



Aepyornis maximus showing the enormous size of these giant birds relative to a human. Illustration by Virge Kasl.

SPRINGS, WIRE PLANTS AND THE ELEPHANT BIRDS OF MADAGASCAR

BY WILLIAM BOND AND JOHN SILANDER

The plants of the dry forests of southern Madagascar are among the strangest growth forms of any in the world. Besides the astonishing Baobabs and Bottle Trees, you will see many shrubs with thin, often intertwined twigs with widely scattered small leaves. Try pulling them and you will be astonished at their tensile strength. Let the branch go and they spring back into shape. These are 'wire plants' designed to resist browsing by Elephant Birds which roamed these landscapes until a few centuries ago.

WHAT ARE ELEPHANT BIRDS?

Among the extraordinary animals of Madagascar were several giant flightless bird species in the family Aepyornithidae. The largest, *Aepyornis maximus*, stood three metres tall and weighed nearly half a ton (450 kg); these were the largest of all modern birds. Their eggs are thought to

be the largest ever laid by any vertebrate, including the dinosaurs. Goodman and Jungers estimated their volume to be about 7.5 litres, equivalent to 150 chicken eggs and enough to feed 75 people! You can still see pavements of egg shell fragments in the coastal dune fields of southern Madagascar where the birds are thought to have congregated for communal breeding and nesting.

Etienne de Flacourt, named commandant of Madagascar in 1649 by the French king, was based in the region of Fort Dauphin (=Tolagnaro), near to the 'spiny' thickets of the south. Flacourt chronicled local knowledge of Elephant Birds and appears to have heard, but not seen them. Indeed one French explorer from the 17th century relates in his diary encountering one of these birds and calling it a frightening dragon.



Left: The strange surreal thickets of southern Madagascar with Bottle Trees, Baobabs and springy wire plants. Photo by John Silander.

Right: Wire plants have small leaves, very tough thin branches often with wide angles producing a tangled mass of fine twigs. Photo by William Bond.

It is a tantalising thought that these giant birds may still have been extant just a few centuries ago. If only the Malagasy conservation lobby of the 1600s had worked harder to convince their fellows to conserve the giant birds for future generations.

Elephant Birds are ratites. Their living relatives are Ostriches, Rheas, Emus, Cassowaries and the Kiwi Bird of New Zealand. Like Madagascar, New Zealand also had a dozen or so species of giant birds, the Moas, all of which became extinct after the arrival of Polynesian settlers on these islands.

PLANT DEFENCES AGAINST VERTEBRATE BROWSERS

Many plants defend themselves against mammal browsers such as deer, antelope, goats and sheep by producing sharp spines on the branches. Such plants are generally highly palatable and favoured food. The

spines function as a defence by slowing feeding rates so that animals move to another plant seeking better rewards for their effort. Spines on new growth are initially soft and easily consumed along with leaves and green stems. Leaves are easy to replace but stems are more expensive to produce and stem spines provide a long-lived deterrent to browsing.

Many of the species in the Madagascan thickets of the south have close relatives in Africa where they are fed on by antelope. Though they are often called 'spiny thickets' they are nothing compared to African thickets where the woody species have thick branches, large leaves, dense branching, and formidable spines to deter browsers. In Madagascar, in contrast, related species have very reduced spines or none at all. Branches are thin and widely-spaced, with much smaller leaves. These striking differences can be understood by comparing the feeding mode of bird browsers versus mammals such as

antelope. Ratites feed by clamping the beak on a leaf or branch and tugging off leaves or shoots. They have no teeth to cut branches, small tongues and no cheek muscles to manipulate food in the mouth to facilitate swallowing. Instead, like chickens or herons, they throw their head over a food item to force it down their throats.

Plants have responded to this feeding mode by constructing: thin branches, difficult to clamp with the beak; widely-spaced, small leaves which reduce losses from pecking; and, most importantly, stems with high-tensile strength so that the bird cannot tear off whole branches. Many plants are also springy so that when the birds clamp and tug, the force is reduced as the plant unwinds. This clever defence mechanism has evolved in over 25 families and many genera of Madagascan woody plants. The 'wire plants' of Madagascar share many features with woody species in New Zealand. There too, many plant species



Left: The fruits of *Uncarina* (Pedaliaceae) were probably dispersed by clinging to the feathers of Elephant Birds. Today they stick to human clothing and are extraordinarily difficult to pull off. It is likely that dispersal services for other plant species provided by Elephant Birds have also been disrupted. Photo by Rachel Prunier.

Right: Spiny plants are generally rare in Madagascar and genera that are spiny in Africa (e.g. *Acacia*, *Dichrostachys*) typically have much reduced spines in Madagascan endemics. However the juvenile forms of many species of Dideriaceae often have long spines protecting the succulent leaves in a formidable prickly cage. How the spines functioned, and against which kind of browser, is poorly understood. Photo by Rachel Prunier.

from diverse families have a 'divaricate' – widely branched – growth form to deter browsing by the extinct Moas.

It is striking how few Madagascan plants have spines, or else have tiny, reduced spines relative to their African counterparts. Spines are ineffective for defence against bird browsers because of their hard beaks. However there are a few groups of spiny plants in Madagascar's thickets, most notably in the Madagascan endemic family Dideriaceae. Their function remains a mystery. They are most prominent below about 1.5 m and are ineffective against extant lemurs which leap from one tree to the next. We suspect that the long spines of some Dideriaceae may have deterred birds from pecking off leaves for fear of piercing their eyes. They may also have inhibited feeding by extinct giant tortoises. Observations of the feeding mode of similar extant species of giant tortoises are needed!

The anti-bird defence system is useless against mammals that feed like African antelope (deer, goats, sheep, etc.) because these creatures can easily cut the thin stems with their teeth. Consequently, wire plants are only found where birds are the most important browsers and not where mammals feed by slicing off branches. Primates, such as African monkeys, baboons and Madagascan lemurs, use their hands to manipulate branches to pluck off leaves and spines do little to deter this feeding mode.

So, if you are lucky enough to travel to Madagascar, try and visit the surreal southwest. There you can enter the world of the giant Elephant Birds – not a spiny 'forest' but a springy 'forest' – where many plant species have been shaped by giant bird browsers producing one of the strangest botanical landscapes on Earth.

Professor Joel Ratsirarson, eminent Madagascan conservation biologist, holding an Elephant Bird's egg. They are reputed to be the largest eggs ever laid by vertebrates, including those of dinosaurs. Elephant Bird egg shells are so common they form a pavement in the coastal dunes of parts of southern Madagascar.

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