

History
Chapter 2

June 3rd, 2010

Birds ARE Reptiles.

	Birds	"Reptiles"	Mammals
Occipital Condyles	1	1	2
Middle Ear	1 Bone	1 Bone	3 Bones
Mandible	Multiple Bones	Multiple Bones	1 Bone
Ankle in Tarsals?	Yes	Yes	No
Scales?	Yes	Yes	No
Eggs?	Yes	Many	Mostly No
Heterogametic Female?	Yes	Some	No
Nucleated RBCs?	Yes	Yes	No

Evidence.

- *Archaeopteryx lithographica*
 - Jurassic Period
 - ~150 mya
 - 7 specimens
 - Fully Articulated →
 - Real Feathers
 - "Reptilian"

Evidence.

- *Archaeopteryx lithographica*
 - Furcula

Evidence.

- *Archaeopteryx lithographica*
 - Larger brain
 - Better vision
 - Better hearing
 - Compared to reptiles

Comparison.

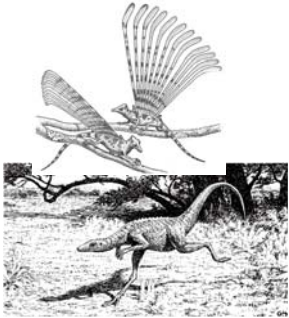
- *Archaeopteryx lithographica*

Relevance.

- *Archaeopteryx lithographica*
 - Links traditional reptiles with modern birds
 - Intermediacy supported Darwin and Wallace


What Kind of Reptiles?.

Triassic	Jurassic	Cretaceous
		Crocodylians
		Birds
		Sauropod dinosaurs
		Theropod dinosaurs
		Birds
		Ornithischian dinosaurs
		Flying reptiles




What Kind of Reptiles?.

- Theropod Dinosaur Support
 - Some may have been warm-blooded
 - Feathers, furcula, pygostyle, bill, one-way respiration present in dinosaurs



What Kind of Reptiles?.

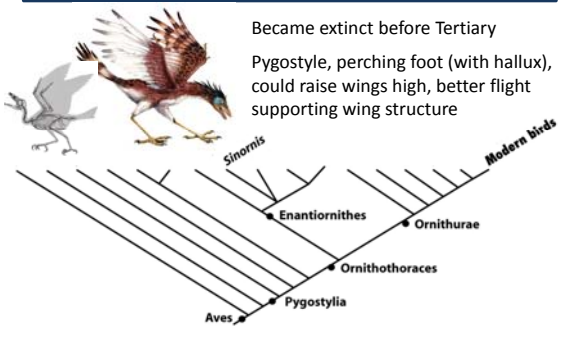
- Theropod Dinosaur Problems
 - Digit Reduction



Era	Period	Epoch	MYA
Cenozoic (age of birds and mammals)	Quaternary	Recent	0.01
		Pleistocene	1.5 - 3.5
	Tertiary	Pliocene	7
		Miocene	26
		Oligocene	36 - 38
		Eocene	53 - 54
Mesozoic (age of reptiles)	Cretaceous	Paleocene	65
		Late	100
	Jurassic	Early	135
		Late	155
	Triassic	Early	170
		Middle	180 - 190
			230

Early Avian Evolution

Became extinct before Tertiary
 Pygostyle, perching foot (with hallux), could raise wings high, better flight supporting wing structure



Early Avian Evolution.

Survivors included species related to modern chicken, waterfowl, and ratites

The diagram is a phylogenetic tree with 'Aves' at the base. A branch leads to 'Pygostylia'. Another branch leads to 'Ornithothoraces', which further divides into 'Enantiornithes' and 'Ornithurae'. 'Ornithurae' leads to a group of 'Modern birds', including 'Yanornis', 'Patagopteryx', 'Hesperornis', 'Apsaravis', and 'Ichthyornis'. An illustration of a feathered dinosaur is shown above the tree.

Evolution of Feathers.

- Feathers originated with theropod dinosaurs
 - Similar to modern feathers
- Form and function diversified in birds
- Feathers originated for thermoregulation
- Not from scales
- Allowed flight to develop

Evolution of Flight

- **Two Theories**
 - **Arboreal**
 - Trees down
 - **Cursorial**
 - Ground up

The diagram shows a staircase-like progression of flight evolution. From bottom to top: 'Quadrupedal locomotion—ground-dwelling ancestral thecodont', 'Bipedal locomotion—thecodonts or later theropod dinosaurs', 'Cursorial life—preproavis', 'Arboreal life—proavis', 'Leaping between trees', 'Parachuting', 'Gliding', 'Archaeopteryx', and 'Active flight To modern birds'.

Evolution of Flight.

- **Two Theories**
 - **Arboreal**
 - Trees down
 - **Cursorial**
 - Ground up

Theropod Dinosaurs that hunted by leaping and jumping would be aided by extra maneuverability and increased gliding distance

Evolution of Flight.

- **Two Theories**
 - False dichotomy
 - Lift and thrust most important

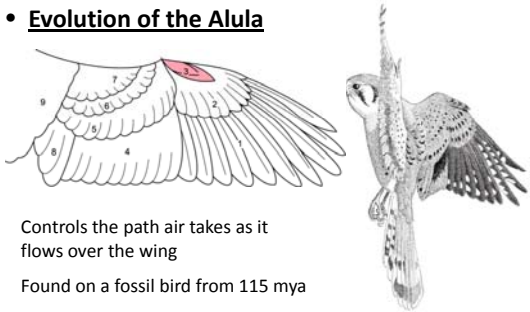
Evolution of Flight

- **Wing-assisted Incline Running**

The diagrams show six flight modes with labels: 'Horizontal (Walk and run only, no flapping)', 'Incline (Walk and run only, no flapping)', 'Incline > 45° (Run-flapping)', 'Vertical flight (Run-flapping)', 'Vertical flight (flapping only)', and 'Horizontal flight (flapping only)'. Arrows indicate the direction of movement and the position of the wings.

Evolution of Flight.

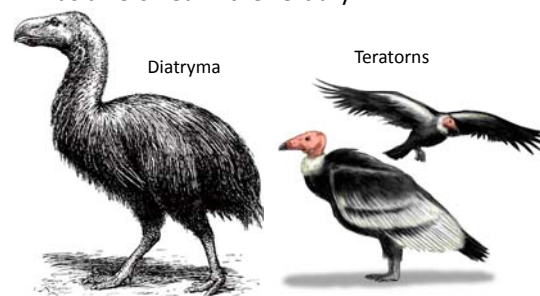
- Evolution of the Alula**



Controls the path air takes as it flows over the wing
 Found on a fossil bird from 115 mya

Modern Birds.

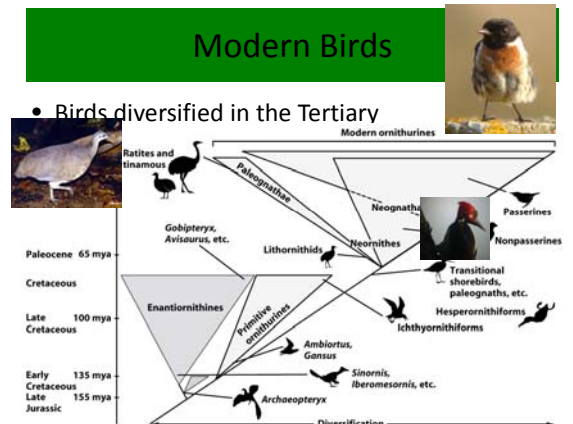
- Birds diversified in the Tertiary



Diatryma Teratorns

Modern Birds

- Birds diversified in the Tertiary



Timeline labels: Paleocene 65 mya, Cretaceous, Late 100 mya, Early 135 mya, Cretaceous Late 155 mya, Jurassic.

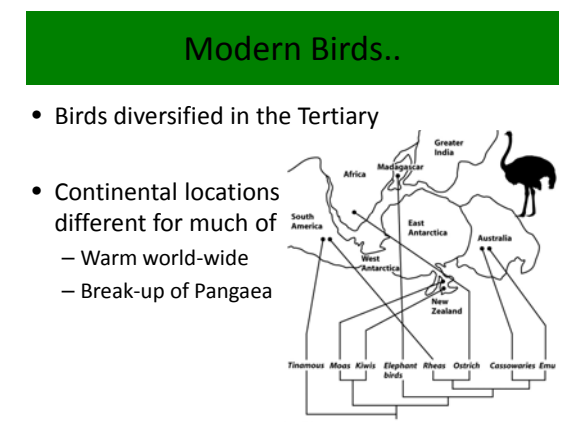
Key groups: Enantiornithines, Primitive ornithurines, Ambiorius, Gansus, Sinornis, Iberomesornis, etc., Archaeopteryx, Hesperornithiforms, Ichthyornithiforms, Transitional shorebirds, paleognaths, etc., Neornithes, Lithornithids, Gobipteryx, Avisaurus, etc., Palaeognathae, Neognathae, Passerines, Nonpasserines, Ratites and tinamous, Modern ornithurines.

Era	Period	Epoch	MYA
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			155
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Rapid Evolution of flowering plants and insects

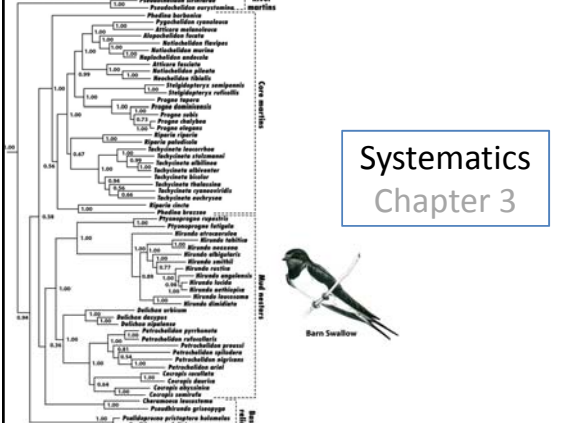
Modern Birds..

- Birds diversified in the Tertiary
- Continental locations different for much of
 - Warm world-wide
 - Break-up of Pangaea



Map labels: South America, West Antarctica, East Antarctica, Africa, Madagascar, Greater India, Australia, New Zealand, Timonius, Moas, Kiwis, Elephant birds, Rheas, Ostrich, Cassowaries, Emu.

Systematics Chapter 3



Barn Swallow


Taxonomy.

- Classifying and naming organisms
 - Standardizes names and facilitates communication
- Taxon: a group of organisms (e.g., species, family)
 - Plural is "taxa"
- Basic unit is scientific name
 - Example: *Bubo virginianus*

Taxonomy

- Species then placed into larger groups

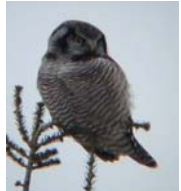
Class Aves
 Order Strigiformes
 Family Strigidae
 Genus *Bubo*
 Scientific Name *Bubo virginianus*



Taxonomy.

- Species then placed into larger groups

Class Aves
 Order Strigiformes
 Family Strigidae
 Genus *Surnia*
 Scientific Name *Surnia ulula*



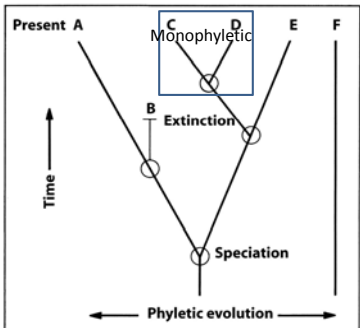
What is a Species?

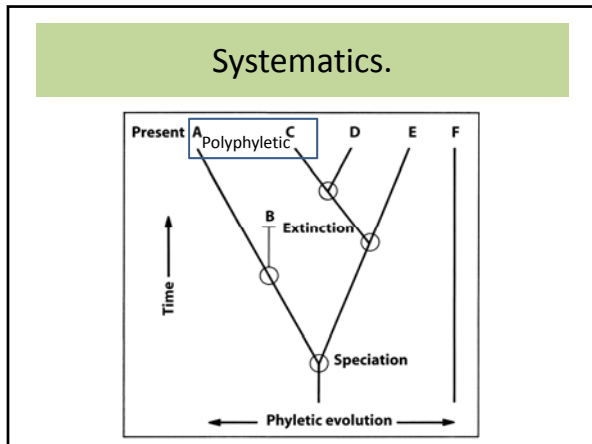
- **Biological Species Concept** (Mayr, 1970):
 "Species are groups of interbreeding natural populations that are reproductively isolated from other such groups"

Systematics.

- Taxonomy informed by evolutionary relationships
- Goal is to have a naming system that accurately reflects how taxa are related to each other
- **Monophyletic** Groups

Systematics





Systematics

- Scrub Jay Distribution

A map of the United States with shaded regions indicating the distribution of Scrub Jays. To the right of the map is a photograph of a Scrub Jay perched on a branch.

Taxonomic Characters.

- What is relevant to relatedness?
 - Need to evaluate when similar characters indicate **common ancestry**, versus convergence
 - Some characters are **conservative**

Taxonomic Characters

- What is relevant to relatedness?

A detailed phylogenetic tree of birds showing diversification over time. The vertical axis is labeled with geological periods and time in millions of years (mya): Early Cretaceous (155 mya), Late Cretaceous (135 mya), Late Cretaceous (100 mya), Cretaceous, Paleocene (65 mya), and Modern ornithurines. The tree shows various groups: Archaeopteryx, Sinornis, Iberomesornis, etc. (Late Cretaceous); Ambiortus, Gansus (Early Cretaceous); Primitive ornithurines (Late Cretaceous); Enantiornithines (Late Cretaceous); Gobipteryx, Avisaurus, etc. (Paleocene); Lithornithids (Paleocene); Palaeognathae (Modern ornithurines); Neognathae (Modern ornithurines); Passerines (Modern ornithurines); Nonpasserines (Modern ornithurines); Transitional shorebirds, paleognaths, etc. (Modern ornithurines); Hesperornithiforms (Modern ornithurines); Ichthyornithiforms (Modern ornithurines). A horizontal arrow at the bottom is labeled 'Diversification'.

Taxonomic Characters

- What is relevant to relatedness?

An anatomical diagram of a bird skull with various bones labeled: Premaxillary, Maxillopalatine, Maxillary, Palatine, Jugal, Pterygoid, Quadratojugal, Occipital condyle, Prevomer, Paraphenoid rostrum, Basipterygoid process, Quadrate, and Basisphenoid.

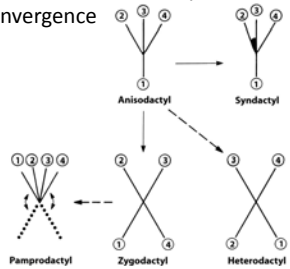
Taxonomic Characters

- What is relevant to relatedness?

A phylogenetic tree of Charadriidae birds. The tree shows relationships between Thick-knee, Avocet, Oystercatcher, Lapwing, and Plover. The Oystercatcher and Lapwing are sister taxa, and the Avocet and Plover are sister taxa. The Thick-knee is the outgroup.

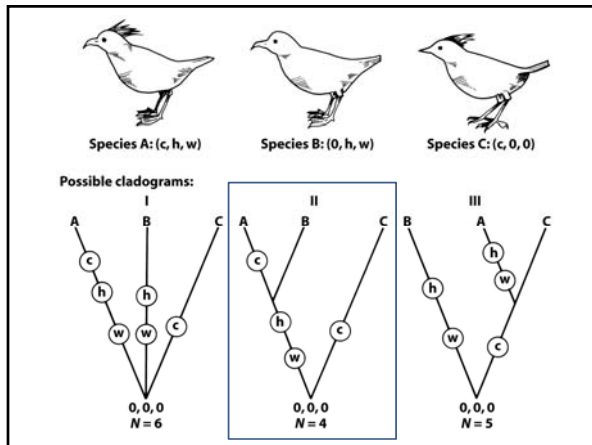
Taxonomic Characters.

- Foot Structure
 - More complex characters are less likely to be confounded by convergence

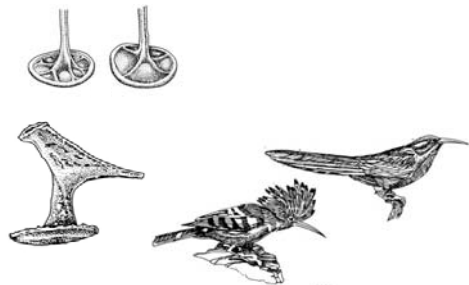


Cladistics.

- Study of Evolutionary Branching Sequences
 - Determine relatedness through **parsimony**
 - Less evolutionary change is probably more correct



Cladistics.



Biochemistry.

- Egg White Proteins
- Allozymes
- DNA
 - DNA-DNA Hybridization
 - Discovered convergence of Australian Songbirds with Eurasian species
- Mitochondrial Genes
 - Species level comparisons

Biochemistry

- DNA-DNA Hybridization

