Anyone see any birds lately?


Bolsa Chica bird challenge: Anna and Leeza tied with 30/30 birds

Eared Grebe

Horned Grebe

Discussion: Hill House Finch Paper

Plumage colour signals nutritional condition in the house finch

GEOFFREY E. HILL[1] AND ROBERT MONTGOMERIE[2]

[1] *Department of Zoology and Wildlife Science, Auburn University, Auburn, Alabama 36849, U.S.A.*
[2] *Department of Biology, Queen's University, Kingston, Ontario, Canada K7L 3N6*

SUMMARY

Many animal species have bright, carotenoid-based integumentary coloration that is an important criterion in female choice. It has generally been assumed that carotenoid-based colour displays act as signals of quality because they reflect the foraging ability of the bearer, but this hypothesis has not been tested. In birds, carotenoid pigmentation of feathers is deposited at the time of moult. During moult, feathers grow in regular daily cycles resulting in 'growth bars' that provide a record of the rate of feather growth. To test the idea that the brightness of carotenoid coloration reflects nutritional condition during moult, we compared the brightness of carotenoid-based plumage coloration with both feather growth rate and timing of moult in male house finches (*Carpodacus mexicanus*). Among four populations with substantial differences in mean male plumage brightness, there was no significant variation in mean feather growth rate. Thus, the reduced brightness of some populations is not the result of reduced access to food per se. Within populations, we found a significant positive relation between the growth rate of a male's tail feathers and the brightness of his plumage, suggesting that males growing brighter feathers are in better nutritional condition. The growth rate of tail feathers of captive males provided with ad libitum food was also significantly greater than the growth rate of males in any wild populations. Within populations, we also found a significant negative relation between the onset of moult and plumage colour, with males growing brighter feathers starting moulting earlier. These observations provide support for the hypothesis that carotenoid-based plumage coloration is an indicator of nutritional condition during moult. Variation in nutritional condition may arise from differences among individuals in either their foraging ability or their health.

Independent projects: Mini research paper

Two options: You can choose your own topic, or choose from a few "pre-boxed" projects

"pre-boxed" projects

-Birds of Occidental college: Front and back laminated photo guide of most common birds of campus, with a complete list of the birds of campus along with their status and distribution

-Campus feeder projects: Seed pile or hummingbirds feeders. Maintain food sources and conduct research: How long does it take birds to find food? Which species are dominant? How does weather affect bird activity at food? How does proximity to cover affect food usage? (Can be multiple students to a team, but you all need to TEST A SEPARATE HYPOTHESIS and write up your own separate paper)

Independent projects:

-Must test a hypothesis

-Must use some bird data

-You can collect your own data or use:

-eBird
-iNaturalist
-Audubon Christmas bird count data
-CBRC online book data
-Data from peer-reviewed literature
-THE COLLECTION

Avian Physiology

Body temperature

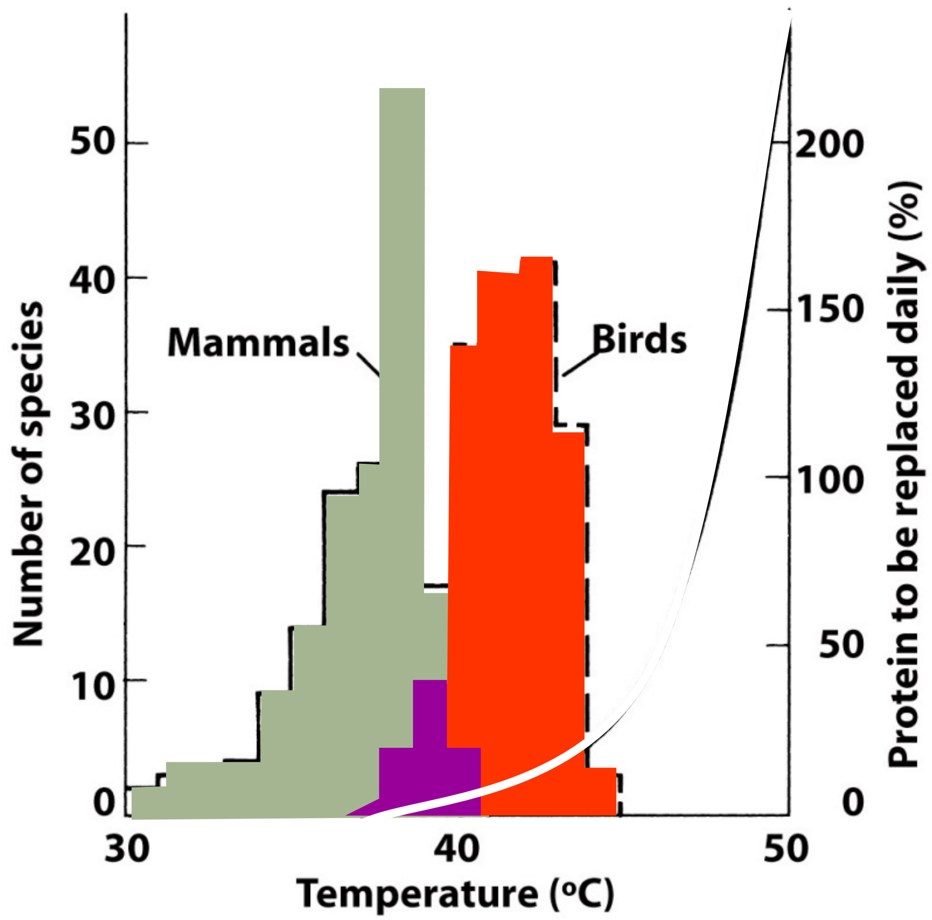


Figure 6-1
Ornithology, Third Edition

-Birds' bodies are hotter than mammals

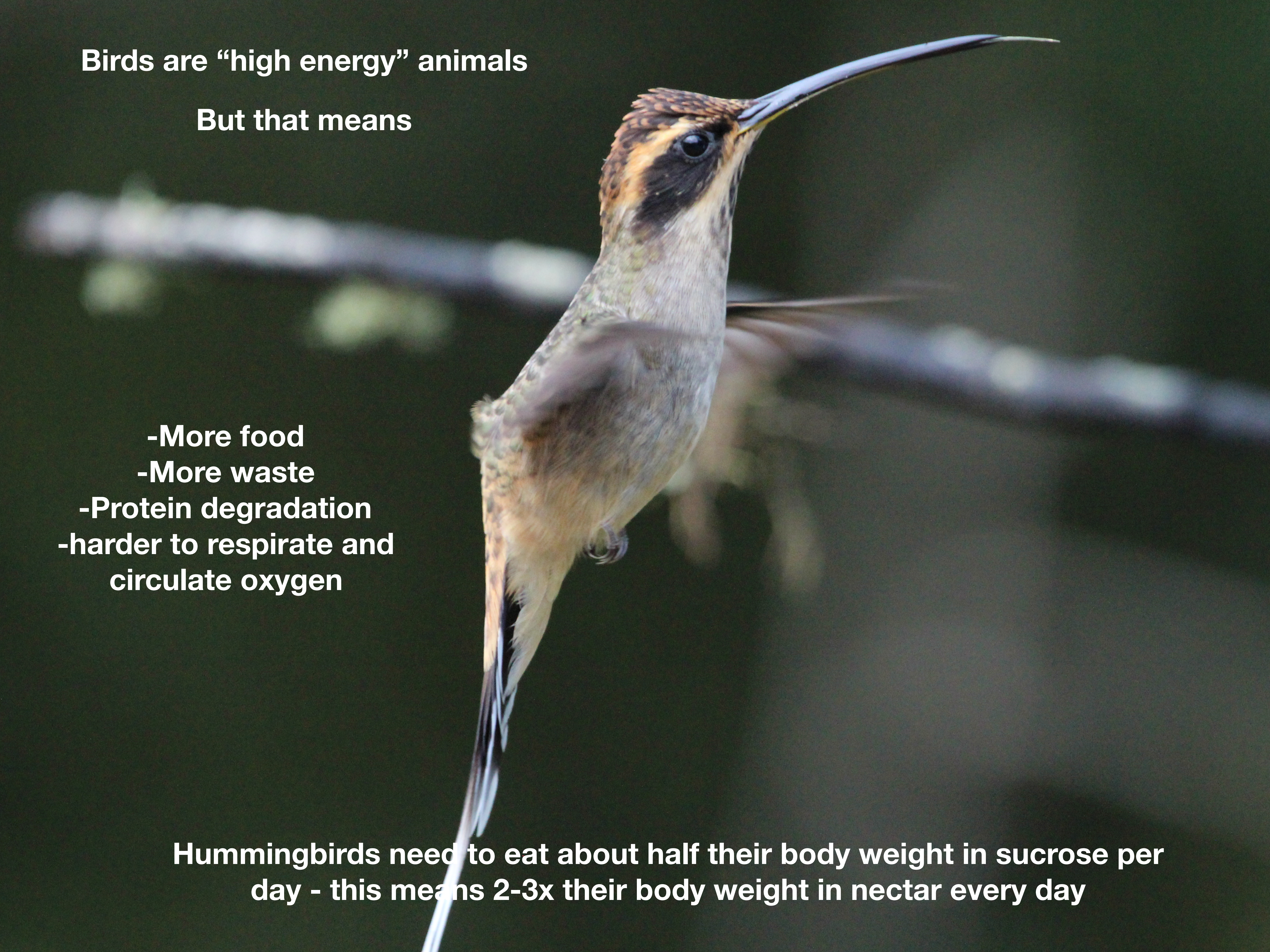
-Everything goes faster when it's hot

-Nerve impulses

-Muscle fibers

-Energy consumption

-Water evaporation


Birds are “high energy” animals
But that means
-More food
-More waste
-Protein degradation
-harder to respirate and circulate oxygen
Hummingbirds need to eat about half their body weight in sucrose per day - this means 2-3x their body weight in nectar every day

Body temperature - when did warm bloodedness evolve in Archosaurs?

Dinosaurs were about as warm-blooded as animals
-Some (like gigantic sauropods) were a little cooler

Dinosaurs were thought to be ectotherms, but now there is clear evidence they were largely endothermic

When did endothermy evolve in Archosaurs?

Evidence for Endothermic Ancestors of Crocodiles at the Stem of Archosaur Evolution

Roger S. Seymour[1] **Christina L. Bennett-Stamper**[2] **Sonya D. Johnston**[1] **David R. Carrier**[3] **Gordon C. Grigg**[4]

[1]Department of Environmental Biology, University of Adelaide, Adelaide, South Australia 5005, Australia; [2]Center for Biological Microscopy, University of Cincinnati, 3125 Eden Avenue, P.O. Box 670521, Cincinnati, Ohio 45267-0521; [3]Department of Biology, University of Utah, Salt Lake City, Utah 84112; [4]Department of Zoology, University of Queensland, Brisbane, Queensland 4072, Australia

ACCEPTED: 11,

Abstract Full Text Cited by PDF

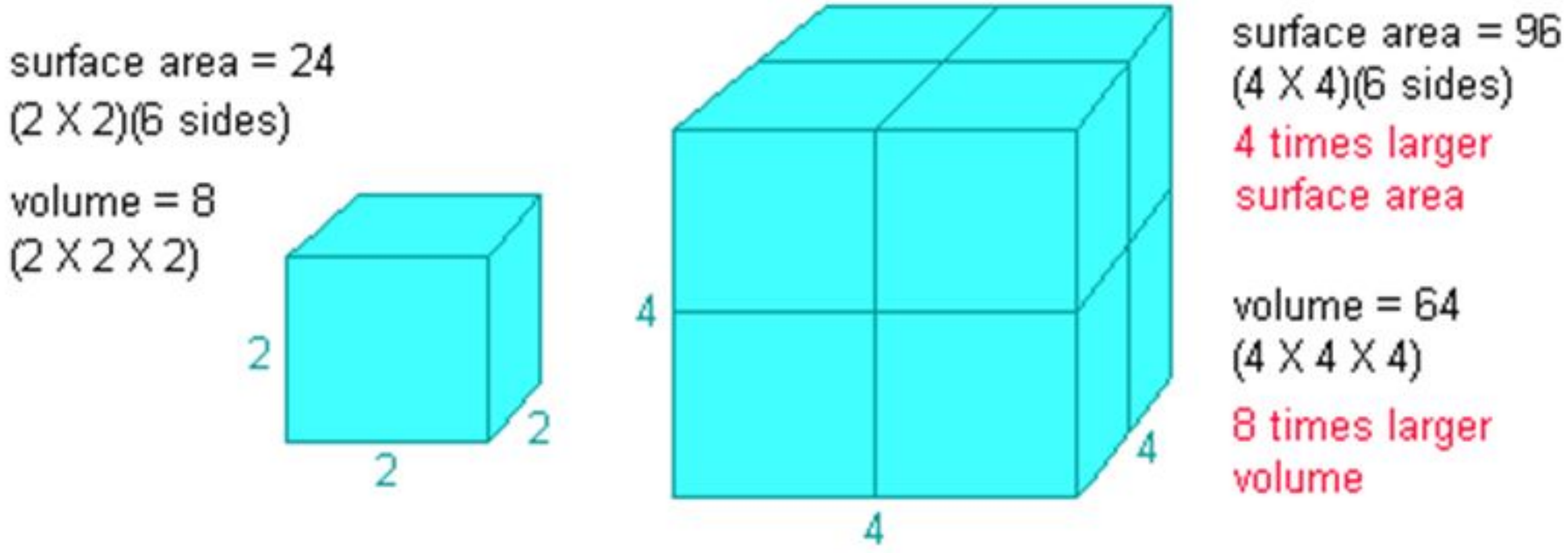
Abstract

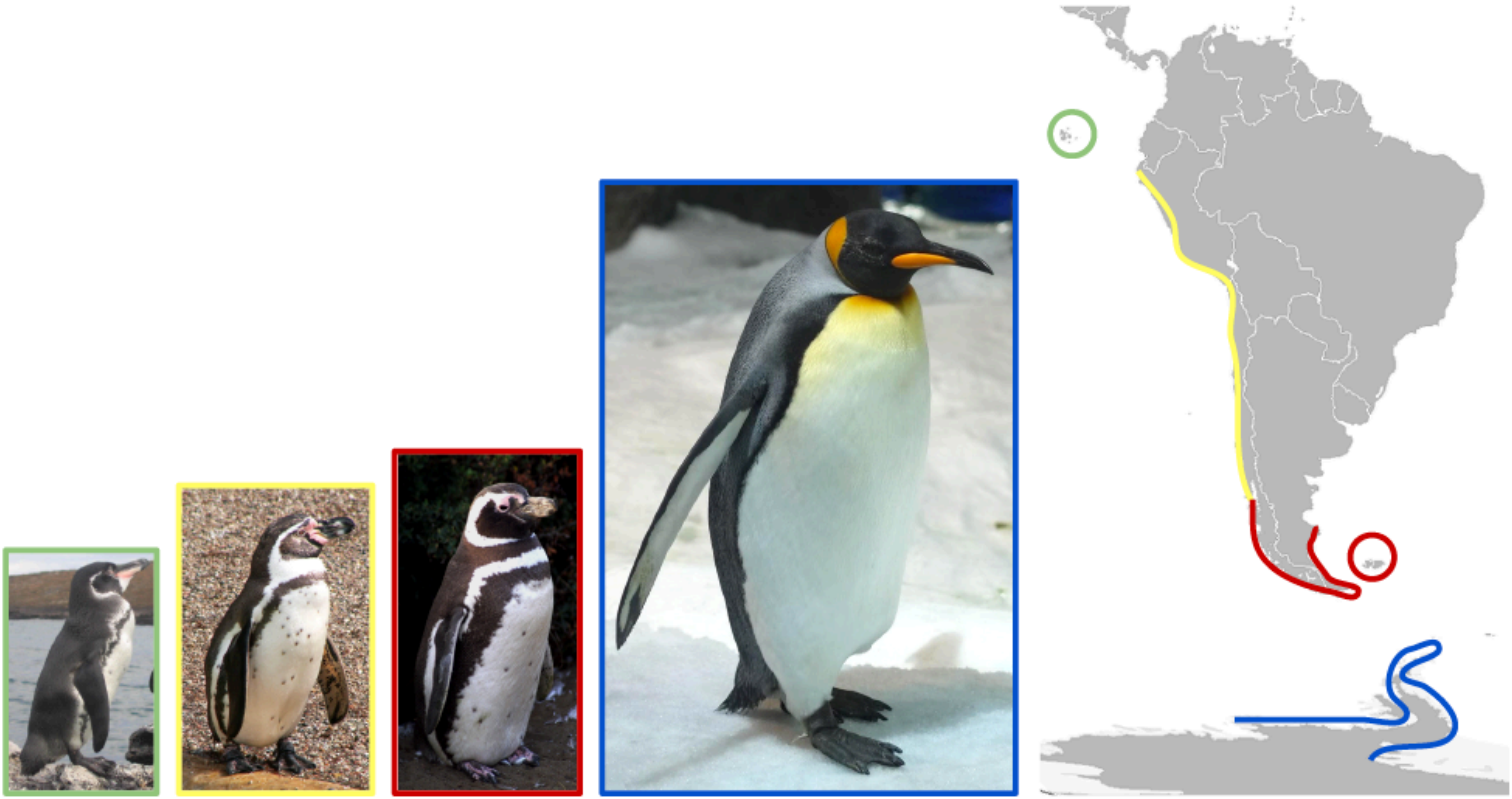
Physiological, anatomical, and developmental features of the crocodilian heart support the paleontological evidence that the ancestors of living crocodilians were active and endothermic, but the lineage reverted to ectothermy when it invaded the aquatic, ambush predator niche. In endotherms, there is a functional nexus between high metabolic rates, high blood flow rates, and complete separation of high systemic blood pressure from low pulmonary blood pressure in a four-chambered heart. Ectotherms generally lack all of these characteristics, but crocodilians retain a four-chambered heart. However, crocodilians have a neurally controlled, pulmonary bypass shunt that is functional in diving. Shunting occurs outside of the heart and involves the left aortic arch that originates from the right ventricle, the foramen of Panizza between the left and right aortic arches, and the cog-tooth valve at the base of the pulmonary artery. Developmental studies show that all of these uniquely crocodilian features are secondarily derived, indicating a shift from the complete separation of blood flow of endotherms to the controlled shunting of ectotherms. We present other evidence for endothermy in stem archosaurs and suggest that some dinosaurs may have inherited the trait.

Endothermy served as a preadaptation for flight in birds
-Why?

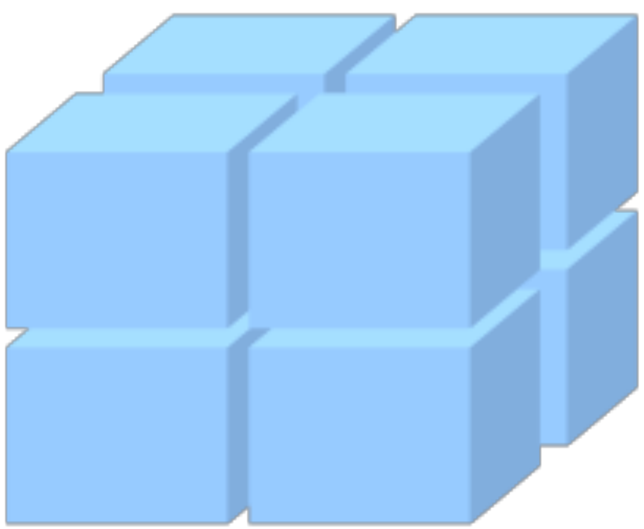
Bergmann's Rule: Colder climate = larger body size

From biology, it states that warm-blooded animals from colder climates usually have larger body masses than the equivalent animals from warmer climates.

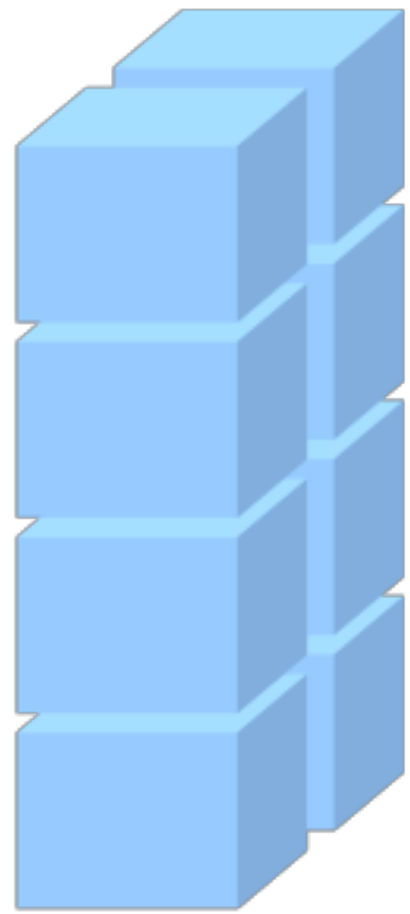




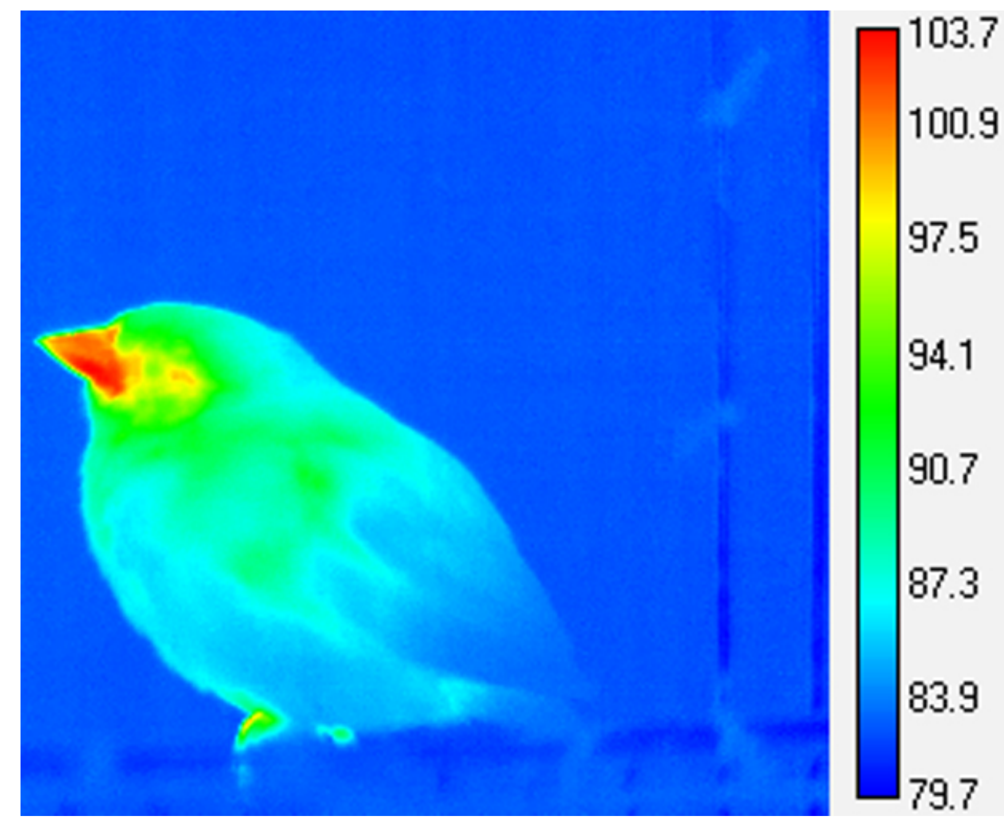
Allen's Rule: Colder climate = shorter appendages



$$\frac{\text{Surface}}{\text{Volume}} = \frac{24}{8} = 3$$



$$\frac{\text{Surface}}{\text{Volume}} = \frac{28}{8} = 3.5$$

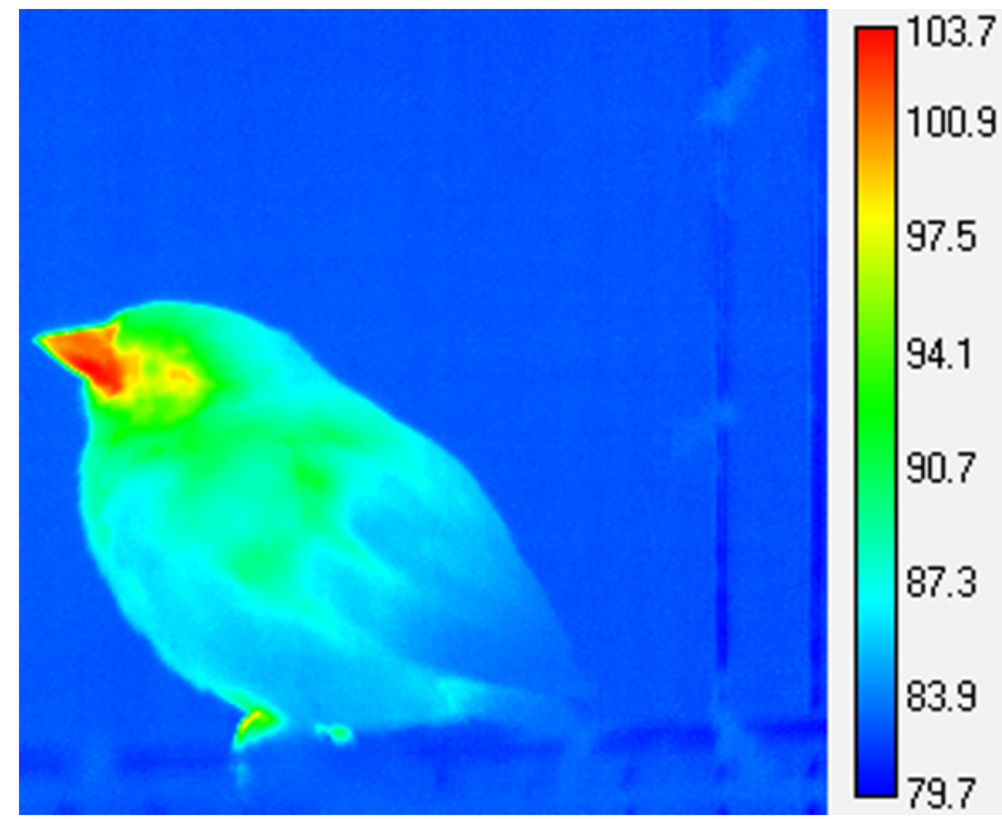


Temperature regulation

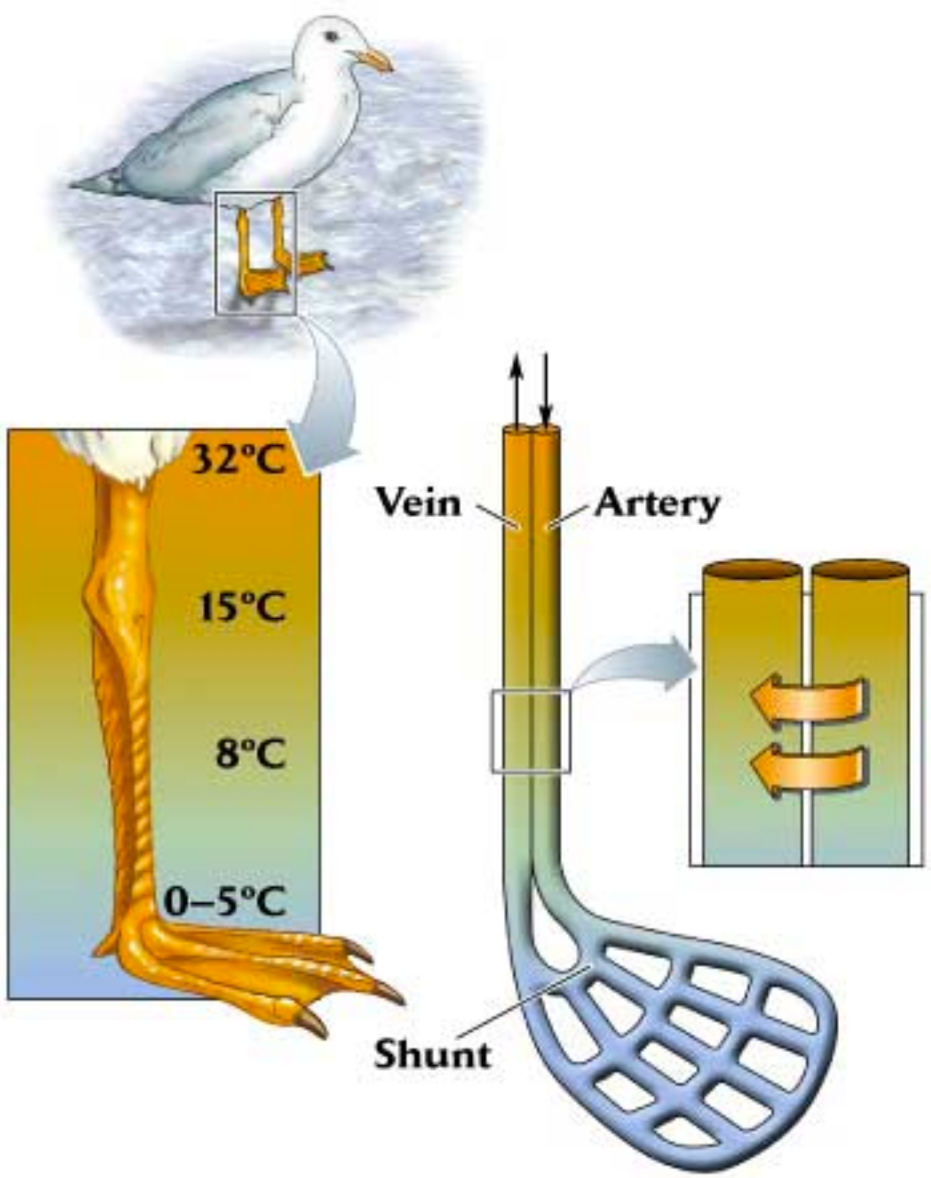
Cold

-Fluffing feathers
-Torpor
-Moving legs under feathers
-Countercurrent exchange
-Bill tucking
-Huddling

Metabolism - temperature regulation



Countercurrent exchange



© Dinu Bandyopadhyay

Metabolism - Hummingbirds

Topor - a state of deep sleep where the metabolism is reduced by up to 95%

https://www.youtube.com/watch?v=8ObONmJ4VU8

https://www.youtube.com/watch?v=iNOKW8NkAVM

Temperature regulation

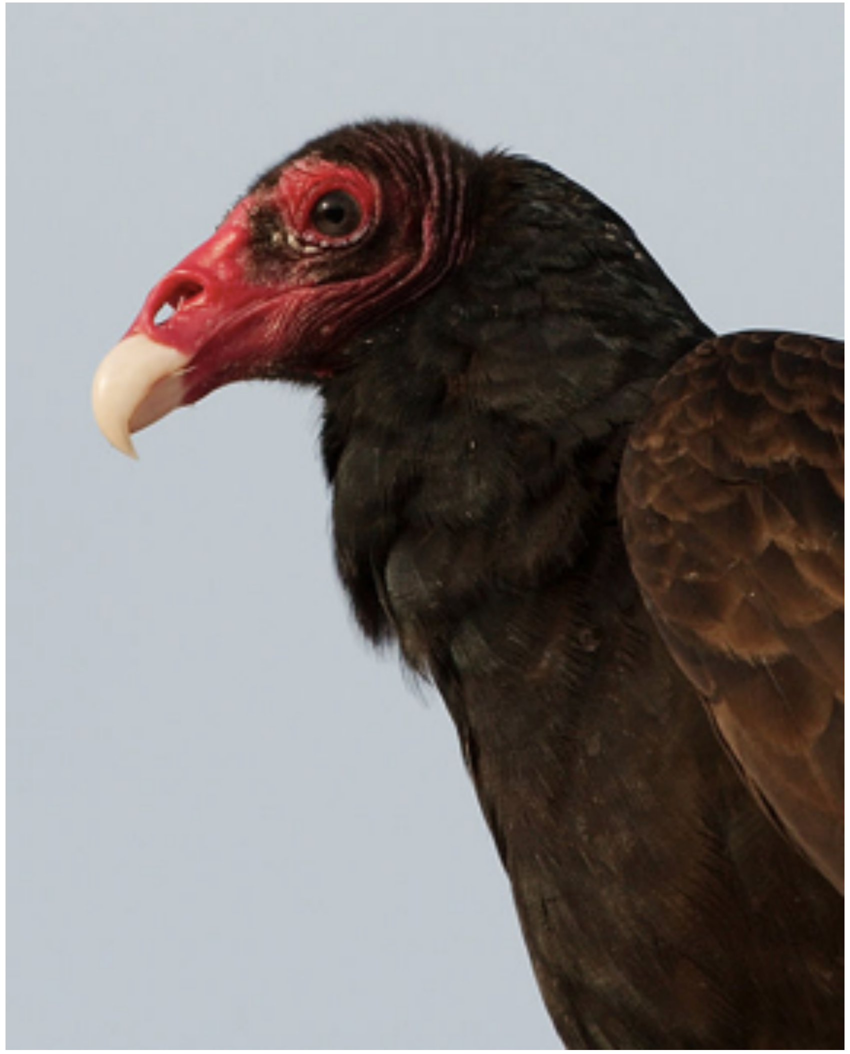
Heat

-Panting

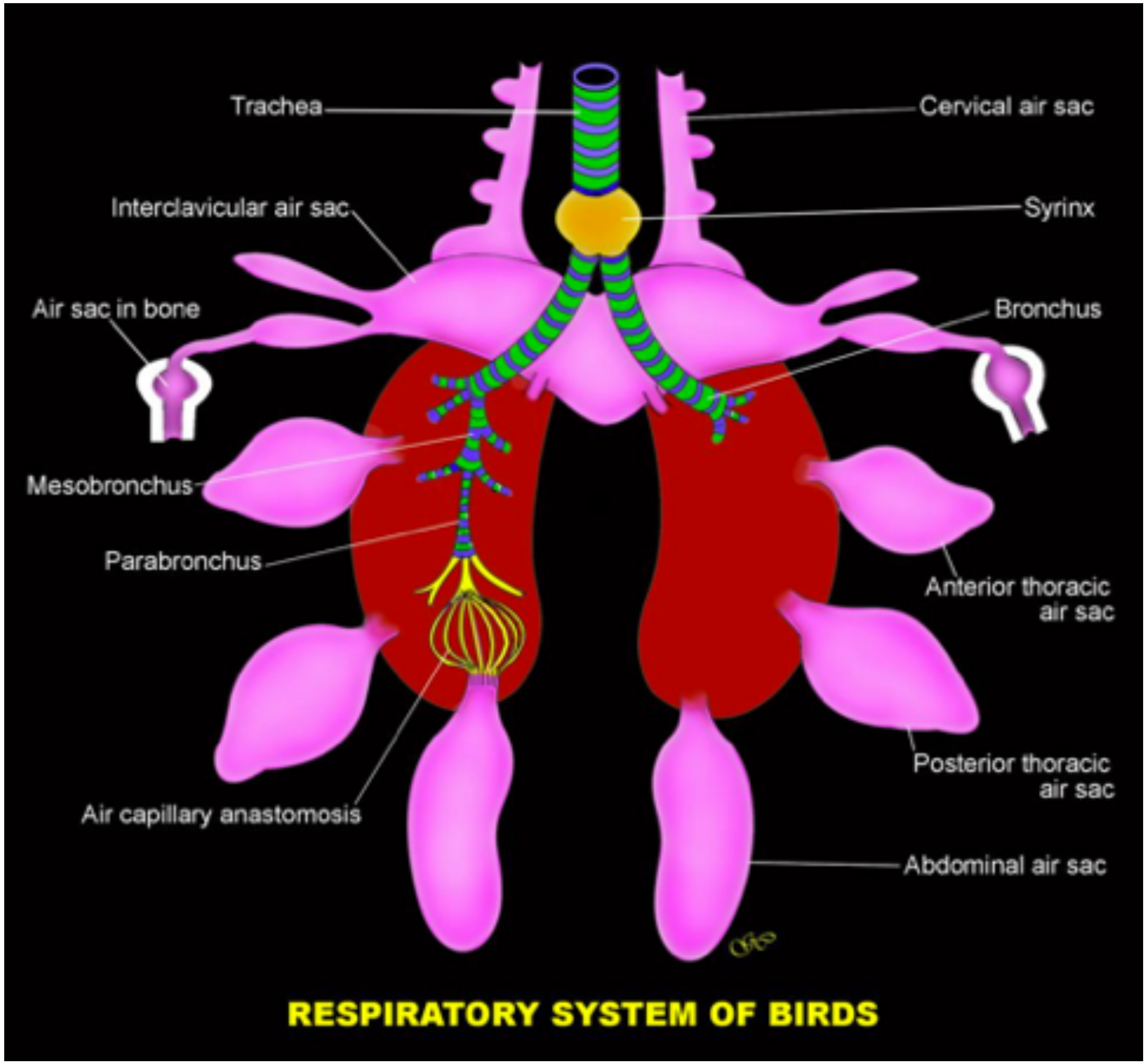
-Defecation on legs

-Exposing legs

-Exposing bill



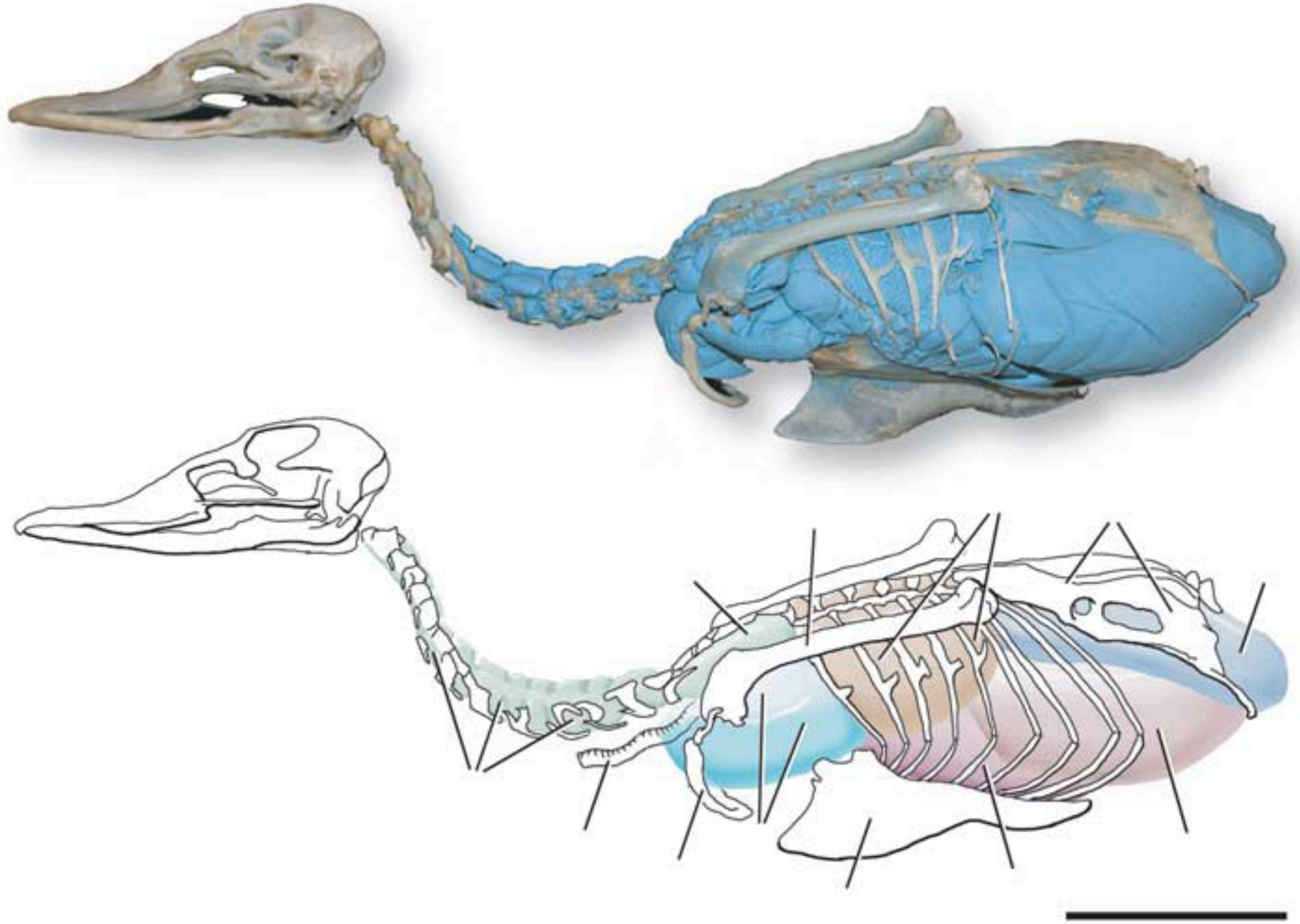
Respiration system



Cervical Air sac

Magnificent Frigatebird

Greater Sage-Grouse

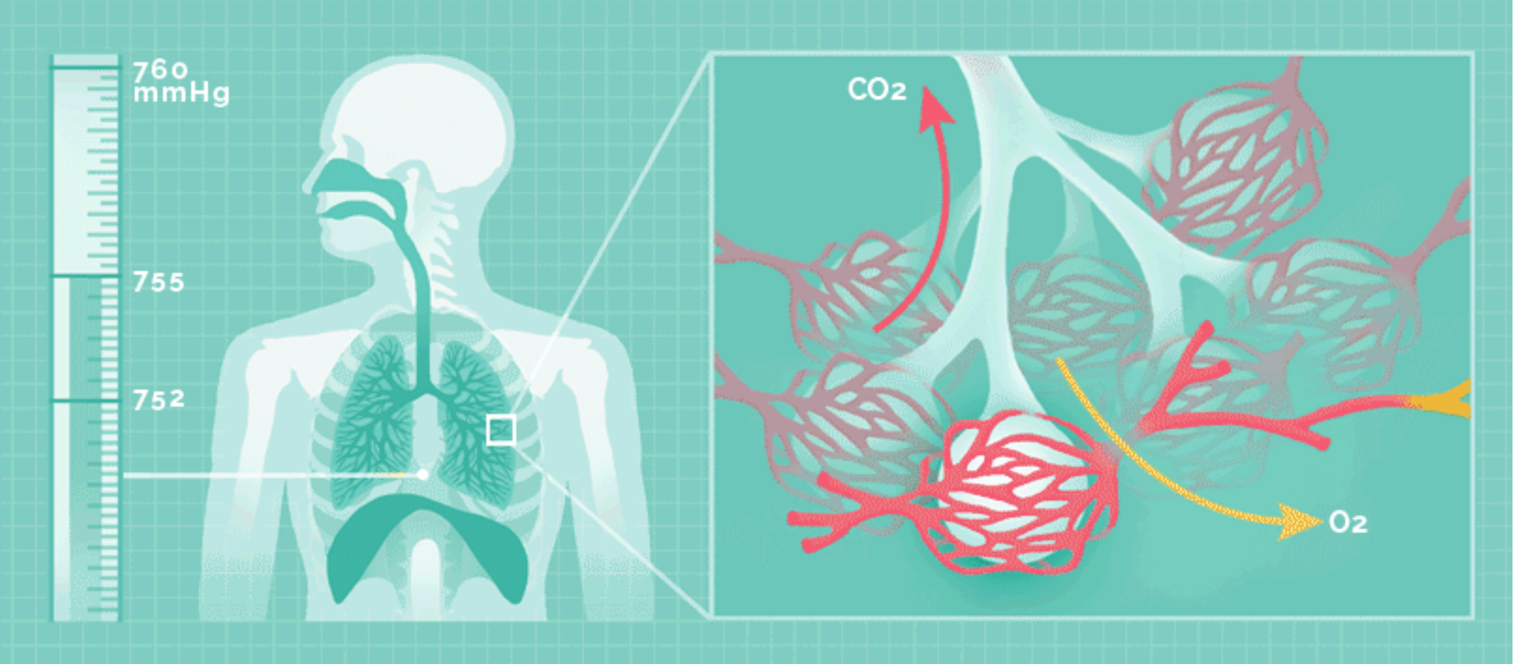


O’Connor & Claessens 2005 Nature 436:253-256

3 DIFFERENT WAYS TO BREATHE

HUMAN LUNGS

Mammals inhale by moving the diaphragm to lower the air pressure in the chest cavity and pull air into the lungs. The human chest cavity is always at a lower pressure than the outside enviroment (usually 760mmHg at sea level)

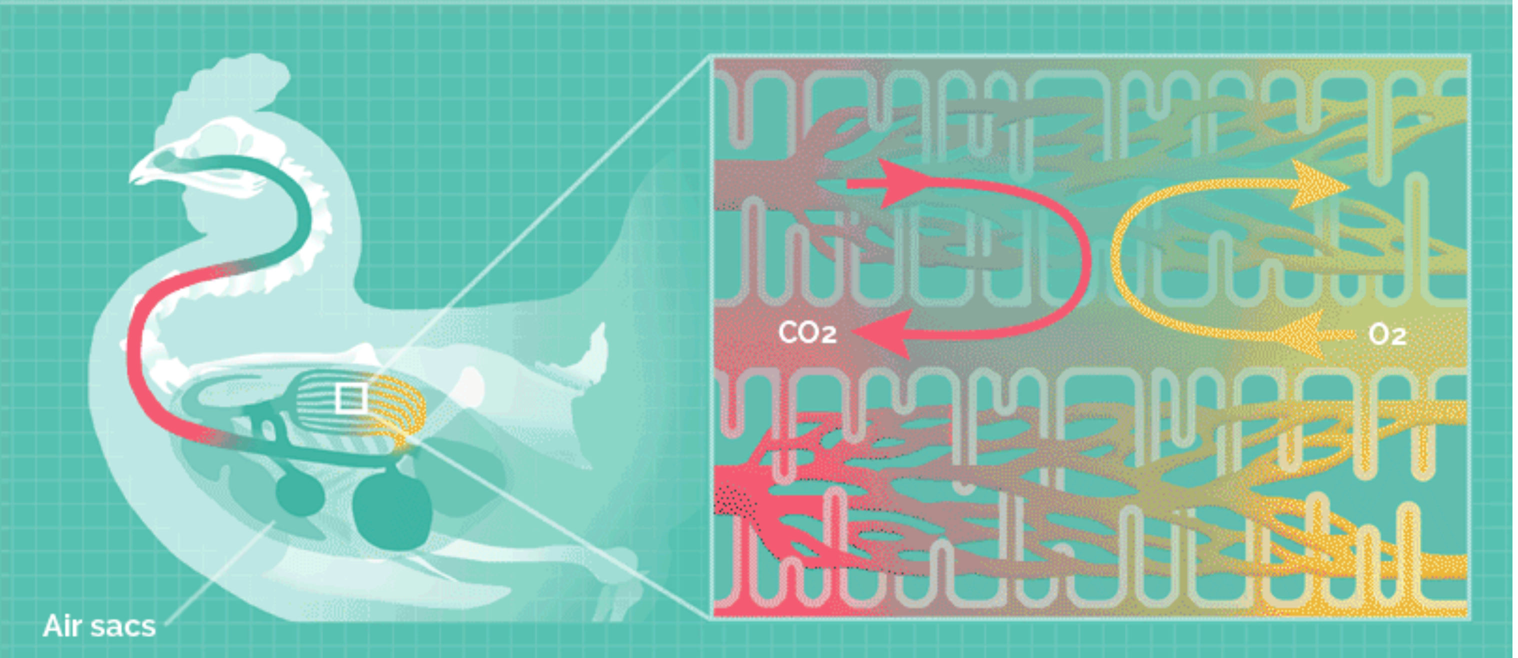


BIRD LUNGS

Birds have air sacs that store and pump air through the stationary lungs.

Unlike in mammals, air flows in only one direction through bird lungs. With the help of the air sacs, this allows birds to take in oxygen even during exhalation.

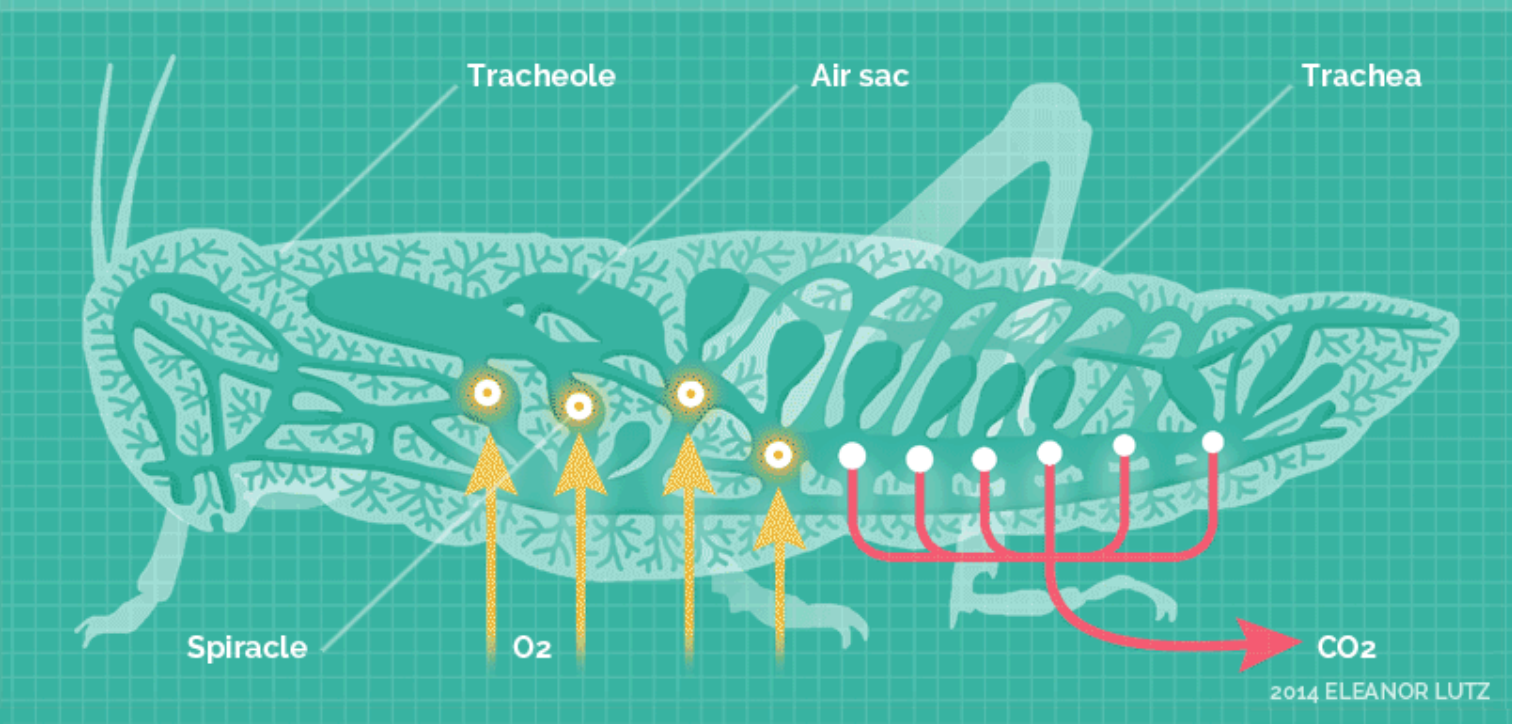
Birds can breathe at much higher elevations than mammals because of their more efficient lung structure.



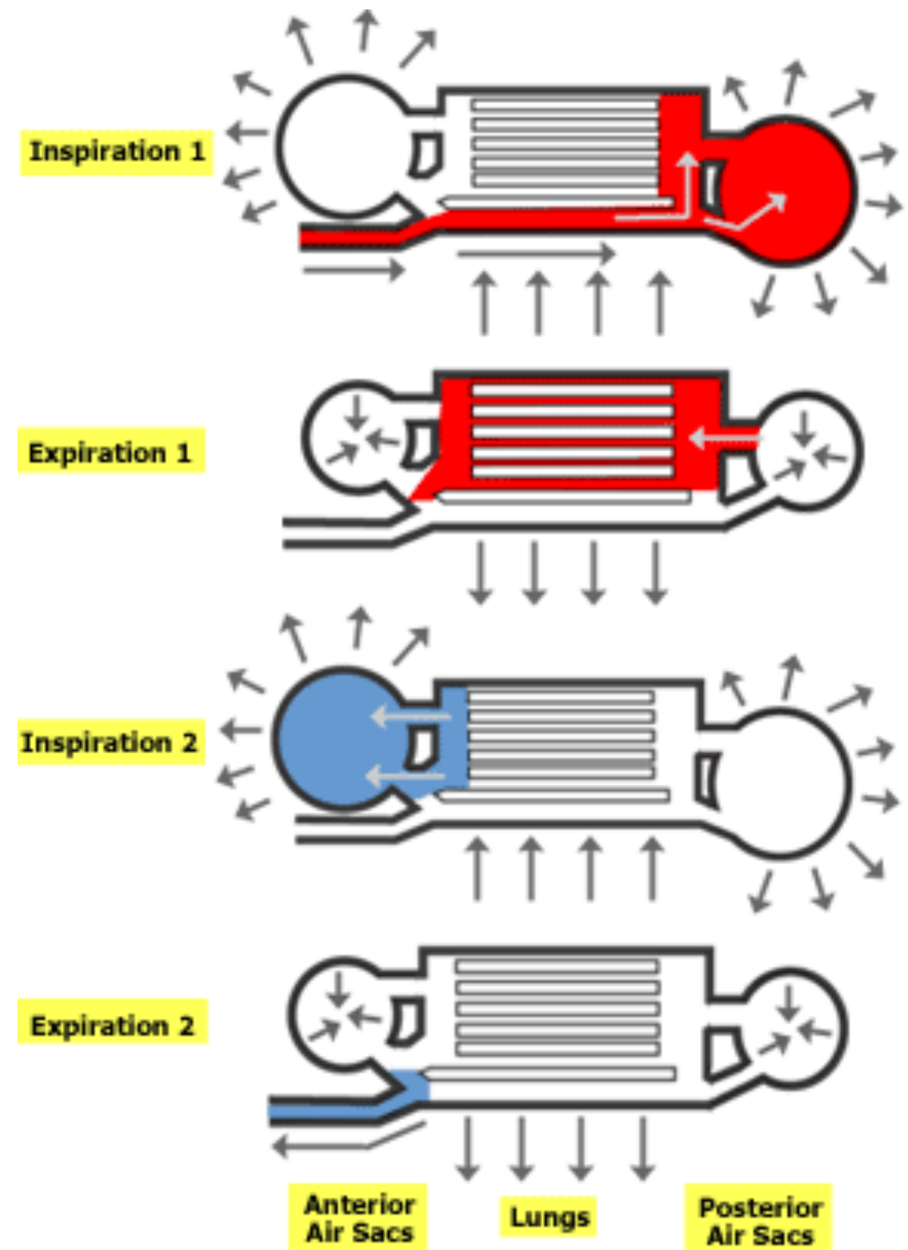
GRASSHOPPER TRACHEA

Grasshoppers have no lungs and do not use their circulatory system to move oxygen. They transport air directly to tissue cells using tracheal tubes.

Grasshoppers use different breathing methods when they are resting, alert, hopping, or flying. The alert grasshopper shown here is pumping its abdomen to change the volume of its air sacs. This helps pump air through the trachea.



- Takes two breaths for air to enter and exit bird’s system
- On first EXHALE, air goes to lungs
- On second exhale, it leaves
- Maximizes air use



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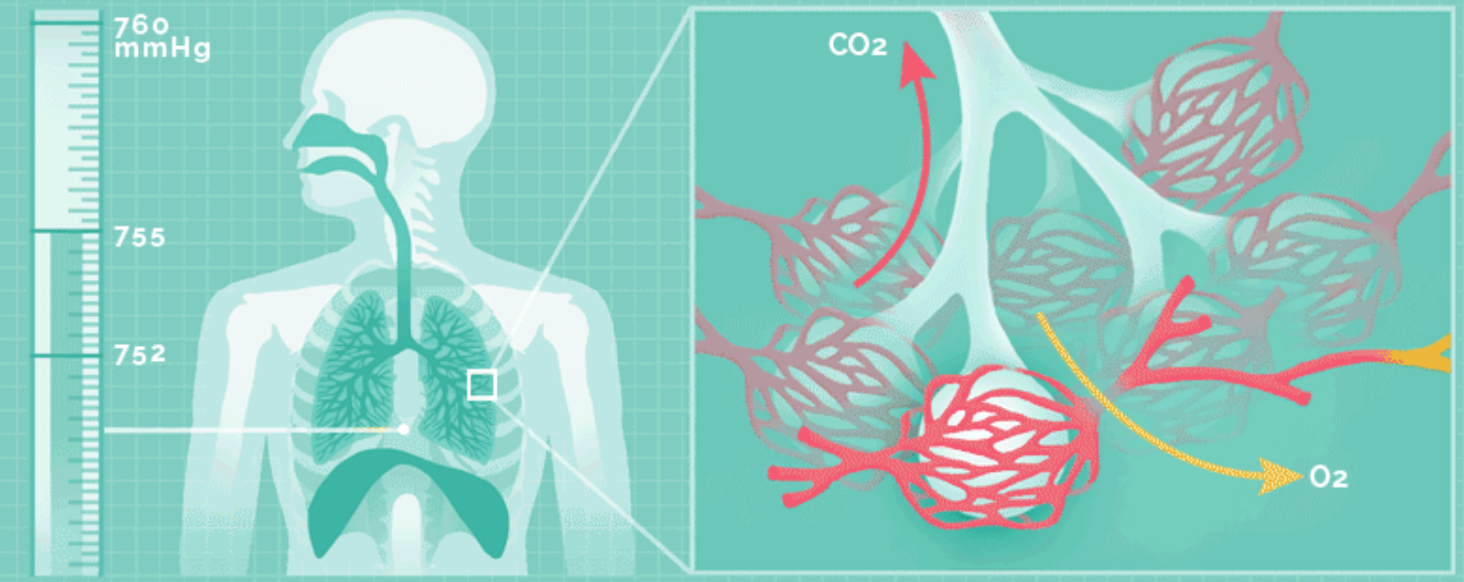

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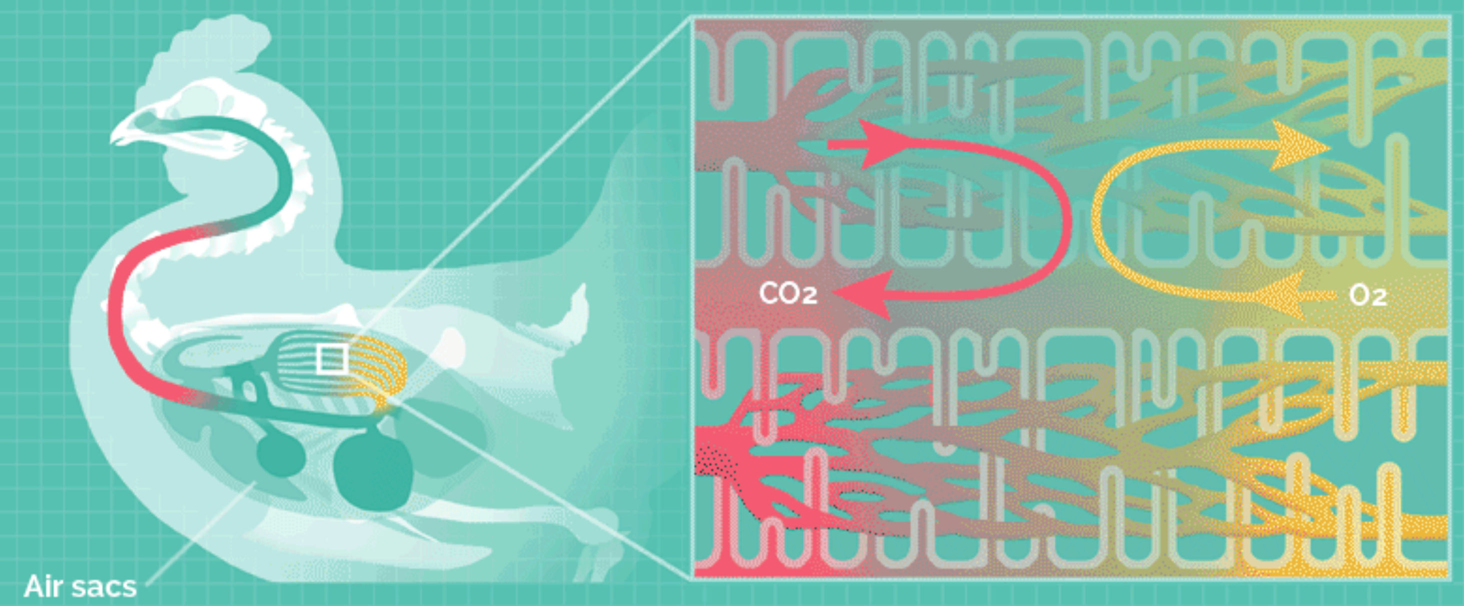

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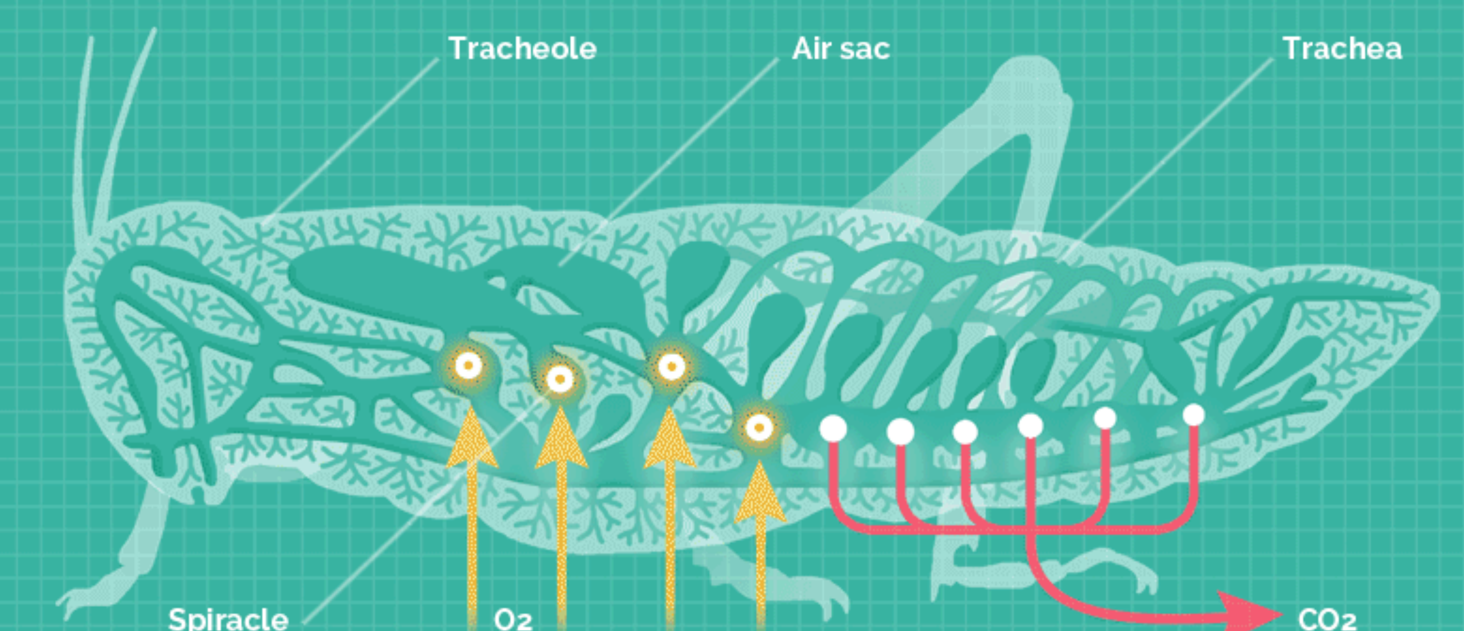
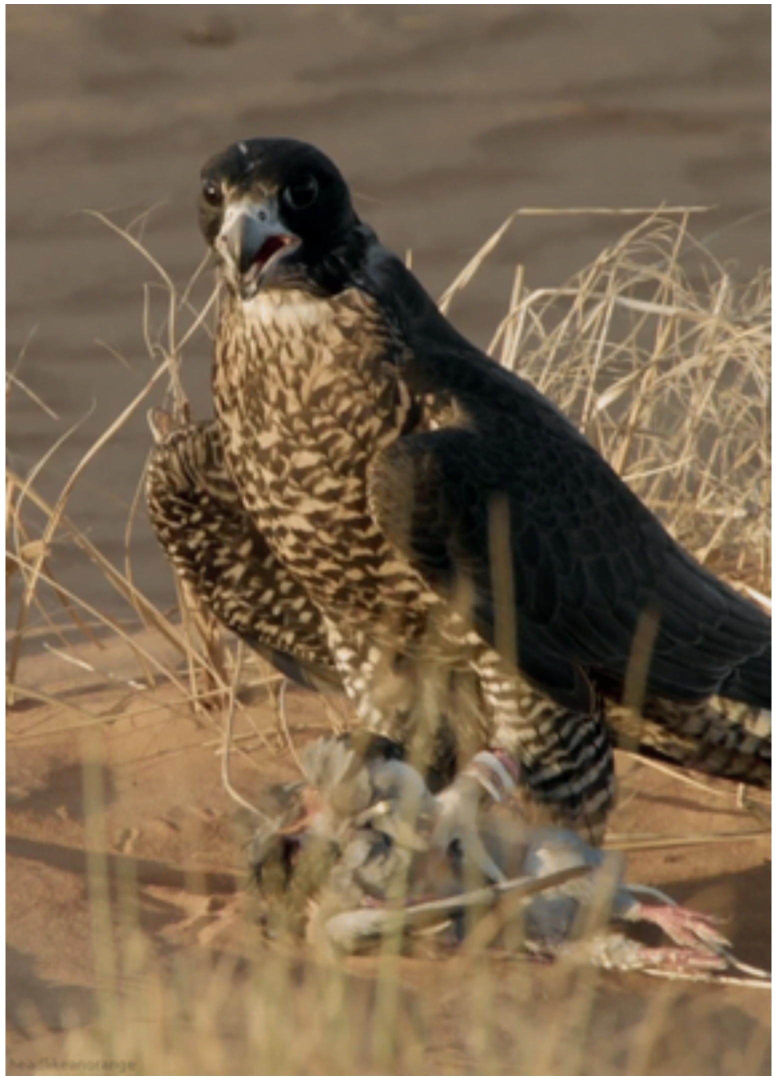
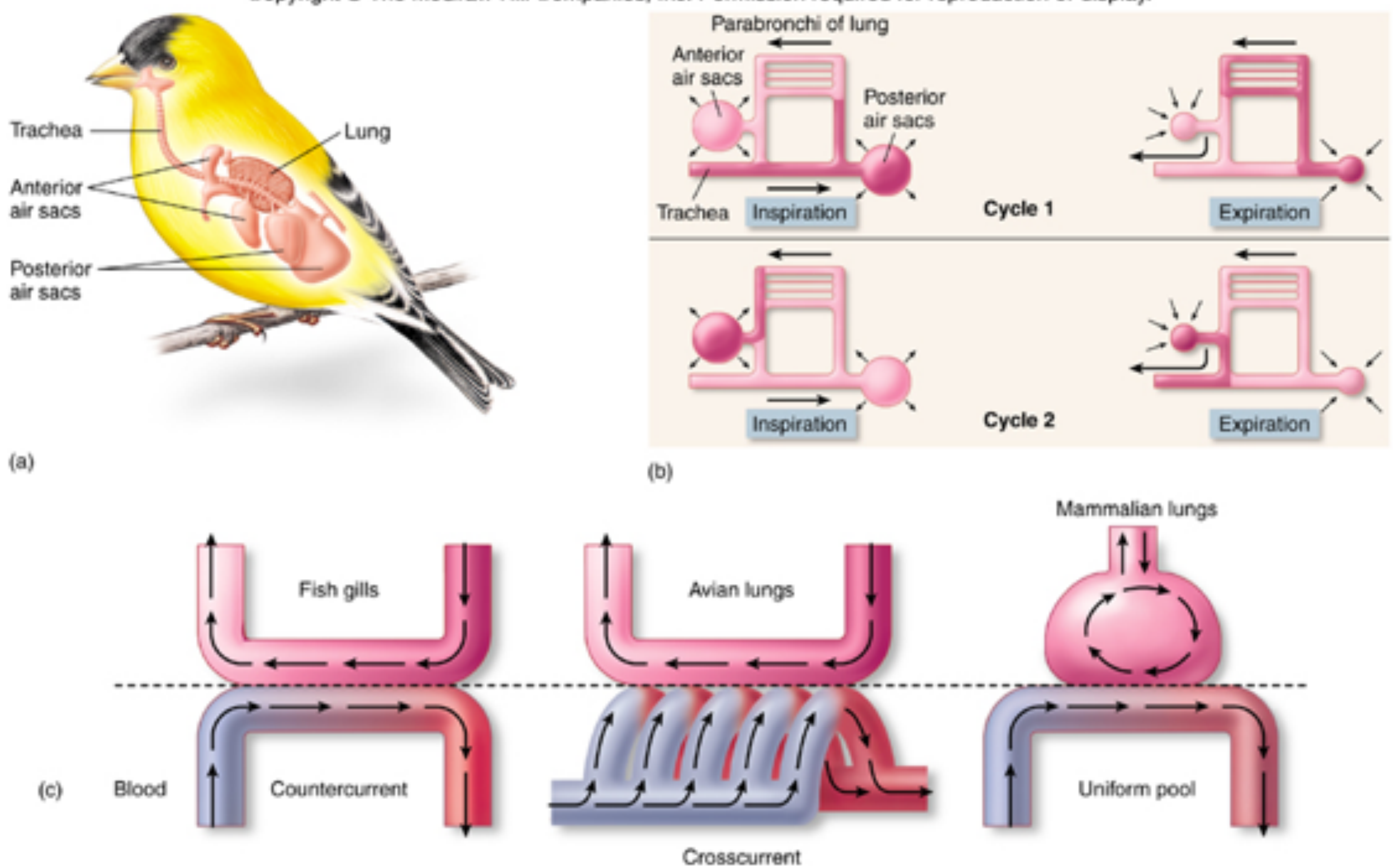


Birds don’t have a diaphragm, but instead breathe by dropping the sternum, creating a vacuum

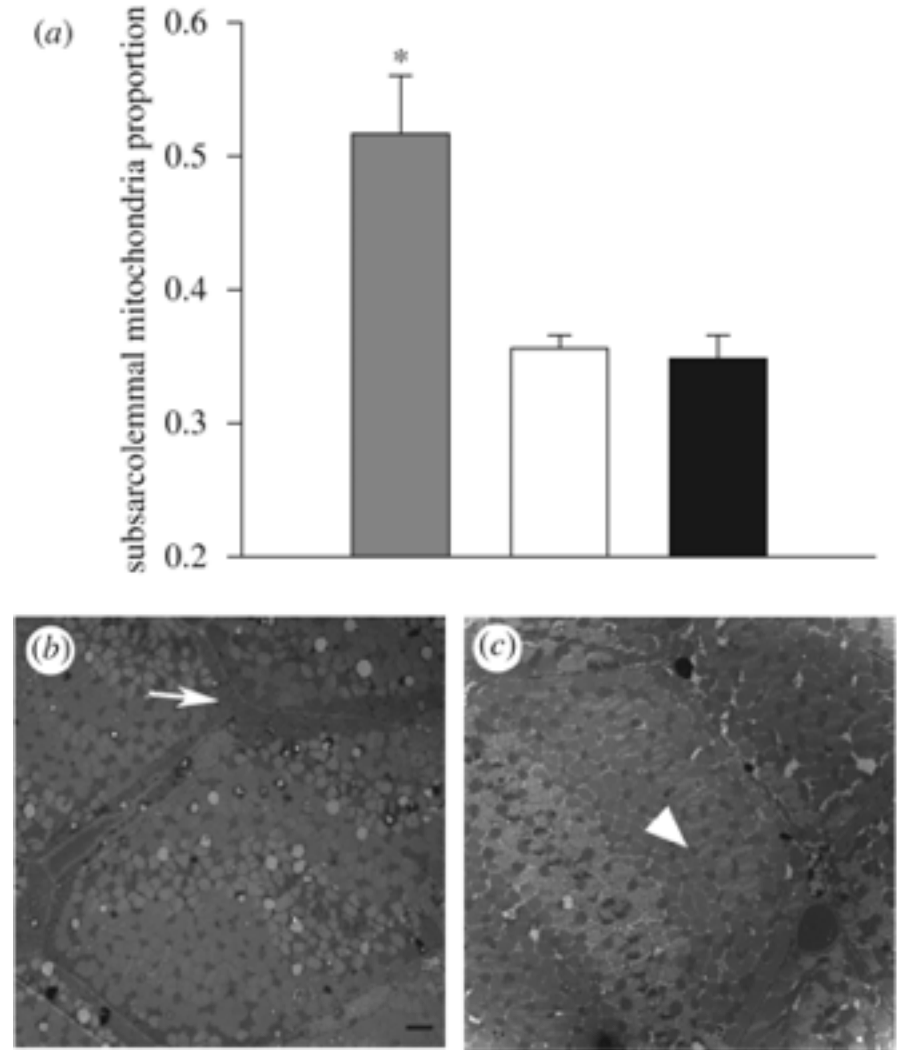


Crosscurrent exchange

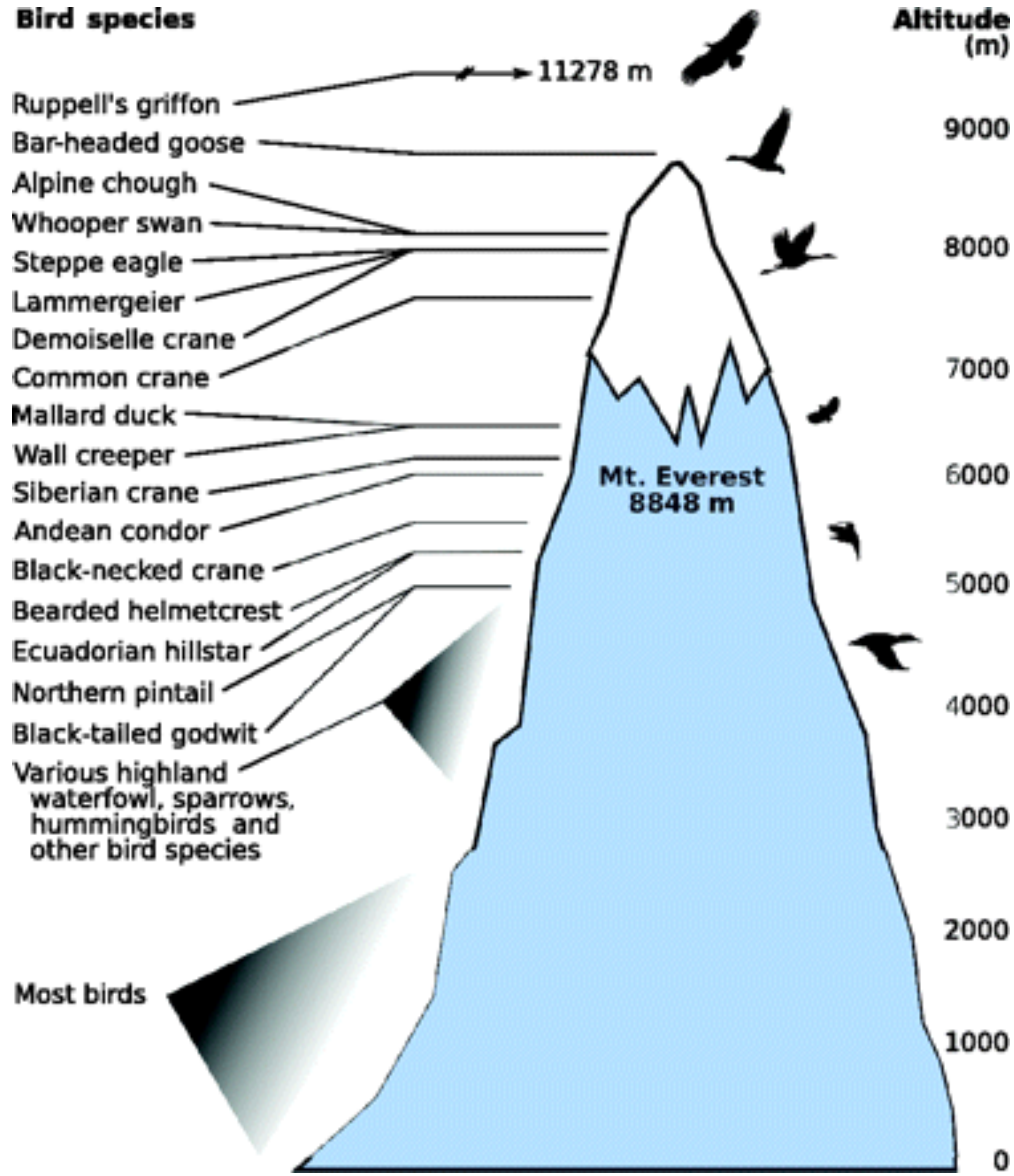


- Larger hearts (per body size) than mammals
- And lower heart rate (given size)
- But more volume per beat
- Cost: high blood pressure

In bar-headed geese, which migrates at extremely high elevation, mitochondria closer to the capillaries for better O_2 transport



Scott, G.R., Egginton, S., Richards, J.G. and Milsom, W.K., 2009. Evolution of muscle phenotype for extreme high altitude flight in the bar-headed goose. Proceedings of the Royal Society of London B: Biological Sciences, 276: 3645-3653.

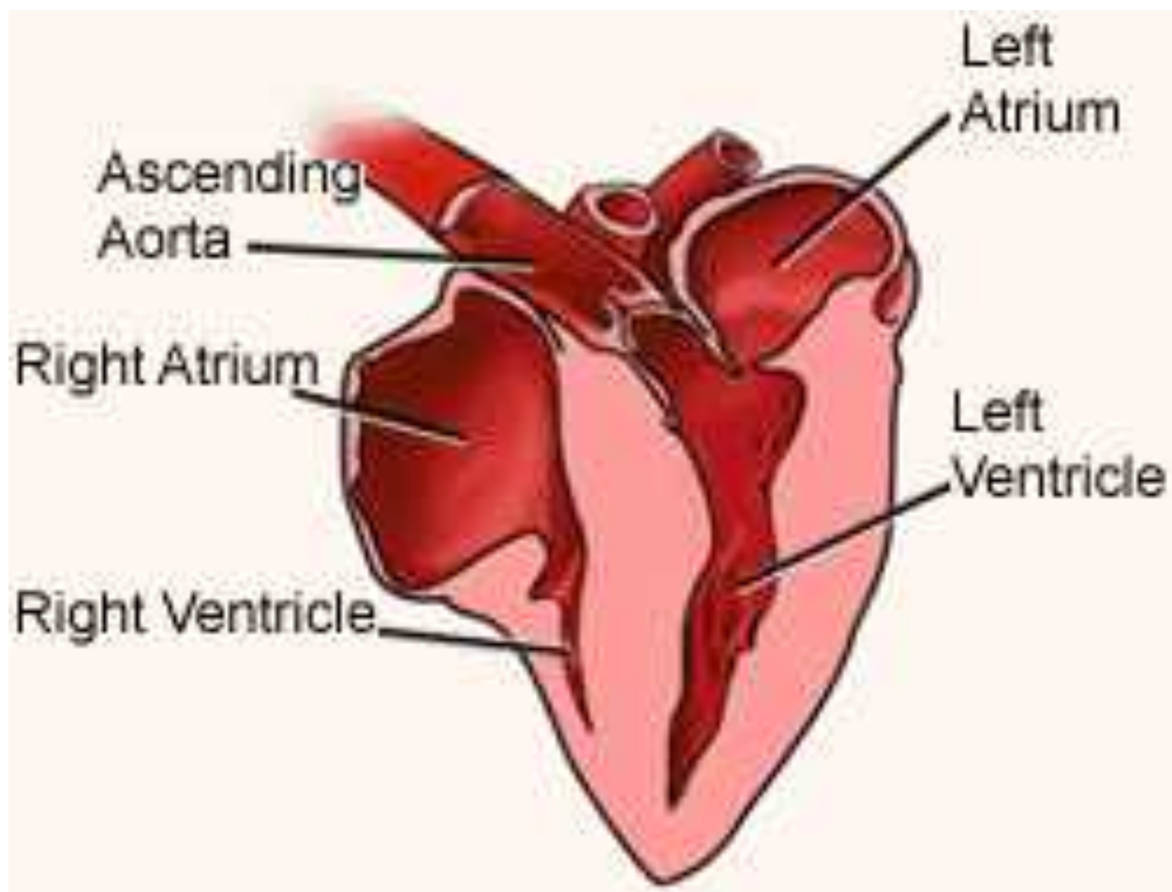


Bird species
Altitude (m)
11278 m
Ruppell's griffon
Bar-headed goose
Alpine chough
Whooper swan
Steppe eagle
Lammergeier
Demoiselle crane
Common crane
Mallard duck
Wall creeper
Siberian crane
Andean condor
Black-necked crane
Bearded helmetcrest
Ecuadorian hillstar
Northern pintail
Black-tailed godwit
Various highland waterfowl, sparrows, hummingbirds and other bird species
Most birds
Mt. Everest 8848 m
9000
8000
7000
6000
5000
4000
3000
2000
1000
0

Circulatory system

Birds have a 4-chambered heart like mammals

Avian hearts are larger than mammal hearts compared to their body size



Circulatory system - red blood cells

Letter | Published: 08 March 2007

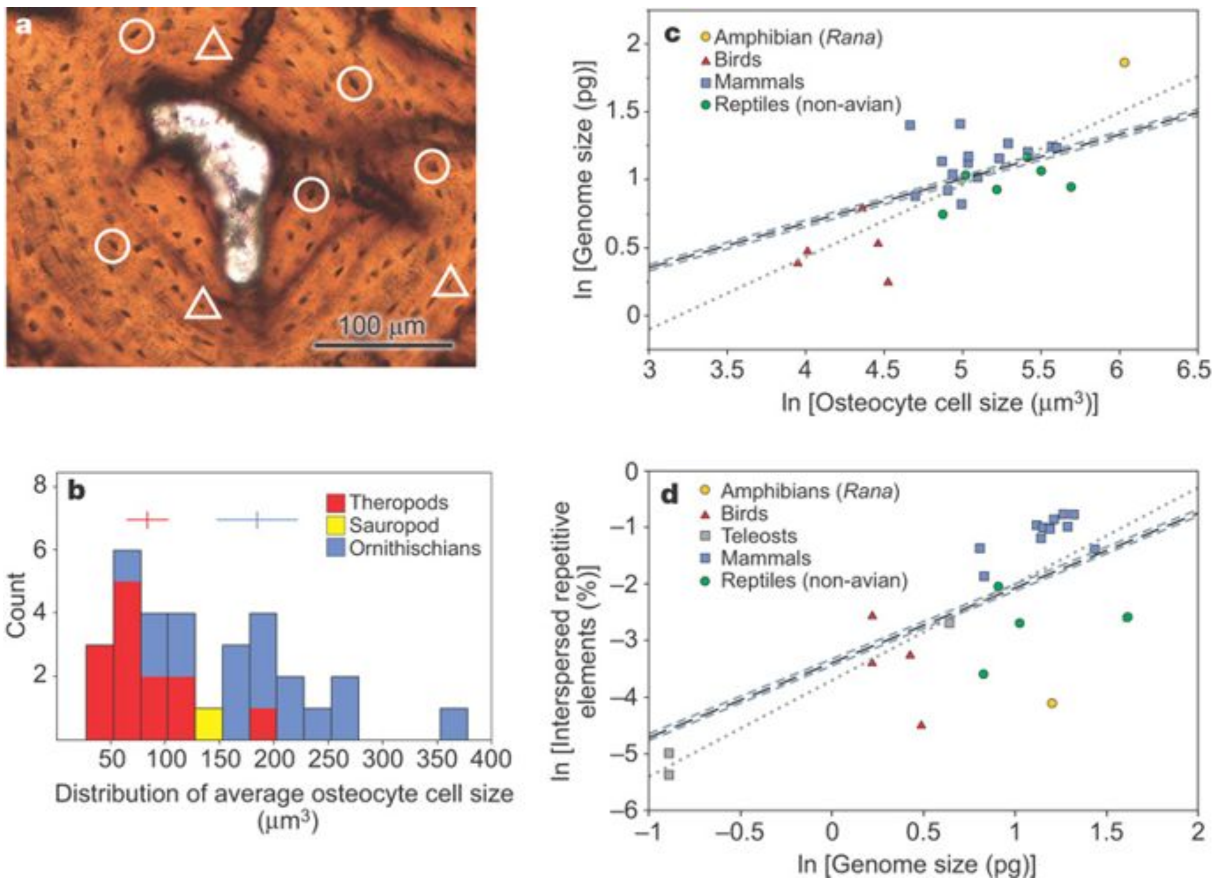
Origin of avian genome size and structure in non-avian dinosaurs

Chris L. Organ, Andrew M. Shedlock, Andrew Meade, Mark Pagel & Scott V. Edwards

Nature **446**, 180–184 (08 March 2007) | Download Citation

Abstract

Avian genomes are small and streamlined compared with those of other amniotes by virtue of having fewer repetitive elements and less non-coding DNA[1,2]. This condition has been suggested to represent a key adaptation for flight in birds, by reducing the metabolic costs associated with having large genome and cell sizes[3,4]. However, the evolution of genome architecture in birds, or any other lineage, is difficult to study because genomic information is often absent for long-extinct relatives. Here we use a novel bayesian comparative method to show that bone-cell size correlates well with genome size in extant vertebrates, and hence use this relationship to estimate the genome sizes of 31 species of extinct dinosaur, including several species of extinct birds. Our results indicate that the small genomes typically associated with avian flight evolved in the saurischian dinosaur lineage between 230 and 250 million years ago, long before this lineage gave rise to the first birds. By comparison, ornithischian dinosaurs are inferred to have had much larger genomes, which were probably typical for ancestral Dinosauria. Using comparative genomic data, we estimate that genome-wide interspersed mobile elements, a class of repetitive DNA, comprised 5–12% of the total genome size in the saurischian dinosaur lineage, but was 7–19% of total genome size in ornithischian dinosaurs, suggesting that repetitive elements became less active in the saurischian lineage. These genomic characteristics should be added to the list of attributes previously considered avian but now thought to have arisen in non-avian dinosaurs, such as feathers[5], pulmonary



Birds have nucleated red blood cells — unlike mammals

Genome Size -> Nucleus size -> Cell Size

Letter | Published: 08 March 2007

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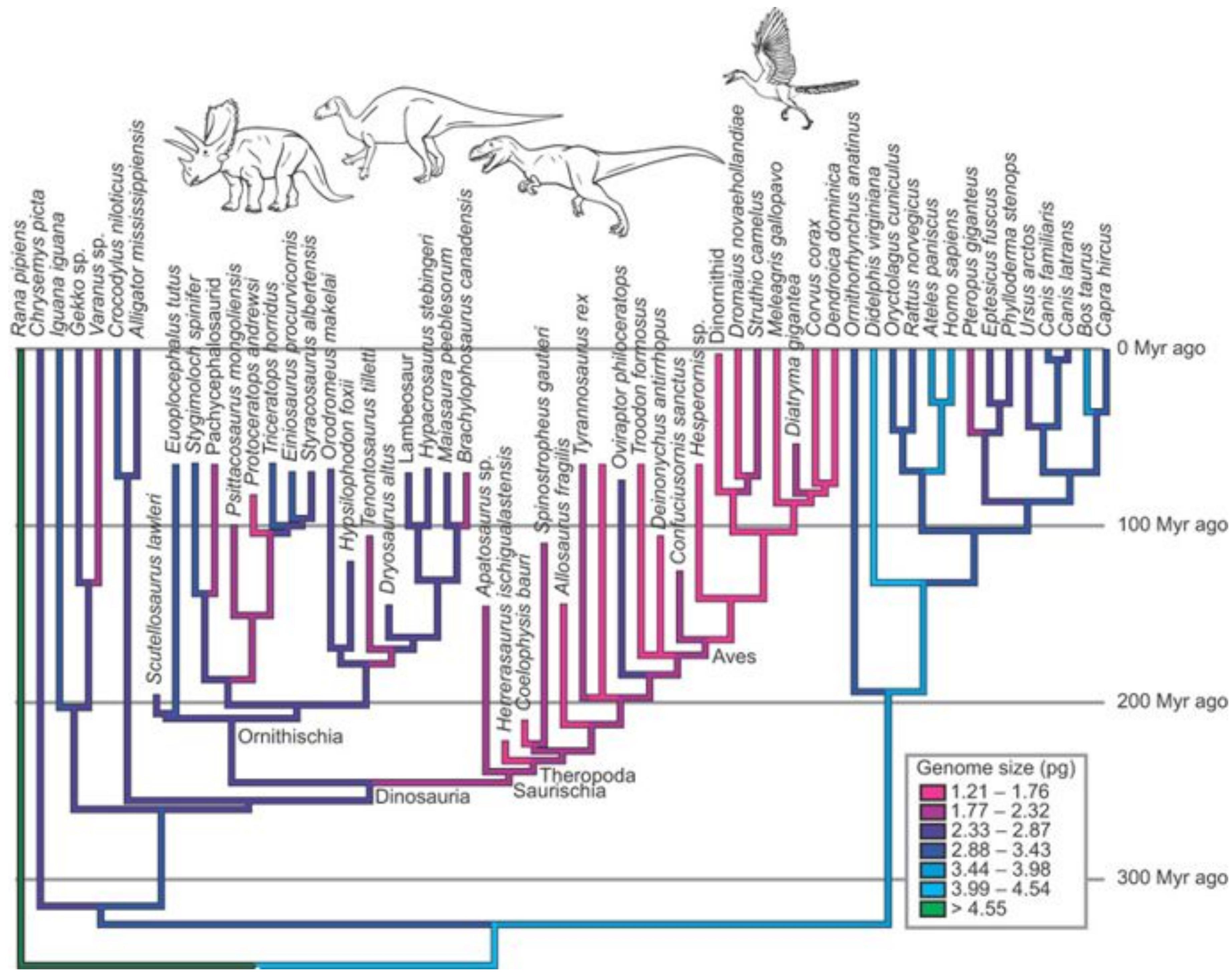
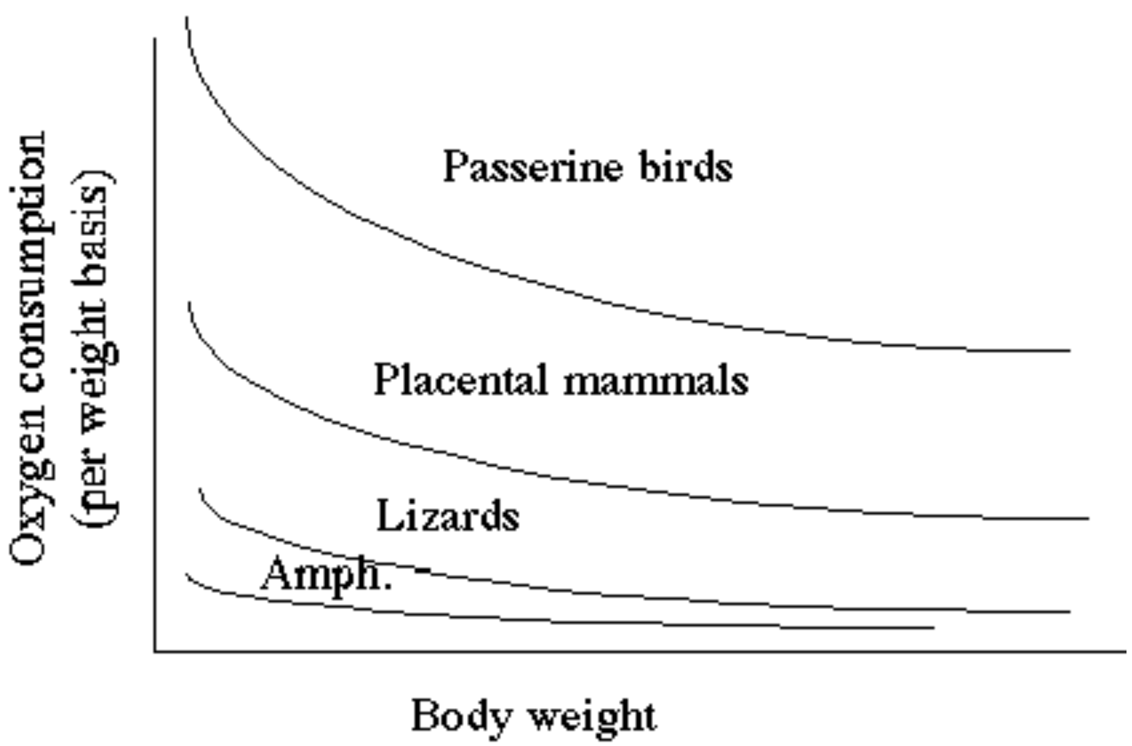


Metabolism

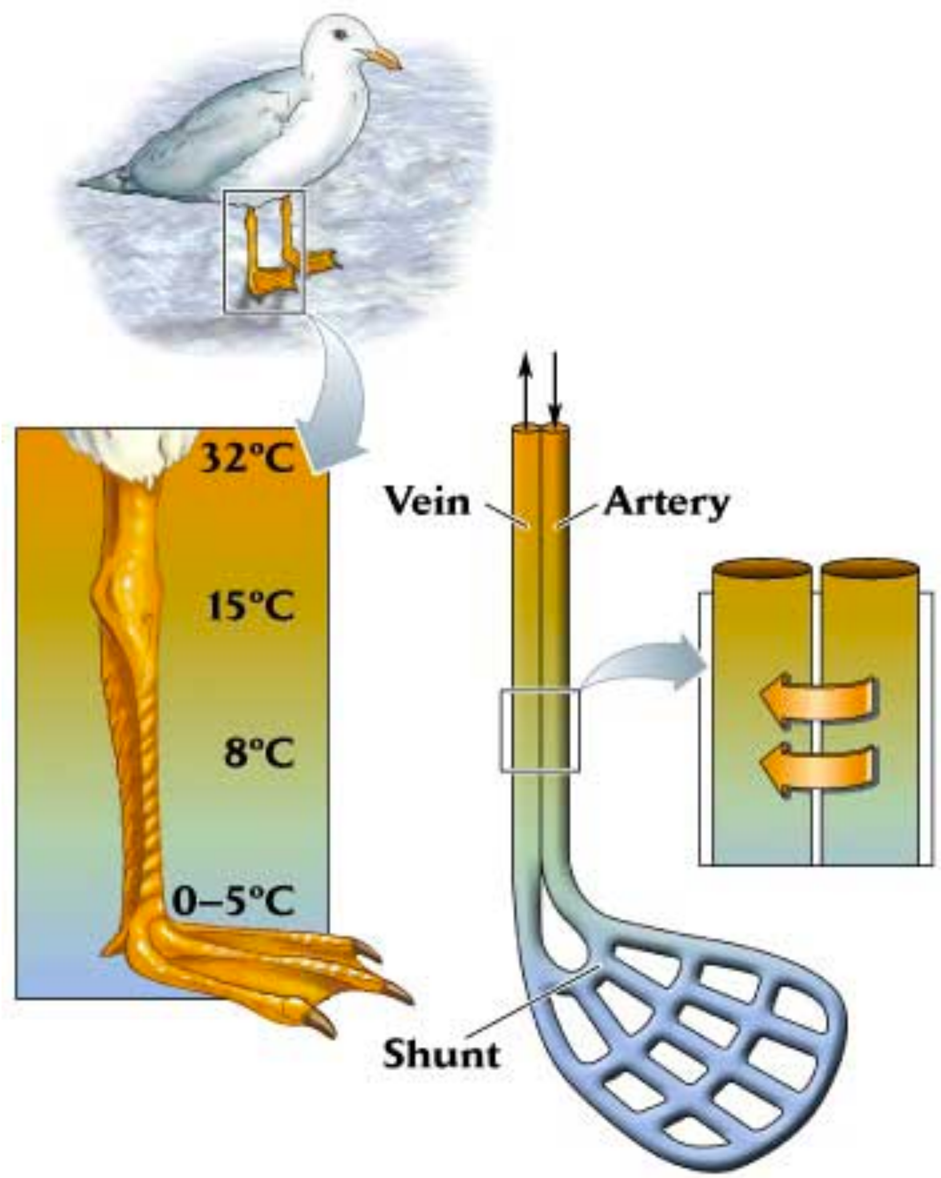
Birds have the highest metabolism of vertebrates



Species	Mass (gms)	Kcal/kg/day
Trumpeter Swan	8900	47
Brown Pelican	3500	75
Common Raven	850	108
American Kestrel	110	157
White-crowned Sparrow	27	324
House Wren	11	589
Rufous Hummingbird	3.5	1600

Smaller birds have higher relative metabolisms

Metabolism - countercurrent exchange

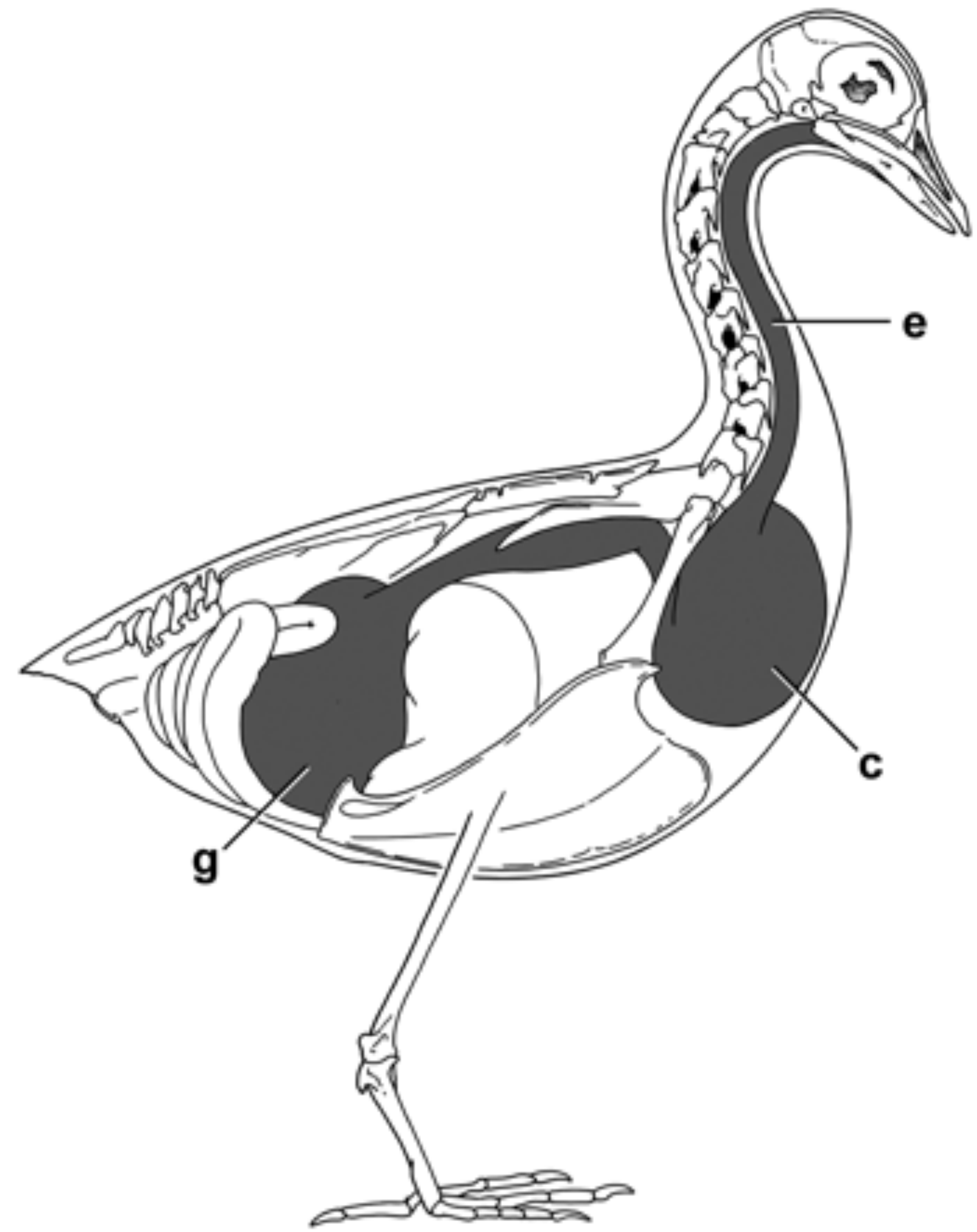


Crop and Gizzard

Crop - food storage and predigestion in neck

© Wade Nolan

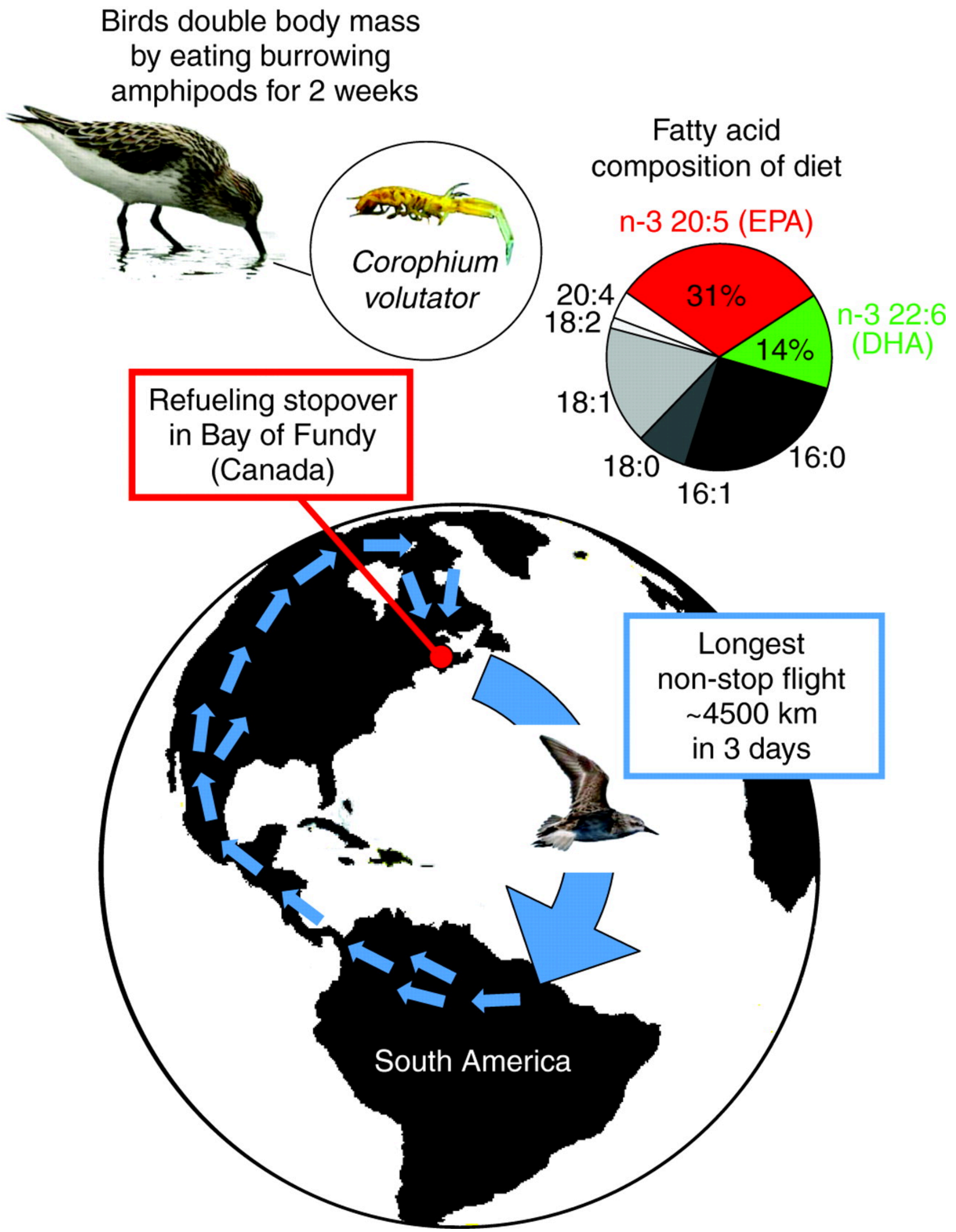
Gizzard: holds stones to help digest



Migration - fat storage

Birds can double their body mass in under a week during migration

Migration cycle of the semipalmated sandpiper (*Calidris pusilla*)



Wood Thrush *Hylocichla mustelina*

Abundance

This map animates weekly estimated relative abundance, defined as the expected count on a one-hour, one kilometer eBird Traveling Count conducted at the ideal time of day for detection of that species in a region.

RELATIVE ABUNDANCE birds per km/hr

0.2 0.93 9.61

WEEK OF THE YEAR January 4

J F M A M J J A S O N D

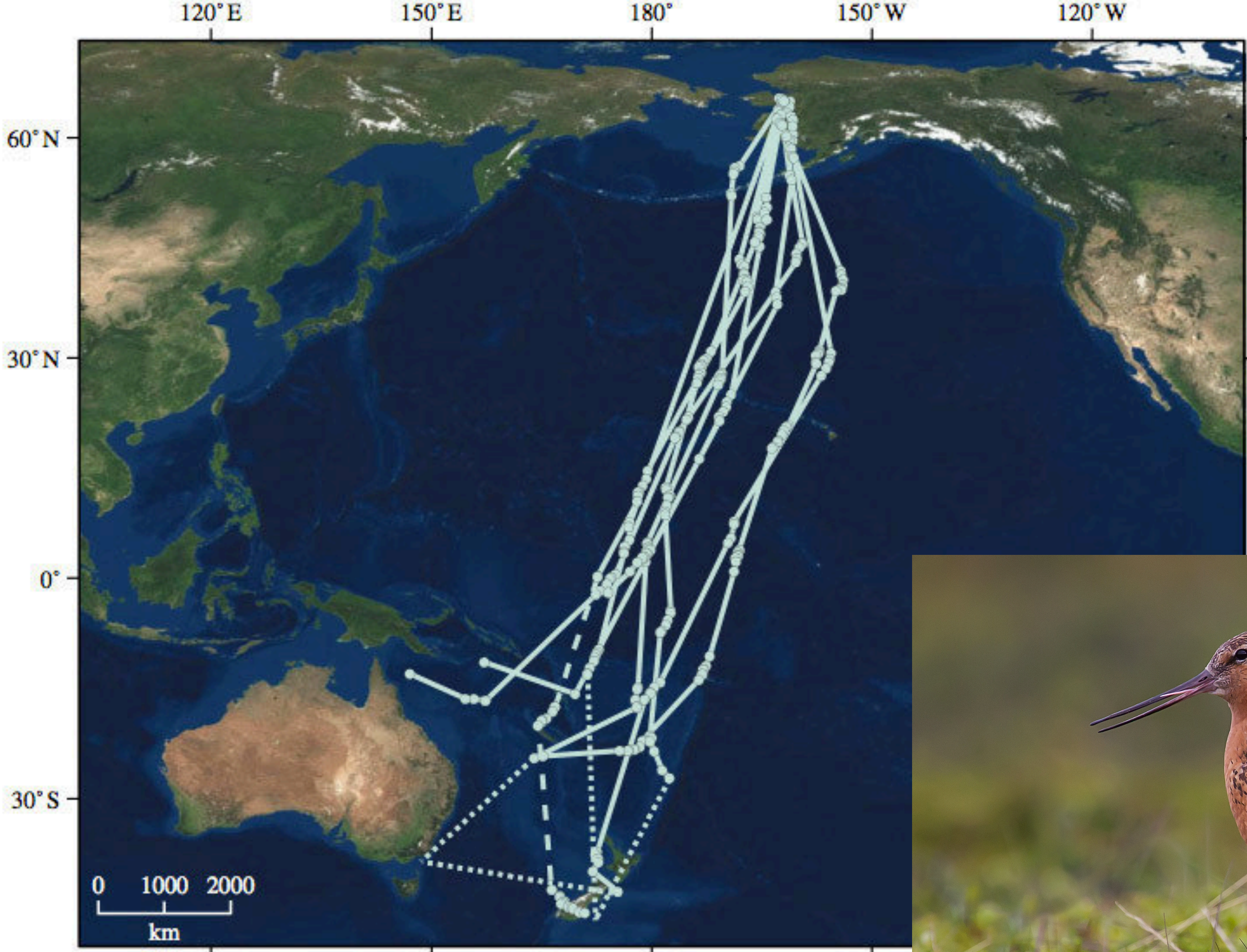
Modeled area (0 abundance)

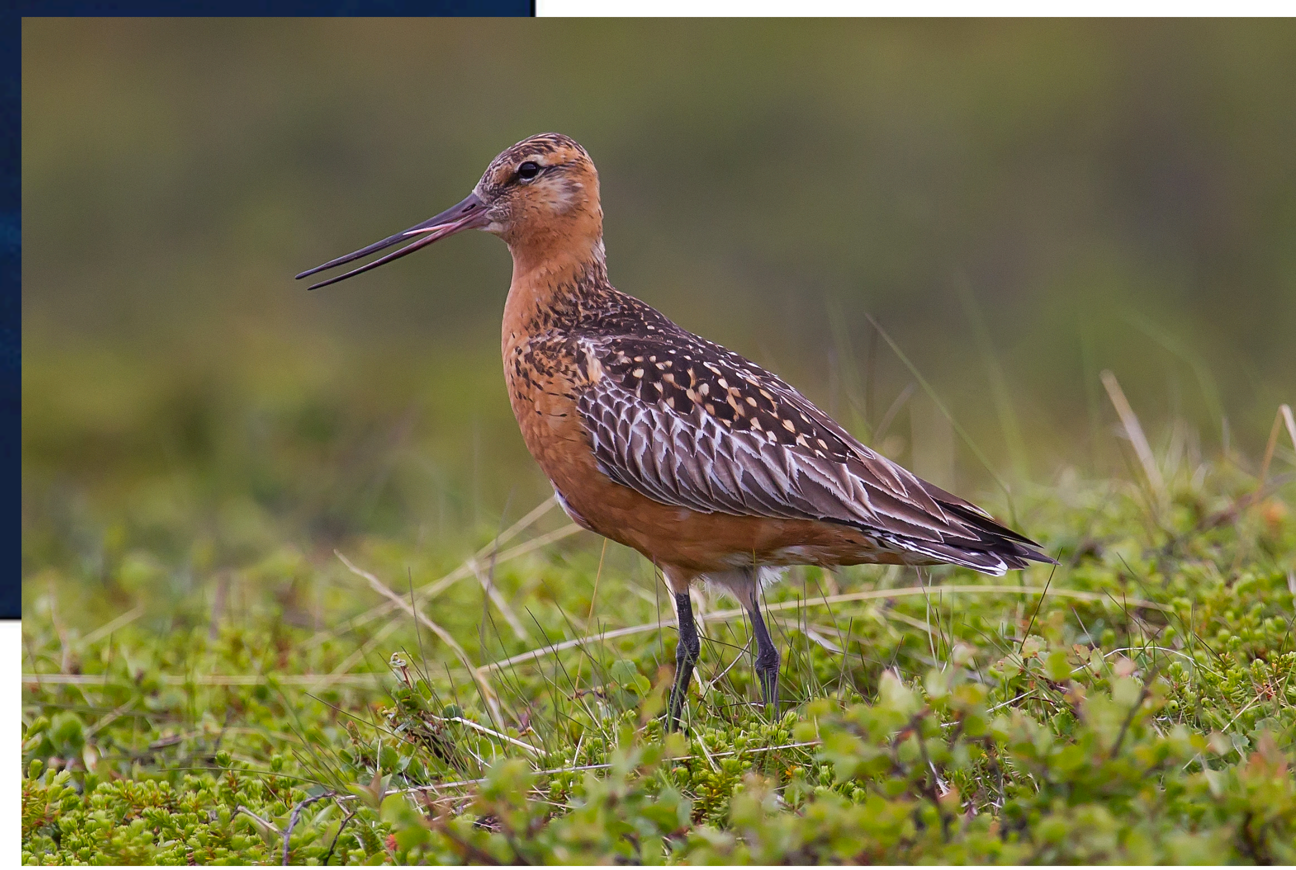
No prediction

Released November 2018. eBird data from 2004-2016. Estimated for 2016.

Fink, D., T. Auer, A. Johnston, M. Strimas-Mackey, M. Iliff, and S. Kelling. eBird Status and Trends. Version: November 2018. https://ebird.org/science/status-and-trends. Cornell Lab of Ornithology, Ithaca, New York.

Migration - fat storage and organ absorption - 25% of organs absorbed to make room for fat - liver, gonads, kidneys, essentially gone, guts highly reduced



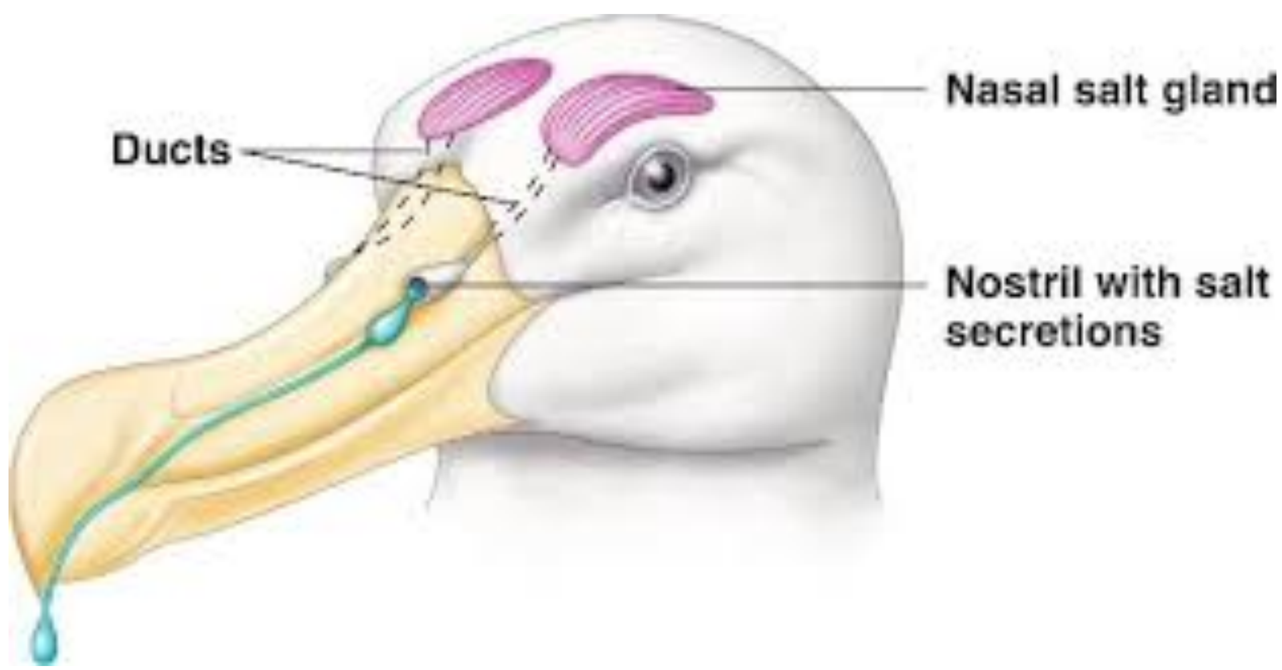


Bar-tailed Godwit

Organs reconstituted after migration
-Gonads especially can gain >1000% mass after spring migration

Salt physiology - Salt glands and kidneys

Nasal salt glands are most pronounced in procellariiformes and gruiformes



Uric acid is more efficient at holding nitrogen waste that urea

That means:
-Birds can handle drinking more salty water
-Birds don't pee
-Birds don't need their kidneys to be as efficient as mammals

-Their loops of henle are shorter than in mammals

To do:

<u>40</u> birds for Malibu field trip

Start thinking about independent projects

Independent project proposals due March 5th (1 page max)

-Question

-Hypothesis

How will you test this hypothesis?

What results do you expect? What is the null hypothesis

-Feel free to email or meet with me to develop your project before this is due

Hazlehust seminar Feb 26th - Go to it, write up a 1-2 paragraph summary