

Sulawesi's Maleo Bird: What Do We Know? What Do We Wish We Knew?

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Natural History and Legal Status

- Scientific name: *Macrocephalon maleo*
- Family: *Megapodidae*. The megapodes of SE Asia do not incubate their eggs. Most megapode species, except the maleo, lay their eggs in a mound of vegetation, which incubates the eggs as it decomposes.
- The maleo is *endemic* to Sulawesi and Buton Island; that is, it occurs only there and nowhere else in the world.
- The IUCN (International Union for the Conservation of Nature), the international body that ranks status of plants and animals, has ranked the maleo as ENDANGERED since 2002, their second-highest category of concern (under "Critically Endangered"). This listing reflects the maleo's continued decline, since prior to 2002 it was only listed as "Vulnerable".
- The maleo has been fully protected by Indonesian law since 1972. It is illegal to hunt, capture, kill, or harass maleo adults or eggs, subject to a fine of up to Rp 40 million

Biology and Habitat Use

- The maleo inhabits Sulawesi's lowland and montane forests, up to at least 1065m. Maleos also utilize coastal and wetland habitat for breeding.
- Maleos feed on nuts, fruits, seeds, snails, worms, insects, and other invertebrates.
- It is not known how long maleos live in the wild, but one maleo in captivity lived more than 44 years. The IUCN has estimated generation length as 16 years.
- Male and female maleos mate for life.
- It is estimated that young maleos first mate at about age 2 yrs.
- When ready to lay, a maleo pair travels (mostly by walking rather than flying) from its forest home to a communal nesting ground on the coast or near hot springs. The male and female take turns digging a large hole in the soil or sand in which a single large egg is laid and then covered over with sand or soil. After laying, the adult birds do not guard the egg, but return to the forest. The egg is incubated by solar heat on the warm beaches, or geothermal heat from hot springs.
- Male and female birds look nearly identical, 55-60 cm. Female weights 1500-1800g. Most of the bird is black, with a medium-long neck and medium-length tail which spreads vertically. The underparts are white, with variable amounts of pink or salmon coloring on the breast. The legs are black, the bill is stout and pale-colored, and the area around the eyes is featherless and yellowish-orange in color. Adult birds have a distinctive bare bony casque on the top of the head whose function is not known.
- Maleos are shy and often silent, except around the nesting grounds. There, several vocalizations can be heard, including a distinctive loud braying; a rolling, turkey-like gobble; and a duck-like quacking.

Nesting and Hatching Biology and Behavior

- We really do not know how often a maleo pair travels to the nesting ground to lay, or how many eggs per year a female will lay. There have been guesses that a maleo pair comes to the nesting ground, lays an egg, and then remains nearby for some time to lay one more egg before returning to the forest for months until the next laying. There have also been guesses that a female will lay as many as 8 eggs per year. But these are just that—guesses! In fact no research has been done to establish the number of eggs a female will lay in a year or in her lifetime, or in what pattern.
- What is known is that laying occurs throughout the year, though often a distinct high season can be noted at a particular nesting ground. We also know that the maleo egg, because it is so large, requires a great deal of energetic investment on the part of the female, and therefore is likely to take some time to produce inside her body (as contrasted with domestic chickens, for example, who may lay an egg nearly every day). Finally, it is also known that communal nesting areas may be quite distant (10 km or more) from the birds' forest habitat, so it is unlikely that a maleo pair makes the journey back and forth with great frequency.
- Female maleos in captivity have been observed to stop eating in the period before egg laying, and to make a special vocalization.
- The maleo egg is one of the largest of all megapodes, approximately 11 cm x 6 cm and 175-270 g. The yolk of the egg is also the largest of megapodes; large yolks are associated with advanced development of the chicks before hatching. Maleo chicks are among the most advanced of all birds at hatching; they are ready to fly and find food completely on their own after hatching, and receive no parental care.
- Maleos can nest wherever soil temperatures are between 32-38° C and soft enough for digging. Within this range, maleo eggs seem to be able to tolerate a good deal of temperature fluctuation, and also variability in soil moisture content. Maleo eggs have a low water content because of the large yolk and small albumen (white), and are thus vulnerable to dehydration, but this does not seem to be a problem in the wild, as soils from 1.6% - 45% moisture content have been used for nesting.
- There is a large depth range in which maleos bury their eggs in the wild: at Tambun in N. Sulawesi (a forest hot spring nesting area), maleos laid their eggs anywhere between 20-85 cm deep. Depth also depended on distance to the hot spring. At Panua, a coastal nesting ground, eggs were buried deeper, averaging 70 cm deep in the sand.
- It has been surmised that maleos have temperature sensors in their bills. Observing the birds taking soil or sand into their bills at the nesting ground, researchers supposed that the birds may be testing soil temperatures in order to assess the appropriate depth for egg burial.
- Hatching may take 74-85 days, with the average time to hatching at Panua being 78.6 days. At Panua, researchers observed that when the weather was cold, chicks seemed to “wait” (i.e., their metabolism slowed) until warmer weather for hatching. The eggs became warmer to the touch before hatching.
- Maleo chicks do not have an egg tooth, like some birds, and hatch from their eggshell by pushing with their feet, not by pecking. While inside the egg, maleo chicks have a form of “plug” on each toe, which protects the chick from scratching itself or the egg membranes inside the egg. It takes a maleo chick several hours of pushing with its feet just to emerge from the egg.

- After emergence, a maleo chick begins digging itself to the surface. It digs with its eyes closed, feet above its head and pushing the soil downward. At hatching, its feathers are still sticky with egg material, but this, like the plugs on the toes, dries and scratches off as the chick digs its way to the surface.
- It takes the chick 1-2 days to dig its way to the surface, and wild birds open their eyes and are ready to fly immediately upon emergence.
- Maleo hatcheries have established numerous other details about egg placement and hatching. For example, if an egg is dug up and then reburied upside down, the chick inside will continue to grow for a time, but dies late in its development before hatching.

Threats & Conservation Strategies

- The taking of maleo eggs by humans, along with destruction of its forest habitat, has become by far the greatest threat to maleo survival.
- Some scientists surmise that the maleo habit of nesting in a communal nesting ground originated as a “predator swamping” strategy: that is, when maleo numbers were very high, by clustering their eggs in one area, natural predators might take some eggs but would be sated long before most eggs were disturbed. This strategy breaks down when maleo numbers fall below a certain point, as they have now in most areas, or when there is a predator—humans—which is never sated.
- Natural predators to the maleo include monitor lizards, wild pigs, rats, snakes, giant civets, and brahminy kites (esp on chicks). Dogs are also known to prey on maleos.
- In order to survive, maleos require intact native forest surrounding or at least connected to their nesting areas. How large these forested areas must be, however, is not known. It is also not known, at this time, how far maleos will travel through disturbed areas to reach nesting grounds, but many coastal nesting grounds have been abandoned because natural corridors linking them to native forest have been destroyed.
- For conservation of maleos to be successful, then, it is essential that we: a) protect nesting areas to allow chicks to hatch; b) protect native forests as habitat for juvenile and adult birds; c) preserve forested corridors between forest habitat and nesting areas.

Maleo’s Current Status

- The IUCN estimates the rate of maleo decline at present to be 50-79% in the space of 10 years or 3 maleo generations. In one area in N. Sulawesi, maleo decline was estimated at more than 90% between 1950-1990. Of the approximately 142 nesting grounds formerly known and documented, about half have already been abandoned, and nearly all the rest are threatened or severely threatened. As of 2004, only four nesting grounds were known to be not yet threatened. In 2004 the IUCN estimated the total earthly maleo population at 8,000-14,000 individuals.
- The steep decline is almost certainly due primarily to overharvest of eggs by humans. At Tangkoko, for instance, Sangihe settlers made the first permanent encampment at Batuputih beach in 1913. Within a few years, the population of maleos nesting on the beach there was gone. Maleos remained nearby on the lower slopes of Tangkoko for some years, however, and in 1981 it was reported that about 20 pairs/day still nested

there. By the 2000's, maleos were thought to be gone from Tangkoko, but recently a small remnant population has reappeared after their former nesting area was cleared of vegetation. As another example, the Panua reserve was created in 1938 to protect a large nesting area there. In one year (1949), humans took as many as 9705 eggs, and the harvest continued until the nesting ground's functional extinction in more recent years. Every year there are new reports of a nesting ground being abandoned.

- Remaining maleo nesting grounds are clustered in areas around Bogani Nani National Park, N. Sulawesi; the outer coast of Gorontalo/Central Sulawesi; Central Sulawesi near Lore Lindu and Morowali National Parks; a few sites in Sulawesi Tenggara and Buton Island; and at Taima, Sulawesi Tengah.
- The nesting ground at Taima is particularly important from a biological standpoint because of its relatively large numbers of maleos coming to nest and because the maleo population in the Tompotika area is somewhat isolated and therefore likely to be genetically distinct from other maleo populations.

Some Things We Don't Know, But Wish We Did!

- We do not know how many eggs a maleo female lays, or how often
- We do not know why the maleo has a funny knob in its head
- We do not know whether maleo pairs always return to their natal nesting grounds to lay, or whether they sometimes shift to new nesting areas
- We do not know how many maleos may be laying eggs outside of traditional communal nesting ground areas
- We do not know how far adult maleos travel to reach nesting grounds, or how much they are willing to travel through disturbed areas to reach there.
- We do not know how far maleo chicks disperse from their hatching grounds to the forest, or how many of them survive to adulthood.
- We do not know whether forest- and coastal-nesting maleos are genetically similar or distinct from one another, whether they interbreed, or whether they change or not between forest and coastal nesting areas within lifetimes or generations.
- We do know that we must do all that we can to save this magnificent treasure of creation from being lost forever to extinction!