

is associated mainly with inland freshwater wetlands, particularly margins of streams and rivers, muddy ponds in open country, wet rice fields, and artificial lakes; it is not normally found on open coastlines but does use saline habitat at the edges of salt marshes, estuaries, or brackish inland lakes. The distinctive endemic race *C. t. bifrontatus* is widespread on Madagascar, although habitat for it is limited in the dry south and southwest, and it is largely absent from the Central Highlands. The species has not been studied in detail on Madagascar but behaviorally appears to be a typical small *Charadrius* (Appert 1971; Zefania and Székely 2013d).

Three more *Charadrius* species visit Madagascar's coastal wetlands as migrants from the Palearctic region: *C. hiaticula* (Common Ringed-plover); *C. leschenaultii* (Greater Sand-plover); and *C. mongolus* (Lesser Sand-plover) (see Young et al., pp. 1627–36). The latter two are difficult to distinguish, making their status somewhat uncertain, but all appear to be fairly common wherever appropriate sandy and muddy habitats, often intertidal, are found.

Subject editors: Roger J. Safford and Steven M. Goodman

JACANIDAE: ACTOPHILORNIS ALBINUCHA, MADAGASCAR JACANA, TSIKIRANTA, PIRITRY

J. D'Urban Jackson, S. Zefania, and T. Székely

Actophilornis albinucha (Madagascar Jacana) is endemic to Madagascar and distributed in freshwater wetlands in the west and north, mainly in lowland areas. It is found in wetlands with floating vegetation such as water lilies (*Nymphaea stellata* and *N. lotus*, family Nymphaeaceae) and also in lakes with the invasive water hyacinth (*Eichhornia crassipes*, family Pontederiaceae). This bird species occurs in natural and human-modified wetland habitats such as rice paddies, although the relative importance of these habitat types for the long-term persistence of *A. albinucha* is not known.

A recently published molecular phylogeny of extant Jacanidae species using mtDNA fragments indicates that *A. albinucha* is a sister species of *A. africanus* (African Jacana) (D'Urban Jackson et al. 2019). These species are the only two in the genus *Actophilornis*. No subspecies have been recognized for *A. albinucha*.

PLUMAGE AND SEXUAL SIZE DIMORPHISM

Adults of both sexes have a predominantly chestnut-brown back, belly, breast, and wings; white, black, or piebald (see below) hind neck and hind crown; and black underside of neck, with a pale blue frontal shield. Upper tail coverts can be white, rufous brown, or anything in between, and the middle tail feathers are black. The neck plumage is variable among adults: some individuals have almost entirely black necks with only white speckles on the hind neck, whereas others show a clear contrast between the black fore neck and largely white hind neck; some birds with white hind necks show golden plumage at the base of this area. Birds with more white on the hind neck, including golden coloration, tend to also have more white on the upper tail coverts; Figure 13.21 shows such a bird. Studies based on marked individuals through time have not been carried out, but this variation is thought to be age related (Safford 2013q; D'Urban Jackson et al. 2019). The legs and toes are gray to almost blackish,



FIGURE 13.21 *Actophilornis albinucha* (Madagascar Jacana) adult walking on lily pads (*Nymphaea stellata*), Lake Sariaka, Baly Bay protected area. (PHOTO by L.-A. Rene de Roland.)

and toes are elongated, enabling these birds to walk across floating vegetation. Local people report that individuals undergo a simultaneous molt of primary feathers, making them flightless, during which time they swim when disturbed or avoiding predators.

Actophilornis albinucha displays reversed sexual size dimorphism, with females significantly larger than males. The following measurements are based on a sample of 13 females and 22 males unless stated

otherwise, and the sex of each individual has been confirmed with molecular methods (D'Urban Jackson et al. 2019): mass of females 240–285 g (266.2 g, $n = 4$), males 145–185 g (166.6 g, $n = 8$); tarsus length of females 64.3–80.1 mm (72.5 mm), males 62.7–71.02 mm (66.8 mm); wing length of females 180–190 mm (185.7 mm, $n = 12$), males 139–167 mm (161 mm); and shield length of females 46–58.8 mm (54.3 mm), males 47.3–54.7 mm (50.5 mm).

Immatures and juveniles have buffy plumage with the neck plumage colors reversed (black hind neck and hind crown and white underside). They have white cheeks with a black stripe from the beak across the eye to the hind crown, and a small gray shield. Their legs and toes are gray as in adults. During this life stage, their plumage is curiously similar to that of adult *A. africanus*, which in the distant past even led to erroneous reports of the latter species on Madagascar (Milne Edwards and Grandidier 1879–1885).

DISTRIBUTION AND POPULATION DENSITY

Recent surveys have found jacanas as far south as Lake Ihotry, at different localities toward the north, and in the northeast as far as Lake Sahaka (D'Urban Jackson et al. 2019). The surveys indicated that the distribution of this species is patchy. It was found at 22 of the 54 surveyed lakes, presumably reflecting the presence of suitable wetlands. Four of the 22 lakes with this species were east of the recently documented range by up to 113 km. In lakes where *A. albinucha* occurred, density was found to be on average 3.5 ± 0.74 individuals/ha. Repeated wetland bird surveys around Lake Mandrozo suggest that this area is a stronghold for this species, with 78–127 birds recorded between 2009 and 2015 (Razafimanjato et al. 2015). In addition, 80 individuals, together with a large diversity of wetland birds, were found in the Ambonara wetlands in the extreme south of the Boeny Region during wetland bird surveys in 2017 (Bamford et al. 2017).

Wetland bird surveys conducted by the Durrell Wildlife Conservation Trust and The Peregrine Fund Madagascar suggest that the number and density of *A. albinucha* at any given site vary widely throughout the year, potentially related to optimal environmental conditions for breeding but also associated with agricultural practices, notably the rice-growing season. Jacanas are often found alone or in small groups (Langrand 1990; Safford 2013q).

Historically *A. albinucha* was more widespread and common than today, occurring in the central east at Lake Alaotra into the 1990s (Safford 2013q). In the most recent survey, only three individuals were observed in the Lake Sahaka region (including Lake Anosy and Lake Ambinagny), which in 1998–1999 was occupied by slightly fewer than 70 individuals year-round (Safford 2000). Reports from local bird guides and repeated bird surveys from Lake Bemamba (Durrell Wildlife Conservation Trust, unpublished data) suggest a rapid decline in population size. The current global population estimate is 975–2064 birds (D'Urban Jackson et al. 2019).

BREEDING ECOLOGY AND SOCIAL BEHAVIOR

Actophilornis albinucha can presumably breed year-round. However, breeding records (including sightings of nests and downy young)

fall between December and July, coinciding with wetter weather conditions (Rand 1936; Appert 2011; D'Urban Jackson et al. 2019).

Their nests consist of built-up vegetation floating above the water surface; a nest found by the authors (with eggs, in January 2016) was in an area largely covered by invasive *Eichhornia* mixed with (also invasive) *Pistia stratiotes*. Other jacana species in the world typically lay four eggs (Jenni 1996); only two clutches have been reported for *A. albinucha*: one with four eggs (Rand 1936) and the other with three eggs (D'Urban Jackson et al. 2019). The eggs are ovate and dark greenish brown, with a dense, dark pattern of lines and scribbles, similar to *A. africanus* eggs, and they measure $35.5 \text{ mm} (\pm 1.8, n = 7) \times 25.2 \text{ mm} (\pm 0.4, n = 7)$ (Rand 1936; D'Urban Jackson et al. 2019).

High numbers of *A. albinucha* have been reported for some areas (see above). However, when they are looking after young, more solitary behavior has been observed. During breeding, female and male territorial aggression has been witnessed. In addition, aggression (vocalization and chasing) toward *Gallinula chloropus* (Eurasian Moorhen) and *Porphyrio alleni* (Allen's Gallinule) when coming into close contact has been observed (D'Urban Jackson et al. 2019).

Sex-role reversal behavior is assumed, which may include incubation and brood care by the male and polygamy by the female (Jenni 1996; Safford 2013q), based on breeding behavior and the extent of reversed sexual size dimorphism in *A. albinucha* being similar to that in the closely related *A. africanus* (D'Urban Jackson et al. 2019). However, breeding biology studies are needed in *A. albinucha* to confirm these assumptions, and virtually nothing is known about their breeding behavior or parental care. There is a single case of a molecularly sexed brooding adult male.

DIET AND ECOLOGY

No formal dietary study has been conducted on *A. albinucha*, but it has been observed foraging in floating vegetation by overturning leaves and eating small invertebrates, larvae, and aquatic plant seeds (Milne Edwards and Grandidier 1879–1885). These birds have also been seen foraging through piles of dried rice plants.

MOVEMENTS, GENE FLOW, AND GENETIC DIVERSITY

This species does not seem particularly keen to fly long distances; it takes short flights between vegetation patches when disturbed but otherwise tends to walk on floating vegetation (Rand 1936; Safford 2013q). A number of individuals have been banded, but no resightings of these birds have been recorded. Local dispersal or nomadic movements have been predicted based on high within-year fluctuations in their presence at Lake Bemamba and Lake Mandrozo, where repeated bird surveys are regularly conducted. Further, local people report that the species is at times absent from some breeding sites (D'Urban Jackson et al. 2019).

High gene flow has been found across the entire range of this species, and no barriers to gene flow have been identified, suggesting few or no barriers to their movements (D'Urban Jackson 2018).

This supports the prediction of widespread dispersal. Identical sequences of one mitochondrial gene (ND2) have been found in all 15 individuals that have been sequenced, representing a substantial part of their geographic range. Genomic data (RADseq) have shown that *A. albinucha* is less genetically diverse than *A. africanus* (D'Urban Jackson 2018).

THREATS AND CONSERVATION

In the 2020 revision of the IUCN Red List, *A. albinucha* was for the first time recognized as Endangered because its small population was undergoing a moderately rapid population decline through

habitat degradation and hunting pressure (BirdLife International 2020a). The greatest threats suffered by this species are habitat loss and wetland conversion to rice paddies (Safford 2013q; D'Urban Jackson et al. 2019). It can tolerate low-level human disturbance and even uses flooded rice paddies for breeding and foraging. However, more generally the degradation of natural wetlands resulting from conversion to rice paddies, including the siltation of rivers and the use of pesticides, is likely contributing to declining wetland bird populations (Bamford et al. 2017). As with other waterbirds on Madagascar, illegal hunting also threatens this species (BirdLife International 2020a).

Subject editors: Roger J. Safford and Steven M. Goodman

ACCIPITRIFORMES AND FALCONIFORMES: HAWKS, EAGLES, KITES, AND FALCONS

L.-A. Rene de Roland and R. Thorstrom

Globally, diurnal birds of prey, or raptors, were formally placed in the order Falconiformes but are today considered best split into three separate orders. The Cathartiformes (New World vultures) and Accipitriformes (Secretarybird, Osprey, hawks, eagles, and kites) are sister to each other, while the order Falconiformes now contains only the falcons and caracaras and is not related to the other two orders (Prum et al. 2015). The Accipitriformes and Falconiformes are well represented on Madagascar. Owls, which are generally nocturnal, remain a separate order, Strigiformes.

Twelve (55%) of the 22 regularly occurring (i.e., excluding vagrants; see below) diurnal and nocturnal raptor species occurring on Madagascar are endemic, and three more are restricted to the Malagasy Region (see Table 13.1). Five resident species are widespread outside Madagascar, while two are regular migrant visitors. Within the Old World tropical region, Madagascar as a country has the highest percentage of predatory raptor species (Falconiformes and Strigiformes, excluding vultures, which are obligate scavengers) per the total known local avifauna: they make up slightly over 8.5% of the island's bird species (Goodman et al. 2018). Further, at least three diurnal birds of prey have disappeared from Madagascar in recent geological time, at least one of which was certainly endemic and is therefore now globally extinct (see Safford et al., pp. 1553–602).

Of Madagascar's 22 regularly occurring raptor species, according to the IUCN Red List, one is considered Critically Endangered, *Haliaeetus vociferoides* (Madagascar Fish-eagle); and two are Endangered, *Eutriorchis astur* (Madagascar Serpent-eagle) and *Circus macroscelus* (Madagascar Harrier). Although some more open-country species of Malagasy raptors have benefited from the degradation of forests (e.g., *Falco newtoni*, Madagascar Kestrel), most are forest species and have been adversely affected. Other causes of species

declines have been modification of original wetland habitat, burning of grasslands, and persecution by humans for food, beliefs and practices related to superstitions or sorcery, and protection of poultry.

In this contribution, we provide information on the status, threats, habitat, and ecology of the island's 16 regularly occurring diurnal raptors. Three more species, *Pandion haliaetus* (Osprey), *Elanus caeruleus* (Black-winged Kite), and *Lophaetus occipitalis* (Long-crested Eagle) have occurred as vagrants (Safford and Hawkins 2013) and are not considered further.

ACCIPITRIFORMES

Eutriorchis astur, Madagascar Serpent-eagle, *Fandrasalambo*

Distribution and Status

The endangered, endemic *Eutriorchis astur*, in a monospecific genus, is one of the rarest birds of prey in the world (del Hoyo et al. 1994). An elusive raptor more often heard than observed, *Eutriorchis* is restricted to eastern moist evergreen forests (Rene de Roland 2013a), and 11 museum specimens were collected at seven sites in four different forested areas (Ampasimanava, Analamazaotra, Fito, and Maroantsetra) between 1874 and the 1930s (Collar and Stuart 1985; Langrand 1990). After a sight record in 1988 at Marojeje (B. Sheldon and Duckworth 1990) and the discovery of carcass remains in 1990 at Ambatovaky (Raxworthy and Colston 1992), it has been only since 1993 (Thorstrom et al. 1995) that its distribution and habits have been confirmed by intensive fieldwork.