

ZOO 329 Ornithology - Birds of the World

The information below should be considered "lecture notes", even though all of this material won't actually be discussed in lecture. This means that you are responsible for the material on the hourly exam. For the lecture exam, you are required to know all taxonomic designations at the level of order and above (in lab, we are learning order, family, and common name). After each order name, three numbers appear separated by slashes, e.g. 83/1161/5712. These are the numbers of families/genera/species in that order. Use these numbers to help you identify the order, but remember that they are only estimates. Taxonomy is a very dynamic field of study.

On the exam, there will be a short description, and you will be expected to write the order name. For example:

_____ the largest order, 5712 spp.

You would write Passeriformes in the blank. Spelling counts! About 60% of Exam 1 will be devoted to the orders of birds.

Domain **Eucarya**

Kingdom **Animalia**

Phylum **Chordata**

Subphylum **Vertebrata**

Class **Aves**

Subclass **Sauriurae** (extinct, includes *Archaeopteryx lithographica* and the Enantiornithines)

Subclass **Ornithurae** (extant birds: 29 orders, 187 families, 2050 genera, 9648 species.

extinct forms include Hesperornithiforms and Ichthyornithiforms)

Superorder **Palaeognathae** (the ratites and tinamous. These orders share unique bones of the palate. The ratites (Dinornithiformes, Struthioniformes, Rheiformes, Casuariiformes) are all flightless, and lack a carina (keel) on the sternum. Tinamous (Tinamiformes) are weak flyers, and have a small carina.

Superorder **Neognathae** (all the other remaining extant orders are in this group)

We now examine each of the extant orders:

1. **Dinornithiformes** (1/1/3) kiwis, found only in (endemic to) New Zealand. Kiwis are 19-33 in, have long, slender bills, and an unusual, hair-like plumage. They produce very large eggs for their body size. Wings are present, but very reduced (birds are flightless). Four toes, elevated hallux. Live in humid forest; somewhat gregarious; good runners. Nest is a hole in ground lined with leaves and grass. The 1 or 2 large eggs are incubated by the males.

The moas are an extinct group in this order. Moas were also limited to New Zealand. There were about 13 species, some of which were huge (9-10 feet tall; 1000 pounds - the largest known birds). Recent evidence indicates the moas went extinct within about 60 to 100 years of the arrival of the first people in New Zealand. The last moas lived about 300 years ago.

2. **Tinamiformes** (1/9/47) tinamous. Neotropical; 8 - 21 in; some polyandrous (one female mated with several males) species. Some brightly colored; some lay glossy eggs. Ground nester; nidifugous (young are able to walk and leave the nest right after hatching). Crepuscular (active at dusk and dawn); walk along forest floor eating fruits, seeds, insects. Often crouch in presence of danger rather than fleeing. Poor flyers, cannot fly long distances. A weak carina is present on the sternum.

3. **Struthioniformes** (1/1/1) ostrich. Six feet tall, 300 pounds. Males are black, females brown. Live in open, arid country; eat succulent plants, berries, seeds, some animal material. Powerful legs; 2 toes (apparently toes III and IV). Males produce booming roar; all hiss when upset. Nest is a depression scraped in the ground. Males incubate only at night; females will incubate during day or night. Both sexes care for the nidifugous young. Note: there is some thought that all of the ratites should be united in this order.

4. **Rheiformes** (1/1/2) rheas (also called the "nandus"). South America (Brazil, Bolivia, Peru). 36 to 52 in; 45 pounds. Sexes similar; have three toes (II, III, IV). Live in grassland and open brush; eat grass roots, seeds, insects, molluscs. Flightless; run swiftly; swim well. Gregarious; crouch in presence of danger. Adults make a deep, booming noise; young whistle. Polygamous; nest is a large hollow scraped in the ground; 20-30 eggs laid by several females ("dump nesting" = several females use a common nest). Incubation and care of nidifugous young done only by the male. Hatching of all the eggs in a nest is synchronous. While in the egg, young communicate with each other by making clicking noises - when there is enough clicking, all the young start to come out of the egg at the same time. This facilitates parental care, especially with so many young in a nest.

5. **Casuariiformes** (2/2/4) cassowaries (Australia, New Guinea, nearby islands); emus (Australia). Cassowaries are 52-65 in with black feathers. Head and neck are featherless, and the skin is brilliantly colored. Heavy casque (large, bony "helmet" protruding from the top of the head), used to protect the head as the bird runs through dense vegetation. Forest dwellers; swim well; very reduced wings; no retrices (tail feathers). Eats fruits, invertebrates. Voice harsh and guttural ("snorts, grunts, and bellows"). Shallow ground nest; male incubates and cares for nidifugous young. Due to heavy loss of limited forest habitat in Australia, cassowaries are very much endangered in Australia; population size is estimated at 1500 - 3000 individuals.

The emu is 55 - 78 in; feathers black to brown. Side of head and neck lack feathers, and are bluish-white in color. Live in open, arid country; eats vegetable matter and fruits. Good runner and swimmer; voice like cassowary. Nest is a hollow in the ground; 7 - 12 eggs are mainly incubated by the male; both sexes care for the nidifugous young.

6. **Podicipediformes** (1/6/21) grebes. Worldwide distribution. Short wings and tail, lobed toes, tarsi laterally compressed. Live on lakes and ponds (some along seacoast in winter). Swim under water (propelled by feet), fly weakly and infrequently. Eat fish, aquatic inverts, vegetation. Also eat (and feed to young) their own body feathers. Nest is a heap of wet, decaying vegetable matter, usually floating in the water (a raft; to protect nest from terrestrial predators). 3 - 9 eggs incubated by both male and female. Nidifugous young cared for by both - young often carried on back, even when diving. Although usually placed close to the loons, the affinities of this order are uncertain. May be related to loons, pelicans, tubenoses, penguins, or some or all of these orders.

7. **Gaviiformes** (1/1/5) loons. Northern parts of Eurasia and North America. Dense plumage often streaked and barred in black (or brown) and white. First 3 toes fully webbed. Tarsi reticulate and laterally compressed. Live on lakes and ponds, usually at sea during the winter. Swim under water (foot propelled); go ashore only to nest. Diet is mainly fish, but also molluscs, crustaceans, and other aquatic inverts. Flight is strong, but usually have to run across the water to gain sufficient speed to get flying. Voice is a variety of deep guttural noises, and they are especially famous for loud, quavering, rather demented-sounding calls ("crazy as a loon"; "loony"). Nest may be a depression, or a heap of vegetable matter, usually at edge of water. 2 eggs. Incubation and care of nidifugous young by both sexes. Affinities uncertain; may be related to grebes, pelicans, tubenoses, penguins.

8. **Sphenisciformes** (1/6/17) penguins. Antarctic north to the equator (the Galapagos Penguin actually occurs just north of the equator on the Galapagos islands). Paddle-like wings used to propel the birds under water (they don't use their feet). Eat fish, squid, crustaceans. Gregarious; nest can be in burrows or caves, but some species nest right on the ground or ice. In some species, the egg is held and carried on top of the feet to prevent the egg from freezing. Incubation usually by both sexes (males only in the Emperor Penguin). Young are nidicolous (stay in the nest after hatching; must be fed); usually cared for by both parents. This order is thought to be related to the tubenoses.

9. **Procellariiformes** (4/24/115) "tubenoses" (named for the tubular-shaped nostrils). Albatross, shearwaters, petrels, fulmars, storm-petrels, diving-petrels. Found in most of the oceans of the world; often pelagic (far out at sea). Able to excrete salt from glands in the nostrils, which allows them to drink sea water. Eat fish, squid, other marine animals, sometimes carrion (dead animals). Albatross are accomplished gliders; diving-petrels swim under water propelled by wings (like penguins). Some species discharge a musky, stinky stomach oil from nostrils and mouth when disturbed. Many of the species have an excellent sense of smell, which is used to find the nest at night. Nest is a hollow, crack, or crevice; sometimes lined; often on isolated islands. 1 egg; incubation and care of nidicolous young by both parents. Thought to be related most closely to penguins, secondarily to pelicans.

10. **Pelecaniformes** (6/8/67) Pelicans, cormorants, boobies and gannets, tropicbirds, frigatebirds, anhingas ("water turkeys"). Oceans and lakes of the world. Totipalmate feet; nostrils small or absent. Predators on fish and aquatic inverts. Nest is made of sticks, reeds, grasses, and mud; often placed in trees. 1 to 6 eggs; incubation and care of nidicolous young by both sexes. Thought to be related to tubenoses, and perhaps to the herons and storks.

11. **Ciconiiformes** (6/42/120) Herons, bitterns, egrets (Ardeidae - 65 species); Storks (Ciconiidae - 19 species); new world vultures (Cathartidae - 7 species); Ibis (Threskiornithidae - 34 species); whale-head stork and hammerhead (both found in Africa). Worldwide distribution; usually associated with water (new world vultures are an exception). Large birds (11 - 60 in), most with long bills used to probe and capture aquatic vertebrates and inverts. The new world vultures are carrion eaters, although they will attack living animals, especially young. Large nests built mainly from sticks, usually placed in trees. 2 - 6 eggs; incubation and care of nidicolous young by both sexes. This order is a big problem for systematics, and probably is a polyphyletic group. The whale-head stork and hammerhead may actually be more closely related to pelicans than to the other families in this order. Herons may actually be more closely related to the rails (Gruiformes). The flamingos (see below) are often included in this order. Until fairly recently, the new world vultures were placed with the hawks and eagles (Falconiformes). There have been proposals to leave the vultures in Falconiformes, and move the storks to that order. It has also been proposed to move all of the families in the Falconiformes to this order. This order will certainly be changed at some point, but there is a lot of discussion needed before it becomes clear what the changes will be.

12. **Phoenicopteriformes** (1/1/5) flamingos. Shallow lagoons and lakes in tropical areas of the West Indies, South America, Europe, Asia, and Africa. 36 - 48 in; usually pinkish, but color depends on diet. Filter feeders - scoop-up a bill full of water and muck, then use plunger-like tongue to force water through bill lamellae, which captures solid material, such as aquatic animals and algae. Mud nest built on mud flats. 1 - 2 eggs; incubation and care of nidifugous young by both. Another controversial group in terms of systematics. DNA, egg-white proteins, and skeletal evidence suggest they're related to Ciconiiformes (which is itself a problem - see above). The flamingos share unique bile acids with the Anseriformes (ducks, geese, swans). Other have suggested (based on the fossil record) they are related to shore birds (Charadriiformes). The flamingos often appear as a family (Phoenicopteridae) in the Ciconiiformes, but we'll treat them as a separate order (at least for the time being).

13. **Anseriformes** (2/48/161) ducks, geese, swans, "screamers". Worldwide. The ducks, geese, and swans (Anatidae - 158 species) are a fairly stereotyped group, i.e. they are all somewhat similar. A duck, goose, or swan in the old world looks pretty much like one in the new world. The differences among ducks, geese, and swan generally involve anatomy and molt patterns, but the systematics of this family is complex and dynamic. Diet is highly variable, some species eat mainly vegetable matter. Mating habits are also highly variable, some are even nest parasites (lay eggs in nests of other species, and the other species unwittingly cares for the young). Some species are flightless, but most are strong fliers. The "screamers" (Anhimidae) are 3 species native to South America. They don't look very much like ducks - screamers have semipalmate feet and a bill like a chicken. They eat only vegetable matter. They produce a very loud trumpeting sound. Underneath the skin is a layer of thin, air-filled sacs. The function of these "air bubbles" is unclear. Although once considered primitive, screamers are now thought to represent a highly specialized, derived condition. The Anseriformes are closely related to the Galliformes, based on a variety of DNA and morphological evidence.

14. **Falconiformes** (3/80/304) hawks, eagles, falcons, secretarybird. Worldwide. One of the most recognizable and familiar groups. The hawks and eagles (Accipitridae - 239 species) are predators on mammals, reptiles, fish, and other birds. The large, heavy bodied hawks (like the common Red-tailed Hawk) hunt for mammals and reptiles by soaring, descending when a prey item is located, and grasping the item with the talons. The slimmer bodied hawks (such as the Cooper's Hawk) tend to prey on bird. One very small hawk of the neotropics (the Tiny Hawk) specializes on hummingbirds. Falcons (Falconidae - 63 species) are famous for being excellent fliers that "stoop" on flying birds. However, this family also includes carrion eaters, such as the Crested Caracara of the southern U.S. and the neotropics. The Osprey (or fishhawk) is a fish-eating hawk in its own family (Pandionidae) that is found almost everywhere in the world. The secretarybird (Sagittariidae) is a large (50 to 59 in) bird of the African plains, where it specializes on catching reptiles. Although they can fly, they are usually cursorial (walk/run on the ground). The new world vultures (Cathartidae) were once placed in this order, but have now been moved to the Ciconiiformes. As would be indicated by the changing status of the vultures, the Falconiformes are generally considered close to the Ciconiiformes, but the systematics of both groups remains uncertain.

15. **Galliformes** (5/70/258) pheasants, grouse, quail, turkeys, chicken, megapodes, curassows, guans, chachalacas, guineafowl. A large, diverse group with representatives found worldwide. The nominate family (Gallidae) includes the familiar chicken. About two-thirds of the species are in the Phasianidae (pheasants, grouse, turkeys). The five species of new world quail are now placed in their own family (Odontophoridae). The Cracidae are 50 species of mostly large birds of the new world tropics (curassows, guans, chachalacas). Guineafowl (Numididae) are seven species of African birds, which are widely raised domestically. They make very loud, raucous noises, especially early in the morning - you will know right away if there are ever guineafowl living next door to you. The megapodes (Megapodiidae), or "brush turkeys", are 19 species found in Australia, New Guinea, the Phillipines, and other islands of the south Pacific with unusual nesting habits ("mound nesting"). With their large feet, they scrape vegetation into large mounds (10 feet tall and 25 feet in diameter). Eggs are laid in the mounds, where incubation is accomplished by the sand, volcanic ash, soil, and decaying vegetation of the mound. The adults regularly stick their head into the mound to sense the temperature, and they will remove or add more material as needed. The incubation period is very long (60 days), the babies molt from down to flight feathers while still in the egg. After hatching, they dig their way out of the mound (they may be as much as a meter deep), and when they reach the top, they fly away, usually without ever seeing the parents. The Galliformes are most closely related to the Anseriformes.

16. **Gruiformes** (11/55/213) cranes, rails. A very large, diverse order distributed worldwide. The cranes (Gruidae - 15 species) are large, gregarious omnivores known for their loud, resonant voice. Some species have an elongated trachea that's actually coiled in the body, and which provides the resonance. Rails (Rallidae - 142 species) are solitary, secretive, mainly terrestrial omnivores. This is a very ancient order. There are many extinct families and species known from the tertiary, including some large, cursorial predatory birds. They are considered relatives of the Charadriiformes. The boundary between the two orders is unclear.

17. **Charadriiformes** (19/85/366) the "shorebirds", includes sandpipers, plovers, gulls, terns, avocets, stilts, phalaropes, skimmers, auks, oystercatchers, sandgrouse. A large, diverse group usually associated with water, where they prey on aquatic animals. Toes are palmate or semipalmate; distribution is worldwide. Sandpipers (Scolopacidae - 86 species) and plovers (Charadriidae - 64 species) are especially common on mudflats, both near the coast and inland. Gulls and terns (Laridae - 88 species) are especially familiar near the coasts, but several species are common inland. Auks (Alcidae - 23 species) are marine birds, found in the northern oceans of the world, where they dive for food (primarily fish). They are (in some respects) the northern hemisphere ecological equivalents of penguins. Sandgrouse (Pteroclididae - 16 species) live in dry areas of Africa and Eurasia. They visit remote waterholes at dawn and dusk where they soak their belly feathers with water and carry it back to the nest. Distance to the nests can be as much as 25 miles, and the birds will often make several trips. Sandgrouse somewhat resemble grouse, which is how they got their name. However, they are not closely related to Galliformes. At various times, the sandgrouse have been put in their own order (Pterocliiformes), or placed in with the pigeons (Columbiformes). However, DNA and other biochemical evidence suggests they belong in the Charadriiformes. The Charadriiformes are probably most closely related to the Gruiformes, although they are also somewhat close to Columbiformes.

18. **Columbiformes** (1/40/310) pigeons, doves. Worldwide; fairly stereotyped - it is easy to recognize most pigeons or doves. Short, slender bill with cere at the base. Short neck and legs. Crop produces "pigeons milk", which is fed to young. Primary foods are seeds and fruit; some species eat inverts. Can drink water by sucking, which is unusual in birds. Dodos (extinct since 1681) were found on Mauritius Island, and Solitaires (extinct since 1800) were on Rodrigues Island (two islands of the Mascarene Island group in the Indian Ocean east of Madagascar). These large, flightless birds (both species are placed in the same family - Raphidae) were

defenseless against sailors who landed on the islands and killed them for food. Introduced rats and pigs also ate eggs and baby birds. The Columbiformes are usually considered most closely related to the Charadriiformes.

19. **Psittaciformes** (3/80/358) parrots, parakeets, macaws. A large group of familiar, brightly colored birds. Pantropical (found in all tropical areas of the world). Fairly stereotyped, you generally know a member of this order when you see one, regardless of where you are. Often brightly colored; hooked beak. The upper mandible is hinged at the articulation with the skull, allowing some flexion. Zygodactyl toes (II and III forward; I and IV back). Raucous voice; very strong fliers. Primarily eat fruits, nuts, grains, other vegetable matter; they tend to be seed predators (they destroy and metabolize the seed) rather than dispersers. One unusual species is the raptor-like Kea of New Zealand. This large, aggressive parrot is famous for pulling the nails out of the roofs of buildings, ripping up automobile upholstery, and even attacking and killing sick sheep in order to feed on the fat around the kidneys. This Psittaciformes are a distinctive and unique group; their systematic affinities are uncertain. They are usually placed near the pigeons and the cuckoos.

20. **Musophagiformes** (1/5/23) touracos, "go-away-birds", "plaintain eaters". Africa. Large (14 - 38 in); usually crested; usually very colorful. The red pigment is unique. Feet semizygodactyl (toe IV is reversible). Inhabit forests and forest edges; arboreal; eat fruit, seeds, inverts. Loud, raucous voice consisting of shrieks and croakings. Although some treatments have placed this order close to the cuckoos, they are rather distinctive, and the affinities are uncertain.

21. **Cuculiformes** (2/30/143) cuckoos, anis, roadrunners, Hoatzin. Worldwide. Stout, usually curved bill. Long, graduated tail; zygodactyl toes. Some arboreal and strong fliers; others rarely fly (e.g. roadrunners). Wide variety of nesting habits. The neotropical anis are communal nesters; some old world cuckoos are accomplished nest parasites, having the ability to mimic the eggs of different hosts in different parts of the range. The Hoatzin is an unusual South American species that ferments leaves in its crop (as an aid to digestion), is a very clumsy flyer, and the young are born with claws on the manus which regress after a few days. Hoatzins give off an awful odor, evidently as a predator protection device. The affinities of the Cuculiformes are uncertain; they may be close to parrots.

22. **Strigiformes** (2/25/178) owls. A distinctive, familiar group distributed worldwide. Nocturnal predators; eyes are fixed in their sockets; soft plumage for silent flight. Excellent hearing, the ears are slightly asymmetrical in their placement, which allows localization of the direction from which sounds are coming. Swallow food whole, and regurgitate "pellets" of skin and bones. Barn owls (Tytonidae - 17 species) and "typical" owls (Strigidae - 161 species) are both fairly common worldwide, but many people rarely see them due to the nocturnal habits. Uncertain affinities; may be related to Caprimulgiformes or Falconiformes.

23. **Caprimulgiformes** (5/20/113). Nighthawks; nightjars; poor-wills; frogmouths; potoos; Oilbird. Most catch flying insects at dusk. Their extremely large gape (big mouths) resulted in the group being called the "goatsuckers", due to a myth that the birds suckle from lactating goats. Many species lay eggs directly on the ground; species in the eastern US lay eggs on flat roofs of buildings. An unusual species is the Oilbird of South America. These are colonial nesters, and the nests are on ledges in caves. They can navigate the caves by echolocation (at least two other species of birds - the Humboldt Penguin and the Cave Swiftlet - are capable of echolocation); and they have a well-developed sense of smell. The nestling period in Oilbirds is very long (90 - 125 days), and the nestlings become quite fat (often twice the weight of adult birds). The native people would gather nestlings and use the fat for fuel in oil lamps. The Caprimulgiformes are probably related to the Apodiformes, or perhaps the Strigiformes.

24. **Apodiformes** (3/128/422) Swifts (Apodidae - 99 species) are worldwide. Hummingbirds (Trochilidae - 319 species) are found only in the new world. Crested-swifts (Hemiprocnidae - 4 species) are found in India and southeast Asia. Swifts are strong flyers who catch flying insects; they spend most of the day in flight (some species even mate in flight); use saliva to "glue" nesting material together (the origin of "birds nest soup"). Crested-swifts are similar to other swifts, except that they are larger and crested, and they often perch in trees. Hummingbirds are strong fliers with a long thin bill; they feed on nectar, insects, and arachnids. The nectar moves up the tongue by capillary action (the birds lack the facial muscles to suck the fluid as through a straw). Hummingbirds are aggressive; often interspecifically territorial; and are important pollinators of some plants. Their diminutive size and striking colors have often resulted in unusual species names, such as the "Adorable Coquette". Swifts and hummingbirds share a unique egg white protein. The Apodiformes are probably most closely related to the Caprimulgiformes.

25. **Coliiformes** (1/2/6) Mousebirds (or "colies"); Africa. Brown or gray colored; with very long tail and crest. Inhabit forest and forest edges; gregarious; they scurry through the vegetation like a group of mice (therefore the term "mousebirds"). Eat fruits and plant material, rarely insects. Often hang upside down, even when sleeping. Affinities of the order are uncertain.

26. **Trogoniformes** (1/6/39) Trogons; pantropical. Forest dwellers; frugivores. Heterodactyl feet (toes III and IV forward; I and II back). Arboreal; eat fruit, large insects, snails, lizards, frogs. Often beautifully colored. Have a unique red pigment which breaks down in study skins - older specimens look pink or even white where they once were a brilliant red. The Resplendent Quetzal is a beautiful trogon of central America - it is the national bird of Guatemala, and was sacred to the Inca and Maya. The Elegant Trogon is a regular breeding bird in a few isolated canyons in southeastern Arizona (e.g. the southfork of Cave Creek Canyon); people travel from all over the country (and the world) to see this bird. The Eared Trogon is an occasional breeder in southeastern Arizona. The trogons are thought to be related to the Coraciiformes.

27. **Coraciiformes** (10/46/218) kingfishers, rollers, motmots, bee-eaters, hornbills, hoopoes. Worldwide. Syndactyl feet; strong, prominent bill. All are cavity nesters. Mainly an old world group, the only representatives in the U.S. are the kingfishers (Alcedinidae). Motmots are a small group (Motmotidae - 9 species) found in the neotropics. Bee-eaters (Meropidae - 24 species) are found in the old world tropics - they capture bees and in the bill, and then bang the bee against a tree branch until the bee releases its stinger. The hornbills (Bucerotidae - 56 species from Africa and Asia) are familiar to zoo visitors - in one species, the female enters a tree cavity for nesting, and the male builds a wall of mud and debris across the entrance, leaving only a small opening through which the male provides food for the female and the young. This order is believed to be related to the trogons, however, the order may be polyphyletic. In some treatments, various families are sometimes subsumed into other orders (usually Piciformes or Passeriformes), or some families (e.g. hornbills and/or hoopoes) are placed into their own order.

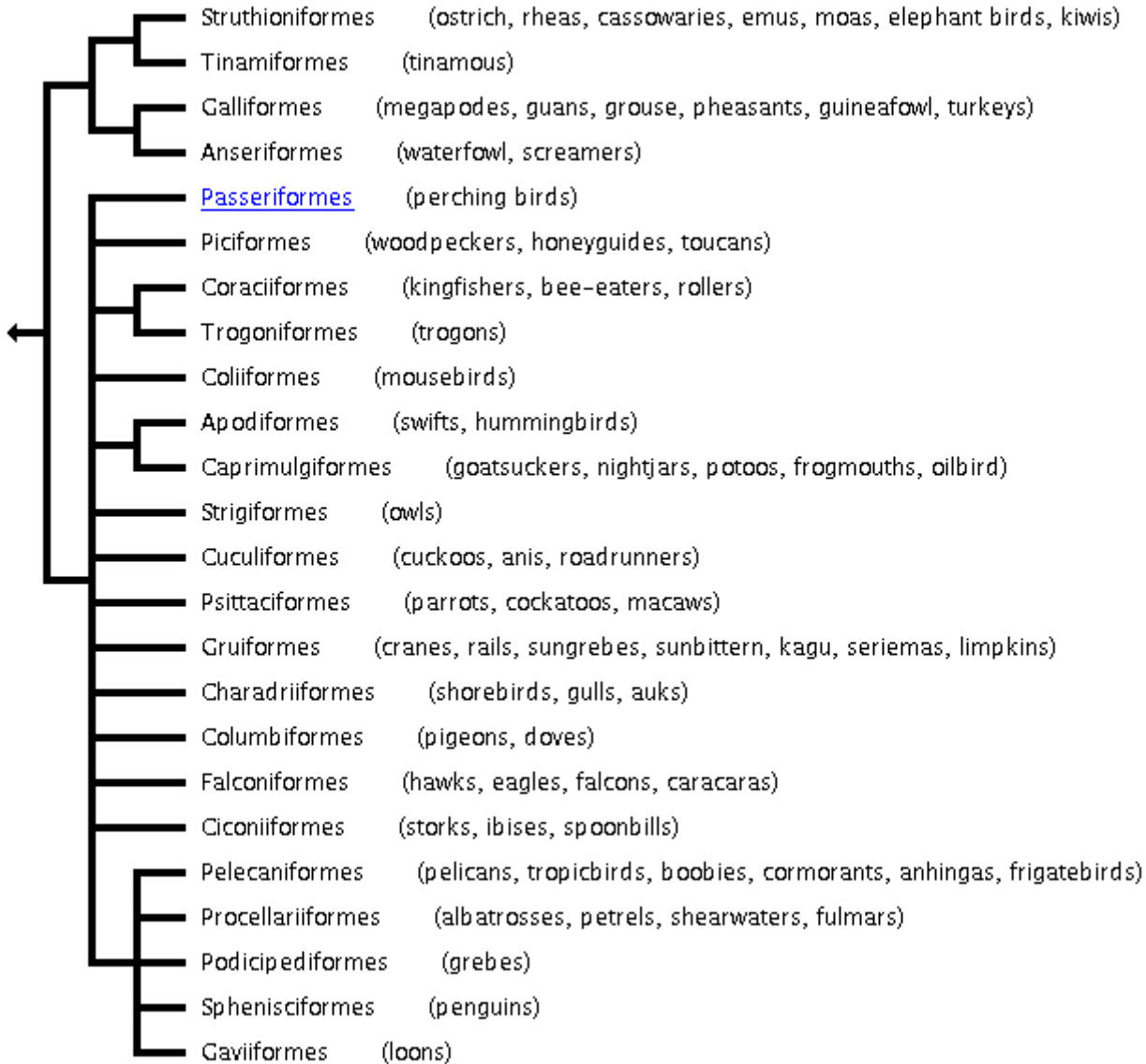
28. **Piciformes** (8/62/410) woodpeckers, honeyguides, toucan, aracarís. Worldwide. Zygodactyl feet; specialized bills; stiffened retrices in some (woodpeckers); cavity nesters. The woodpeckers (Picidae - 215 species worldwide) are the only US representatives. Toucans and aracarís (Ramphastidae - 41 species) are large neotropical birds (often colorful) with large bills that are primarily frugivorous. Honeyguides (Indicatoridae - 17 species from Africa and southeast Asia) include species that specialize on eating bees, bee larvae, honey, and beeswax. Since the birds are not capable of tearing apart a bee hive, they lead man and other large mammals to the hives. A study published in Science (1989. 243:1343-1346) showed that the Boran people of Kenya are led to bee nests by the Greater Honeyguide (*Indicator indicator*). Furthermore, the Boran can deduce direction and distance to the bee nest, as well as when they have arrived at the nest from the bird's flight pattern, perching height, and calls. The affinities of the Piciformes are uncertain, but they are usually placed close to the Passeriformes.

29. **Passeriformes** (83/1161/5712). Perching birds. Worldwide. The feet are well suited for perching - ansiodactyl toes and incumbent hallux with a long claw allows grasping. 9 or 10 primary feathers; 12 retrices. Characteristic palate; distinctive spermatazoa. Sometimes divided into two subgroups: the "suboscines" - 15 families (many are neotropical) with relatively simple syrinx; the "oscines" - 68 families with a more complex syrinx, these are the "songbirds". Most of the small birds you see on campus are oscine passeriforms. With ~60% of the world's species in this order, the systematics of the group is incredibly complex. The order is usually placed close to the Piciformes.

Note: On the following page, you will find a phylogeny of the existent orders of birds of the world, from the Tree of Life Web Project: <http://tolweb.org/tree/>

This phylogeny is provided to demonstrate to you how "unresolved" the relationships are, that is, the relationships among the orders are very uncertain. There are some differences in the orders seen in the tree and those discussed above. **You are responsible for the orders as discussed above, not for how they are presented in the phylogeny below.** The phylogeny is extra, "value added" material that will not be on the exam.

A phylogeny of existent orders of birds of the world (from <http://tolweb.org/tree/>):



Summary phylogenetic hypothesis for extant avian orders modified from Cracraft (1988), Sibley and Ahlquist (1990) and Mindell et al. (1997). Hypothesized relationships shown are common to at least two of the three studies. See the original publications for conflicting alternative topologies. Placement of the Galliformes and Anseriformes clade as sister to Struthioniformes and Tinamiformes follows Sibley and Ahlquist (1990; Fig. 357) and Mindell et al. (1997; Fig. 8.4B). Cracraft (1988) places Columbiformes, Gruiformes and Charadriiformes in a trichotomy arising from within the most basal polytomy (polychotomy). Sibley and Ahlquist (1990) place those three orders in a pectinate fashion as sister to a large clade including Falconiformes, Pelecaniformes, Ciconiiformes and others, and they are left as unresolved here.

Cracraft, J. 1988. The major clades of birds. In *The Phylogeny and Classification of the Tetrapods*. (M. J. Benton, ed.), Systematics Assoc. Special Vol. No. 35A, pp. 333-355. Clarendon Press, Oxford.

Mindell, D.P., M. D. Sorenson, C. J. Huddleston, H. Miranda, A. Knight, S. J. Sawchuk, and T. Yuri. 1997. Phylogenetic relationships among and within select avian orders based on mitochondrial DNA. In *Avian Molecular Evolution and Systematics* (D. P. Mindell, ed.). Academic Press, New York. (In Press)

Sibley, C. G., and Ahlquist, J. A. 1990. *Phylogeny and Classification of Birds: A Study in Molecular Evolution*. Yale University Press, New Haven.