

Short Communication

Assessments of Maleo *Macrocephalon maleo* nesting grounds in South-east Sulawesi reveal severely threatened populations

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Summary

The Maleo *Macrocephalon Maleo* is a megapode bird endemic to Sulawesi, Indonesia, that lays large eggs at communal nesting grounds in naturally-heated sands or soils. It is classified as 'Endangered' and many populations have been extirpated due to overexploitation of eggs and loss of connectivity between forest and nesting grounds. The distribution and status of nesting grounds across Northern and Central Sulawesi are relatively well-established, but almost nothing is known about potential Maleo populations of South-east Sulawesi. In this study we used previously established methods to formally assess the status of three Maleo nesting grounds in Buton, South-east Sulawesi, and interviewed egg collectors at these three sites to determine the trends of populations and threats over time. All nesting grounds were severely threatened and can be expected to be abandoned in the near future due to extensive harvest of eggs and deforestation. Eggs were collected both for the wildlife trade (intensively harvested and sold as luxury items to people from distant cities) and local use (opportunistically harvested and both eaten and sold locally). All egg collectors remarked on an increase in illegal logging around nesting grounds over the previous decade. Though the Maleo's current situation is dire, previous case studies show that collaborative grassroots initiatives supported by government and NGOs can protect nesting grounds and reverse population declines.

Introduction

The Maleo *Macrocephalon Maleo* is a megapode bird endemic to Sulawesi, Indonesia (Figure 1). The Maleo has a unique reproductive strategy where over a period of several months each year pairs lay numerous large eggs in communal nesting grounds on naturally-heated substrates of either sun-warmed coastal sand or inland geothermal-heated soil; chicks are born without parental care and disperse to the nearest suitable forest habitat until they reach reproductive age and begin to return yearly to a nesting ground with their mate (Butchart and Baker 2000). The highly specific habitat requirements and localised reproductive strategy of the Maleo makes them especially vulnerable to habitat loss and overexploitation of their eggs; they are listed as 'Endangered' due to rapidly declining and fragmented populations (BirdLife International 2016).

It was documented in English as early as the 1980s that overharvesting of Maleo eggs was driving populations at some nesting grounds to local extirpation (MacKinnon 1981). Further surveys in 1998 showed that 31.7% of sites in Central and South Sulawesi were abandoned and 61.9%



Figure 1. Maleo accidentally captured (and subsequently released uninjured) on Buton, Sulawesi (photograph: Graden Froese).

severely threatened or threatened (Butchart and Baker 2000). In 2003–2004, 50% of nesting grounds in North Sulawesi were abandoned and the remaining 50% were severely threatened or threatened (Gorog *et al.* 2005). However, there is almost no available data on possible Maleo populations in South-east Sulawesi, due in part to the greater logistical difficulty of completing research in the area and perhaps a perceived lesser regional importance to the species at large (Butchart and Baker 2000; Indrawan *et al.* 2012). Buton is an island of approximately 4,520 km² located just off the south-east coast of Sulawesi (Froese *et al.* 2015). There are at least three confirmed Maleo nesting grounds on Buton, but prior to this study the status of only one had been formally assessed, and was severely threatened (Catterall 1996), and the potential for other sites had not been investigated (Butchart and Baker 2000).

Methods

In July 2014, we visited these three nesting grounds with local egg collectors. We were accompanied by a local colleague well-respected across the island; his presence quickly established a sense of trust and frankness between the collectors and us. We categorised the condition, access, and status of each nesting ground using a method created by Dekker (1990) and further used by Argeloo (1994), Butchart and Baker (2000), and Gorog *et al.* (2005). We also conducted interviews with the egg collectors at each site to gain insight into the drivers of threats and population trends over time (Table 1).

Results

All nest sites were partly destroyed (disturbed by deforestation and /or overgrown with secondary vegetation), had disrupted access (were completely separated from intact forest), and were severely threatened (few pairs remained in the area and abandonment appeared imminent) (Table 2). Interviews suggested that Maleo populations at all sites had declined over the previous

Table 1. Questions asked in interviews with egg collectors.

Do you gather eggs from this area?
 If yes, how many (per year, month, week, day, etc.)?
 If yes, do you eat or sell the eggs (or both)? If sold, for how much and where?
 How many other people do you think gather eggs from this area?
 Do you ever catch or eat adult birds? If so, how many?
 How long have you been coming to this area?
 Are there more, less, or the same Maleo here now than in the past?
 Are there more, less, or the same eggs here now than in the past?
 Have you seen any changes in the area since you first started coming here?

decade and at one site for over thirty years (Table 3). Given that Maleo have been declining throughout Sulawesi for a far longer period than the time in which our interviewees have been collecting eggs, the observed decline on Buton likely comes on top of already reduced populations.

Egg harvesting at visited sites came in two distinct forms. Intensive harvesters regularly visited the nesting ground throughout the season and sold the majority of their take, often to people from large urban centers far away who came to their homes to purchase the eggs (such visits would require extensive travel, including ferries). One man claimed that “they know my name in Jakarta”. Opportunistic harvesters collected eggs more sporadically, for example when they were in the general vicinity for another reason such as cutting timber, and both ate and sold the eggs. These eggs were more likely to be sold locally. The price of locally sold eggs was usually less expensive than those sold to people from cities, but this was not universal (Table 3). The harvesters we interviewed at visited sites struggled to estimate a number of how many other egg collectors were using each nesting ground, but the general consensus was very many along the Lebo and Siloi rivers, and a handful of others at the coastal site near Kambowa.

Overexploitation of eggs is not the only threat facing the Maleo. Interviews showed they were sometimes caught in snares, but this seemed to be a low frequency event. Snares were generally set for jungle fowl rather than actively targeting Maleo. More detrimental is deforestation, which severs connectivity between nesting grounds and intact forests (and thus potentially greatly increasing chick mortality rates) (Indrawan *et al.* 2012). In North Sulawesi, such disrupted access was the habitat characteristic most strongly associated with recently-abandoned nesting grounds (Gorog *et al.* 2005). Connectivity to intact forest was destroyed at all nesting grounds we visited. The main change over time the collectors noted was a proliferation of illegal logging. Many of the

Table 2. Assessments of Maleo nesting grounds on Buton, Sulawesi, as following Dekker (1990). Lahumoko is called Bubu and the Menara complex is called Maligano in Butchart and Baker (2000); the latter is classified as Severely Threatened in Catterall (1997). Lansunolemo is unmentioned in previous literature.

Nesting ground local names	Location description	Coordinates and elevation	Condition	Access	Status
Lahumoko	Coastal site near town of Kambowa	S 04.98439 E 122.96019 22 m	Partly Destroyed	Disrupted	Severely Threatened
Menara/ Kumbou/ Pondoubi	Three inland sites in close proximity (< 1 km) along the Lebo river	S 04.65660-4.64354 E 122.87263-122.87709 36-70 m	Partly Destroyed	Disrupted	Severely Threatened
Lansunolemo	Inland site along the Siloi River	S 04.68979 E 122.98479 42 m	Partly Destroyed	Disrupted	Severely Threatened

Table 3. Data collected from interviews with egg collectors at three Maleo nesting grounds on Buton, South-east Sulawesi. Interviews at the Menara complex were conducted together, and the younger men deferred to the elder for population estimates.

Age	Years collecting	Nesting ground	Intensive/ Opportunistic	Number of eggs collected last year	Percentage sold or eaten	Price eggs are sold for (IDR)	Who eggs are sold to	Estimated population trend
mid 50s	33	Lahumoko	Intensive	27 ⁰	>95% sold	25,000	People from large cities (incl. Kendari, Raha, Bau-Bau)	Decline
31	10	Menara, Kumbou, & Pondoubi	Intensive	225	76% sold	35,000 - 40,000	People from large cities, as well as Maligano	Decline
18	3	Menara, Kumbou, & Pondoubi	Opportunistic	15	67% eaten	35,000 - 40,000	People from large cities, as well as Maligano	Decline
25	5	Menara, Kumbou, & Pondoubi	Opportunistic	43	65% sold	30,000	Local	Decline
32	10	Lansunolemo	Opportunistic	1 (average of 3 eggs a year)	83% eaten	5,000 (2004) - 15,000 (2014)	Local	Decline
38	15	Lansunolemo	Opportunistic	0 (usually < 4 eggs a year)	100% eaten	Not sold	Not sold	Unknown

men directly blamed this illegal logging for both increasing flooding and decreasing Maleo populations.

There are more Maleo nesting grounds on Buton than those we assessed during this study. Talking to people across the island, we were told of many other putative sites, as well as forested areas where people had seen adult birds. In August 2014, a villager came to us with a Maleo which he had caught in his farmland in a trap intended for his own domestic chickens (it was alive and uninjured; we released it in a nearby forest close to its capture site) (Martin *et al.* 2017) (Figure 1). This was over 20 km from the nearest known nesting ground.

Discussion

The current situation of the Maleo is dire and requires urgent action. It is not, however, too late to prevent their extinction. The continued decentralisation of natural resource management in Indonesia means that locally-led conservation efforts now offer a viable hope for the future of Maleo populations (Indrawan *et al.* 2012). For example, in Central Sulawesi, the number of pairs visiting a nesting ground increased by over 60% in just a decade due to collaboration between a grassroots NGO and local people buoyed by governmental support (The Alliance for Tompotika Conservation 2016). It is currently impossible to say whether any nesting grounds across South-east Sulawesi contain a population size large enough to be “important” for the survival of the species, and it could be argued that all nesting grounds are important due to their immense cultural significance and ability to engender local concern for and pride in Sulawesi’s unique natural heritage. The first vital step towards assessing overall population status and trends and identifying the most promising candidate sites for follow-up conservation action is to find and assess the remaining nesting grounds unknown by the conservation community.

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