

1

- Often heavy and less pneumatic bones.
- No keel on sternum - hence their name (Latin *ratis* = raft).
- Flight muscles are very much reduced.
- Wings are reduced or absent. Feathers bear barbs but barbules and barbicels absent.
- 2 to 4 toes in their legs (Lack the opposable first toe of many flying birds).
 - African ostrich (2)
 - American ostrich and Emu (3)
 - Kiwi (4)
- Tail feathers and oil gland absent.
- Pygostyle, furcula, syrinx are absent.
- Penis is found in males.
- Precocial young ones.
- Eggs are hatched by males.

2

FLYING BIRDS (CARINATAE)	FLIGHTLESS BIRDS (RATITAE)
1. These are usually small birds with 4 toes in their legs.	1. These are usually large birds adapted for running or walking with 2 or 4 toes in their legs.
2. Feathers have barbules and barbicels.	2. Barbules and barbicels are absent in feathers and barbs are free.
3. Tail feathers are present. An oil gland is present at the base of the tail.	3. Tail feathers are absent. Oil gland is absent.
4. Palate is well developed.	4. Palate is most primitive type.
5. Wings, feathers and flight muscles are developed.	5. Wings, feathers and flight muscles are well reduced.
6. Pygostyle is present.	6. Pygostyle is absent.
7. Furcula is present.	7. Furcula is absent.
8. Syrinx is present.	8. Syrinx is absent.
9. Keel is present in the sternum.	9. Sternum is without keel.
10. These birds are worldwide in distribution.	10. These birds are discontinuous in distribution.
11. Newly hatched young ones lack feathers.	11. Freshly hatched young ones are covered by feathers.
12. Newly hatched young ones cannot lead independent life (Altricial).	12. The young ones can lead independent life (Precocial).
13. Penis is absent in males.	13. Penis is found in males.
14. Eggs are hatched generally by females. Eg: Pigeon, Crow, Peacock, and Sparrow.	14. Eggs are hatched by males. Eg: Ostrich, Emu, Kiwi, Penguin, Tinamus.

3

- Four orders and five families of living flightless birds.
 - 1) Order Struthioniformes
 - Family Struthionidae : Ostrich (Africa)
 - 2) Order Rheiformes
 - Family Rheidae : Rhea
 - 3) Order Casuariiformes
 - Family Dromaiidae : Cassowary/Emu
 - Family Casuariidae : Cassowary/Emu
 - 4) Order Apterygiformes
 - Family Apterygidae : Kiwi

4

Ostrich (*Struthio camelus*)

- Restricted to the Africa and Arabia.
- Largest (and also the heaviest) living bird and therefore the largest flightless bird
 - Tall: 8 feet
 - Weight: 100 kg plus
- Just two toes (only bird species), giving them a great advantage as the *fastest bird / two-legged animal* on the planet.
 - 50 km/h over long distances
 - Stride of 11.5 feet (3.5 m)
- Polygamous

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Emu (*Dromaius novaehollandiae*)

- Restricted to Australia
- The 2nd largest (and heaviest) living flightless bird.
 - Tall: 6 feet (1.8 meter)
 - Weight: 34 kg
- Each leg possesses 3 digits.
- A tracheal pouch for communication especially during courtship.
- Strictly monogamous birds

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Cassowary (*Casuaris casuaris*)


- Restricted to Australia and New Guinea.
- The 3rd largest flightless bird.
- The wing feathers are in the form of long black spines (like quills of porcupine).
- Only ratite with a casque (a protective horn-like crest on the head).
- Powerful legs with sharp claws.
 - Quarrelsome birds which may attack even human beings.



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Rheas (*Rhea americana*)


- Restricted to the South America.
- Resemble African ostriches in shape and habits
 - Smaller than African ostrich
 - No distinct feathers or showy wing plumes like that of African ostrich.
- Three digits are found in each leg.
- These are the only ratitae birds with syrinx.
- Outstanding swimmers, can easily cross rivers.



8

Kiwis (*Apteryx* sp.)

- Restricted to New Zealand (National Bird).
- Smallest ratite (of the size of domestic hen)
- Nocturnal but have poor night vision, contrary to evolutionary theory for nocturnal birds.
- Each leg possesses **4 digits**.
- Unlike most birds, kiwis' nostrils are at the tip of their flexible 8-inch long bill.
- In proportion to the size of the body, the kiwi lays the largest eggs of any known animal.
- Unique because they have some mammalian characteristics: excellent sense of smell and hearing, hair-like plumage, body temperature (100°F; against 102–106°F) and dig burrows.

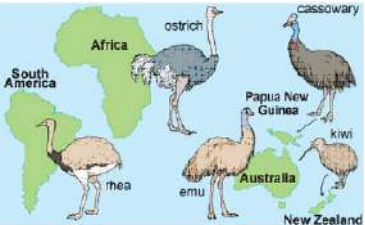


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Origin



- How did a group of flightless birds end up scattered far and wide across the Southern Hemisphere ?

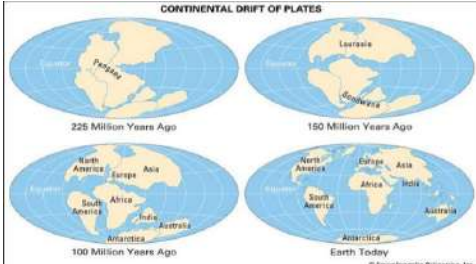
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J. Zool. Lond., (1973) 169, 455-545

Continental drift, paleoclimatology, and the evolution and biogeography of birds


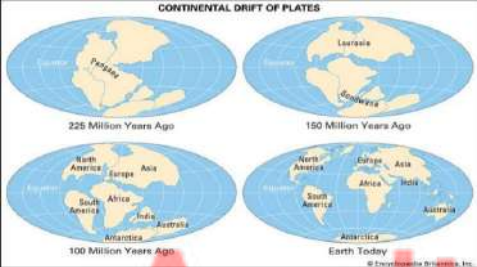
JOEL CRACRAFT
Department of Anatomy, University of Illinois at the Medical Center, Chicago, Illinois

CONTINENTAL DRIFT OF PLATES



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Rafting theory: Ratites evolved from a *common flightless ancestor* that probably lived at a time when all the southern continents were fused into a single land mass called Gondwana, and then diverged into separate forms when the supercontinent broke apart.

CONTINENTAL DRIFT OF PLATES

225 Million Years Ago 150 Million Years Ago

100 Million Years Ago Earth Today

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- Alan Cooper, the director of the Australian Centre for Ancient DNA at the University of Adelaide said:

"The idea was that, as this supercontinent broke up into pieces, "the ratite birds were sitting on board and were being separated by these continents moving, and that that's how they came to be where they were And because they're flightless, it seemed like a pretty good model."

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Genomic Support for a Moa–Tinamou Clade and Adaptive Morphological Convergence in Flightless Ratites

Allan J. Baker,^{1,2} Oliver Haddrath,¹ John D. McPherson,³ and Alison Cloutier²



Tinamou **Extinct giant moa**

The closest relative of the moa from New Zealand was a small flying bird* from Central and South America called the tinamou.

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Science **Ancient DNA reveals elephant birds and kiwi are sister taxa and clarifies ratite bird evolution**


Kirsten J. Mitchell et al. *Science* 344, 898 (2014); DOI: 10.1126/science.1251981

EVOLUTION

Ancient DNA reveals elephant birds and kiwi are sister taxa and clarifies ratite bird evolution

Kirsten J. Mitchell,¹ Bastien Llamas,² Julien Bouffort,² Nicolas J. Kondea,^{1,4} Fraser H. Worby,² Jamie Wood,² Michael X. Y. Lee,³ Alan Cooper¹

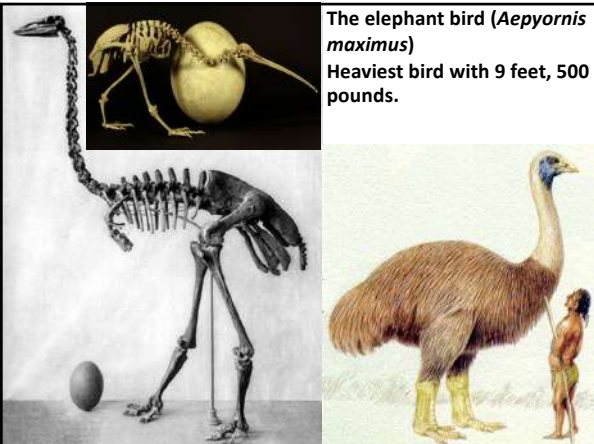
The evolution of the ratite birds has been widely attributed to vicariant speciation, driven by the Cretaceous breakup of the supercontinent Gondwana. The early isolation of Africa and Madagascar implies that the extant and extinct Madagascar elephant birds (*Aepyornithidae*) should be the closest ratite lineages. We sequenced the mitochondrial genomes of two elephant birds and performed phylogenetic analyses, which revealed that these birds are the closest relatives of the New Zealand kiwi and are distant from the least ratite lineage of ostriches. This unexpected result strongly contradicts continental vicariance and instead supports flighted dispersal to all major ratite lineages. We suggest that convergence toward gigantism and flightlessness was facilitated by early Tertiary expansion into the diurnal herbivore niche after the extinction of the dinosaurs.



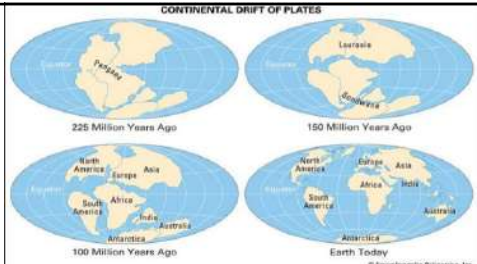
Geographical neighbours aren't necessarily evolutionary neighbours

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The elephant bird (*Aepyornis maximus*)
Heaviest bird with 9 feet, 500 pounds.



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CONTINENTAL DRIFT OF PLATES

225 Million Years Ago 150 Million Years Ago

100 Million Years Ago Earth Today

Common ancestor

50 million years

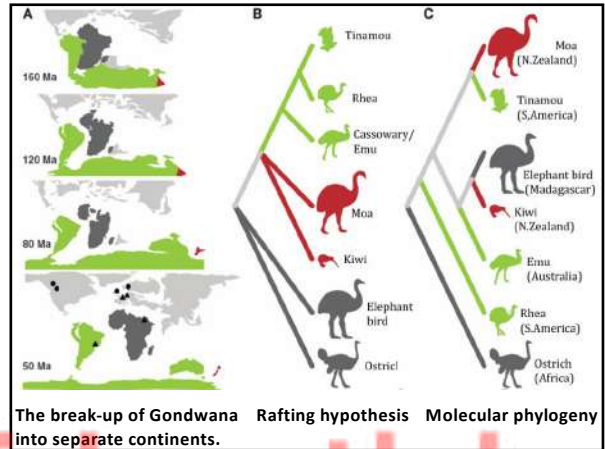
Kiwi Elephant bird

That date poses a serious problem to the idea that ratites have been flightless since the days of Gondwana because by 50 million years ago, Madagascar and New Zealand were already separated by an ocean. "You can't get from Madagascar to New Zealand without flying,

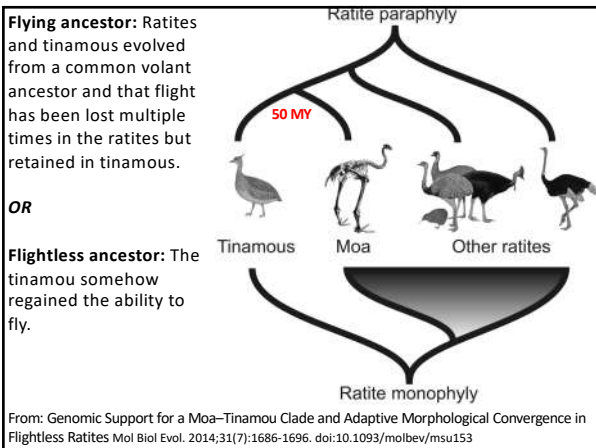
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- Scientists believe that small ancestral birds must have flown long distances, taking up residence in new places around the Southern Hemisphere.
- These small birds then independently evolved (in at least six instances) into the big, flightless birds by losing their wings and becoming plant-eating birds.
- It was a lucky time for them. The large plant-eating dinosaurs had become extinct, and it would take millions of years before large plant-eating mammals would take their place.
- The rafting hypothesis is dead, and the kiwi-elephant bird is the “final nail in the coffin”, says Michael Bunce from Curtin University, who studies ancient DNA. “A number of textbooks need to be re-written.”

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- There's only one plausible explanation: the ratites evolved from small, flying birds that flapped their way between continents and *independently* lost the ability to fly on at least six separate occasions.
- Rise of the ratites probably took place shortly after the extinction event that wiped out most of the dinosaurs. Their absence created an ecological vacuum—there were lots of plants around and no big animals to eat them. The ratites filled those niches. Time and again, they evolved into big plant-eaters, losing the ability to fly in the process.

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- Their ancestors lost the ability to fly independently of one another because
 - 1). they did not need to fly to obtain food or escape from predators probably because they had no important enemies in their habitats.
 - 2). they evolved until they were huge enough to deter most predators, but hard to get off the ground. For e.g., now-extinct 12-foot-tall Moas of New Zealand.
- Being flightless was apparently a winning strategy—as long as humans didn't arrive on their island and wipe them out.



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