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The Avian World's Large Flightless Marvels: The Ratites

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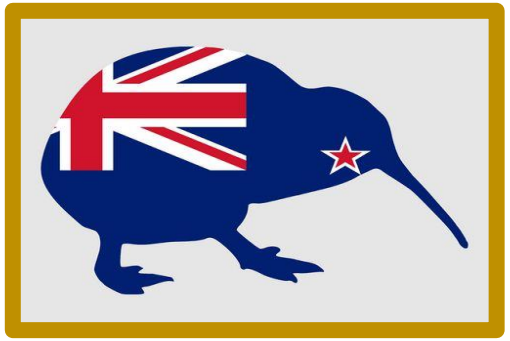
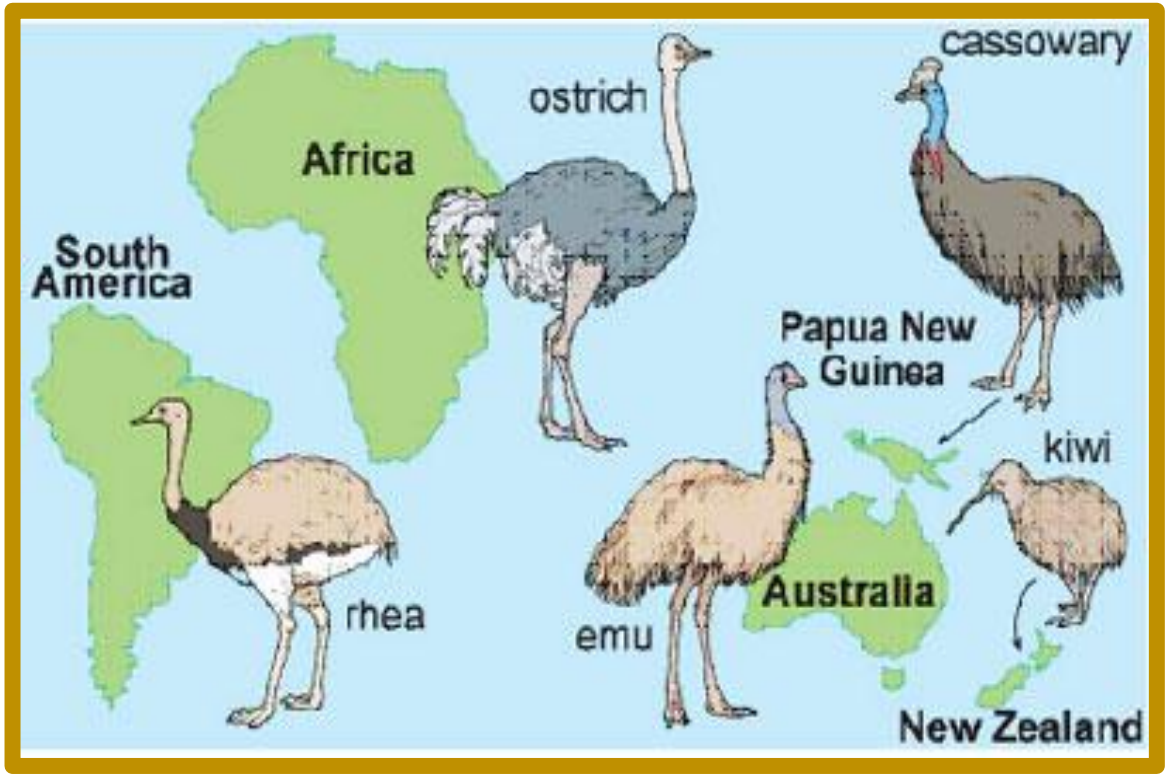
Why Ratites for a Topic?

- **Well, it seems that many people are aware of ratites**
  - ✓ **Even if they are unfamiliar with the term used to describe these birds**
- **And ratites seem to be popular**
- **A ratite stars in its own commercial!**
- **And one nation boasts a group of ratites as a national symbol**



What is a Ratite?

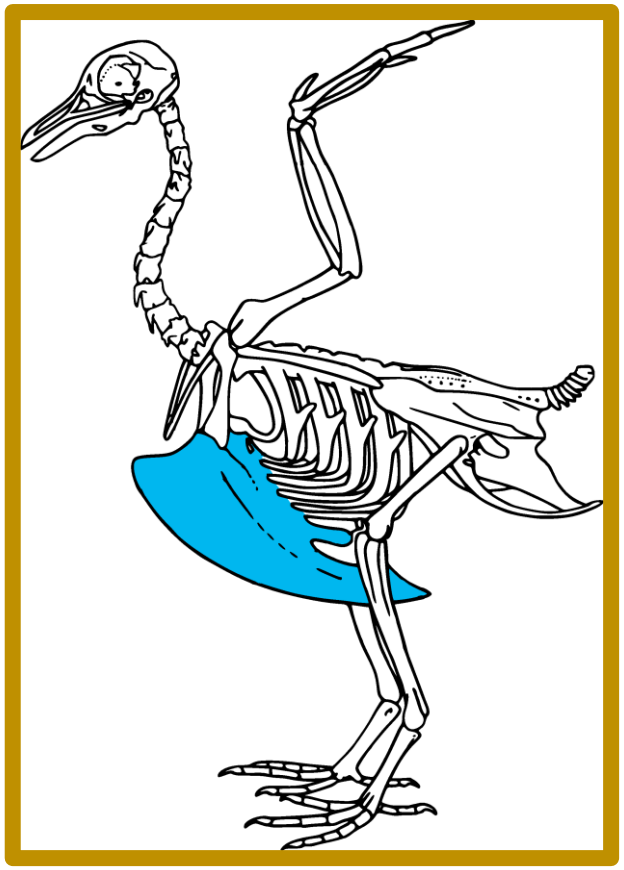
- **Ratites are a group of flightless birds that lack a keeled sternum**
- **Except for Kiwis, ratites are large, long-legged birds**
  - ✓ **With powerful leg muscles permitting them to run at great speeds**
- **Wing and tail feathers have retrogressed into primarily decorative plumes**
- **While the skeleton and muscles of the ratite wing have been simplified**



Note that the Ratites portrayed here are all located in the Southern Hemisphere

Keeled vs Flat Sternums

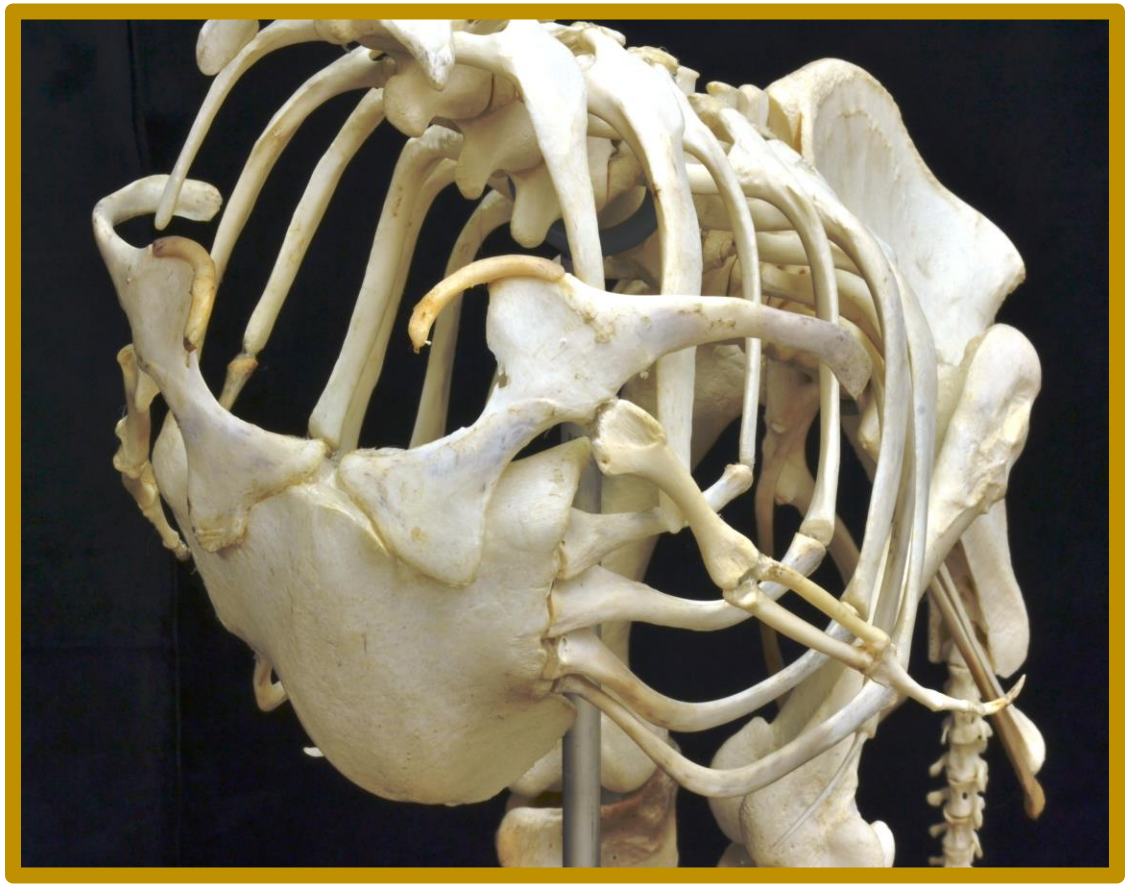
The keeled sternum of flying birds like this pigeon anchors the chest muscles, permitting powered flight



While ratites, as shown by this Emu skeleton, have a flat sternum that is unable to anchor chest muscles and support flight

It’s all in the Name

- **Ratites are named after their flat sternums**
- **The word ratite is derived from the Latin ratitus, meaning a raft or boat with a flat bottom**
  - ✓ **An appropriate name for these group of birds**
- **Birds having keeled sternums have been referred to as carinates**
- **Carinate means sharp edge**
  - ✓ **Also a fitting name for birds displaying prominent projections from the sternum**



A close view of the Emu’s flat sternum

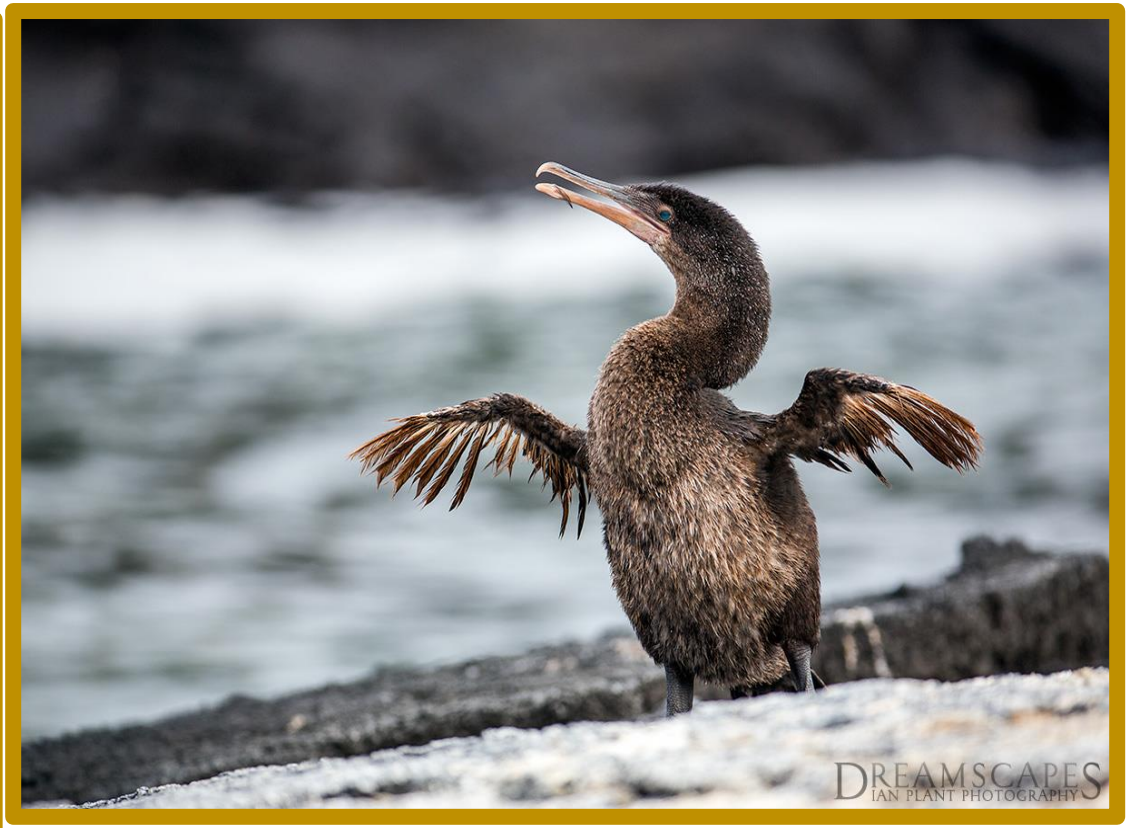
Question Time: Are Penguins Ratites?

No, Penguins are not Ratites

- **Although flightless, penguins have keeled sternums**
  - ✓ **As this Magellanic Penguin skeleton clearly shows**
- **Penguins derived directly from flighted ancestors**
- **Their wings have evolved into powerful swim fins**
  - ✓ **With strong chest muscles as developed as any flying bird**
  - ✓ **And the keeled sternum supports these muscles**

Other Flightless Birds That are not Ratites

- Some species colonizing remote areas evolved secondary flightlessness
  - ✓ In the absence of predators, flight became an energy burden
- Among these species were the Dodo
  - A now extinct pigeon from the island of Mauritius in the Indian Ocean
- The Great Auk
  - ✓ An extinct alcid from the Arctic
- And the Galapagos Cormorant
- In many cases the keel has been reduced, but the sternum is not flat



Note the short, underdeveloped wings on this Galapagos Cormorant

Now Let's Look at the Ratites

Ostrich

- Number of living species: Two
- The Common Ostrich is the largest living bird in the world
  - ✓ Attaining a maximum height of just over 9 feet and weighing up to 340 pounds
- Running on powerful legs, it can obtain speeds of more than 40 mph
  - ✓ With average speeds of 30 mph for up to 10 miles
- Both Ostrich species are primarily herbivores, but young will readily consume insects

A Common Ostrich breeding pair with young. The adult male is black and the female brown. The necks of both adults are a light pink.

At Home in the Grasslands

- **The Common Ostrich occupies savanna habitat (grassland with scattered trees)**
  - ✓ **In northern and southern Africa**
- **While the range of the slightly smaller Somali Ostrich is confined to the Horn of Africa**
  - ✓ **Where it uses grasslands with more thickly vegetated areas**
- **Ostriches in Asia Minor and the Arabian Peninsula went extinct by the middle of the 20th Century**

- **The neck of the Somali Ostrich is a deep blue-gray unlike the light pink neck of the Common Ostrich.**
- **Ornithologists agreed that the Somali Ostrich was a distinct species in 2014.**

Ostriches do not Bury Their Heads in the Sand

Honest Folks. It's Called Photoshop.

But Tourists Can Ride Them in Kenya

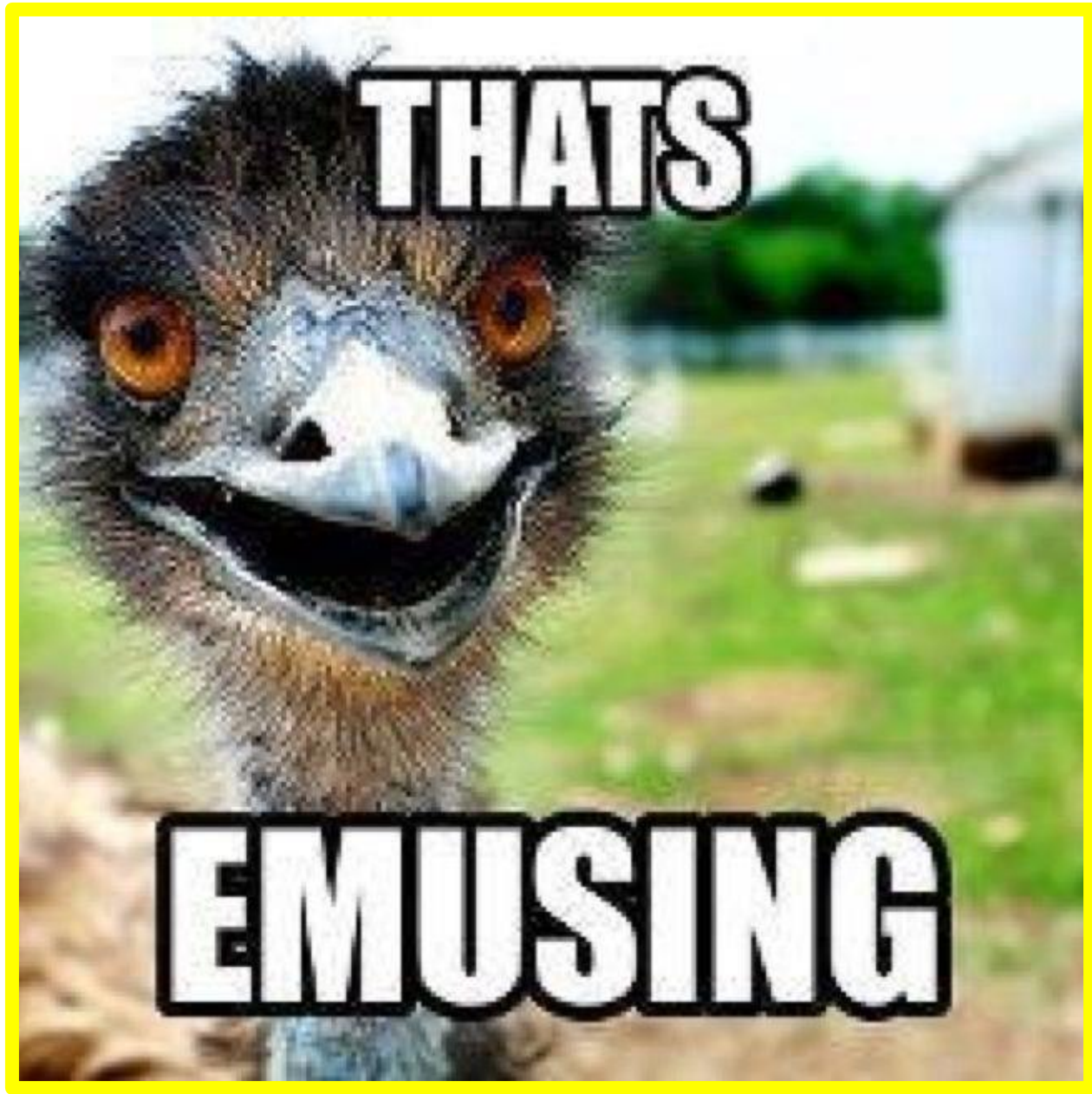
Emu

- Number of living species: One
- The Emu can reach a height of just over 6 feet and weigh up to 110 pounds
- It can sprint up to 30 mph
- The species is native to Australian savanna and scrubland
  - ✓ Where it grazes on plants, but also eats a host of invertebrates when available
- Dwarf Emu populations on islands off the Australian coast are now extinct

The Emu population in Australia appears quite secure

The Emu War of 1932

- **In the latter part of 1932 the Australian military was deployed to western Australia**
  - ✓ **In a "nuisance" wildlife management operation in Campion District**
  - ✓ **To reduce the number of Emus said to be "running amok" over the area**
- **The operation began on Nov 2 and ended on Dec 10**
  - ✓ **When fired upon, Emu flocks broke up into smaller groups that were less easily targeted**
  - ✓ **And the Emus won!**


THATS
EMUSING

Cassowary

- **Number of Living Species: Three**
- **The Southern Cassowary is the largest of the three species**
  - ✓ **Standing up to 5.5 feet tall and attaining a maximum weight of 130 pounds**
- **All three Cassowary species are impressively fast**
  - ✓ **And can run up to 30 mph in the dense forest habitat in which they dwell**
  - ✓ **As well as jump up to 5 feet**

The Southern Cassowary

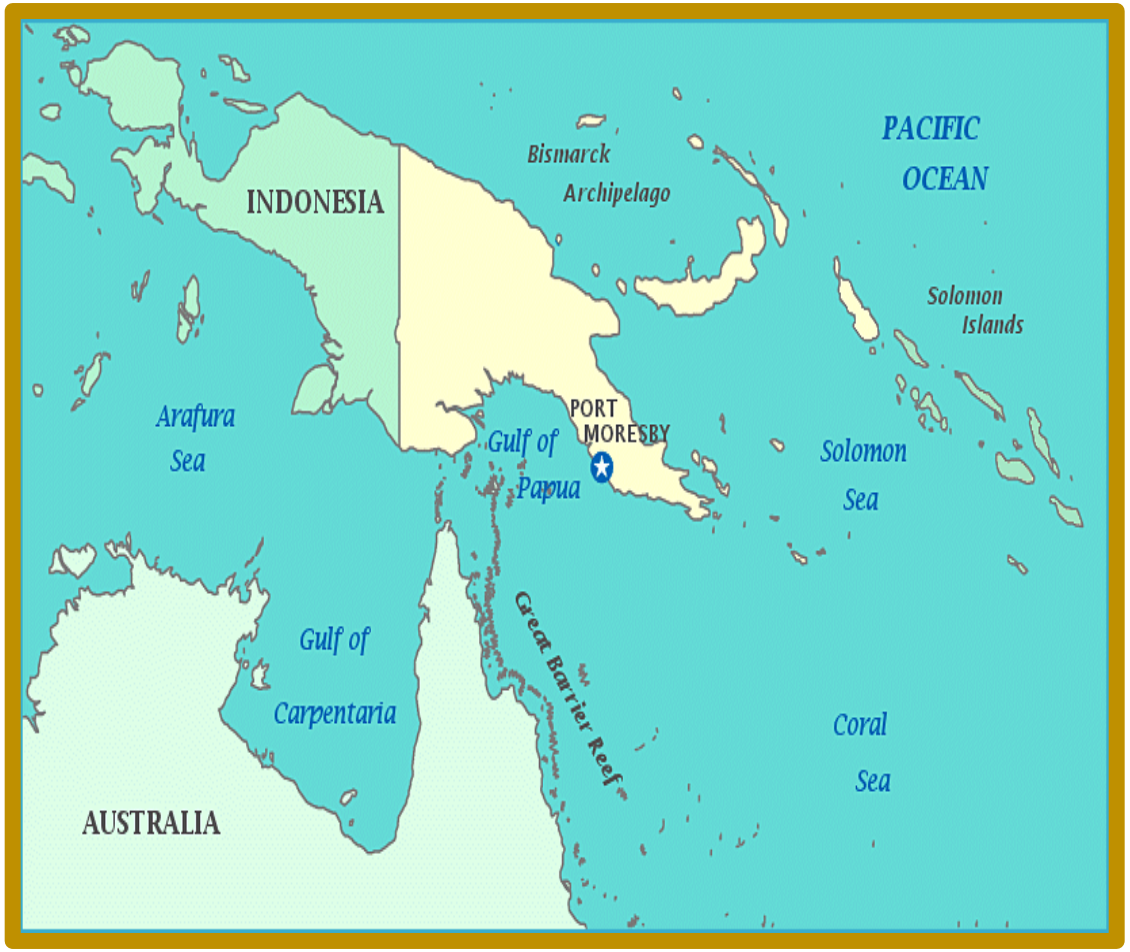
The Other Cassowary Species

The Northern Cassowary

The Dwarf Cassowary

A Bird of the Tropical Rain Forest

- ❑ **The Southern Cassowary occupies lowland rain forests in southern New Guinea and northeastern Australia**
- ❑ **While the Northern Cassowary lives in similar habitat in northern and western New Guinea**
- ❑ **The Dwarf Cassowary is found in upland forests in New Guinea**
- ❑ **All three species have a varied diet, but rely heavily on fruit**
  - ✓ **And are great seed dispersers in the rain forest**



The Casque

- The casque is a hollow, keratinous skin-covered head projection that grows with age
- The casque may be multi-functional
  - ✓ It can be used in mating displays or as a weapon in dominance disputes
  - ✓ It may protect the bird's head from dense vegetation as it runs through the forest
  - ✓ It may have a cooling function
  - ✓ It may amplify deep sounds and assist in transmitting the Cassowary's low frequency vocalizations

Both male and female of all three Cassowary species have a casque

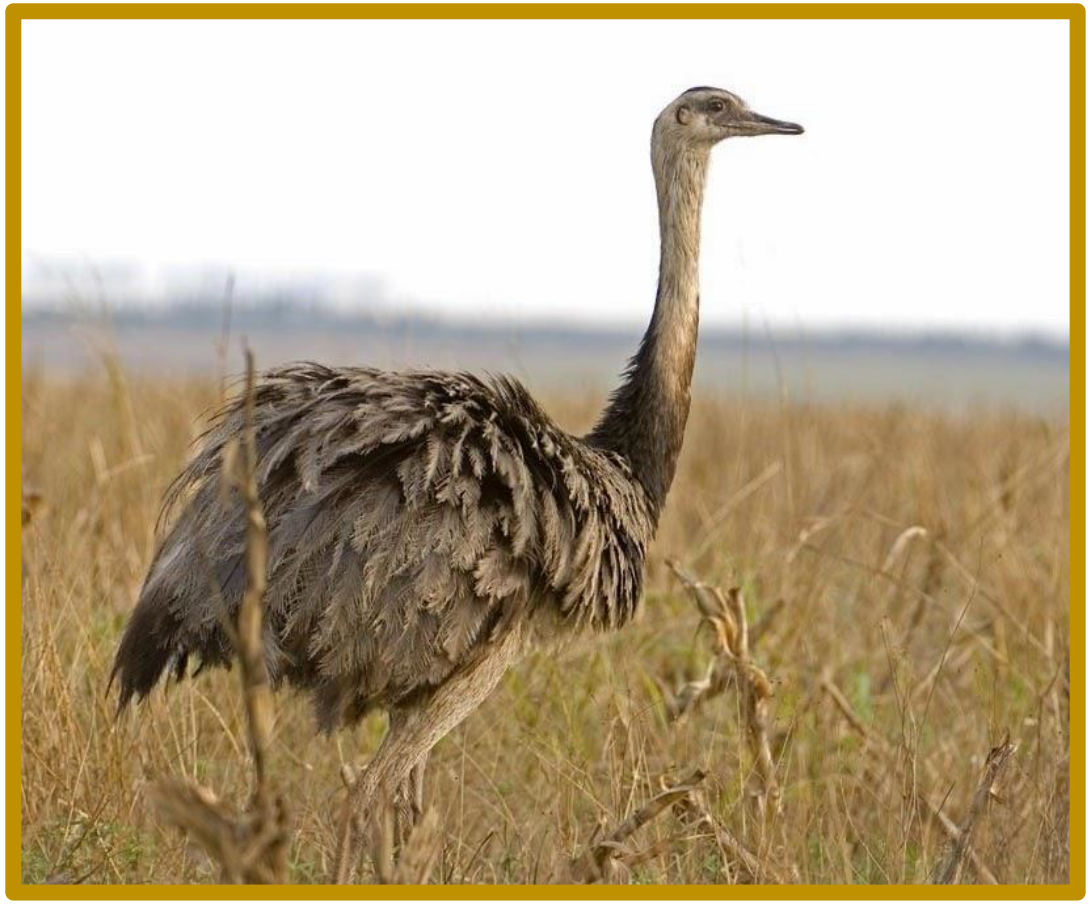
The “Deadliest Bird in the World”

- **A 1999 study documented 150 Cassowary attacks on humans**
  - ✓ **Three-quarters involved Cassowaries chasing, and less frequently, attempting to kick victims**
    - ❖ **Often these birds had been fed by humans**
  - ✓ **One-quarter involved Cassowaries protecting themselves or nests from real or perceived human attack**
- **In April 2019, a hand-raised bird in Florida clawed his owner, 75-year old Marvin Hajos, to death after Hajos tripped and fell to the ground**

Of all the ratites, and likely of all living birds, Cassowaries have the reputation of being the most dangerous to humans.

Rhea

- **Number of Living Species: Two**
- **The larger Greater Rhea measures up to 4.5 feet tall and can weigh as much as 85 pounds**
- **The Greater Rhea, and its sister species, the 55-pound Lesser Rhea, are small compared to the Ostrich**
  - ✓ **But they most closely resemble the Ostrich in structure and form**
  - ✓ **At least in my opinion**



The Greater Rhea

Unique to the Western Hemisphere

- The Greater Rhea is native to lowland savanna and open grasslands in Brazil and several neighboring countries
- While the Lesser Rhea occupies similar habitat in Argentina and Chile
  - But in both upland and lowland grassland areas
- Rheas are primarily vegetarian, preferring broad-leaf plants
  - But will consume invertebrates and small animals when available
  - However, recently-hatched young may eat only invertebrates for a brief time

The Lesser Rhea

The Longest Wings of any Living Ratite

- Rheas can run up to 40 mph
  - ✓ Making them perhaps the fastest ratite
- The long wings are generally outstretched when running
- The wings may be used as stabilizers when running over uneven ground
- Or as rudders for making quick turns
  - ✓ By dipping the left wing down for turning left for example
- The wing may even function as a sail when there is a strong backwind

Kiwi

- Number of Living Species: Five
- The Great Spotted Kiwi, the largest species, gets no more than 1.5 feet tall and barely exceeds 7 pounds
- And the Kiwi is no speedster
  - ✓ As it saunters along on short legs
- The Kiwi fills the ecological role of small land mammals in New Zealand
  - ✓ That were absent until Maori settlers introduced rats in the 1200s.

The Kiwi, like the Great Spotted Kiwi shown in the photo, is an anomaly among ratites because of:

- ✓ small size
- ✓ inability to run quickly
- ✓ lifestyle

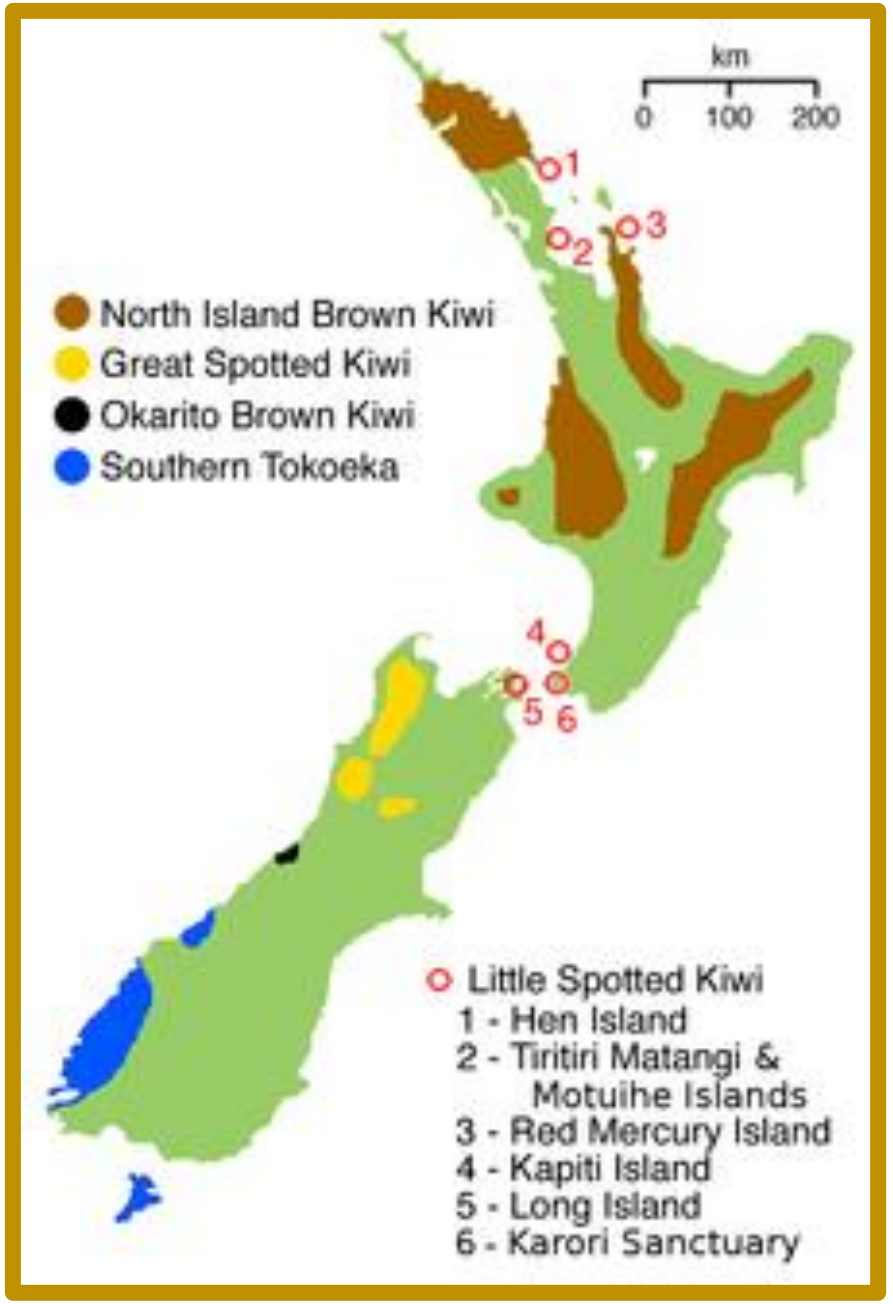
The Kiwi Lifestyle

- Kiwis eat many worms, grubs, and other underground invertebrates
  - ✓ That they can detect through a keen sense of smell
  - ✓ They are primarily nocturnal foragers
- Kiwis had difficulty competing with introduced small mammals
  - ✓ Many of which have similar, if not identical, foraging habits
- Also, the introduction of predators, like dogs, cats, and stoats, in the 1800s became a significant threat

- The introduction of invasive mammals caused population declines among all Kiwi species.
- New Zealand has made great efforts to protect the birds.
- The North Island Brown Kiwi, pictured here, with an estimated population in 2008 of 25,000, is the most common Kiwi species in New Zealand.

Kiwi Distribution

- Kiwis prefer dense forest habitat
  - ✓ But appear to be adapting to more open areas
- The New Zealand government has opened numerous predator-free sanctuaries to protect the birds
  - ✓ With hopeful results in some areas
- The distribution of the five Kiwi species is shown on the map



The Kiwi is the National Symbol of New Zealand

The Kiwi patch worn by New Zealand troops serving in Kandahar, Afghanistan

New Zealanders Even Refer to Themselves as Kiwis

Moa

- Number of estimated species: Nine
- All are extinct
- Moas were native to New Zealand and the dominant herbivore there
  - ✓ Occupying rain forest, scrubland, and alpine habitat
- The two largest species were 12 feet tall and weighed up to 510 pounds
- Maori settlers arrived in New Zealand by 1280 and hunted all Moa species into extinction by 1450

The Upland Moa in alpine habitat

Elephant Bird

- Number of estimated species: Nine
- All are extinct
- Elephant Birds were native to Madagascar
  - ✓ Occupying both forest and grassland
- Elephant birds were likely nocturnal
  - ✓ Based on their small occipital lobes
- They were the largest ratites ever
  - ✓ With at least two species standing over 10 feet tall
  - ✓ And easily clearing 1000 pounds

- An illustration of Aepyornis maximus.
- This species weighed up to 1100 pounds. An even larger species,
- Vorombe titan, topped the scales at an impressive 1400 pounds.

The Demise of Big Bird and the Big Egg

- **All Elephant bird species were extinct probably by the late 1600s**
- **The first humans in Madagascar arrived between 200 BC and 500 AD**
- **These and successive waves of settlers hunted Elephant Birds**
  - ✓ **While eating the eggs and using the shells for cups and bowls**
- **Avian diseases introduced by domestic fowl like chickens likely contributed to the extinction process**

- **The Elephant Bird egg was a foot long and 28 inches in circumference, providing a meal plus its container**

The Lesson to be Learned?

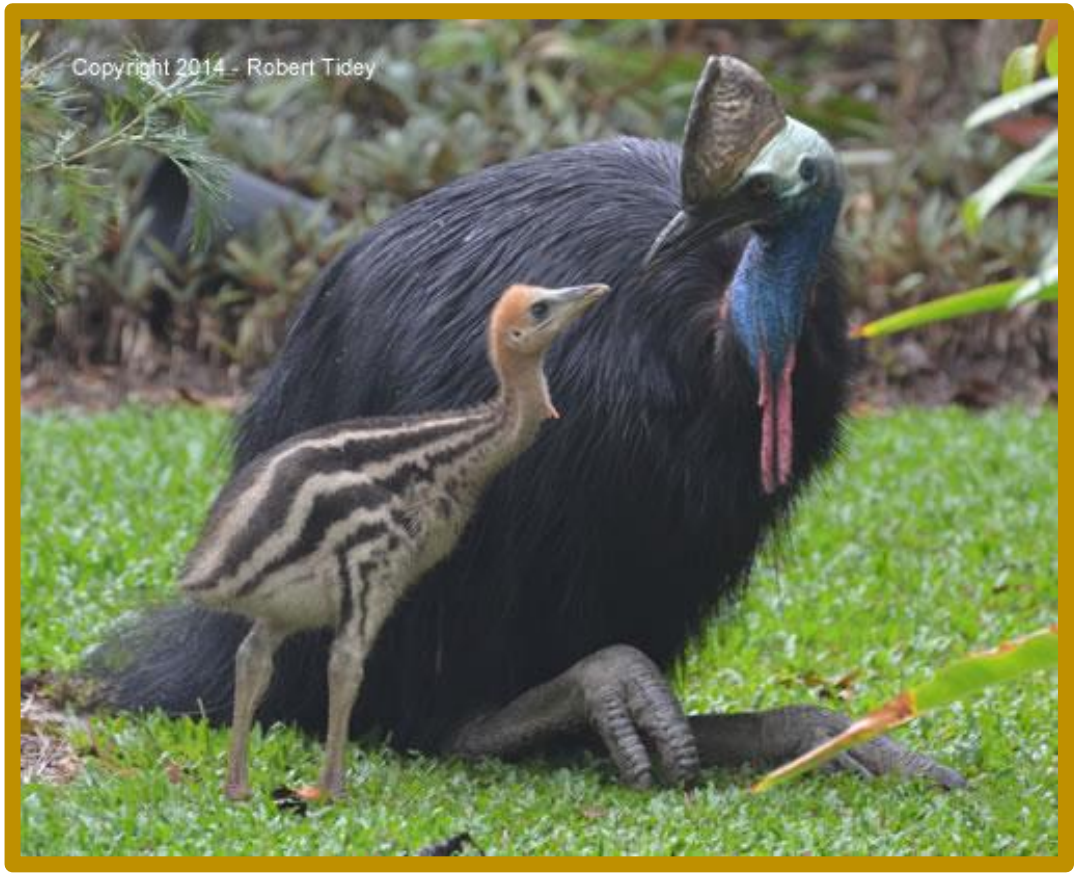
It’s bad news to be a flightless bird living on an island when humans arrive

Ratite Longevity

- **Ratites are long lived birds**
- **A wild Emu can live up to 20 years**
- **Wild Ostriches and Cassowaries can reach a maximum of 40 to 50 years**
- **Kiwis can make it to 60 years**
  - ✓ **Kiwi chick survivability is 5% where mammalian predators are present**
  - ✓ **But well over 50% survivability has been documented in predator free areas**
- **Captive ratites live for longer periods**
  - ✓ **With 70-year old Ostriches reported**

Ratite Breeding and Sexual Role Reversal

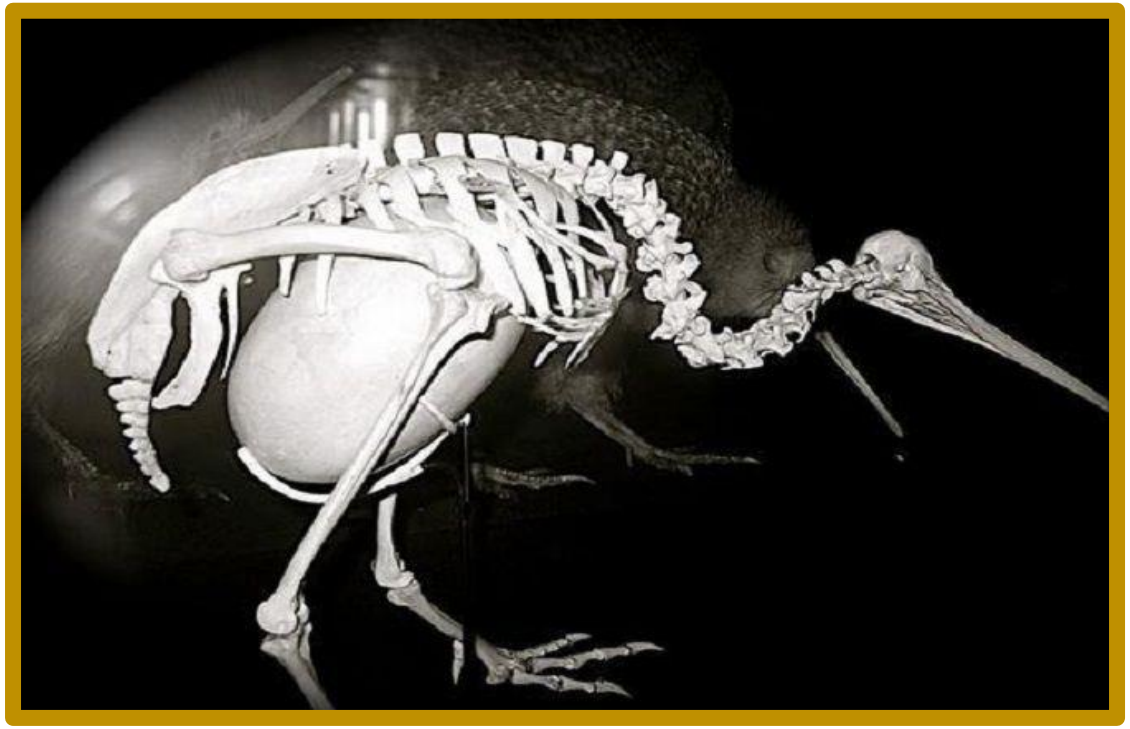
- In most cases, only male ratites incubate eggs and care for young
- Female ratites are generally bigger than males
  - ✓ And often mate with multiple partners
  - ✓ Leaving each male the responsibility of parental duty
- The exception is the Ostrich and the Great Spotted Kiwi
  - ✓ In which both sexes incubate eggs
  - ✓ Ostriches may also raise young collectively with other breeding pairs



A male Southern Cassowary tends to a chick

Bless the Poor Female Kiwi

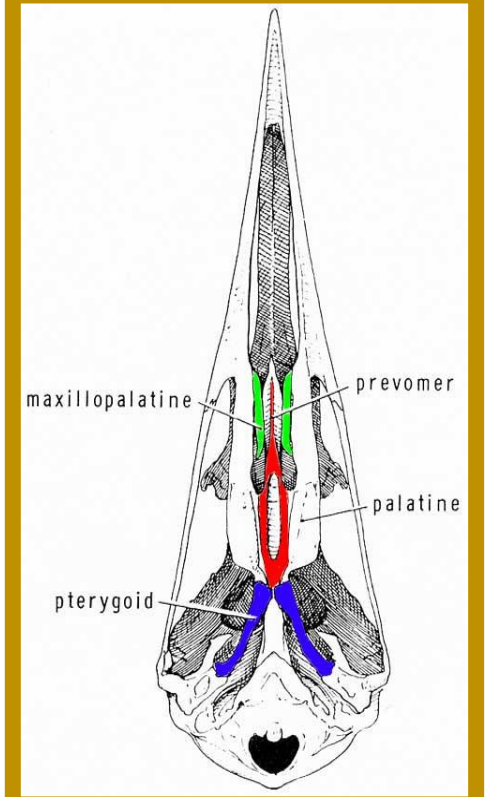
- In proportion to body size, female Kiwis lay bigger eggs than any other bird in the world
- A Kiwi female carries an egg that is 20% of her body weight
- Meaning the egg of a 7-pound female Great Spotted Kiwi weighs about 1.4 pounds



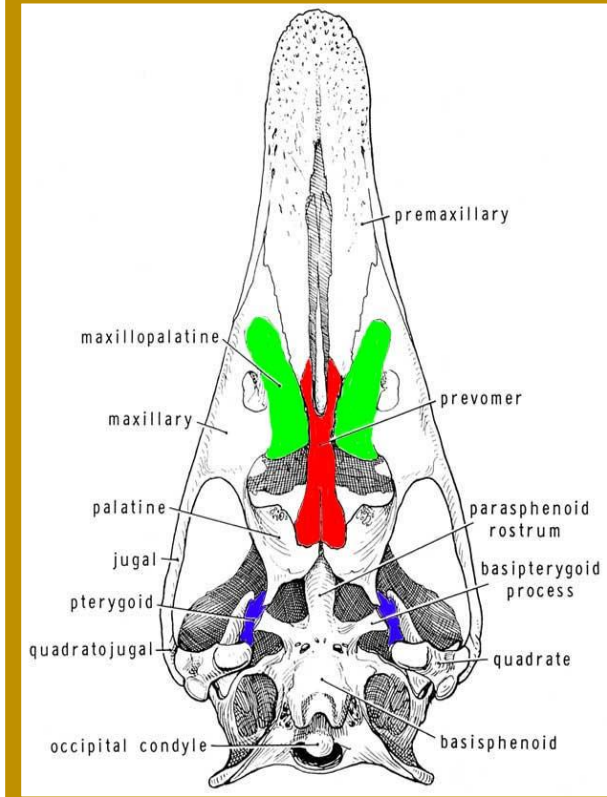
- This Kiwi skeleton shows how the incredibly large Kiwi egg is positioned in the female's body

A Review and Additional Details of Ratite Similarities

- ❑ They are flightless and have a flat sternum
  - ✓ And except for Kiwis, have powerful legs
- ❑ The male alone takes responsibility for rearing young
  - ✓ With the Ostrich and a Kiwi species the only exception
- ❑ They belong to the Paleognaths
  - ✓ Or birds with “ancient jaws”
  - ✓ Meaning that the palate morphology is more reptilian than in typical birds
- ❑ They are genetically related



The palate, or roof of the mouth, in a typical bird, like this Laughing Gull



The palate in Ratites, like this Rhea, has a more reptilian structure

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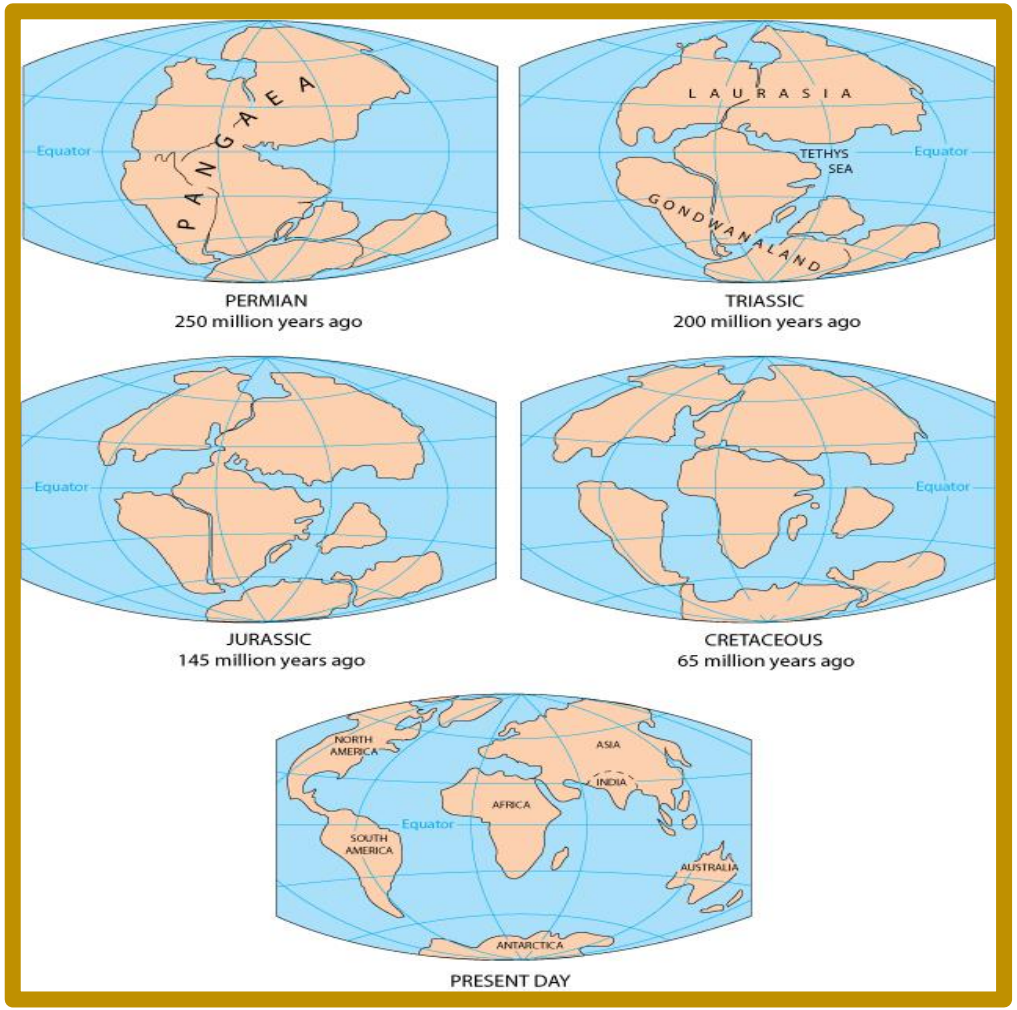
The Geological Background to Ratite Evolution

- **Two continents existed during the Triassic Period between 252 and 200 million years ago (mya)**
  - ✓ **Laurasia and Gondwanaland**
- **Gondwanaland began to break up during the middle of the Jurassic period about 170 mya**
  - ✓ **Before the evolution of birds began some 10 to 15 million years later**
- **By the end of the Cretaceous Period 65 mya, Gondwanaland's break up had been nearly completed**

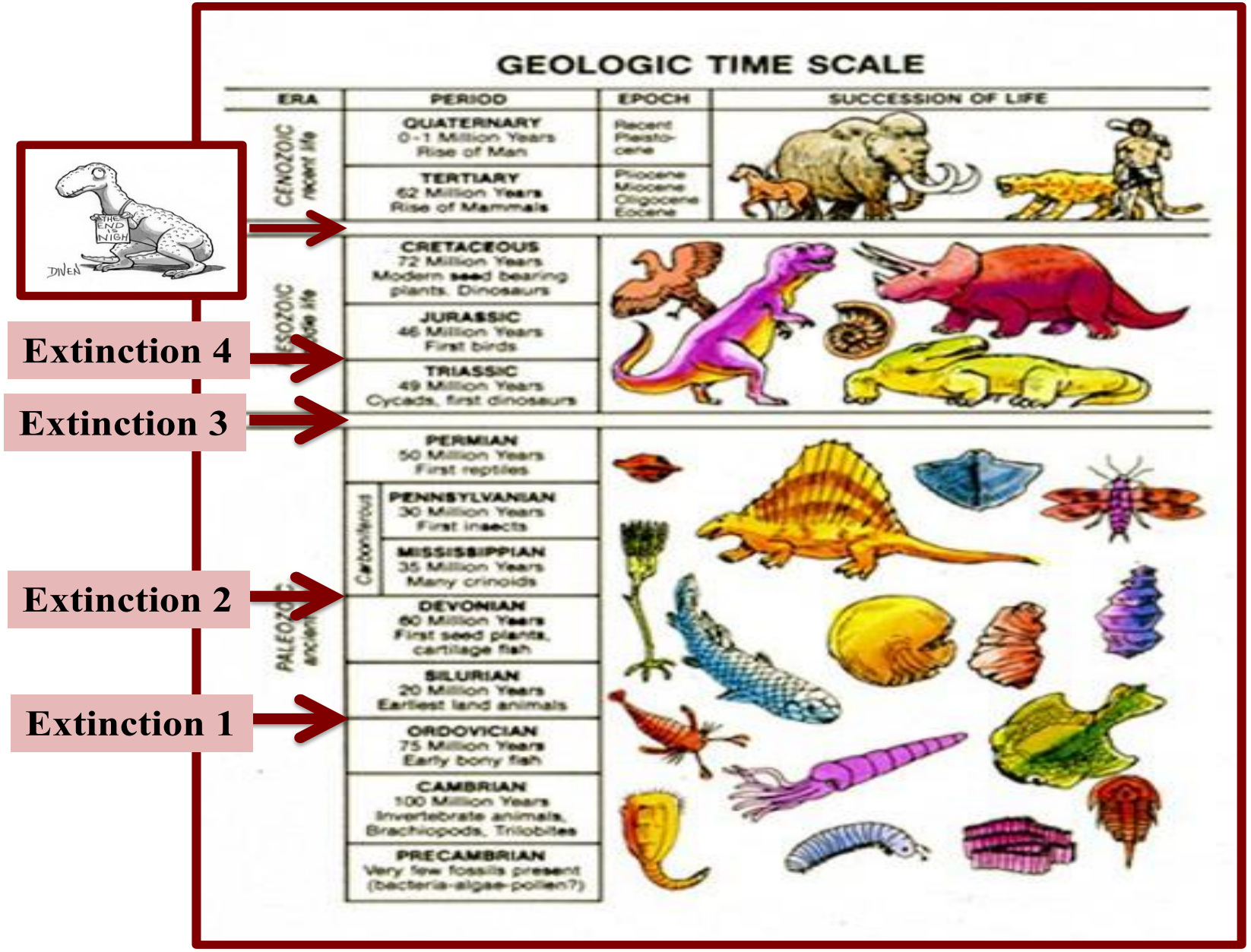


The Gondwanaland Theory of Ratite Evolution

- **This theory claims that flightless Ratites evolved in the Cretaceous Period in Gondwanaland**
  - ✓ **And spread throughout the Southern Hemisphere on foot while the landmass was mostly intact**
  - ✓ **Explaining why Ratites are found only in the south**
- **The problem is that Ratite ancestors are not found in the fossil record until after the Cretaceous-Tertiary Extinction**
  - ✓ **And then primarily in the Northern Hemisphere**

- **Lithornis is a genus of birds that gave rise to the Ratites. Fossil records of Lithornis date from the upper Paleocene to mid-Eocene Epochs of the Tertiary Period (60 to 45 mya).**
- **Unlike the Ratites, Lithornis was an accomplished flyer.**

The Post-Cretaceous Extinction Theory of Ratite Evolution



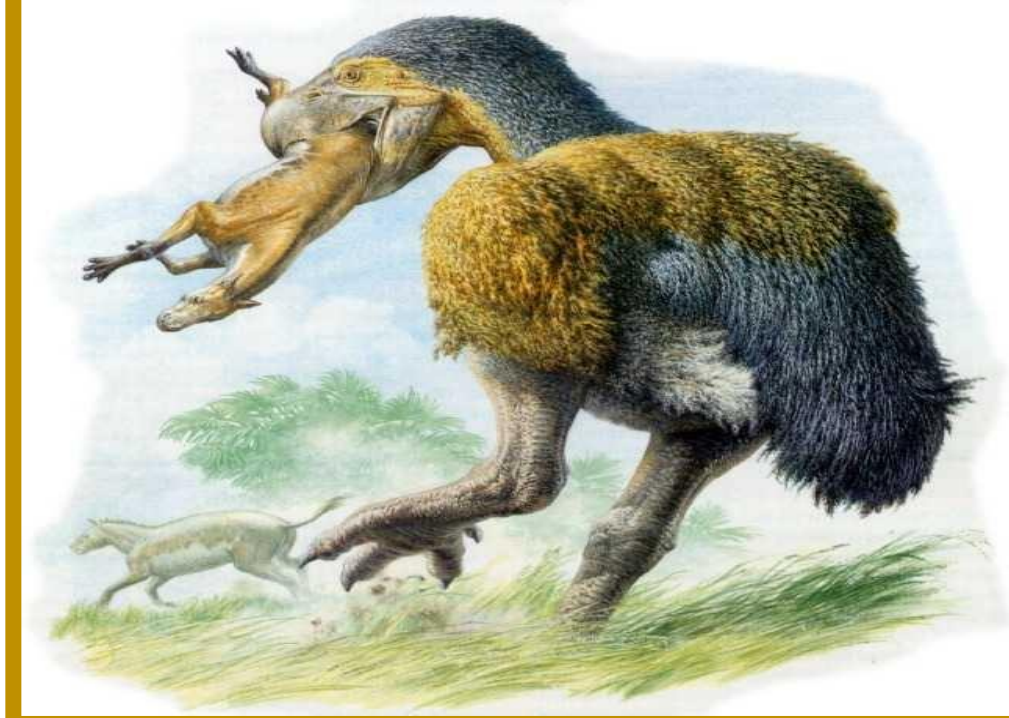
The Post-Cretaceous Extinction Theory of Ratite Evolution

- This theory states that several species of Lithornis evolved in the Northern Hemisphere
  - ✓ And after the Cretaceous-Tertiary Extinction
- They expanded into the Southern Hemisphere by flying
  - ✓ And evolved into Ratites
- This means that all Ratites became flightless and achieved large size independently
  - ✓ In a process called convergent evolution

A fossil of a Lithornis species of bird

The End of the Dinosaurs and the Brief Reign of Large Birds

- The extinction of the dinosaurs left many niches vacant
  - ✓ Including those for large animals
- Birds initially filled these niches
  - ✓ One example was a 7 to 10-feet tall non-Ratite carnivorous bird
  - ✓ From the genus Diatryma that filled the Tyrannosaurus Rex niche
- Eventually large mammals evolved and prevailed in filling these niches
  - ✓ As large birds like Diatryma went extinct



- Evolving from a flighted ancestor, Diatryma, also known as the Terror Bird, lived in the Paleocene and Eocene Epochs.
- Diatryma is shown here preying on an ancient horse.

Ratites Persisted

- Ratites evolved and survived past the Eocene (34 mya) into modern times
  - ✓ While other large birds gradually went extinct
- Ratites persisted primarily because they could outrun predators
  - ✓ And were successful against niche competitors
- And Ratites on islands had few predators and niche competitors were absent
  - ✓ That is of course until humans arrived

A Collage of Ratites

Why Are Kiwis Small Compared to Other Ratites?

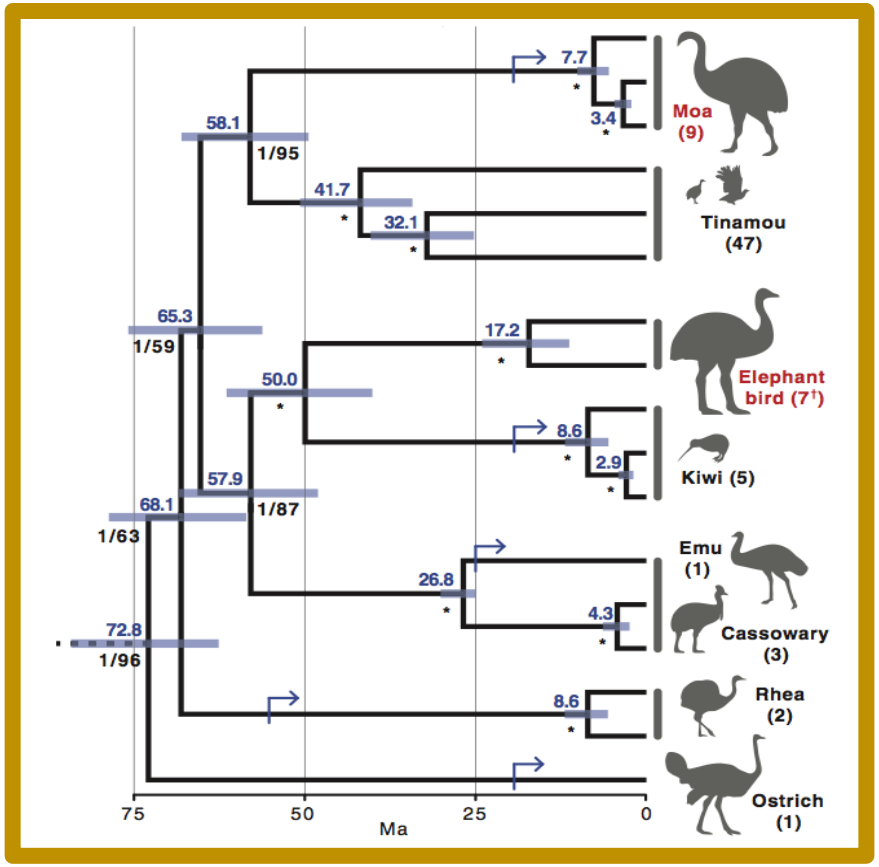
- **Some experts suggest that flighted Moa ancestors arrived in New Zealand about 58 mya**
  - ✓ **While Kiwi ancestors arrived 8 million years later**
- **They state that the large herbivore niche in New Zealand had already been filled by the Moa**
  - ✓ **While the small animal niche, generally filled by mice, shrews, and other small mammals, was completely vacant**
  - ✓ **And the Kiwis evolved to fill it without the necessity to grow large**

Kiwis are the only Ratites that fit in the palms of your hands

A Final Word on Ratite Taxonomic Relationships….. Or is it?

- ❑ The latest research shows that Ostriches and Rheas are basal Ratites
  - ✓ Meaning the first to evolve
- ❑ Emus and Cassowaries are each others closest relatives
- ❑ Kiwis and Elephant Birds are closely related
  - ✓ Surprising, but they both share small occipital lobes and are nocturnal
- ❑ Finally, Moas and Tinamous are….

✓STOP! WHAT IS A TINAMOU?



Ratite Lineage in Chart Format

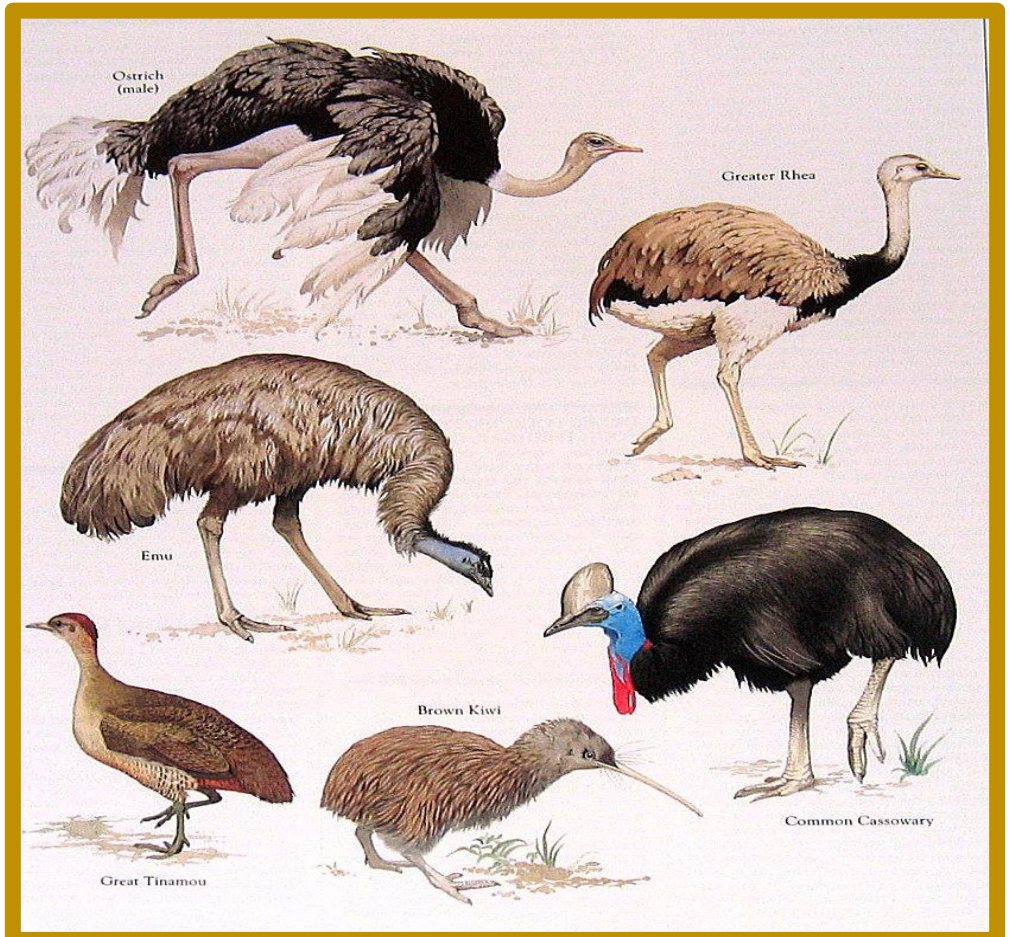
Tinamou, or the non-Ratite Relative of Ratites

- Tinamous are found exclusively in Central and South America
- They are not Ratites
  - ✓ They have a keeled sternum and are capable of flight, but prefer to walk
- But they are Paleognaths
  - ✓ Meaning that they share the same "ancient jaw" palate as Ratites
- Tinamous and Ratites are genetically closer than previously thought
  - ✓ And support the theory that Ratites evolved directly from flighted ancestors

- The Red-winged Tinamou is one of the more common of the 47 living species of Tinamous.

Questions and Final Comments

- The research on this topic was fascinating
- Ratites are more than living fossils
  - ✓ And seem well integrated into their ecosystems
  - ✓ Primarily in terms of seed dispersal
- Previously Tinamous were considered distant Ratite cousins
  - ✓ But are now integrated into Ratite taxonomic charts
  - ✓ Perhaps making the term Ratite archaic
  - ✓ And Paleognath more appropriate



The group of living Paleognaths


BOB'S
ASSORTED
RODENTS
AL'S
Small, flightless
BIRDS

The World of Pollinators
April 15, 2020