opinions regardless of the damage that is caused to fruit. This neutrally facilitated meeting will see members of the popular press and other media outlets together with members of the public, backyard tree owners and other interested parties join together to discuss their issues and potential resolutions.

July 2019 will see the 18th International Bat Research Conference hosted in Phuket, Thailand. It is anticipated that participants from the Mauritius meeting will attend this conference to share the results and outputs from this whole process with the wider community.

Appendix I. List of attendees and contact details

Organisation	Position	Title	Name	Email
Mauritian Wildlife Foundation (MWF)	Conservation Director	Mr.	Vikash Tatayah	vtatayah@mauritian-wildlife.org
Mauritian Wildlife Foundation (MWF)	Scientific Director	Prof.	Carl Jones	carlgjones@btinternet.com
Ministry of Agro-food Security	Deputy Permanent Secretary	Ms.	C. Jhowry	cjhowry@govmu.org
Ministry of Agro-food Security	Assistant Permanent Secretary	Mr.	Nizam Jurawon	ajurawon@govmu.org
National Parks and Conservation Services (NPCS)	Deputy Director	Mr.	Kevin Ruhomaun	kruhonmaunster@gmail.com
National Parks and Conservation Services (NPCS)	Science Officer	Ms.	Houshna Naujeer	naujeerhb@gmail.com
National Parks and Conservation Services (NPCS)	Senior Technical Officer Conservation	Ms.	Shoma Sauba	varsharai08@gmail.com
National Parks and Conservation Services (NPCS)	Ag. SO Conservation	Ms.	Aradna Goury	bgoury@gmail.com
National Parks and Conservation Services (NPCS)	Senior Park Ranger	Mr.	Paul Moolee	
National Parks and Conservation Services (NPCS)	Assistant Park Ranger (Fauna)	Mr.	Feroz Jeetun	ferozejeetun@gmail.com
National Parks and Conservation Services (NPCS)	Park Ranger	Mr.	R. Jumoorty	
Animal welfare group		Ms.	Meera Appadoo	appadoo.meera@gmail.com
Small Planters Association		Mr.	T. Dowlut	sunghoon1108@gmail.com
Small Planters Association		Ms.	P. Dowlut	
University of Mauritius, Faculty of Science	Associate Professor	Dr.	Vincent Florens	v.florens@gmail.com
University of Mauritius	Lecturer	Mr.	V. Bhoyroo	v.bhoyroo@uom.ac.mu
Norwegian University of Life Sciences, University of Mauritius.	MSc student	Ms.	Gabby Krivek	krivek.g@gmail.com
Food and Agricultural Research Extension Institute (FAREI)	Research Scientist	Mr.	V. Dooblad	entomology@farei.mu
Food and Agricultural Research Extension Institute (FAREI)	Senior Extension Officer	Mr.	R. Shimadry	rajivshimadrys@gmail.com
Chester Zoo	Conservation Scientist	Dr.	Simon Tollington	s.tollington@chesterzoo.org
IUCN SSC Human-Wildlife Conflict Task Force / Chester Zoo	Chair, IUCN SSC HWCTF	Dr.	Alex Zimmermann	a.zimmermann@chesterzoo.org
Chester Zoo	Field Programme Coordinator	Dr.	Claire Raisin	c.raisin@chesterzoo.org
Saïd Business School, Oxford/Chester Zoo	Post-doctoral Researcher	Dr.	Ewan Macdonald	ewan.macdonald@zoo.ox.ac.uk
IUCN SSC Bat Specialist Group	Co-Chair IUCN SSC Bat SG	Dr.	Tigga Kingston	tigga.kingston@ttu.edu
Independent (formerly-FAREI)		Mrs.	Ramburn	nirmala.ramburn@gmail.com
Casella	Chief Vet	Ms.	Marie Claire Domaingue	MarieClaireD@caselapark.com
Casella	Head Keeper	Mr.	Paul Ricardo	ricardopa@caselapark.com
Livestock and Veterinary Services	Veterinary Officer	Mrs.	L. Ramprogus	sweetey_lk@yahoo.com
Ecosystem Restoration Alliance	Project Coordinator	Mr.	Laurent Ayady	layady@eraindianocean.org
Organisation	Position	Title	Name	Email
Ecosystem Restoration Alliance	Conservation Biologist	Mr.	Raphael Reinegger	raphael_reinegger@hotmail.com

Forestry Service	FCEO	Mr.	R. Jeebun	rajeevjeebun@gmail.com
Mauritius Society for Animal Welfare (MSAW)	Operations Superintendent	Mr.	T. Ramdin	adminmsaw@intnet.mu
Ministry of Environment	Environment Officer	Ms.	S. Dewan	sdewan@govmu.org

Appendix II. Full list of themed research questions identified.

Biology and Ecology

1. How does availability of fruit (native and exotic) drive dietary preferences of MFB? (temporal patterns, phenology, impact of restoration). Nutritional quality assessment.
2. What is the health status of the MFB population (ecotoxicology, disease, fitness and how it changes over time)?
3. What are the immediate population impacts of cyclones (direct impacts)?
4. Do bats adapt to/learn from deterrents and disturbance?
5. What is the rate & determinants of secondary mortality due to persecution, electrocution etc.
 - What is the annual level of illegal hunting?
6. What are the basic life history parameters of MFB and how does it affect population dynamics and temporal trends?
 - Standardised methods
7. Will MFBs eat decoy fruits?
8. How does netting and other deterrents affect MFB movement?
9. How does weather and climate affect feeding and roost choice?

Economics

1. What is the economic value of ecosystem services provided by MFB?
2. Are there economic benefits of having MFBs? Eco-tourism?
3. What is the potential for green-labelling/certification of MFB friendly products/fruit? (Export)
4. What are the financial gains of using nets in orchards and backyards (ROI, CBA)?
5. Are there alternative crops/varieties (i.e. dwarf) that are economically viable and less likely to be depredated by MFBs?
6. What is rate and impact of non-MFB damage?
7. What are the market dynamics of backyard fruit production and orchard production? Do they differ?
8. What is the export market potential?
9. How does pruning and fruit tree management affect yield and income?

Social/human dimensions

1. **How do we characterise and change stakeholder perceptions of MFB in Mauritius**
2. **What are the political interactions that influence the process/decision making?**
3. What are the barriers to law enforcement?
4. What are the barriers to implementing fruit tree management guidelines?
5. What do tourists/tour operators think about MFBs and MFB eco-tourism opportunities? What is the potential for bat-based eco-tourism?
6. What is the impact of current education/awareness efforts? How can they be increased?
7. **How can we use social marketing improve public perceptions/values of MFB?**
8. Could integrating bat education into curriculum change behaviour?
9. **How do we embrace the media and generate/drive positive news? (Work constructively with the media)?**

Damage

1. What is rate and impact of non-MFB damage?
2. **How does weather and climate affect MFB diet?**
3. What are unintended consequences of netting?
4. Can we generate a standardised damage assessment method?
5. **What are the consequences of controlling macaque on native fruit production and native fauna?**
6. **What are impacts of orchard/tree management on yield?**
7. What are the barriers to growers implementing management/protection?
8. What effective alternative management practices and deterrents (i.e. repellents) are there?
9. How do we disseminate good practice?