

The avifauna of Ankobohobo Wetland, a neglected Important Bird Area in northwestern Madagascar

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Summary

We present here the first detailed inventory of the birds of Ankobohobo Wetland in northwest Madagascar, based on data collected annually in June and July 2010–2018. These wetlands consist of a *c.*35 km² area of mangroves and tidal mudflats which were designated as an Important Bird Area (IBA) within the West Malagasy Wetlands Endemic Bird Area (EBA) in 2001. However, recent and detailed information on their avifauna remains lacking. We used a boat to survey three 4 km stretches of the IBA's river system on four repeated occasions each year, supplemented by opportunistic observations made in various parts of the study area. In total, we detected 59 species in Ankobohobo Wetland through *c.*608 h of observation effort. This includes 26 Malagasy endemics, two Near Threatened species, three Endangered species (Malagasy Sacred Ibis *Threskiornis bernieri*, Malagasy Pond Heron *Ardeola idae*, and Humblot's Heron *Ardea humbloti*), and the Critically Endangered Madagascar Fish Eagle *Haliaeetus vociferoides*. These constitute substantial additions to the inventory of the established Ankobohobo Wetland IBA, which previously stood at 19 species including one Malagasy endemic. We summarise these records here, providing additional details for threatened species. We also report observed threats to the wetlands, particularly with regards to the breeding *H. vociferoides* population, and highlight Ankobohobo as an important conservation priority.

Keywords Endemic, *Haliaeetus vociferoides*, Important Bird Area, Inventory, Mangrove

Introduction

Madagascar possesses one of the most irreplaceable yet threatened biotas on Earth (Myers *et al.* 2000; Goodman and Benstead 2005), which for centuries has been a source of fascination for both the international scientific community (e.g. de Flacourt 1658; Grandidier 1887) and oral tradition and local heritage (Burney and Ramilisonina 1999; Jones *et al.* 2008). Over half (53%) of the island's terrestrial breeding birds are endemic (Warren *et al.* 2013), many of which are now threatened with extinction. These threats have become so great as to prompt concerns that the coming years may represent the "last chance" to safeguard the country's unique natural heritage (Jones *et al.* 2019). A key first step towards safeguarding biodiversity is to identify

priority areas in which to focus conservation resources (Brooks *et al.* 2006). BirdLife International's Important Bird and Biodiversity Area (IBA) programme is a highly successful example, shown to drive tangible conservation outcomes (Donald *et al.* 2019; Waliczky *et al.* 2019).

There are 84 IBAs in Madagascar, but several of these have not had follow-up surveys since they were designated and lack complete species inventories. This includes Ankobohobo Wetland (IBA MG022, BirdLife International 2020a), a relatively small IBA encompassing 34.97 km² of mangrove, tidal mudflats, and some sandy beaches. The site is located 80 km northeast of Mahajanga city in the Boeny region of northwestern Madagascar (Fig. 1). Ankobohobo sits between two larger coastal wetland IBAs, Baie de Bombetoka (MG024, 55 km to Ankobohobo's southwest) and the Mahajamba Bay-Anjavavy Complex (MG023, 32 km to the northeast), within the West Malagasy Wetlands Endemic Bird Area (EBA) (ZICOMA 2001). This EBA has been highlighted as being of urgent priority and incomplete knowledge (Stattersfield *et al.* 1998, BirdLife International 2020b). Ankobohobo's IBA designation was based on surveys carried out in 1997, reporting populations of two threatened and biome-restricted species (Endangered Humblot's Heron *Ardea humbloti* and Critically Endangered Madagascan Fish Eagle *Haliaeetus vociferoides*), along with 17 others (BirdLife International 2020a). Other than this, no further information on the site has been published apart from two species-specific reviews of the status of *H. vociferoides* which include data from the IBA (Rabarisoa *et al.* 1997, Razafimanjato *et al.* 2014).

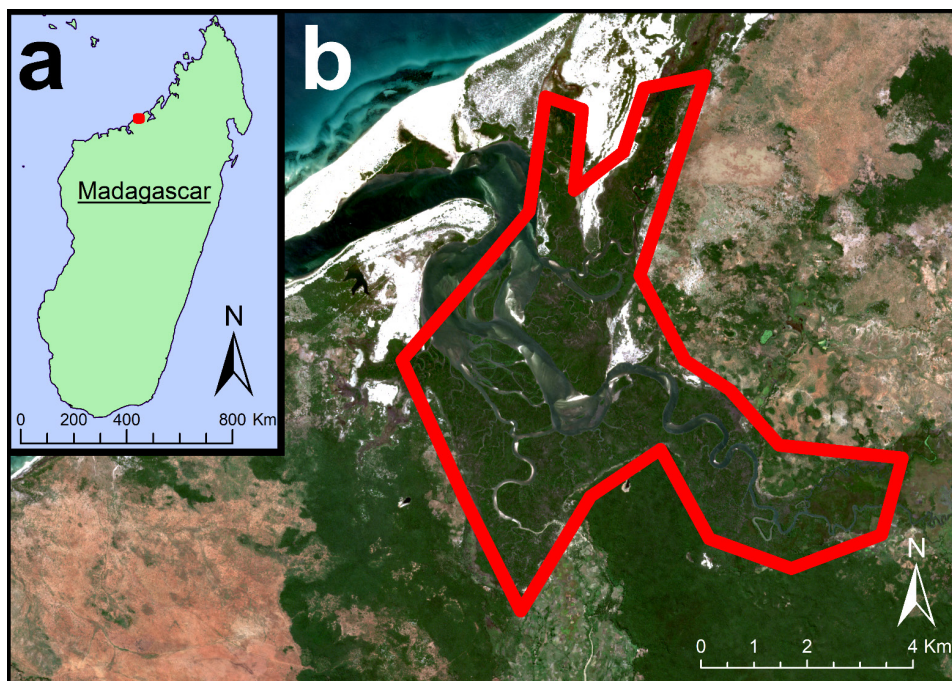


Figure 1. a) Map of Madagascar with the study area marked in red. b) Satellite photo of the study area, with the boundary of the Ankobohobo Wetland IBA shown in red. Created in ArcMap (ESRI 2020) using Copernicus Sentinel-2 imagery (ESA 2020), with IBA boundary data provided by BirdLife International (2020a).

This is an important knowledge gap, as the conservation situation in Ankobohobo, as in Madagascar generally, has deteriorated considerably in the two decades since the site was first gazetted. A disproportionate number of Madagascar's threatened endemic birds rely on wetland ecosystems (Young *et al.* 2014), but Madagascar's mangroves are increasingly threatened by demand for charcoal and *sokay*, a type of lime used to strengthen houses that requires mangrove wood and seashells to produce (Scales *et al.* 2018). Protection of Madagascar's important sites thus depends on further research into how its species are distributed. Palfrey *et al.* (2019) recorded numerous previously undocumented species in the Mariarano forest region adjacent to Ankobohobo, but noted that Ankobohobo would benefit from more intensive exploration. We therefore present here the most detailed information published to date on the avifauna of this globally significant IBA.

Methods

We surveyed the birds of Ankobohobo Wetland between 2010 and 2018, as part of a long-term ecological monitoring programme run in partnership between Operation Wallacea, the Malagasy NGO 'Development and Biodiversity Conservation Action for Madagascar' (DBCAM), the University of Antananarivo, and local community forest management groups. Surveys took place in the dry season over periods of 6–7 weeks between June and August, through semi-structured boat surveys. We conducted these boat surveys on three stretches of the IBA's river system, each 4 km long, each on four repeated occasions per year. These surveys involved recording every bird seen or heard, while travelling in one direction along a set route. We also made incidental opportunistic records in the course of completing ecological research into the local Nile Crocodile *Crocodylus niloticus* population, and through other casual exploration of the study area.

Using records from all our surveys and opportunistic observations, we compiled a full inventory of all species we had detected in Ankobohobo Wetland, following the taxonomy of Gill *et al.* (2020). We obtained the global conservation status of each species from the IUCN (2020), and noted where a species was endemic to the Madagascar biodiversity hotspot as defined by Myers *et al.* (2000). We recorded species as notable range extensions if they were not indicated as occurring in the study area in maps provided in authoritative online resources (BirdLife International and NatureServe 2014, Del Hoyo *et al.* 2020, IUCN 2020) or in three of the region's widely-used ornithological references (Safford & Hawkins 2013, Sinclair & Langrand 2013, Hawkins *et al.* 2015). We also assigned categorical abundance estimates for each species in our inventory based on frequency of observations, following Palfrey *et al.* (2019). Abundant species were those typically recorded multiple times each day in suitable habitat, common species were typically recorded at least once per day, fairly common species were typically recorded about once per week, uncommon species had an average of fewer than five or six records per field season, and rare species were known from fewer than five observations within the study area. We also noted the author who observed each species. Finally, as recommended by Lees *et al.* (2014), we collated all the photographs we had taken of study species within the study area, and uploaded them to the 'Internet Bird Collection' online depository (Lynx Edicions 2020), which has since become part of the Macaulay Library (Cornell Lab of Ornithology 2020). These photos are available at <https://www.macaulaylibrary.org/> using the catalog numbers in Table 1, providing visual verifications for as many species in our inventory as possible.

Results

We recorded 59 species in Ankobohobo Wetland, including 26 endemic species (44% of all species detected), two Near Threatened species, three Endangered species, and one Critically Endangered species. We obtained photographic records for 27 species in our inventory, and a sound recording for one additional species for which we could not obtain a photograph (Madagascan Swamp Warbler *Acrocephalus newtoni*). Table 1 summarizes our findings. The following accounts provide further details on notable records such as endemic and threatened species.

Table 1. Checklist of bird species recorded in Ankobohobo Wetland between 2010 and 2018. All taxonomy follows Gill *et al.* (2020). Species marked * are endemic to the Madagascar biodiversity hotspot as defined by Myers *et al.* (2000). Species marked † are assessed as threatened or near threatened by the IUCN (2020). Species marked (I) are introduced to the study area. Abundance estimates are denoted as follows: A = abundant; C = common; Fc = fairly common; U = uncommon; R = rare. Initials in the ‘observers’ column indicate authors possessing records of each species. Species which have been observed by three or more authors are notated ‘multiple’. FÓM is Fionn Ó Marcaigh, BAR is Bruno Andriandraotomalaza Raveloson, JN is Jamie Neaves, and JB is Jack Baddams. Catalogue Numbers correspond to photographs and sound recordings from this study available on the Macaulay Library (Cornell Lab of Ornithology 2020).

Common name	Scientific name	Abundance	Observers	Catalog No.
White-faced Whistling Duck	<i>Dendrocygna viduata</i>	R	FÓM	
Knob-billed Duck	<i>Sarkidiornis melanotos</i>	R	FÓM	
Lesser Flamingo†	<i>Phoeniconaias minor</i>	R	BAR	
Reed Cormorant	<i>Microcarbo africanus</i>	U	BAR, JN	ML712311
African Openbill	<i>Anastomus lamelligerus</i>	R	BAR	ML712312
Malagasy Sacred Ibis*†	<i>Threskiornis bernieri</i>	R	BAR	ML712310
African Spoonbill	<i>Platalea alba</i>	U	BAR, JN	ML712305
Little Bittern	<i>Ixobrychus minutus</i>	R	BAR, JN	
Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	Fc	Multiple	ML204695631
Striated Heron	<i>Butorides striata</i>	Fc	Multiple	ML204678131
Squacco Heron	<i>Ardeola ralloides</i>	U	BAR, JN	
Malagasy Pond Heron*†	<i>Ardeola idae</i>	R	JN	ML712380
Grey Heron	<i>Ardea cinerea</i>	Fc	BAR, JN	ML712379
Humboldt's Heron*†	<i>Ardea humbloti</i>	R	BAR	
Purple Heron	<i>Ardea purpurea</i>	Fc	Multiple	ML204678081
Great Egret	<i>Ardea alba</i>	Fc	Multiple	ML713014
Black Heron	<i>Egretta ardesiaca</i>	U	BAR, JB	ML204695731
Dimorphic Egret*	<i>Egretta dimorpha</i>	C	Multiple	ML204695781
African Darter	<i>Anhinga rufa</i>	U	Multiple	ML204695601
Madagascan Harrier-Hawk*	<i>Polyboroides radiatus</i>	R	JB	ML204678271
Black Kite	<i>Milvus migrans</i>	R	FÓM	ML713003
Madagascan Fish Eagle*†	<i>Haliaeetus vociferoides</i>	U	Multiple	ML712309
Madagascan Buzzard*	<i>Buteo brachypterus</i>	R	FÓM	ML713004
Bat Hawk	<i>Macheiramphus alcinus</i>	R	JN	
White-throated Rail*	<i>Dryolimnas cuvieri</i>	C	Multiple	ML204678251
Common Moorhen	<i>Gallinula chloropus</i>	Fc	FÓM	ML713009
Crab-plover	<i>Dromas ardeola</i>	R	BAR	
Common Ringed Plover	<i>Charadrius hiaticula</i>	U	BAR	
White-fronted Plover	<i>Charadrius marginatus</i>	U	BAR	

Common name	Scientific name	Abundance	Observers	Catalog No.
Eurasian Whimbrel	<i>Numenius phaeopus</i>	Fc	BAR, JN	
Curlew Sandpiper†	<i>Calidris ferruginea</i>	Fc	BAR	
Sanderling	<i>Calidris alba</i>	U	BAR	
Terek Sandpiper	<i>Xenus cinereus</i>	Fc	BAR	
Common Sandpiper	<i>Actitis hypoleucos</i>	Fc	Multiple	ML204695741
Common Greenshank	<i>Tringa nebularia</i>	Fc	BAR, JN	
Lesser Crested Tern	<i>Thalasseus bengalensis</i>	Fc	BAR	
Malagasy Turtle Dove*	<i>Nesoenas picturatus</i>	R	FÓM	
Namaqua Dove	<i>Oena capensis</i>	R	FÓM	ML713015
Malagasy Coucal*	<i>Centropus toulou</i>	R	FÓM	
Western Barn Owl	<i>Tyto alba</i>	R	JN	
Madagascan Nighthjar*	<i>Caprimulgus madagascariensis</i>	Fc	JN	
Malagasy Black Swift*	<i>Apus balstoni</i>	R	FÓM	
Malagasy Kingfisher*	<i>Corythornis vintsioides</i>	C	Multiple	ML713010
Olive Bee-eater	<i>Merops superciliosus</i>	C	JN, FÓM	ML713012
Malagasy Kestrel*	<i>Falco newtoni</i>	R	FÓM	ML713008
Lesser Vasa Parrot*	<i>Coracopsis nigra</i>	Fc	JN, FÓM	ML713013
Grey-headed Lovebird*	<i>Agapornis canus</i>	R	FÓM	
White-headed Vanga*	<i>Artamella viridis</i>	R	FÓM	
Crested Drongo*	<i>Dicrurus forficatus</i>	C	JN, FÓM	ML713011
Malagasy Paradise Flycatcher*	<i>Terpsiphone mutata</i>	C	JN, FÓM	
Pied Crow	<i>Corvus albus</i>	R	FÓM	ML713007
Malagasy Bulbul*	<i>Hypsipetes madagascariensis</i>	R	FÓM	
Madagascan Swamp Warbler*	<i>Acrocephalus newtoni</i>	Fc	BAR, JB	ML203945641
Common Jery*	<i>Neomixis tenella</i>	R	FÓM	
Common Myna (I)	<i>Acridotheres tristis</i>	R	FÓM	
Madagascan Starling*	<i>Hartlaubius auratus</i>	R	FÓM	
Souimanga Sunbird*	<i>Cinnyris sovimanga</i>	R	FÓM	
Madagascan Mannikin*	<i>Lepidopygia nana</i>	U	FÓM	
Madagascan Wagtail*	<i>Motacilla flaviventris</i>	Fc	JN, FÓM	

Malagasy Sacred Ibis *Threskiornis bernieri* – Endangered

A rare resident. Singles and pairs were observed several times by BAR on sandbanks alongside mangrove-fringed channels in 2011 and 2013 (Fig. 2). The presence of this species here is not unexpected, given known distributions suggest a theoretical occurrence in suitable habitat anywhere on the west coast of Madagascar, and particularly as this section of coast corresponds to the core part of its range (Safford & Hawkins 2013). However, it has not been explicitly reported from Ankobohobo Wetland previously, being absent from the IBA summary for this site (BirdLife International 2020a).



Figure 2. Malagasy Sacred Ibis *Threskiornis bernieri* (photo: Bruno A. Raveloson).

This species has experienced a rapid population decline of over 20% in the last 16 years. The current global population estimate is 1500–1850 birds, which is expected to decline further due to harvesting of eggs, disturbance of nesting sites, and the degradation of wetland habitats in Madagascar (BirdLife International 2020c). Ankobohobo represents an important portion of the wetland habitat that must be protected if this species is to be conserved.

Malagasy Pond Heron *Ardeola idae* – Endangered



Figure 3. Malagasy Pond Heron *Ardeola idae* (photo: Jamie Neaves).

A rare migrant. We have occasionally observed single individuals on sandbanks along mangrove-fringed channels (Fig. 3). The species has a widespread but small population throughout Madagascar, where it breeds in the austral summer between October and March (BirdLife International 2020d). The population of this species has declined substantially in recent decades due to habitat destruction and exploitation at breeding sites (Rabarisoa *et al.* 2020), and the global population is now estimated at just 1100 breeding birds. The species winters

on the mainland of East Africa between May and September, but our photograph (ML712380) provides rare documentation of an individual remaining in the breeding range during that time. Wintering records of the species in the adjacent Mariarano forest region have also been reported (Palfrey *et al.* 2019). Rabarisoa *et al.* (2020) recorded 911 instances of this species remaining in Madagascar during the austral winter, but a search of literature and eBird records revealed few other photographs documenting birds in winter plumage in Madagascar. Rabarisoa *et al.* (2020) found western habitats to be particularly important for this species, highlighting the need to protect sites such as Ankobohobo.

Humblot's Heron *Ardea humbloti* – Endangered

A rare resident. Single individuals have occasionally been observed by BAR on sandbanks of mangrove-fringed channels and on coastal beaches. The presence of this species in Ankobohobo has been reported previously (BirdLife International 2020a).

Lesser Flamingo *Phoeniconaias minor* – Near Threatened

A rare visitor to the wetland. BAR observed two individuals in 2011 on a coastal beach on the fringes of Ankobohobo.

Madagascan Starling *Hartlaubius auratus* – Least Concern

A rare visitor to the wetland. A small flock was observed by FÓM above the wetland's main river system in 2018. Usually a bird of forests and shrublands (Safford &

Hawkins 2013), its presence in Ankobohobo likely results from the proximity to the Mariarano Forest, where it was recorded by Palfrey *et al.* (2019).

Madagascan Fish Eagle *Haliaeetus vociferoides* – Critically Endangered

An uncommon resident. Occasionally recorded within the study area (Fig. 4), where a few pairs have been known to nest in tall mangrove trees (BirdLife International 2020a). The maximum number of individuals we observed at a single time was three birds: a breeding pair and one chick. An image providing evidence of breeding can be found in our photographic inventory (ML712417, Fig. 5). The species was observed breeding at this location annually between 2010 and 2017. Individuals have also occasionally been seen passing over the wetlands of the adjoining Mariarano Forest, but they have not been observed to breed there (Palfrey *et al.* 2019). Our observations show that the *H. vociferoides* population in Ankobohobo, while small, is certainly larger than indicated by the last two reviews of the status of this species. Rabarisoa *et al.* (1997) reported only a single bird in Ankobohobo, while Razafimanjato *et al.* (2014) did not represent the species as still persisting here at all. We expect the population size here to be broadly in line with that of the initial IBA assessment of 2–3 breeding pairs (BirdLife International 2020a). There are only an estimated 240 individuals of this species remaining globally (BirdLife International 2020e), marking this Ankobohobo population as significant. However, this population may now be under severe threat. In 2013 the nesting trees where the eagles consistently bred showed signs of human damage, although whether this was due to firewood collection or a deliberate act of persecution remains unclear. As a matter of greater concern, a visit to Ankobohobo on 25 June 2018 by JN revealed that these nesting trees had been completely destroyed, and that deforestation for charcoal production was much more apparent in the area than in previous survey seasons. The 2018 survey season was the first year since 2010 where no breeding birds were recorded, though sub-adult and adult individuals were still observed. These recent disturbances raise serious concerns regarding the future conservation status of the species here.



Figure 4. Madagascan Fish Eagle *Haliaeetus vociferoides* (photo: Jamie Neaves).



Figure 5. Breeding *Haliaeetus vociferoides* (photo: Jamie Neaves).

Discussion

Globally, wetlands are crucial for biodiversity and for humanity, but their protection requires effective governance and better data (Amano *et al.* 2018). Mangroves in particular provide enormous ecosystem services, but may be functionally extinct within 100 years (Polidoro *et al.* 2010). Our surveys in the mangroves of Ankobohobo Wetland have yielded valuable records that boost the known biological value of this IBA. Where previous surveys had recorded 19 species, our records add a further 40, including 25 more endemic species and five that are Threatened or Near-Threatened, thus greatly improving knowledge of the site. The 59 species and 44% endemism rate reported here compare with 95 species and a 66.3% endemism rate in the adjacent Mariarano Forest landscape (Palfrey *et al.* 2019). Lower diversity and endemism are to be expected in Ankobohobo given that it is a smaller and more homogenous area, and a wetland rather than a forest, but our results still highlight its diversity as being of regional importance. Aside from the presence of endemic and globally threatened species here, this relatively small habitat fragment has been shown to support a significant proportion of the region's bird species, as the 59 species reported here represent over a third (35%) of the 168 non-vagrant species known to occur in western Madagascar (Safford & Hawkins 2013). If the boundaries of the Ankobohobo IBA were extended to encompass the Mariarano Forest, then this larger IBA would contain substantially more threatened and range-restricted bird species and greater habitat diversity, and would still be viable for conservation as one unit due to its well-defined and relatively small area. Sites have been similarly combined into complexes elsewhere in western Madagascar, including in the neighbouring Mahajamba Bay – Anjavavy Complex. In addition to its birds, Ankobohobo supports populations of other threatened taxa, for example a roost of approximately 500 Madagascar Flying Fox *Pteropus rufus*, which is considered Vulnerable by the IUCN (2020). The site is also utilized by troops of the Endangered Coquerel's Sifaka *Propithecus coquereli*, a lemur. Thus, if the two sites were combined as one Ankobohobo–Mariarano Complex, this might warrant additional designation, perhaps under the IUCN's Key Biodiversity Area scheme. The long-term monitoring scheme that gave rise to this study could provide data to assess such proposals. Alternatively, as Mariarano and Ankobohobo represent quite different ecosystems, with each supporting different IBA/KBA trigger species, they are also capable of meeting the criteria for these designations independently. Two IBAs in different habitats within a small area would emphasize this region's ecological richness and diversity. Therefore, we recommend that one or other of these approaches be followed, recognizing the international importance of both Ankobohobo and Mariarano so that legal protection may follow.

Our results have highlighted that the Ankobohobo IBA faces severe environmental pressures. The most significant of these concerns, the destruction of *H. vociferoides* nesting sites, but general deforestation (particularly associated with charcoal burning) has been frequently observed here, particularly around the area's periphery. Urgent conservation actions are therefore needed to safeguard the future of the site, and it is likely that the IBA designation alone is not sufficient to provide meaningful protection. Conservation interventions such as community education to highlight the importance of the *H. vociferoides* population, and provision of alternate means of fuel to mitigate deforestation, are recommended.

Decades after the designation of the Ankobohobo Wetland IBA, and centuries after the rich natural heritage of Madagascar began to be formally described, detailed species inventories are still needed for the adequate understanding and protection of the truly remarkable Malagasy wetlands. Such shortfalls in knowledge are a continuing issue with respect to nature conservation in Madagascar and around the world (de Lima *et al.* 2011, Pino-Del-Carpio *et al.* 2014). Malagasy poet Jean-Joseph Rabearivelo used an image of a bird “falling with the night” (Rabearivelo 1934), which may reflect the future of Madagascar’s birds without adequate knowledge and protection.

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