NEW ZEALAND ECOLOGY
FLIGHTLESS BIRDS

The absence of mammalian predators and competitors in New Zealand, allowed dominant taxa to evolve from other animal groups that were functionally equal to mammals. With the exception of a few oceanic islands, they have no functional or taxonomic equivalent anywhere in the world. Moas were the most significant alternative to mammals on New Zealand, taking the role of the largest dominant herbivores, the same role as large animals such as deer and elephants in other lands.

MOA

After 170 years of controversy over the evolutionary history of the extinct ratite moa, research in 2009 identifies nine species, with three genera and six species in the Dromornithidae family, two Dinornis species in the Dinornithidae family, and one Megalapterygidae species.

Moa are the only species in the Dinornithiformes order, and together with New Zealand’s iconic species, kiwi and tuatara, have endemic designation at order level.

Moa were the dominant herbivore in the New Zealand ecosystem, and another biological peculiarity, which evolutionary scientists relate to the prolonged isolation, size, and geographical complexity of the country, and the scarcity of terrestrial mammals.

New Zealand is Earth’s largest oceanic archipelago, and the most distant from any continental land mass, which together with a mixed topography, provided the conditions for natural selection processes that produced varied evolutionary outcomes.

Extinct giant moa Dinornis robustus and D. novaezealandiae were the tallest birds on Earth - with the top of their back two metres above the ground.

As Dr Jared Diamond of UCLA points out "... the only approach to moa elsewhere in the world were the elephant birds of Madagascar plus the surviving ratites of the continents, but none of these other groups of very large flightless herbivorous birds radiated to anything like the degree that the moas did ..."

Moa were part of the ratite group which diverged to isolated locations throughout the Pacific. They were a notable early group that have no ridge (keel) on their sternum (breast bone) to which wing muscles are attached in birds that fly.

Ratites are a basal lineage of birds that are

Reverse dimorphism - much bigger than mal
The extent of reverse sexual dimorphism is unprecedented for terrestrial mammals with males different in shape than females.

Since the first moa was described in 1839, 13 species were listed by Walter Rothschild in 1907.

At the time eleven moa species were recognised in 2003, three Dromornithidae showed limited cladistic differences. Owen’s description in 1839, they had been separated primarily on limb bone size.

The first sex-linked nuclear sex chromosomes for extinct species showed three forms were one species, whose distinctly different mating habitats.
Falcon, Harrier
Morepork
Laughing owl
Haast’s eagle
Parrots & Parakeets
Kea
Kaka
Kakapo
5 parakeets
Wattlebirds
Hula
Kokako
Saddleback

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MEDIA NEWS

Moas in decline before humans arrived
"Humans may not be entirely to blame for wiping out moas... a huge moa population existed in the few thousand years before the arrival of humans..." New Scientist 10 November 2004

DNA shows female moa three times size of male
"The mystery of New Zealand's giant moa has been solved at last - she was a female" New Zealand Herald 11 September 2003

New Zealand's flight path to disaster
"... New Zealand has a better record of the birds that lived over the past 100,000 years than any other area of the world..." New Zealand Herald 14 January 2003

Feathers to keep moa's toes warm
"Short, stocky and with feathers all the way down to its toes, the upland moa would have been an extraordinary site..." New Zealand Herald

hypothesized to have had a common ancestor 80 million years ago on the Cretaceous southern supercontinent of Gondwana, which subsequently underwent either vicarious speciation as the landmass fragmented, and/or flighted dispersal [Bunce, Worthy, et al., 2009].

Living members of the ratite lineage include the ostrich of Africa, emu and cassowary of Australia and New Guinea, rhea of South America, and New Zealand kiwi. The extinct giant elephant bird of Madagascar, and fossil Sylvornis of New Caledonia were also ratites.

Morphological radiation of moa appears to have occurred much more recently than previous early Miocene (15 mya) estimates, and was coincident with the accelerated uplift of the Southern Alps just 5 to 8.5 mya [Bunce, Worthy, et al., 2009].

Periodic bridging of the North and South Islands from lower sea level during glacial periods also influenced dispersal in the Pleistocene within the last 2 million years.

Together with recent fossil evidence, Bunce, Worthy, et al. suggest that the recent evolutionary history of nearly all of the iconic New Zealand terrestrial biota occurred principally on the South Island.

The absence of deep (20 million years) splits in the moa phylogeny suggest that all recent moa species originated from the southern landmass [Bunce, Worthy, et al., 2009].

A new 5.8 mya estimate for the basal divergence of Megalapteryx correlates closely with the rapid phase of mountain uplift during the Miocene–Pliocene [Bunce, Worthy, et al., 2009].

Other divergence estimates are 5.3 mya for the mean Dinornithidae/Emuidae taxon split, 1.45 mya for Dinornis, 1.9 mya for Pachyornis, 1.8 mya for Anomalopteryx/Emeus plus Eurypapteryx, and 1.35 mya for Emeus/Eurypapteryx.

The tallest bird on Earth.....

The largest females of extrom sexual size dimorphism were 95 yards in weight and 150% the height of males. [Bunce, Worthy, et al., Dinornis weighed between 80 and 100, while males were only 40 to 90.

The stout-legged moa Eurypapteryx was considered to be two spee species recently, because of the differ female which weighed 40 to 1 the weight of an ostrich, and male weighing between 12 an 16.

Moa eggs were normally cream colored, however, some light green and blue has been found. The eggs of 1 species were 24 centimetres (or long, and the largest egg that found has a capacity of 4,302 centimetres (1.8 cubic feet), a capacity of an average sized c

The fastest known extinct megafauna.....

The descendants of the original penguin and developed from millions of years of isolation, until the arrival of humans. Moa had only one natural prec Haast's eagle Harpagornis moa eagle ever known with a wing feet and talons as big as tiger

But life in a bird's paradise could not have been as peaceful as they thought. Their habitat was destroyed by Holdaway and Jacobson explore on moa population of low expi by an initial population of 100 coupled with the habitat loss of them. Conservative estimates mean human population growth rates of habitat removal of the two main islands, and tallowing rates.

The total population of all species at the time of human settlement birds, and only consumption over one year old was considered known that consumption of ma... to extinction less than after Polynesian settler.

"... human hunting and destruction drove nine species to extinction less than after Polynesian settler."
The largest moa, the two female Dinornis species were the tallest birds on Earth - 6 feet tall at the top of their back. Paleontologists no longer think the giant long necked moa normally stood erect (as shown right it would have reached 4 m [13 ft] in height). It is now thought that moa had a more horizontal neck posture, however, it could have reached up to 3 metres to graze on trees. Skeletal remains show that they were built like some dinosaurs.

A female Dinornis robustus weighed 275 kg (600 lb), less than the extinct elephant bird Aepyornis maximus of Madagascar that weighed 1100 lbs, but was much bigger than all other ratites. The largest living bird in the world today is the African ostrich which reaches a maximum weight of 114 kg (250 lb). Some individual Mantell's moa Pachyornis geranoaëris were a mere 17 kg, reaching up one metre, and with a back height of 0.5m, about the size of a large turkey.

Moas were the only avian species in the world without any vestige of a wing. They also had no tail. The junction of a small scapulocoracoid bone, formed from the fused scapula and coracoid, is where the wing humerus was at an earlier evolutionary stage.

Formerly, morphological data defining the ratite family tree, suggested kiwi were closely related to moa by ten skeletal similarities. It was thought that kiwi and moa had the same ratite Gondwanan ancestor from which all ratites developed flightlessness, and co-existed but dispersed separately within New Zealand.

This supports the argument of arrival of moa and kiwi by a land connection prior to the late Cretaceous, before New Zealand broke off from Gondwana.

**Moa were the world's only avian species without any vestige of a wing.**

Genetic research has concluded that kiwi evolved from a Gondwanan ancestor, that along with South American rhea and New Zealand moa diverged early in their evolution.

This places kiwi in the same group as Australia's emu.

Even without habitat loss that have occurred during the extent the most conservative analysis moas were extinct within 160 arrival.

Revised radiocarbon dating of campsites, place the earliest hunters, Polynesians who were of Maori, in the 13th century.

The archaeological record clear moa bones were suddenly mis campsites and Maori middens century. The short period dur were eaten out of existence is the geological time of moa life.

In a commentary on the study Diamond claims that in New 2 Madagascar and many Pacific would deny that the first arrv caused mass extinction, and t question is how fast it occurre hunting was the only cause. I study 'shows that moa extinct fast and were mainly by hunti

Dr Ross MacPhee, a mammal American Museum of Natural I York who has studied ancient says "there is no way of interpret record other than that it had t virtually overnight ... this is ei instance of overkill, of blizkere Moa extinction was more rapic of extermination of large preh mammals such as mammoths ground sloths, mastodons and that some scientists think was hunters in a North American b 13,000 years ago.

The predators that depended animals, which included saber cheetahs. maned lions, wolves short-fac"
and cassowary, and African ostrich, and probably flew to New Zealand about 40 million years ago.

Kiwi have vestigial wings, whereas moas had no wings whatsoever, indicating earlier divergence and the possibility of moa walking into New Zealand. Without ancient fossil evidence, the mystery of when moa became flightless, and how they reached New Zealand will be keenly debated.