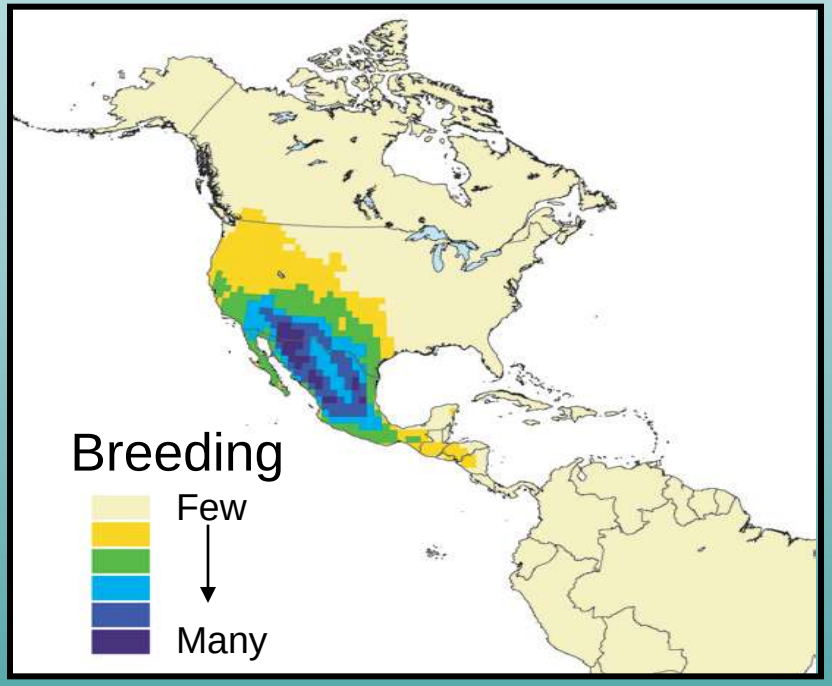
Ornithology:
an introduction to basic concepts



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American Kestrel (*Falco sparverius*)

White-tailed Hawk (*Buteo albicaudatus*)

Variable Hawk (*Buteo polyosoma*)

Black-capped Vireo (*Vireo atricapilla*)

Goals for this workshop:

- Bird diversity
- Behavioral characteristics
- Migration
- Conservation

Prothonotary Warbler feeding Brown-headed Cowbird chick

Birds (class Aves) have many traits: intelligent, bipedal, warm-blooded, vertebrate animals that lay eggs.

There are around 10,000 living species, making them **the most numerous tetrapod vertebrates.**

- inhabit ecosystems across the globe, from the Arctic to the Antarctic.
- range in size from the 5 cm (2 in) Bee Hummingbird to the 2.7 m (9 ft) Ostrich.
- evolved from theropod dinosaurs during the Jurassic period, around 150–200 Mya (million years ago), and the earliest known bird is the Late Jurassic Archaeopteryx, c 155–150 Ma.
- characterized by feathers, a beak with no teeth, the laying of hard-shelled eggs, a high metabolic rate, a four-chambered heart, and a lightweight but strong skeleton.
- have forelimbs modified as wings and most can fly, with some exceptions including ratites, penguins, and a number of diverse endemic island species.
- have unique digestive and respiratory systems that are highly adapted for flight.
- many species undertake long distance annual migrations, and many more perform shorter irregular movements.

Sizes of North American birds

Calliope Hummingbird

Birds are resourceful, especially corvids and parrots (e.g., Alex): among the most intelligent animal species. Some make and use tools, and many social species exhibit cultural transmission of knowledge across generations.

Brown-headed Nuthatch uses bark to pry under other bark.

Lammergeier drops bones onto rocks To break them up.

Woodpecker Finch uses sticks

Bowerbirds construct elaborate nests to attract females.

Great Bowerbirds (Chlamydera nuchalis)

ALEX, the African Grey Parrot

Dr. Irene Pepperberg, listed Alex's accomplishments in 1999:

- could identify fifty different objects and recognize quantities up to six;
- could distinguish seven colors and five shapes, and understand the concepts of "bigger", "smaller", "same", and "different," and
- was learning "over" and "under;"
- had a vocabulary of about 150 words, but was exceptional in that he appeared to have understanding of what he said.

Alex
African Grey Parrot (1976 – 6 Sep 2007).

For example, when Alex was shown an object and was asked about its shape, color, or material, he could label it correctly. If asked the difference between two objects, he also answered that, but if there was no difference between the objects, he said “none.”

- When he was tired of being tested, he would say “I’m gonna go away,” and if the researcher displayed annoyance, Alex tried to defuse it with the phrase, “I’m sorry.”

- If he said “Wanna banana”, but was offered a nut instead, he stared in silence, asked for the banana again, or took the nut and threw it at the researcher.

- When asked questions in the context of research testing, he gave the correct answer approximately 80 percent of the time. In July 2005, Pepperberg reported that he understood concept of zero.

- Although truly amazing accomplishments, there were skeptics in the scientific community. Some raised the issue of Operant Conditioning (reinforcement and punishment), whereby Alex would have been responding to subtle cues rather than thinking on his own.

- Alex died unexpectedly, age 31, on 7 Sep 2007, apparently related to atherosclerosis (‘hardening of the arteries’).

- See more on this amazing bird at: http://www.alexfoundation.org/

Many birds are social.

- communicate using visual signals and through calls and songs,
- participate in social behaviors including cooperative breeding and hunting (Harris's Hawk), flocking (blackbirds, starlings), and mobbing of predators (many passerines).
- vast majority of bird species are socially **monogamous**, usually for one breeding season at a time ("**serial monogamy**"), sometimes for years, but rarely for life.
- other species have breeding systems that are **polygynous** ("many females," grouse, manakins, some hummingbirds, some blackbirds) or, rarely, **polyandrous** ("many males," Galapagos Hawk, some phalaropes, some shorebirds).
- eggs are usually laid in a nest and incubated by the parents. Most birds have an extended period of parental care after hatching.
    - **precocial**: leave nest at an early age, young tend to have bigger brains
    - **altricial**: remain in nest for extended periods, brains are smaller but continue to grow, outgrowing precocial birds at maturity and, hence, have a wider skill set than precocial birds.

Many bird species are of economic importance:

- mostly as sources of food acquired through hunting or farming;
- some species, particularly songbirds and parrots, are popular as pets.
- other uses include the harvesting of guano (droppings) for use as a fertilizer.
- birds figure prominently in all aspects of human culture from religion to poetry to popular music.
- very popular sources of local economic welfare, especially in the Lower Rio Grande Valley:

  • The Texas State Comptroller's Office recently estimated nature tourism to comprise between $25.4 billion -- $39.9 billion!

  • Nature tourism generates approximately $1 billion in state taxes, $739 million in local taxes, and $1.4 billion of economic activity.

- Alas, about 120–130 species have become extinct as a result of human activity since the 17th century, and hundreds more before then. Currently about 1,200 species of birds worldwide are threatened with extinction by human activities, though efforts are underway to protect them.

What is diversity?

- Biological diversity can take many forms.
- Diversity typically refers to number of species (richness) in a community.
- However, a more accurate representation of biological importance takes into account number of individuals (evenness or abundance).

Alpha: species level, diversity within a community
Beta: community level, diversity among communities within landscape
Gamma: landscape level, diversity among landscapes
Omega: diversity within taxa, phylogenetic diversity
Global: diversity across planet Earth

A

C

B

D

Diversity (Richness)

Global count 9,484 sp.

3,255 South America
- 1,860 Colombia
- 1,780 Peru
- 1,750 Brazil
- 1,600 Ecuador

2,900 Asia

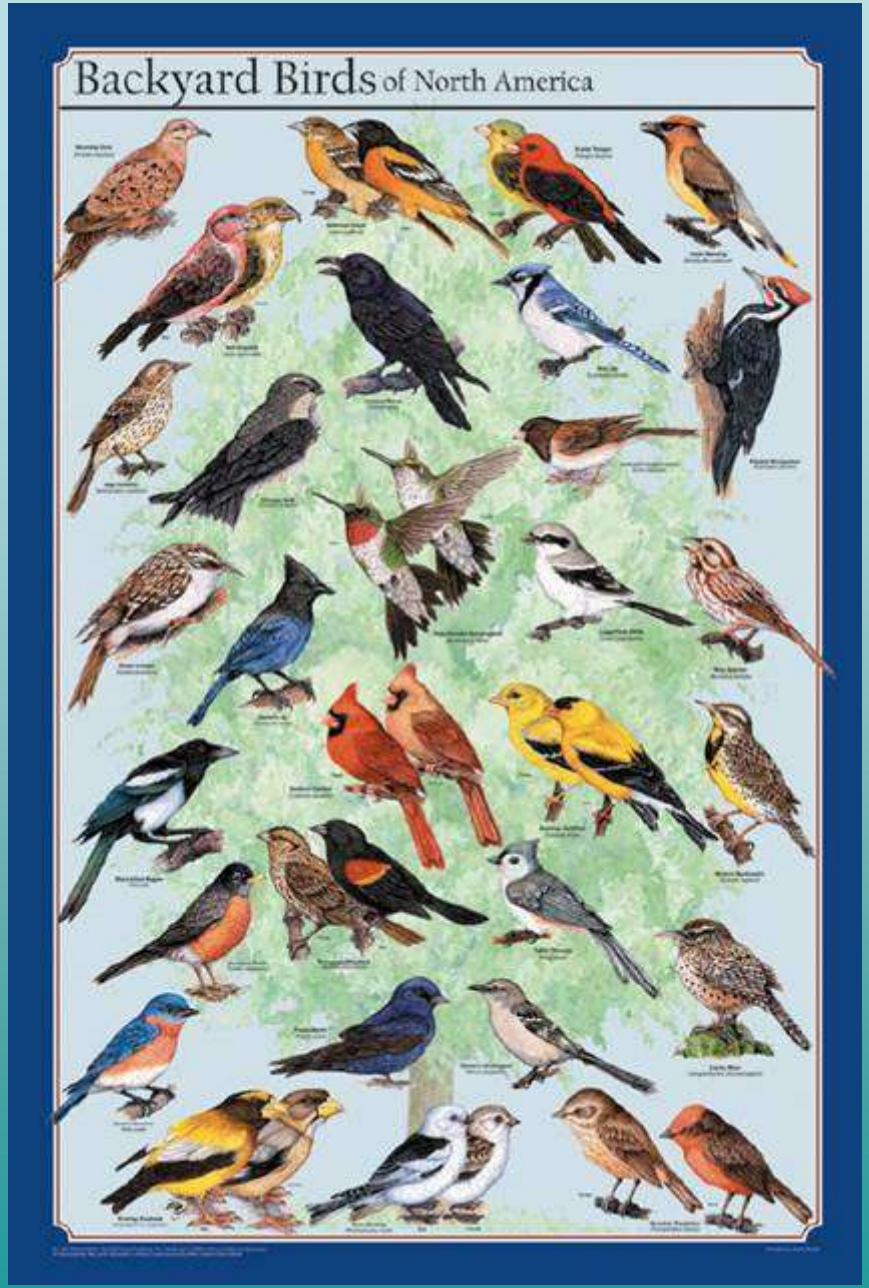
2,300 Africa

2,000 North America (from Panama north + Caribbean)
- 1,070 Mexico and N. Central America
- 925 United States
- 632 Texas

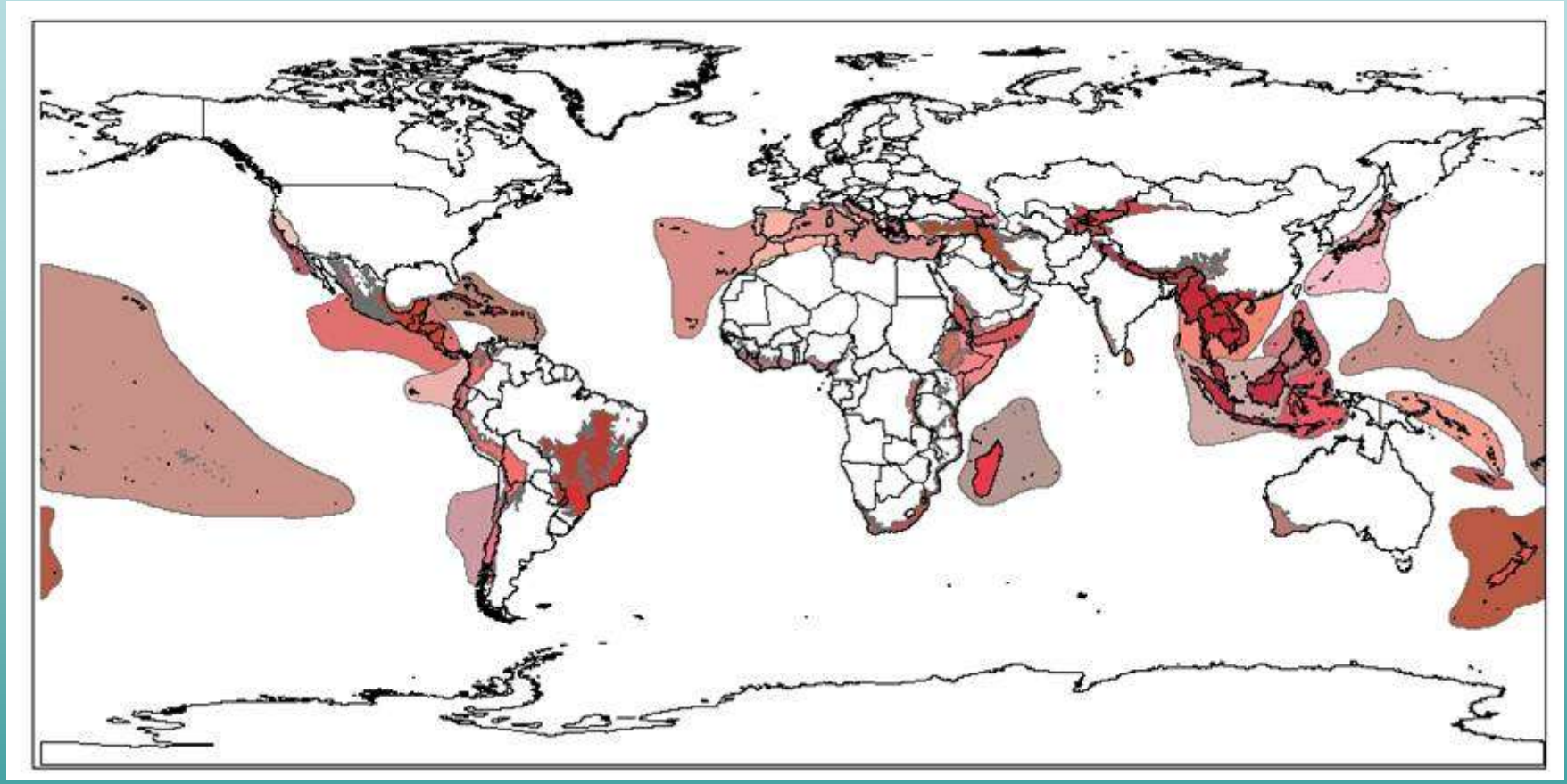
1,700 Australia + surrounding islands

1,000 Europe

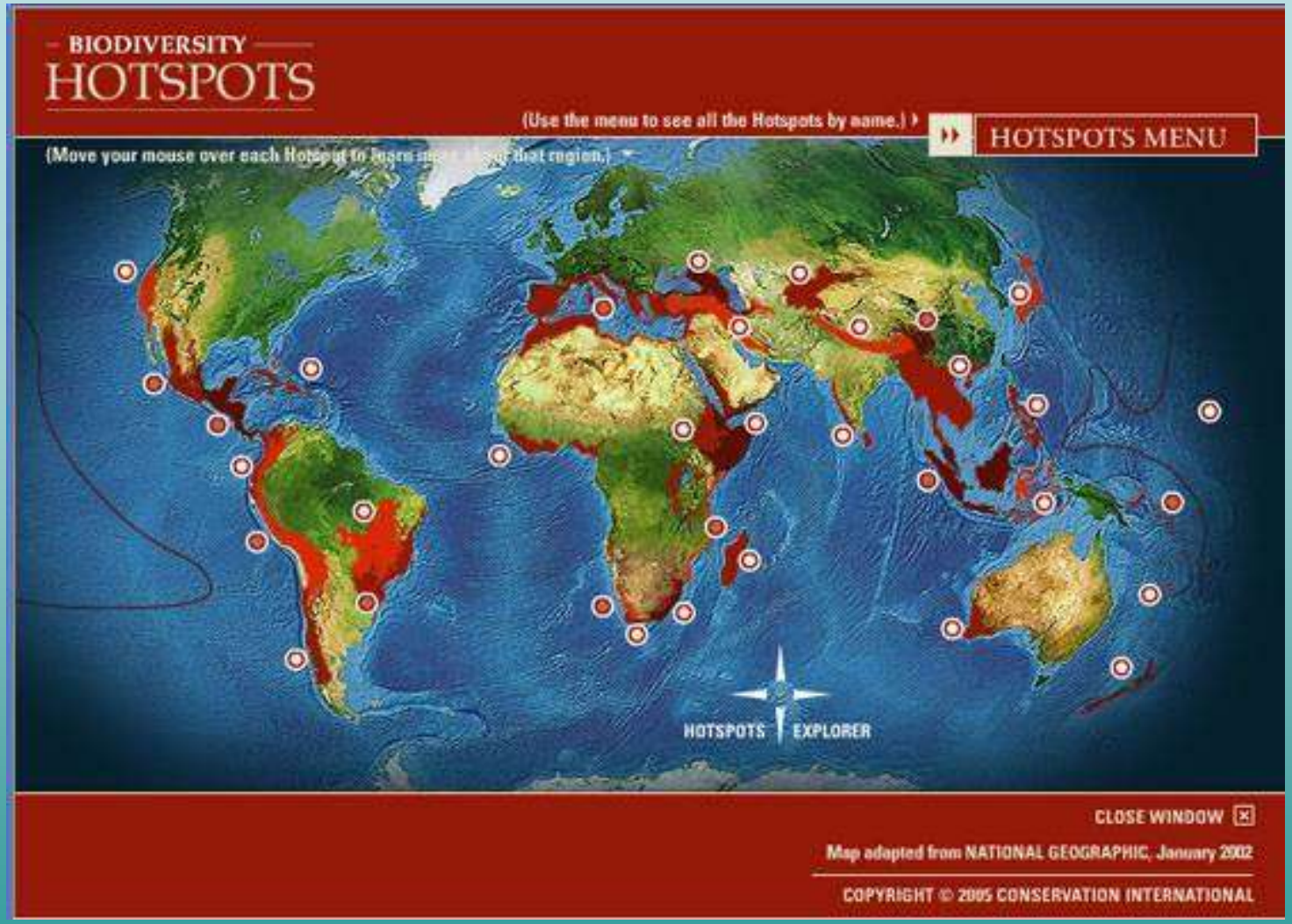
65 Antarctica



Hotspots for global avian diversity (Conservation International 2004)

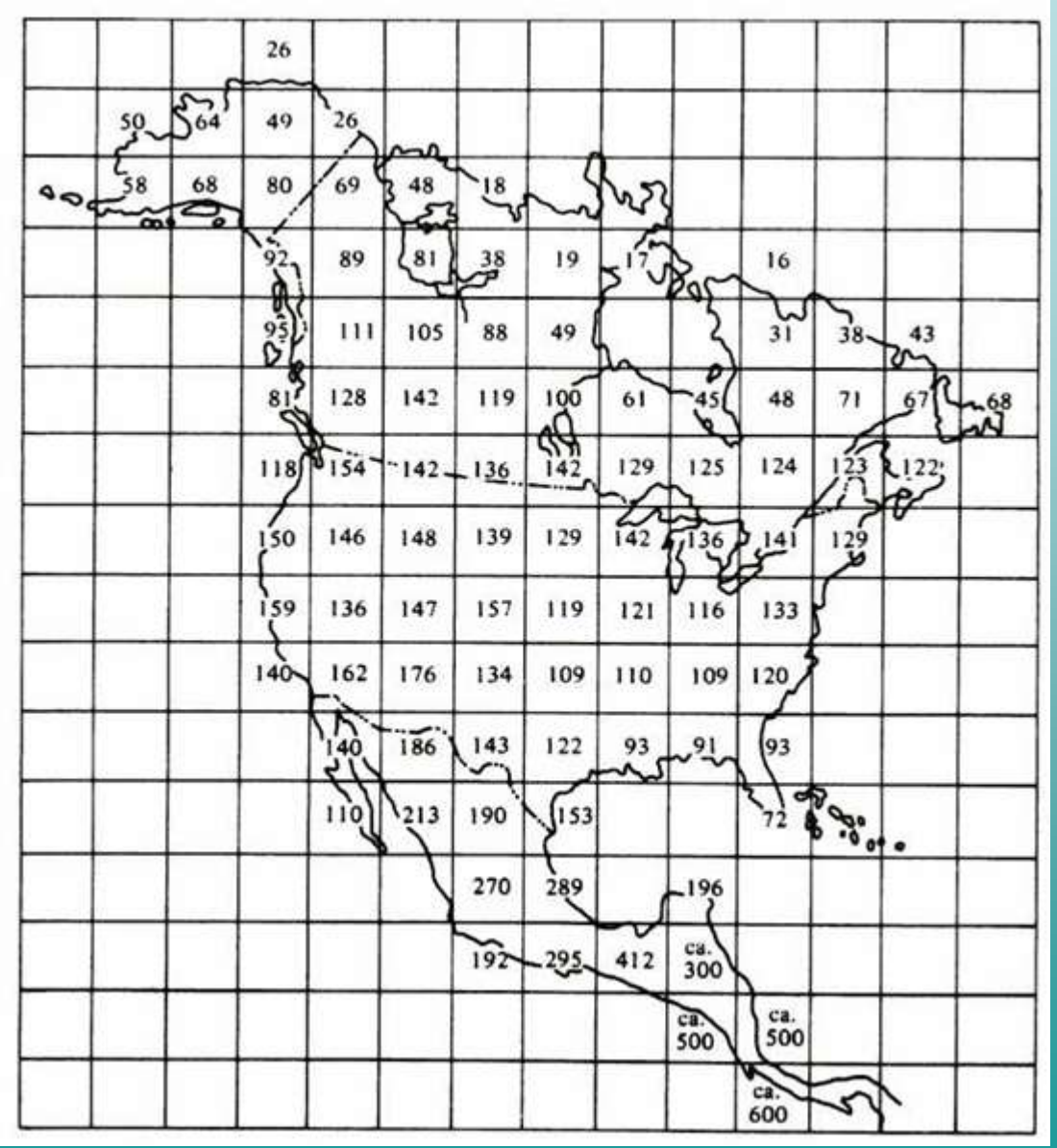


Bird richness is centered in the tropics. Why?



Species richness decreases with increasing latitude.

Numbers of U. S. breeding birds per 400 sq. mi.



Latitudinal gradients in species diversity (richness).

Although many of the hypotheses exploring the latitudinal diversity gradient are closely related and interdependent, most of the major hypotheses can be split into four general categories: 1) spatial/area, 2) energy/climatic, 3) evolutionary/historical, and 4) biotic.

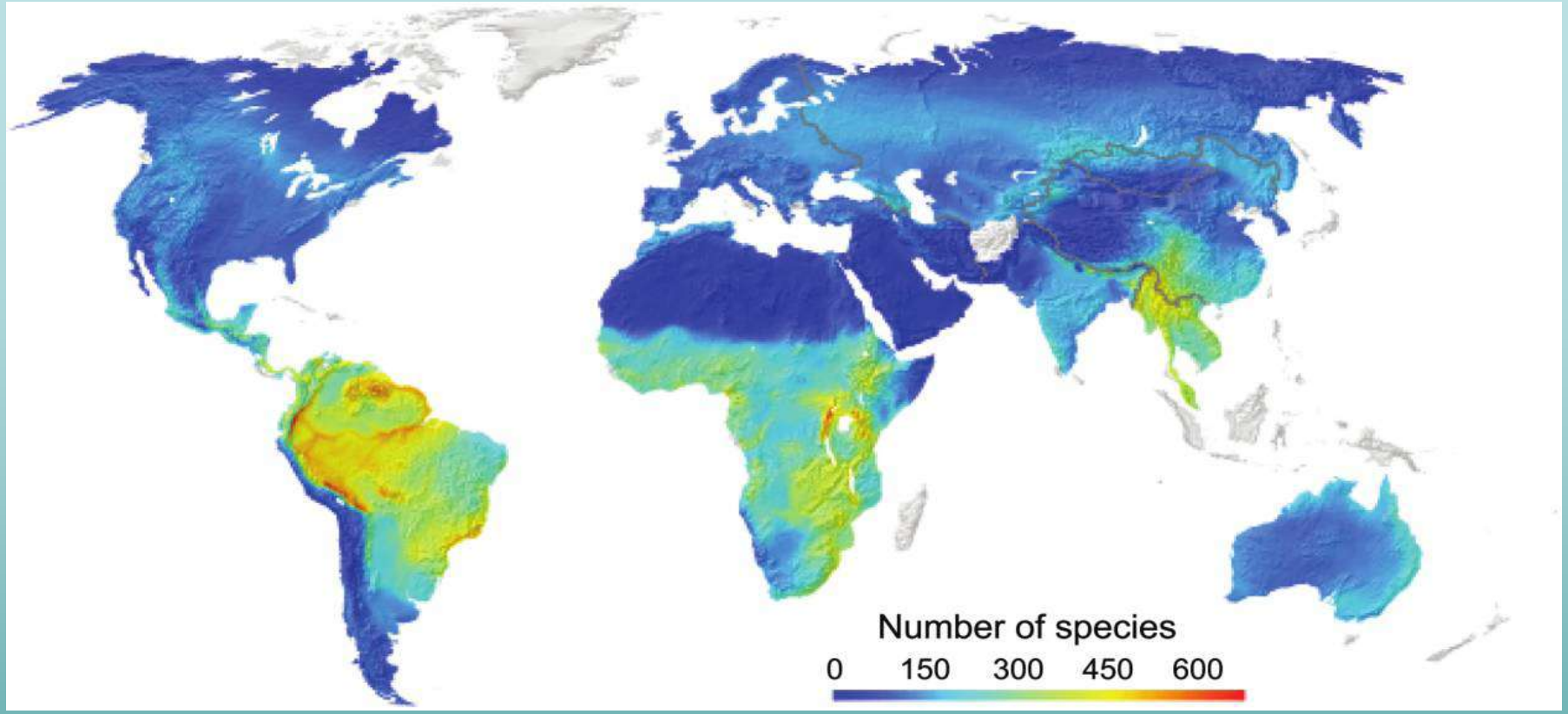
Species richness ultimately depends on whatever proximate factors are found to affect processes of speciation, extinction, immigration, and emigration.

The hypothesis of effective evolutionary time (most popular)

Assumes that diversity is determined by:

- the evolutionary time under which ecosystems have existed under relatively unchanged conditions, and
- evolutionary speed directly determined by effects of environmental energy (temperature) on mutation rates, generation times, and speed of selection

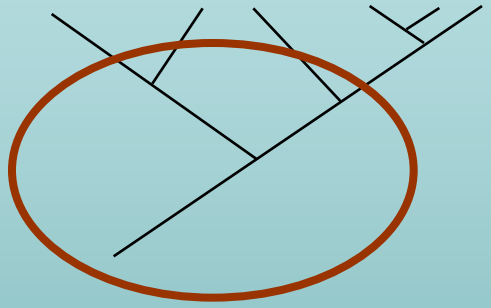
It differs from most other hypotheses in not postulating an upper limit to species richness set by various abiotic and biotic factors, i.e., it assumes a largely non-saturated niche space. It does accept that many other factors may also play a role in determining latitudinal gradients in species richness. The hypothesis is supported by much recent evidence.



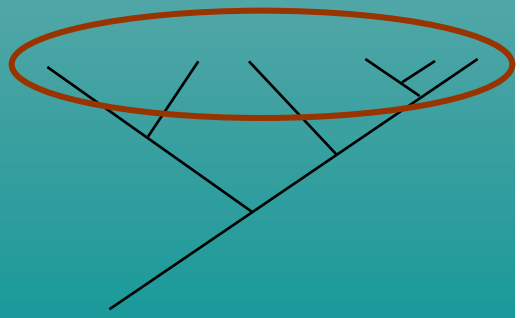
The 7,520 bird species were ranked from the most basal to the most derived (resolved to family), and the approximate 35% and 65% percentiles were selected: 2,700 species from 54 basal families and 2,458 species from 16 derived families. Species richness was then calculated separately for each group.

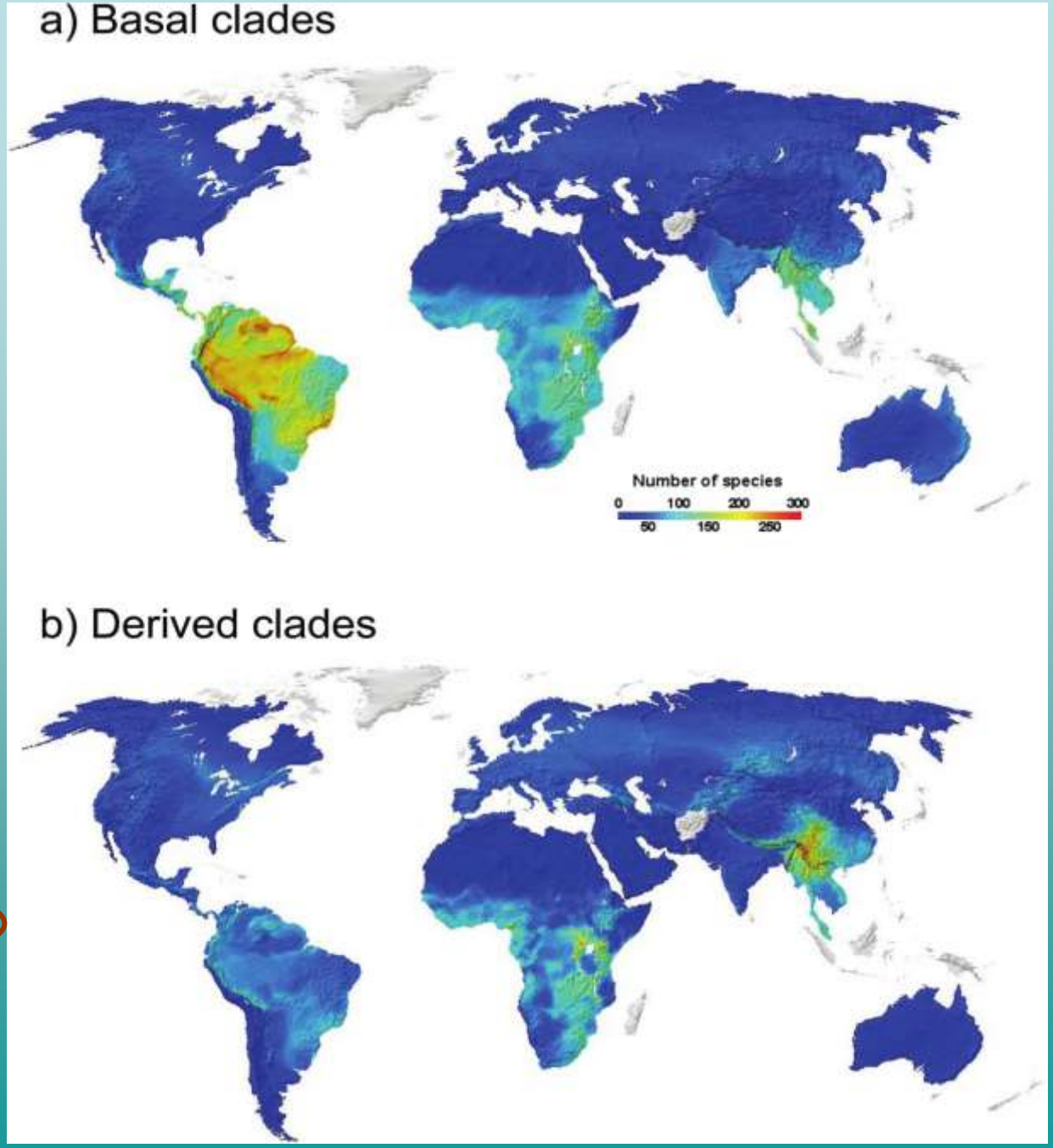
From: **Climate**, **niche conservatism**, **and the global bird diversity gradient**
BA Hawkins, JAF Diniz-Filho, CA Jaramillo, SA … - American Naturalist, 2007

Families of birds having ‘older’ evolutionary origin



Families of birds having ‘newer’ evolutionary origin

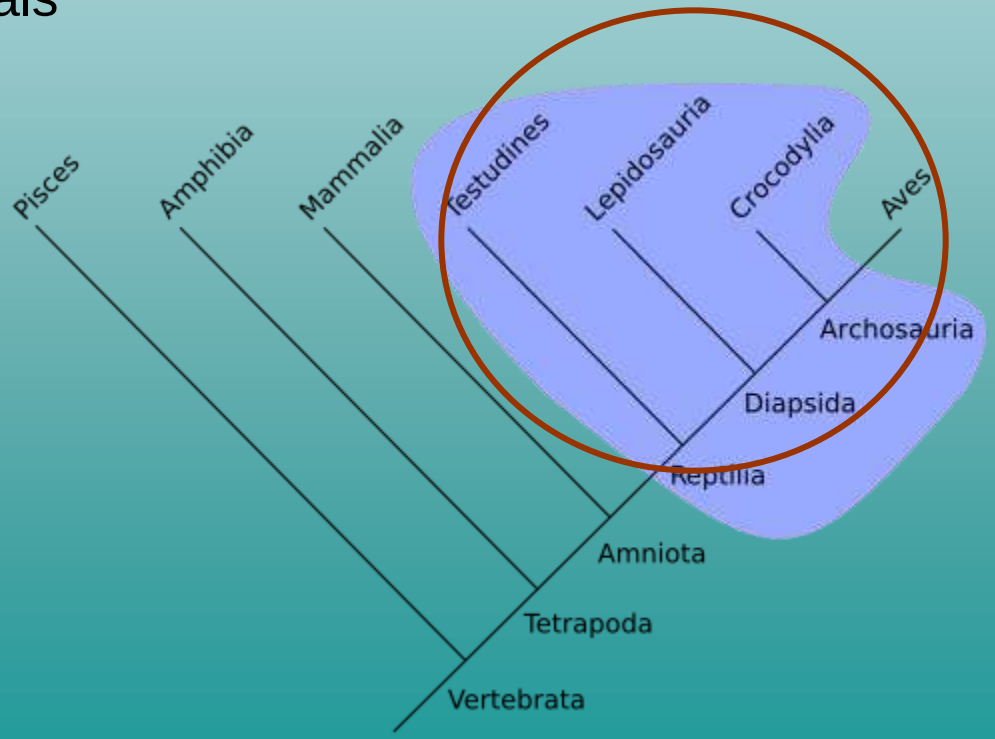




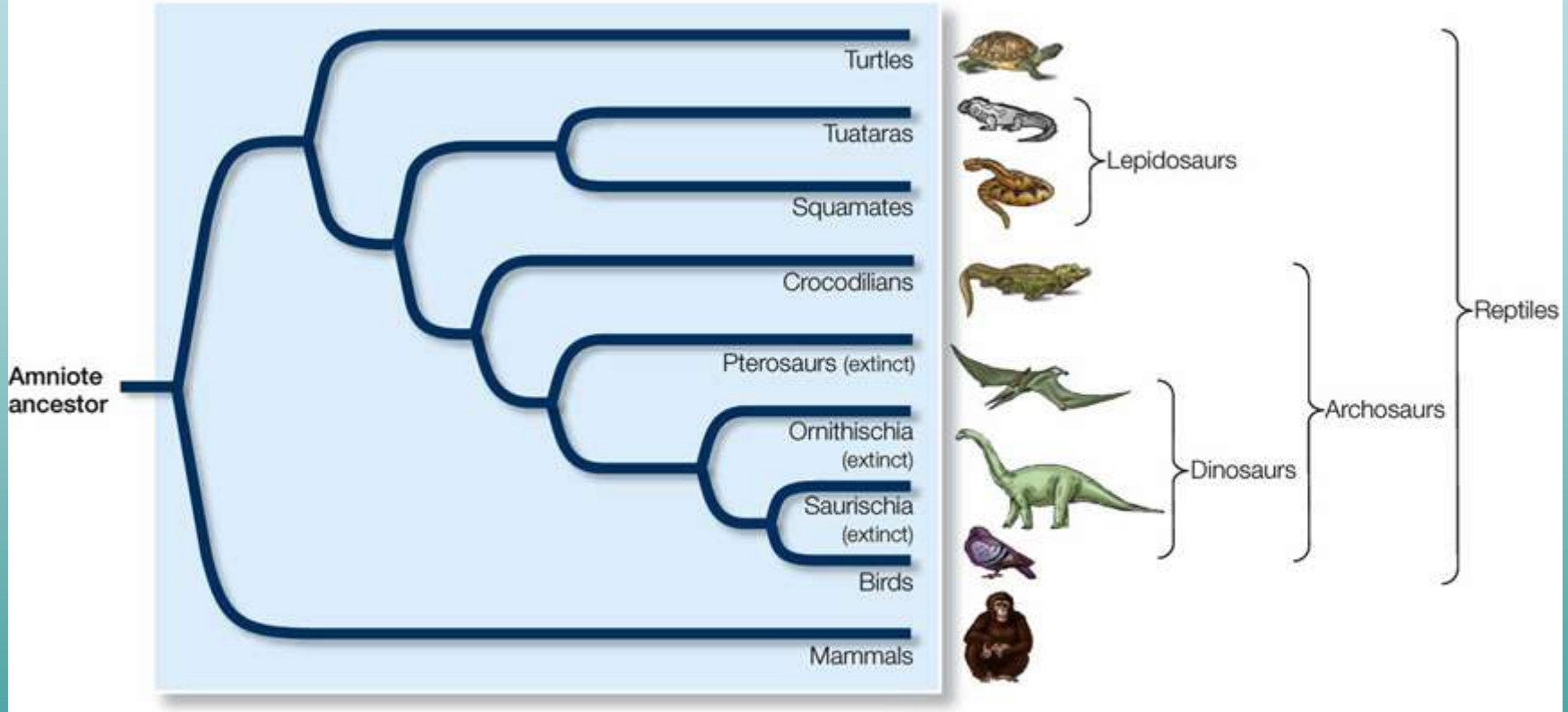
How many classes of vertebrates are there?

1. Fish
2. Amphibians
3. Reptiles
4. Birds
5. Mammals

In a Class by themselves??



- Birds diversified from reptilian ancestors
- **Birds are the lone surviving remnants of the dinosaurs.**



***LIFE 8e*, Figure 33.18**

Bird Phylogeny,

simplified after Chiappe (2007)

AVES

Archaeopteryx

Confuciusornithidae

Pygostylia

Enantiornithes

Ornithothoraces

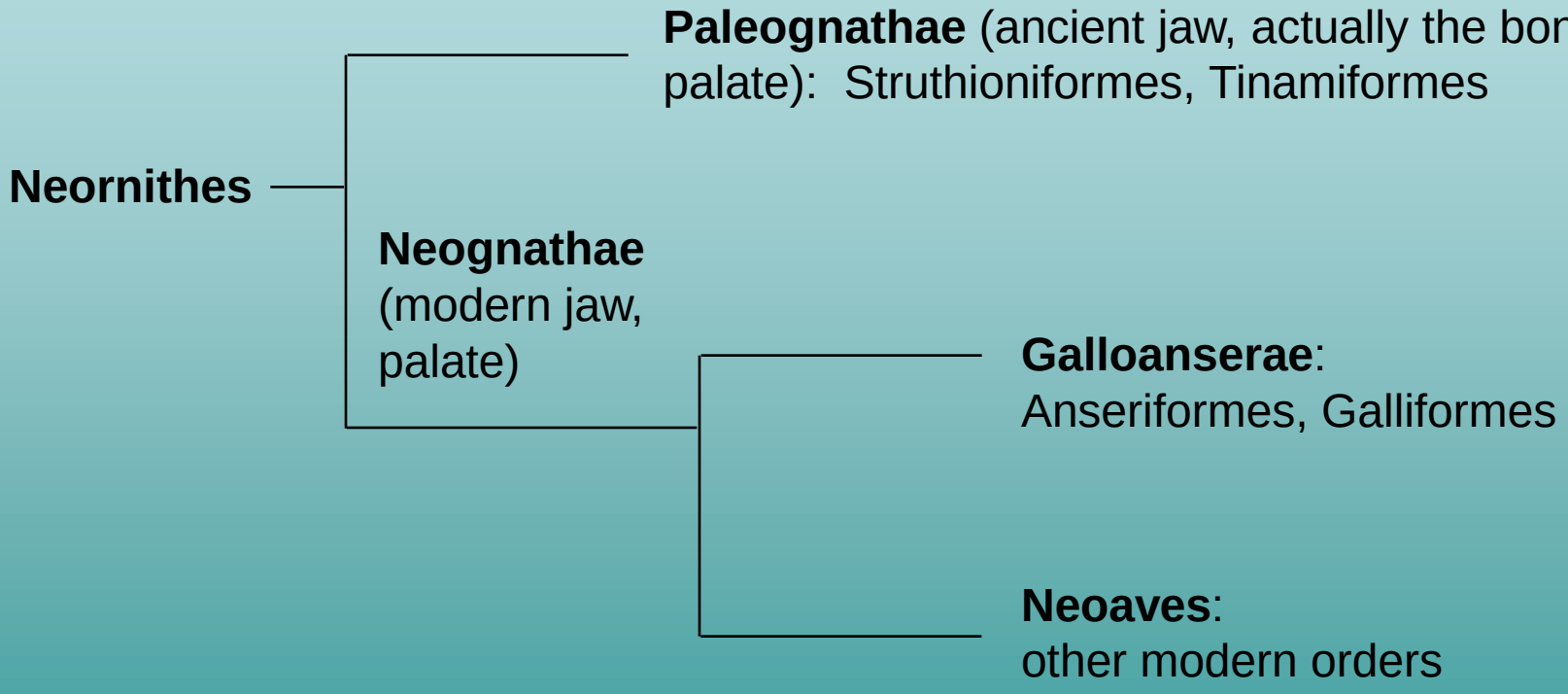
Hesperornithiformes

Ornithurae

Neornithes

(Modern Birds)

Modern Bird Radiation (based on Sibley and Monroe 1990)



Modern Bird Orders

Subclass Neornithes

Paleognathae:
- Struthioniformes—ostriches, emus, kiwis, and allies
- Tinamiformes—tinamous

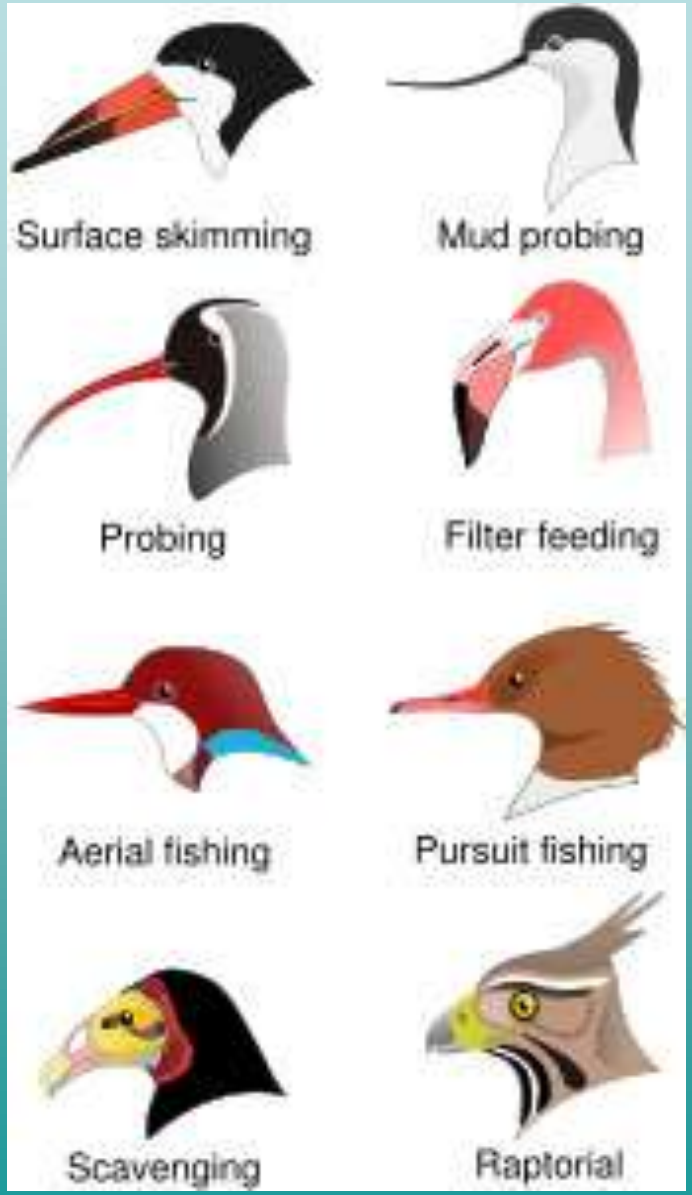
Neognathae:
- Anseriformes—waterfowl
- Galliformes—fowl
- Charadriiformes—gulls, button-quails, plovers and allies
- Gaviiformes—loons
- Podicipediformes—grebes
- Procellariiformes—albatrosses, petrels, and allies
- Sphenisciformes—penguins
- Pelecaniformes—pelicans and allies
- Phaethontiformes—tropicbirds
- Ciconiiformes—storks and allies
- Cathartiformes (?) —New World vultures
- Phoenicopteriformes—flamingos
- Falconiformes—falcons, eagles, hawks and allies
- Gruiformes—cranes and allies
- Pteroclidiformes—sandgrouse
- Columbiformes—doves and pigeons
- Psittaciformes—parrots and allies
- Cuculiformes—cuckoos and turacos
- Opisthocomiformes—hoatzin
- Strigiformes—owls
- Caprimulgiformes—nightjars and allies
- Apodiformes—swifts and hummingbirds
- Coraciiformes—kingfishers and allies
- Piciformes—woodpeckers and allies
- Trogoniformes—trogons
- Coliiformes—mousebirds
- Passeriformes—passerines

Behavior

Activity:

- diurnal, active by day
- nocturnal, active by night (many owls)
- crepuscular (active during twilight hours),
- by environmental conditions (e.g., coastal waders feed when the tides are appropriate, by day or night)

Feeding adaptations (bill morphology)



Feeding

- Birds' diets are extremely variable: nectar, fruit, plants, seeds, carrion, and various small animals, including other birds.
- Because birds have no teeth, their digestive system is adapted to process unmasticated food items that are swallowed whole.
- Birds can be generalists, or specialists.
- Feeding strategies vary by species.

Gleaners: search foliage or other plant material for insects, invertebrates, fruit, or seeds.

Buff-fronted Foliage-gleaner

Nectar feeders: hummingbirds, sunbirds, lories, and lorikeets among others have specially adapted brushy tongues and in many cases bills designed to fit co-adapted flowers.

Rufous Hummingbird

Probers: Kiwis and shorebirds with long bills probe for invertebrates; shorebirds' varied bill lengths and feeding methods result in the separation of ecological niches.

Filter feeders: flamingos, three species of small petrels, and some ducks.

Grazers: geese and dabbling ducks.

Kleptoparasitism: Some species, including frigatebirds, gulls, and skuas, engage in, stealing food items from other birds. Kleptoparasitism is thought to be a supplement to food obtained by hunting, rather than a significant part of any species' diet; a study of Great Frigatebirds stealing from Masked Boobies estimated that the frigatebirds stole at most 40% of their food and on average stole only 5%.

Barnacle Geese grazing

Great Frigatebirds chasing **Red-footed Boobies**

Hawking: suddenly attacking from a branch (often for insects).

Predators: Loons, diving ducks, penguins and auks pursue their prey underwater, using their wings or feet for propulsion, while aerial predators such as sulids, brown pelican, kingfishers and terns plunge dive after their prey.

Common Loon

Peregrine Falcon

Scavengers: vultures, are obligatory carrion eaters; while others, like gulls, certain raptors (eagles, caracaras, buteos), corvids, are opportunists.

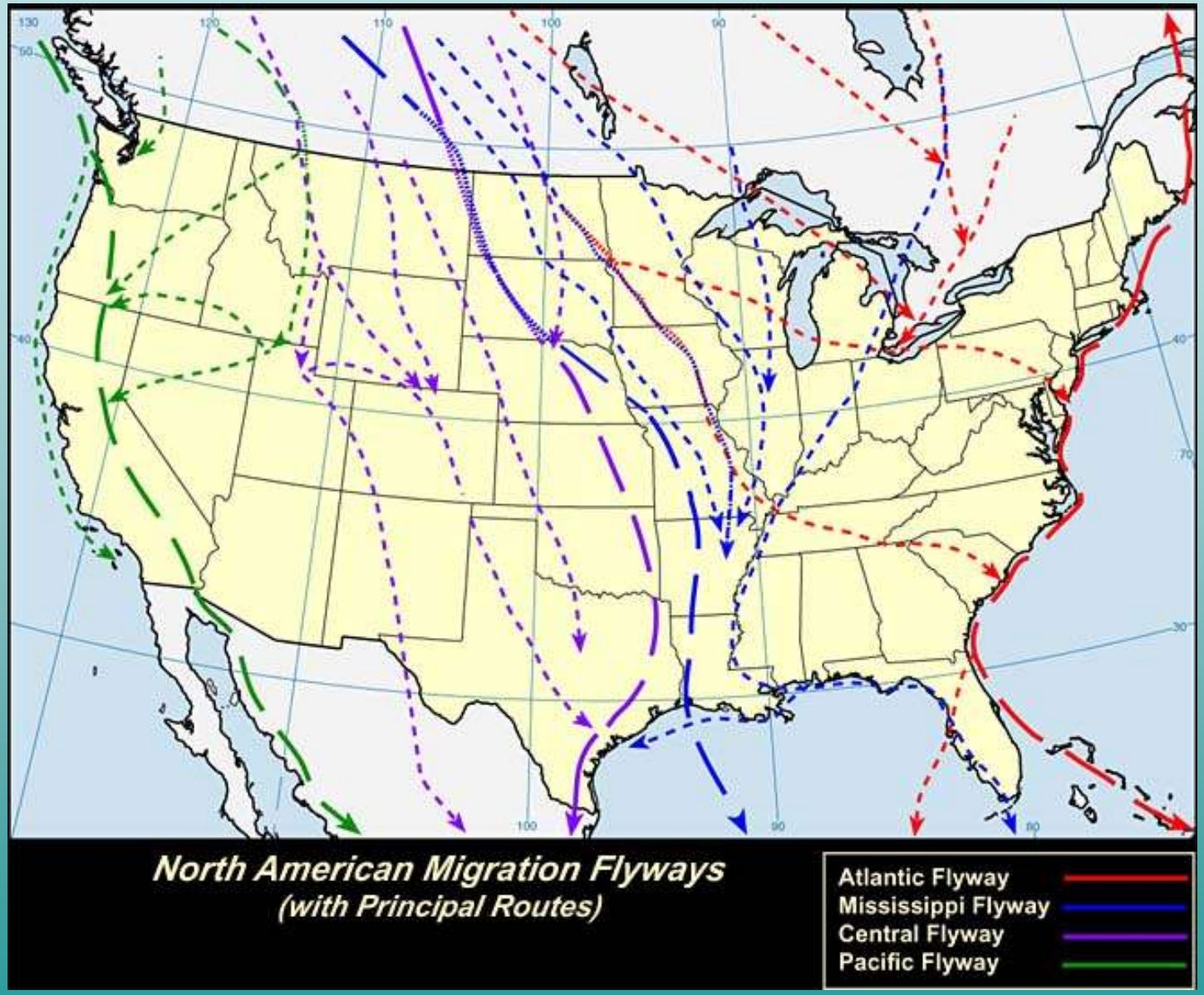
Migration

Regular seasonal (annual) movements.


Sandhill Cranes

- Latitudinal or altitudinal.
- Irregular movements are termed nomadism, invasions
- Non-migratory are known as resident birds.
- Largely in response to changes in food availability, habitat or weather.
- Primary advantage is energetic, even though there is high risk of predation, exhaustion, and other stress.
- Usually triggered by daylength and climate.

- The longer days of the northern summer provide greater opportunities for breeding birds to feed their young. The extended daylight hours allow diurnal birds to produce larger clutches than related non-migratory species that remain in the tropics year-round. As the days shorten in autumn, the birds return to warmer regions where the available food supply varies little with the season.
- Before migration, birds substantially increase body fats and reserves and reduce the size of some of their organs.



http://www.birdnature.com/allflyways.html

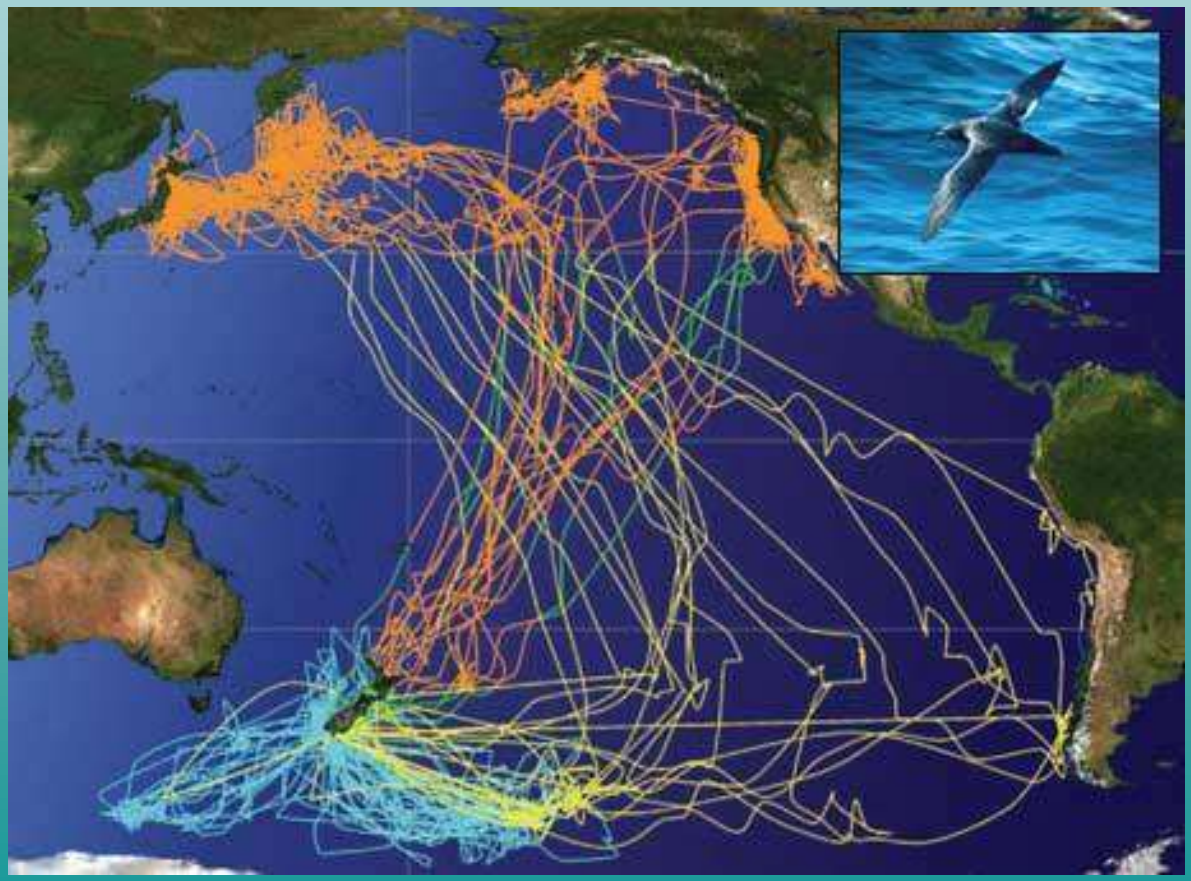
Bird Migration in the Americas Thematic Map (National Geographic classic).

67 types of birds that migrate are shown on a map of the Americas that is overlaid with pathways that show migration routes from nesting grounds to wintering areas.

http://shop.nationalgeographic.com/product/308/3800/173.html

Migration record holders:

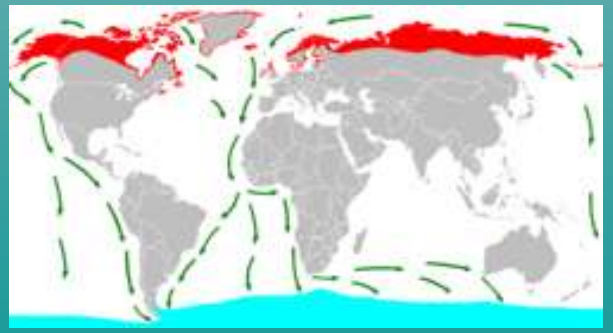
Sooty Shearwaters: nest in New Zealand and Chile and spend the northern summer feeding in the North Pacific off Japan, Alaska and California, an annual round trip of 64,000 km (39,800 mi). Longest animal migration ever recorded electronically.



Arctic Tern (now) has the second longest-distance migration of any bird, and sees more daylight than any other, moving from its Arctic breeding grounds to the Antarctic non-breeding areas.

One Arctic Tern, banded as a chick on the Farne Islands off the British east coast, reached Melbourne, Australia in just three months from fledging, a sea journey of over 22,000 km (14,000 miles).

Arctic Tern

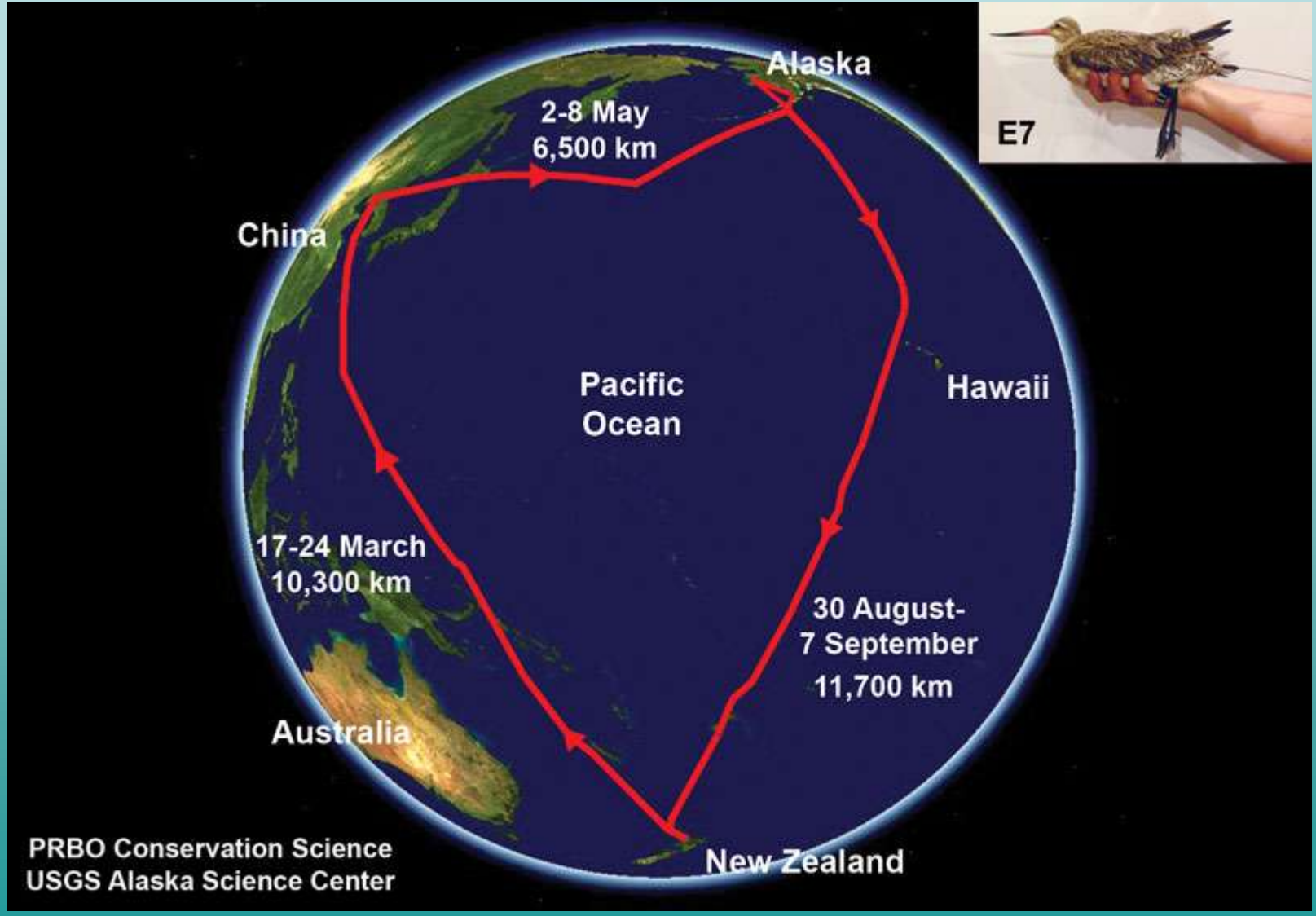


Bar-tailed Godwits: longest known non-stop migration of *any* animal species, up to 10,200 km (6,300 mi) from Yellow Sea in China to New Zealand.

Bar-tailed Godwit (“E7”) flies longest nonstop distance known for any land bird…

- Journey of 18,000-miles, round-trip….
- A series of flights was tracked by satellite, including the longest non-stop flight recorded for a land bird.
- The U.S. Geological Survey's Alaska Science Center tracked the bird as part of an ongoing collaborative effort with colleagues in California and New Zealand.
- The scientists were hoping to better understand potential transmission of avian influenza by migratory birds.
- The bird, dubbed "E7" after the tag on its upper leg, was captured along with 15 other godwits in New Zealand in early February 2007. There each bird was fitted with a small, battery-powered satellite transmitter.
- On March 17, New Zealand to Yalu Jiang, China -- 6,300-miles in eight days.
- Then a 5-week-long layover before departing for the breeding grounds.
- On May 1, to her nesting area on the Yukon-Kuskokwim River Delta in western Alaska. This flight was non-stop, -- 4,500 miles in five days.
- Then tracked to the coast of the Yukon Delta where she joined other godwits preparing for their return flight to New Zealand.
- On August 29, went southeast back across the Alaska Peninsula, over the vast North Pacific and towards the Hawaiian Islands. When less than a day's flight from the main Hawaiian Islands, she turned southwest, crossing the Hawaiian Archipelago over open ocean 125 miles west of Kauai, heading towards Fiji. She crossed the dateline about 300 miles north-northeast of Fiji, and then appeared to fly directly over or slightly west of Fiji, continuing south towards New Zealand.
- On September 7th she made landfall at the mouth of a small river, **eight miles east of where she had been captured seven months earlier.**
- This last leg entailed a non-stop flight of more than eight days and a distance of 7,200 miles, the equivalent of making a roundtrip flight between New York and San Francisco, and then flying back again to San Francisco without ever touching down.
- Since they are land birds, godwits like E7 can't stop to eat or drink while flying over open-ocean. The constant flight speeds at which E7 was tracked by satellite indicate that she did not stop on land.
- Godwits do not become adults until their 3rd or 4th year and many live beyond 20 years of age. If 18,000 miles is an average annual flight distance, then an adult godwit would fly some 288,000 miles in a lifetime.
- The study that recorded E7's epic flight is a collaborative effort led jointly by USGS and Point Reyes Conservation Science, with cooperators from Massey University and Miranda Shorebird Centre, New Zealand, and The Global Flyway Network. The project is funded by the David and Lucile Packard Foundation, the USGS, Alaska Science Center, and the U.S. Fish and Wildlife Service.

Bar-tailed Godwit (“E7”) flies record 18,000 miles (28,500 km)



Other U. S. migrants: examples (one-way distances)

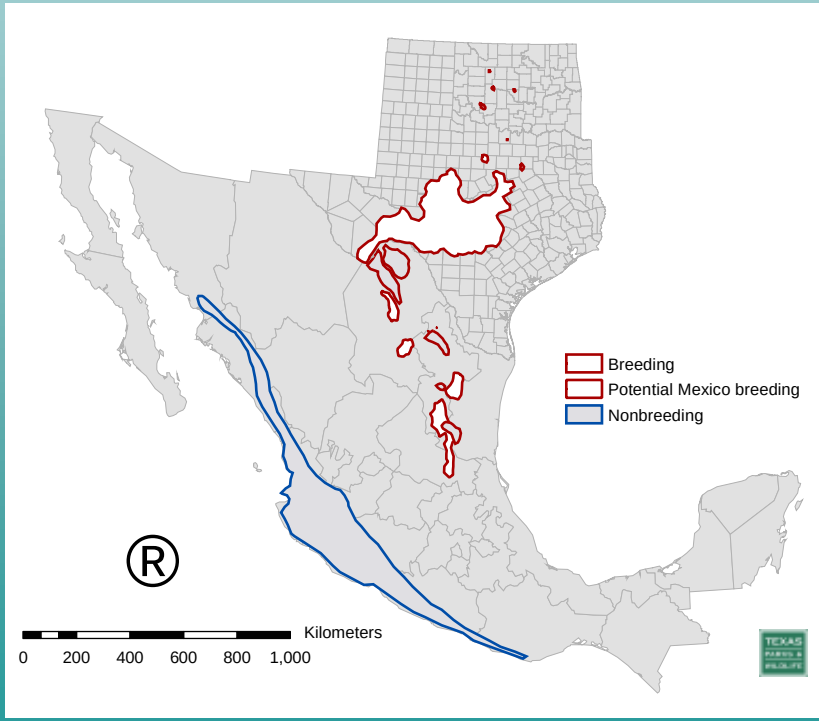
Species	Miles	Breeding Range	Wintering Range
Black-capped Vireo	400-1,250	Oklahoma, Texas	w Mexico
Painted Bunting	300-3,000	s and se U.S.	Mexico to Panama, West Indies
Northern Parula	300-3,000	se Canada, e U.S.	Florida, West Indies, Mexico to Nicaragua
Wood Thrush	600-3,750	se Canada, e U.S.	Mexico to Panama
Scarlet Tanager	600-4,350	se Canada, e U.S.	nw South America
Cerulean Warbler	2,175-4,500	se Canada, e U.S.	nw South America
Blackpoll Warbler	2,500-5,000	Alaska, Canada, New England	n South America
Purple Martin	600-6,000	s Canada, U.S., Mexico	Brazil, Bolivia to n Argentina
Cliff Swallow	1,250-6,800	Alaska, Canada, U.S., n Mexico	s Brazil, Bolivia to c Argentina
Common Nighthawk	2,500-6,800	most of Canada and U.S.	Colombia to c Argentina
Swainson's Hawk	3,750-7,500	sw Canada, w U.S.	s Brazil to c Argentina
Red Knot	1,500-10,000	n Canada	coasts from c U.S. to southern tip of South America

“One-eyed Willie” migrated with only one eye…

Adult male banded 1996 at Dolan Falls Preserve (TNC), Val Verde County, TX. Bred successfully.

Not seen in 1997, but recaptured 1998.

Left eye severely damaged, eye socket healed over.



HOW DO THEY DO THIS? Birds navigate during migration using a variety of methods.

- For diurnal migrants, the sun is used to navigate by day, and a stellar compass is used at night. Birds that use the sun compensate for the changing position of the sun during the day by the use of an internal clock.

- Nocturnal migrants orient with a stellar “compass” which depends on the position of the constellations surrounding the North Star. These are backed up in some species by their ability to sense the Earth's geomagnetism through specialized photoreceptors.

- Recent research suggests migratory birds may also use two electromagnetic tools to find their destinations: one that is entirely innate and another that relies on experience.

- A young bird on its first migration flies in the correct direction according to the Earth's magnetic field, but does not know how far the journey will be. It does this through a radical pair mechanism whereby chemical reactions in special photo pigments sensitive to long wavelengths are affected by the field.

- Birds probably also use mental maps of topography and landmarks.

Note that although this only works during daylight hours, **it does not use the position of the sun in any way**. At this stage the bird is similar to a boy scout with a compass but no map, until it grows accustomed to the journey and can put its other facilities to use.

With experience they learn various landmarks and this "mapping" is done by **magnetites** in the trigeminal nerve system, which tell the bird how strong the field is. Because birds migrate between northern and southern regions, the magnetic field strengths at different latitudes let it know when it has reached its destination.

More recent research has found a neural connection between the eye and "Cluster N", the part of the forebrain that is active during migrational orientation, suggesting that birds may actually be able to *see* the magnetic field of the earth.

Good internet source for US bird migration:

http://www.npwrc.usgs.gov/resource/birds/migratio/routes.htm

Conservation – economic value

National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (USFWS 2006) – update to TPWD handout.

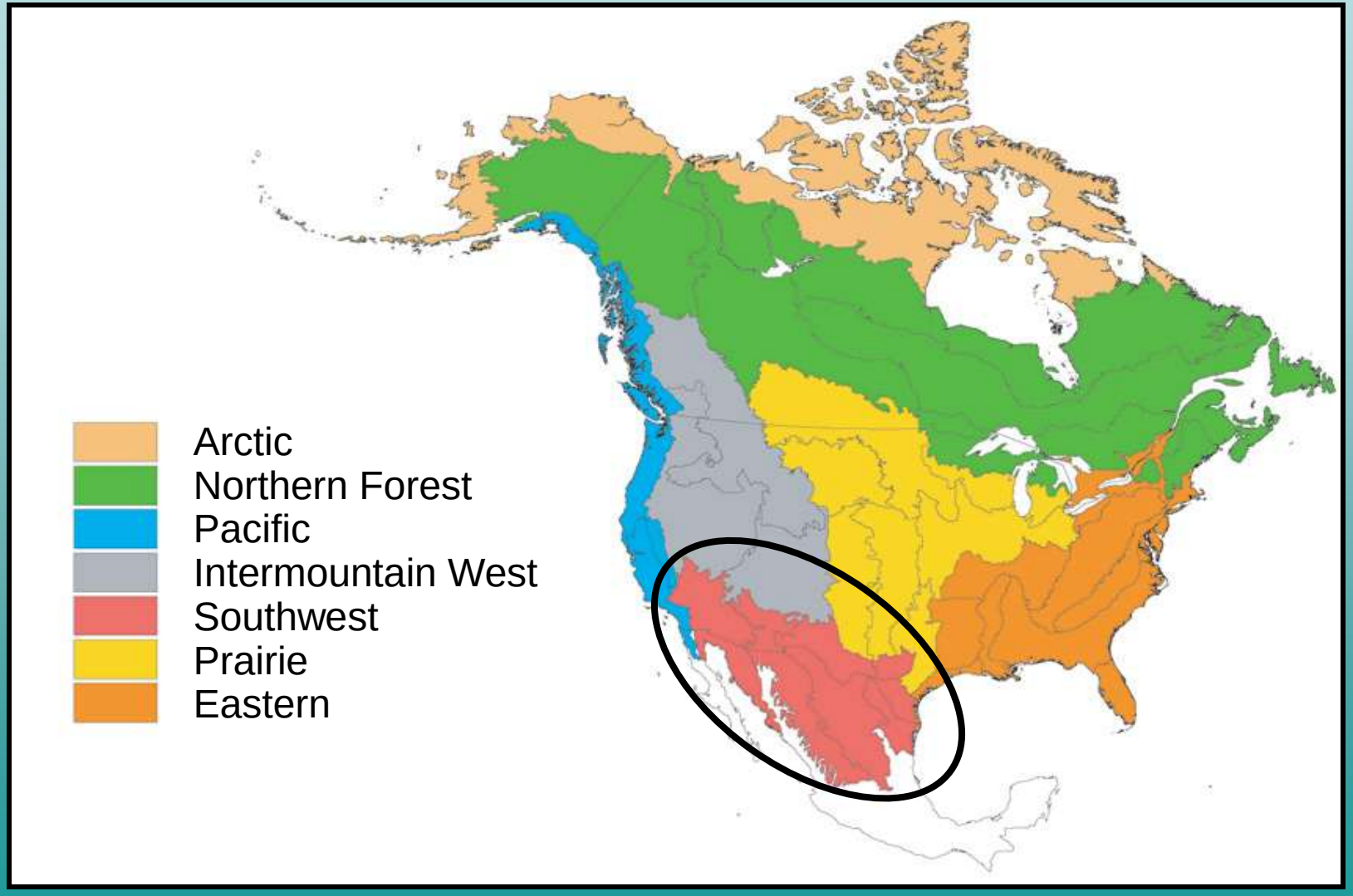
- Fishing $3.2 billion in expenditures, 2.5 million anglers
- Hunting: $2.3 billion in expenditures, 1.1 million hunters
- Wildlife Watching: $2.9 billion in expenditures, 3.7 million participants

A Characterization of Ecotourism in the Texas Lower Rio Grande Valley (Houston Advanced Research Center, 2004)

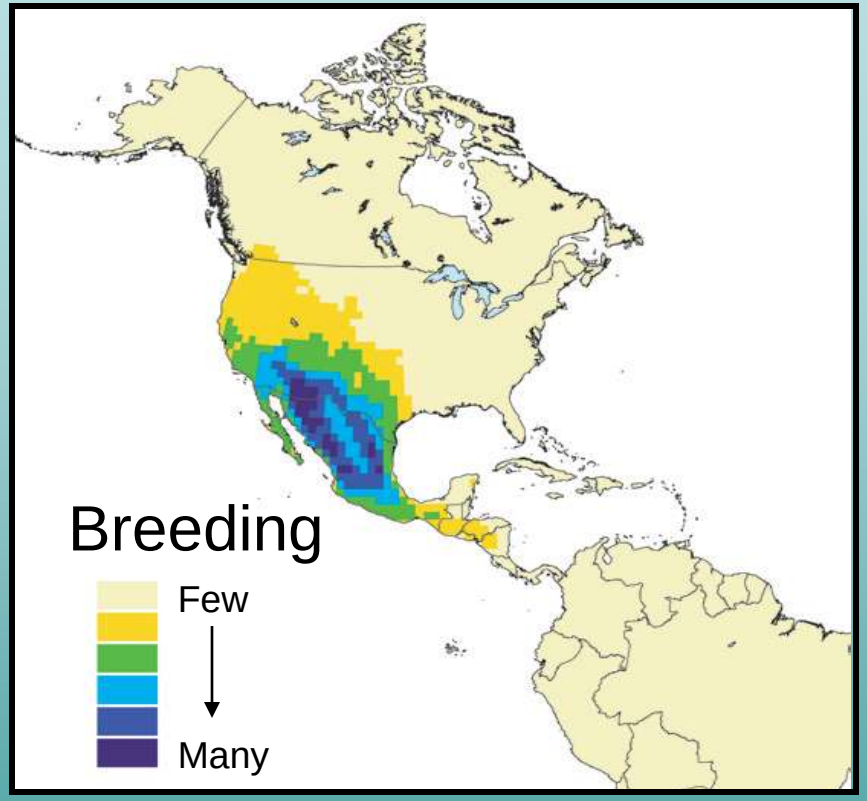
- The Texas State Comptroller's Office recently estimated nature tourism to comprise between $25.4 billion -- $39.9 billion!
- Nature tourism generates approximately $1 billion in state taxes, $739 million in local taxes, and $1.4 billion of economic activity.

Partners In Flight Avifaunal Biomes

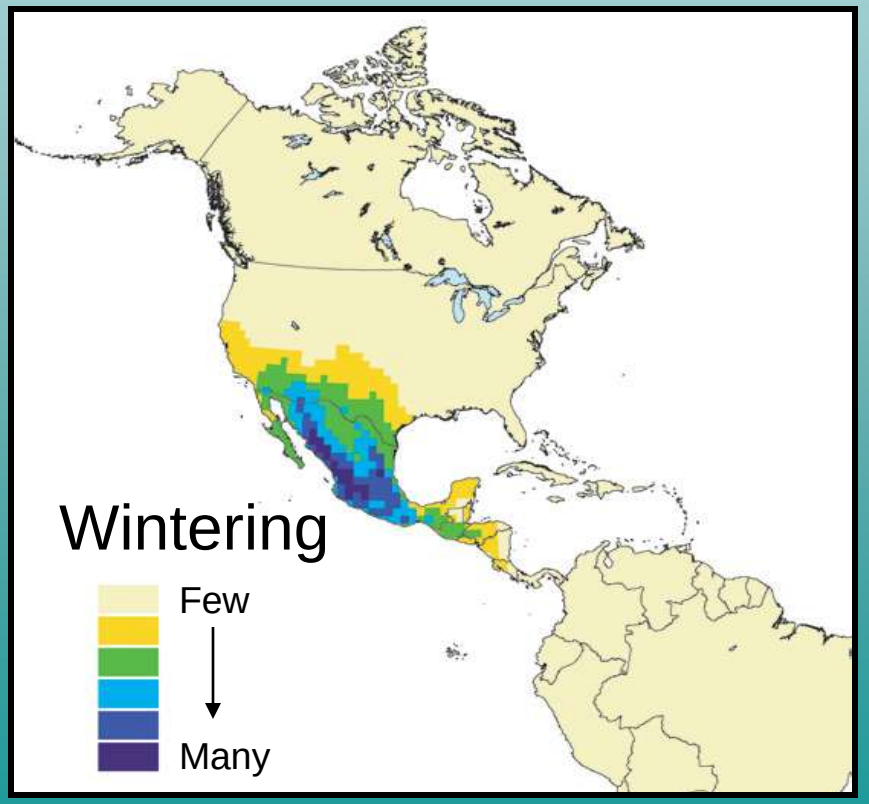
BCRs 20, 33-36



PIF Southwest Avifaunal Biomes



Have the greatest diversity of all….



Texas' Federally listed birds:	Status
• Eastern Brown Pelican	E
• Whooping Crane	E
• Piping Plover	E
• Interior Least Tern	E
• Eskimo Curlew	E
• Greater Prairie Chicken (Attwater's)	E
• Northern Aplomado Falcon	E
• Red-cockaded Woodpecker	E
• Ivory-billed Woodpecker	E
• Southwestern Willow Flycatcher	E
• Black-capped Vireo	E*
• Golden-cheeked Warbler	E

Texas' candidate species birds:

Lesser Prairie Chicken

Yellow-billed Cuckoo

(western ssp.)

Partners In Flight Species of Continental Importance in the Southwest Avifaunal Biome

(Table 6; PIF North American Landbird Conservation Plan)

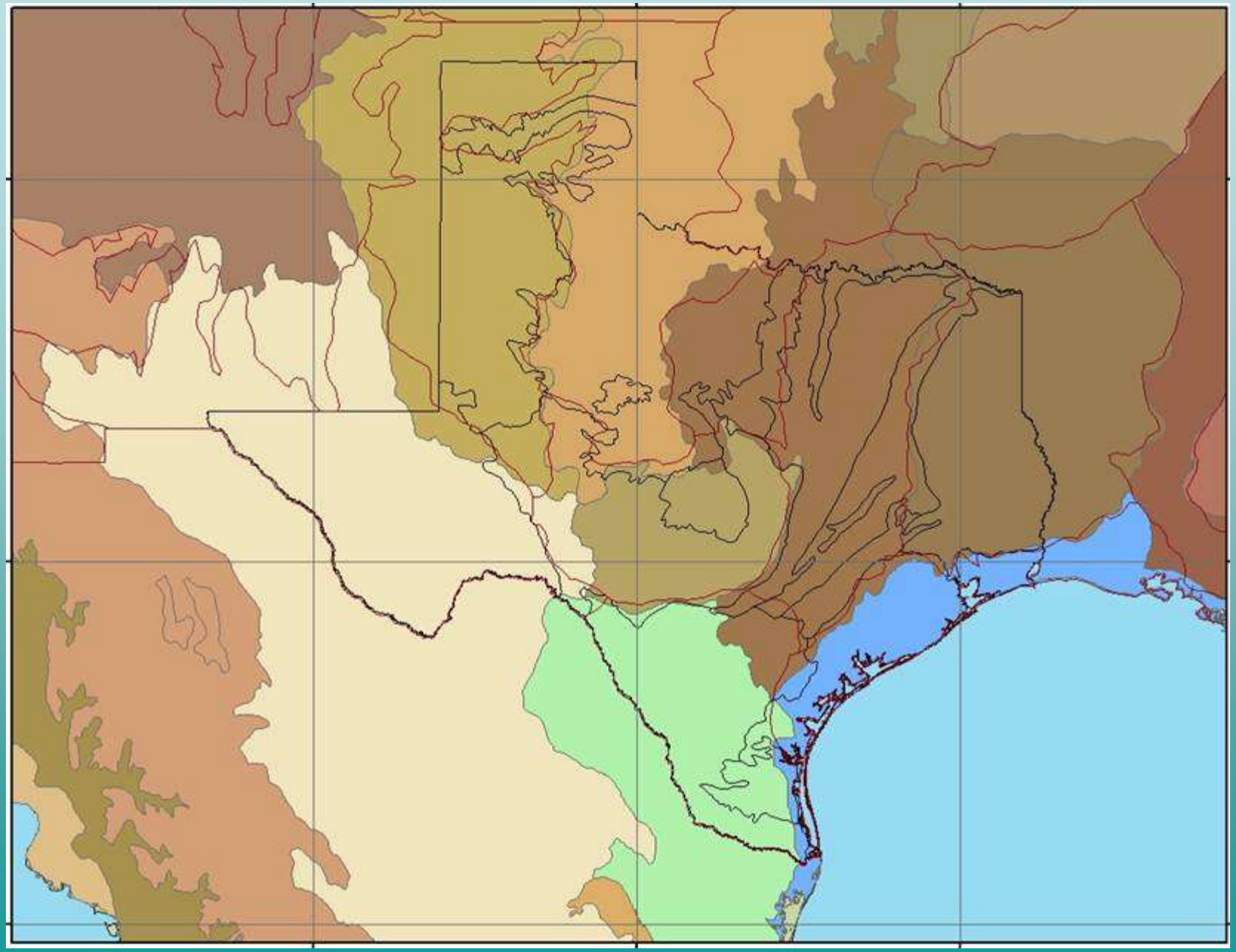
Action Category	Texas	SW Biome	%
Immediate Action	7	11	64
Management	15	21	71
Long-term Planning & Responsibility	12	26	46
Totals	**34**	**58**	**59**

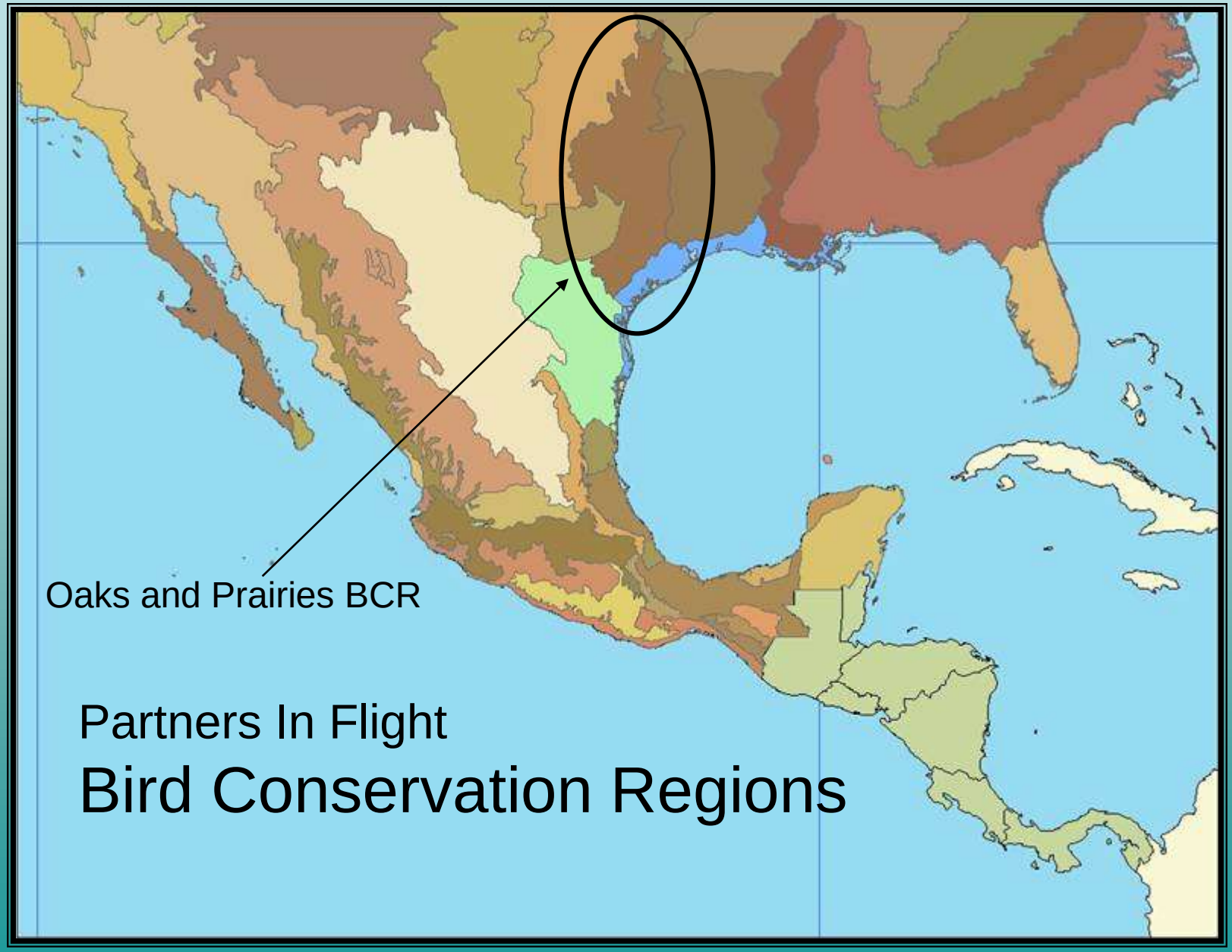
Texas Wildlife Action Plan (TWAP)

BIRDS -- The Texas Priority Species List

Imperiled, declining, or vulnerable….**192**
Official Texas Bird List (2 Jan 08)…..**632**

Percent TWAP Priority Birds.....**30%**




Oaks and Prairies BCR
Partners In Flight
Bird Conservation Regions

The **Oaks and Prairies** extend from approximately the Red River of Oklahoma south to San Antonio, Texas, east to the acidic sandy soils of the East Texas Pineywoods and west to the Eastern Cross Timbers.

Within this area, the **Texas Blackland Prairie** represents the southernmost extension of the North American tallgrass prairie.

- principal habitat is tallgrass; typically occurs on higher areas with good drainage.
- eleven plant associations have been described in the Blackland Prairie, and dominant vegetation includes big bluestem, little bluestem, Indiangrass, switchgrass, brownseed paspalum, and gramagrass.
- also present are bottomland hardwood forests, dominated by burr oak, Shumard oak, black walnut, American elm, cedar elm, and white ash.
- riparian forests include cottonwood, sycamore, black willow, and green ash.
- common trees of upland hardwood forests occurring on the upper slopes and summits of Austin chalk escarpments include Texas oak, San Saba oak, Mexican plum, and cedar elm.
- often an associated dense shrub layer within these forests, including species such as aromatic sumac, poison oak, Carolina buckthorn, and coralberry.
- occasional wetlands and freshwater marshes in the Oaks and Prairies area, primarily associated with the peripheral areas of streams, rivers, and reservoirs.

Oaks and Prairies (PIF) conservation recommendations and needs –

- most heavily altered habitat in the Oaks and Prairies physiographic area is tallgrass prairie. Over 99% of the Blackland Prairie has been plowed for crop production, mostly cotton, and only one tenth of one percent of original prairie exists.
- small fragments of tallgrass species are kept in small “hay meadows” to insure that livestock will have adequate forage even during drought years. The continued loss of tallgrass habitat (at the rate of 20% per year) depletes the inventory of potential local models for restoration projects, and reduces the genetic materials needed to sustain the prairie system.
- areas remaining should be incorporated into some type of preserve system to preserve this vital habitat.
- community based restoration projects would serve to both educate the public and preserve the resource.
- declines in grasslands are also due, in part, to lack of management. In the absence of fire management or appropriate rotational grazing, grasslands were replaced with heavy woody growth and/or exotic species. Appropriate fire management and grazing through private lands incentive programs are needed.
- there is good evidence in grasslands that the introduction of imported fire ants is limiting reproductive success of some birds. More research is needed to quantify this impact.

Priority Bird Populations and Habitats for Oaks and Prairies BCR

Grasslands/scrub habitats:

- Greater Prairie-Chicken (Attwater's subspecies)
- Bewick's Wren (Eastern subspecies, winter only)
- Scissor-tailed Flycatcher
- Painted Bunting
- Bell's Vireo
- Northern Bobwhite


Go to Grassland Birds presentation….