

Seawater ingestion by the Mauritius flying fox

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1 | INTRODUCTION

Mauritius (centred around 20° 20' S; 57° 34' E; area 1,865 km²; 828 m maximum elevation) is a 7.8-million-year old volcanic island with moist-to-wet tropical climate, located around 900 km east of Madagascar in the Indian Ocean. Anthropogenic impacts started shortly before human colonisation in 1638, which itself led to the island becoming one of the most ecologically devastated worldwide (Cheke & Hume, 2008; Florens, 2013; Hammond et al., 2015).

Flying foxes face threats mainly from hunting, natural habitat transformation, invasive alien species and climate change (Vincenot, Florens, & Kingston, 2017) which is likely to increase the occurrence and intensity of stochastic events such as cyclones (Elsner, Kossin, & Jagger, 2008; Kishtawal, Jaiswal, Singh, & Niyogi, 2012; Kuleshov, Qi, Fawcett, & Jones, 2008; Webster, Holland, Curry, & Chang, 2005). In Mauritius, invasive alien species largely contribute to declining native foraging habitat quality of the 'Endangered' Mauritius flying fox (*Pteropus niger*) (Cheke & Hume, 2008; Krivek, Florens, Baider, Seegobin, & Haugaasen, 2020). Furthermore, cyclones accompanied with heavy rainfalls and gusts (around 100 km/hr) previously caused 60% cultivated fruit loss in Mauritius (Anon., 2012, 2015), potentially exacerbating fruit availability for species like *P. niger* (McConkey, Drake, Franklin, & Tonga, 2004; Soto-Centeno & Kurta, 2006).

Other flying fox species in Comoros, Papua New Guinea and Philippines are known to skim over the sea before licking their fur to obtain minerals absent from their frugivorous diet (Iudica & Bonaccorso, 2003; Probst & Winter, 1993; Stier, 2003). However, Thomas (1984) suggested that obligate frugivorous bats adjust nutrient demands by varying amounts of eaten fruits. In Australia, *Pteropus poliocephalus* frequently body dips in freshwater during days of high temperature for cooling and rehydration (Rakotopare & Abhaya, 2019).

2 | METHODS

Eight afternoon kayak expeditions were conducted over three weeks between February and beginning of April 2018 in the lagoon of Pointe d'Esny, Blue Bay and from the beach (located at 20° 26' 41.56" S; 57° 42' 21.25" E). More observations were made in the bay of Mahebourg (20° 24' 50.54" S; 57° 42' 40.60" E) and La Cambuse (20° 27' 26.67" S; 57° 41' 38.04" E) in February 2019. A Nikon D3200 DSLR camera and Sigma 100 – 300 mm telephoto lens were used to photograph observations.

3 | RESULTS

The first observation was made in February 2018 in the lagoon of Pointe d'Esny at around 200 m from the coast. A Mauritius flying fox slowly approached the water surface, within 50 m from our position, and after several attempts clumsily succeeded in dipping its lower belly part into the water and immediately licked its wet fur before flying towards the mainland (Figure 1). Three similar observations were made the next day and fifteen in total over eleven days. Most observations occurred within five weeks following heavy rainfall in January (794 mm) (Statistics Mauritius, 2018) and cyclonic conditions with gusts of 120 km/hr (reliefweb, 2018) and after another cyclone in mid-February 2019. Each observation lasted around fifteen seconds, sometimes occurring on cloudy and rainy days, between February and beginning of April, during temperature averaging 25°C, minimal wind and calm sea conditions, and between 15:00 and 19:00. Similar dipping behaviour throughout the year remains possible although not reported.

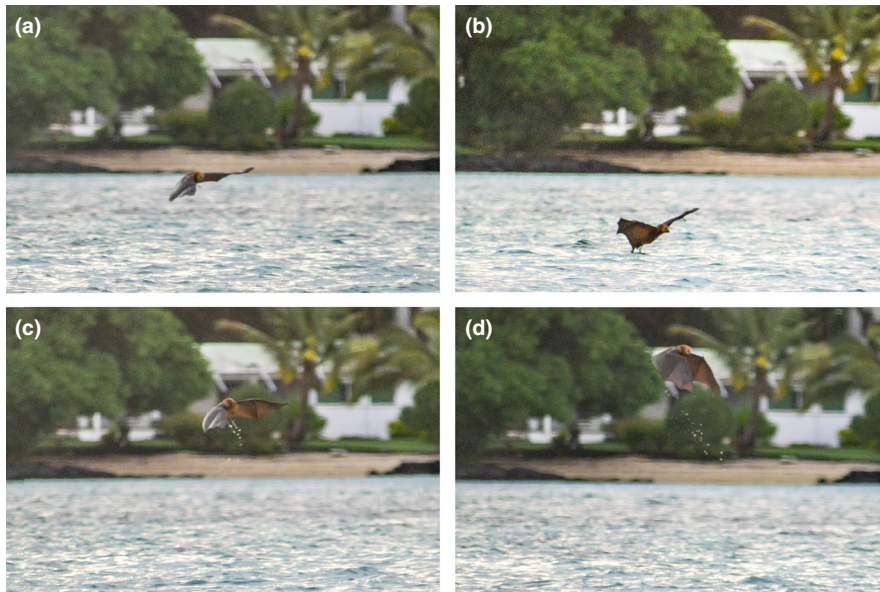


FIGURE 1 (a) A Mauritius flying fox approaching the seawater surface, (b) dipping its lower body part into it and (c) licking the salty water from its wet fur before (d) flying back to the mainland

4 | DISCUSSION

Frugivorous species commonly lack certain minerals like sodium and iron (Stier, 2003; Studier, Sevick, Ridley, & Wilson, 1994) and often compensate through salt licking (Iudica & Bonaccorso, 2003; Klaus & Schmid, 1998). However, environmental factors such as strong cyclonic winds, rainfall and temperature may influence availability (Grant, Craig, & Trail, 1997; Karr, 1976; Remis, 1997) and quality of fruits (Sams, 1999; Worman & Chapman, 2005), altering feeding habits (Elangovan, Marimuthu, & Kunz, 1999; Kunz & Fenton, 2005; Raghuram, Singaravelan, Nathan, & Emmanuel, 2011).

Stochastic events like cyclones and torrential rainfall (794 mm in January 2018 compared to 146 and 185 mm for January 2017 and 2016, respectively (Statistics Mauritius, 2018)), potentially reduce foraging possibilities of *Pteropus niger* (Cheke & Dahl, 1981), beyond consequences emanating from native foraging habitat destruction and degradation from alien species invasion (Florens & Baider, 2013; Florens et al., 2016; Florens, Baider, Seegoolam, Zmanay, & Strasberg, 2017). Furthermore, invasive long-tailed macaques population (*Macaca fascicularis*) increased markedly in the last dozen of years and the species is known to consume large numbers of native fruits, thereby depleting fruit resources otherwise available for *P. niger* (Laurance & Peres, 2006). Such situation could prompt flying foxes to explore alternative ways to supplement their diet. However, food scarcity as a driver for seawater ingestion remains uncertain.

Sea water could provide a rich source of sodium and chloride minerals for flying foxes (Stier, 2003). Despite fruit availability, dipping behaviour by *Pteropus niger* might help obtain nutrients that is scarce in consumed fruits. Similar dipping behaviour has been observed in other flying fox species in the Comoros islands by *P. seychellensis comorensis* (Probst & Winter, 1993; Stobb, 1994), in the Philippines by

P. vampyrus and *Acerodon jubatus* (Stier, 2003), in the coastal regions of Papua New Guinea by *P. conspicillatus*, *P. hypomelanus* and *P. toniganus* (Iudica & Bonaccorso, 2003) and suggested to be either for acquiring nutrients, thermoregulation or protecting against parasites.

Other flying fox species were commonly observed body dipping in freshwater during hot periods for cooling and rehydration. *Pteropus poliocephalus* and *P. alecto* have been seen licking their fur after freshwater body dipping (Markus & Blackshaw, 2002; Rakotopare & Abhaya, 2019). Commerson (Buffon, 1783) observed *P. niger*, in Reunion, to occasionally dip their bodies in fresh water. However, these behaviours, triggered by warm temperatures, seemed different from our observations whereby dipping occurred in sea water, late afternoons with temperature averaging 25°C, sometimes on cloudy and rainy days.

5 | CONCLUSION

To our knowledge, this is the first record of seawater ingestion by *Pteropus niger*. Some local people and fishermen who witnessed this behaviour assumed that the species was fish-hunting, causing resentment that could favour its persecution. Our observations can help reduce incorrect beliefs and improve understanding of the feeding behaviour versatility, resilience ability and local adaptation of *P. niger* to particular opportunities within its environment. Additionally, seawater body dipping to protect flying foxes from parasites could potentially be explored.

CONFLICT OF INTEREST

The authors declared that they do not have any potential sources of conflict of interests.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in 'Dryad' at <https://doi.org/10.5061/dryad.1c59zw3rc> (Seegobin, 2019).

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