NOTE ON THE USE OF PHOTOGRAPHS

Please note that this material is being circulated for the personal educational use of the student of the *Be a Better Birder* class. Please do not distribute, copy, post, share, or further disseminate any of this material.

Most of the photographs used in these presentations are credited to the eBird contributors named in the photographs and to the Macaulay Library of The Cornell Laboratory of Ornithology. Other photographs are credited as indicated.

LAST CLASS
12/14/25
HORNSBY 1-5PM

- Reimer's Ranch yesterday
- 12/14/25 Field Trip ?

- Finish Titmice ?
- Intro to Raptor ID ?
- Sparrow review with emphasis on spizellas ?
- Intro to Gull ID ?
- Meadowlarks ID ?
- Cormorants ID ?

TRAVIS AUDUBON SOCIETY
BE A BETTER BIRDER (B3)
2025

BEAUTY,
SPECIATION,
TITMICE

A TALK ABOUT EVOLUTION

A RANDOM QUOTE

No other textbook, and possibly no other book, will ever have a better opening paragraph than Goodstein's "States of Matter"

"Ludwig Bolzman, who spent much of his life studying statistical mechanics, died in 1906, by his own hand."

"Paul Ehrenfest, carrying on the work, died similarly in 1933."

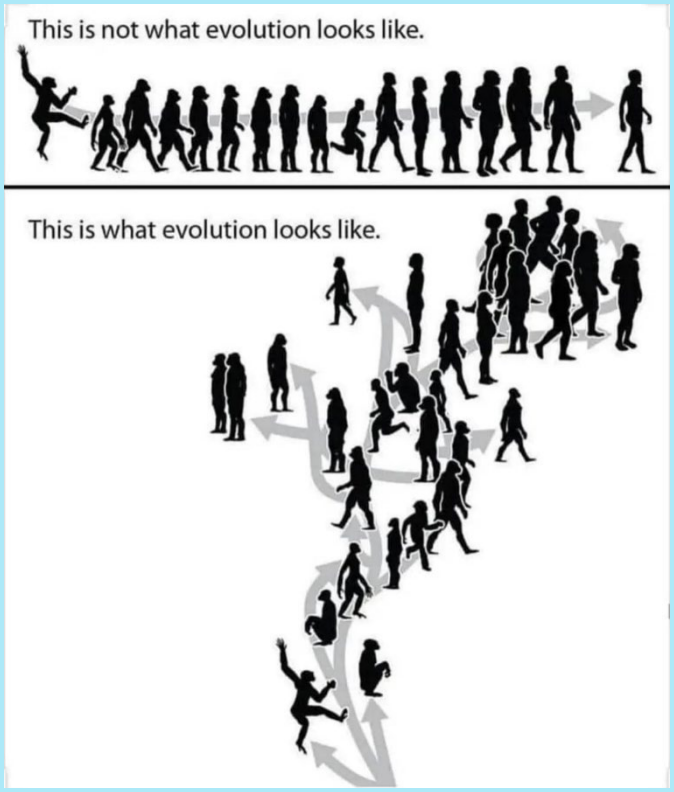
"Now it is our turn to study statistical mechanics."

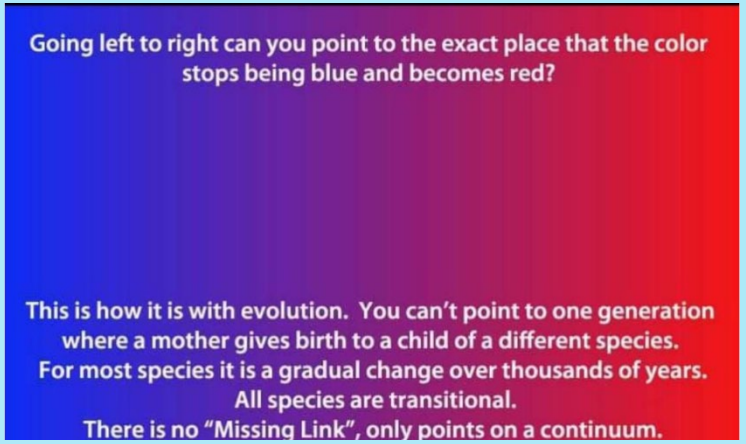
THIS IS A TALK ON EVOLUTION

"Evolution is a fact. It really happened, and the fossil record and the molecular biology all confirm it".

~Carl Sagan

THIS IS A TALK ON EVOLUTION



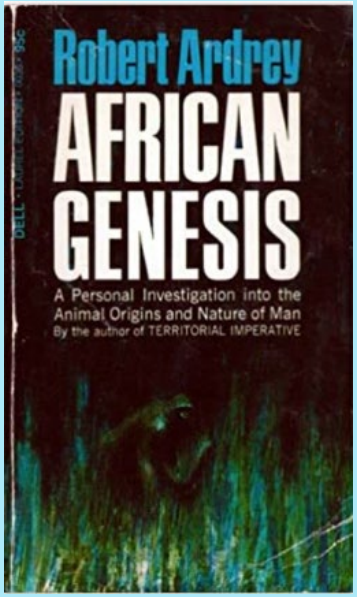


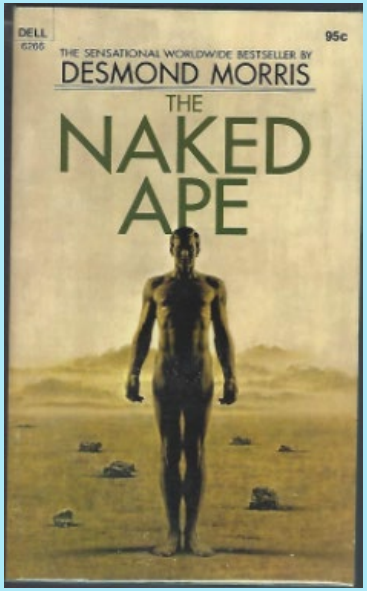
BEAUTY, SPECIATION, TITMICE

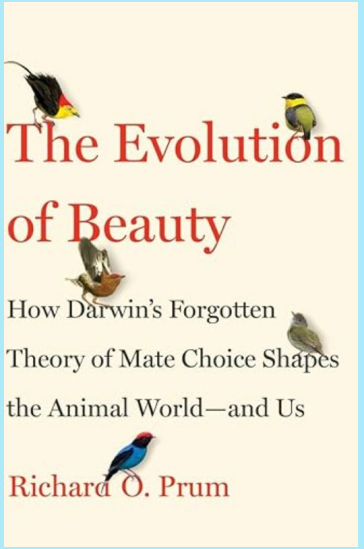
A TALK ABOUT EVOLUTION

INTRODUCTION

- Since class conception – 3 topics:
  - **Beauty**
  - **Speciation**
  - **Titmice**
- 3 interrelated topics





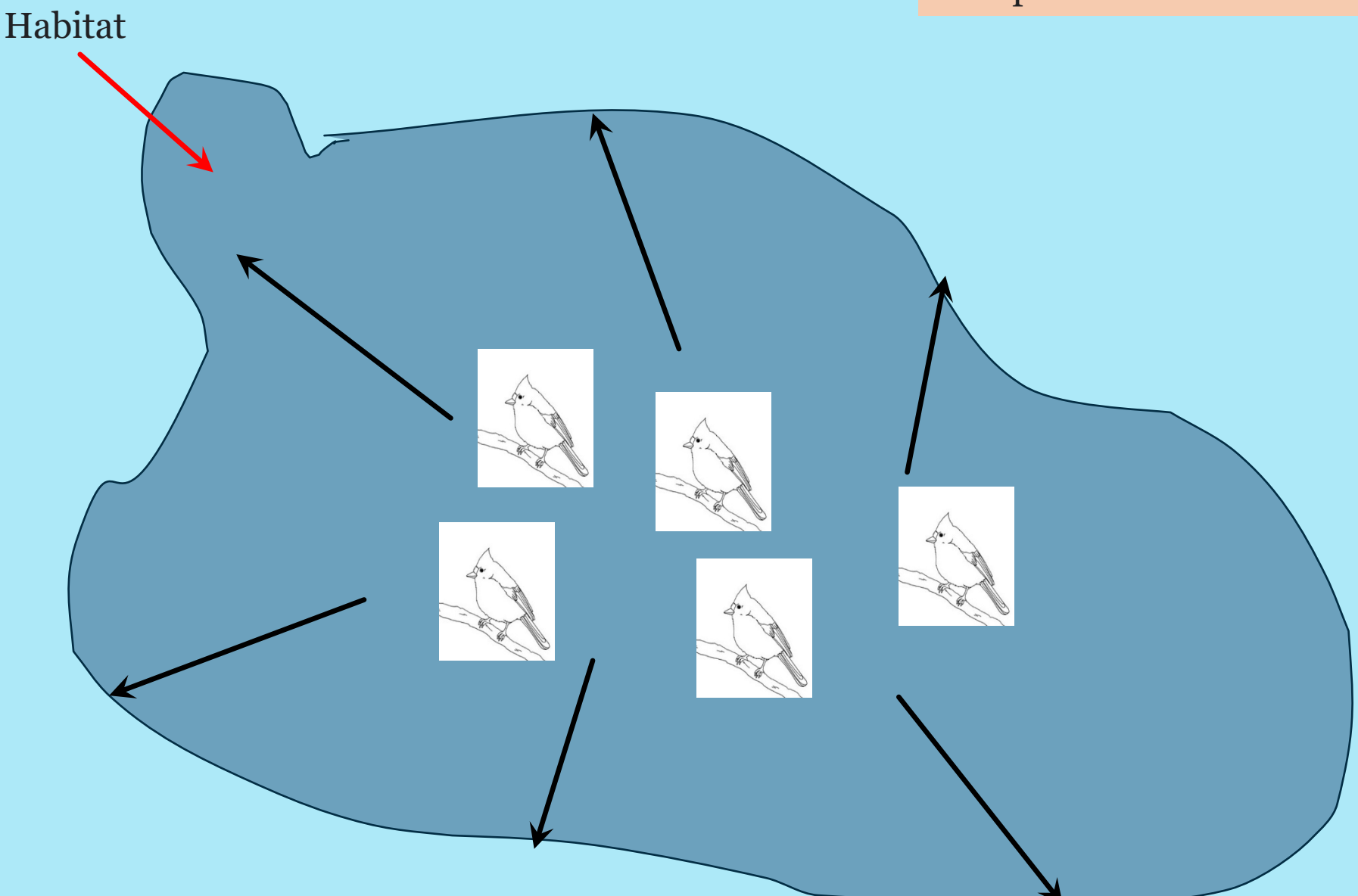


THE FAMILIAR TITMICE

- Everyone knows titmice – easy ID
- But did you know, our 2 titmice differ in:
  - Song
  - Plumage
  - Genetics
  - Physiological differences (e.g. blood glucose levels)
  - Morphology
    - Size, tail length, etc
  - Habitats
    - Tufted – wetter deciduous forest
    - Black-crested – more arid, open woodlands
- Not migratory
- But they are dispersive

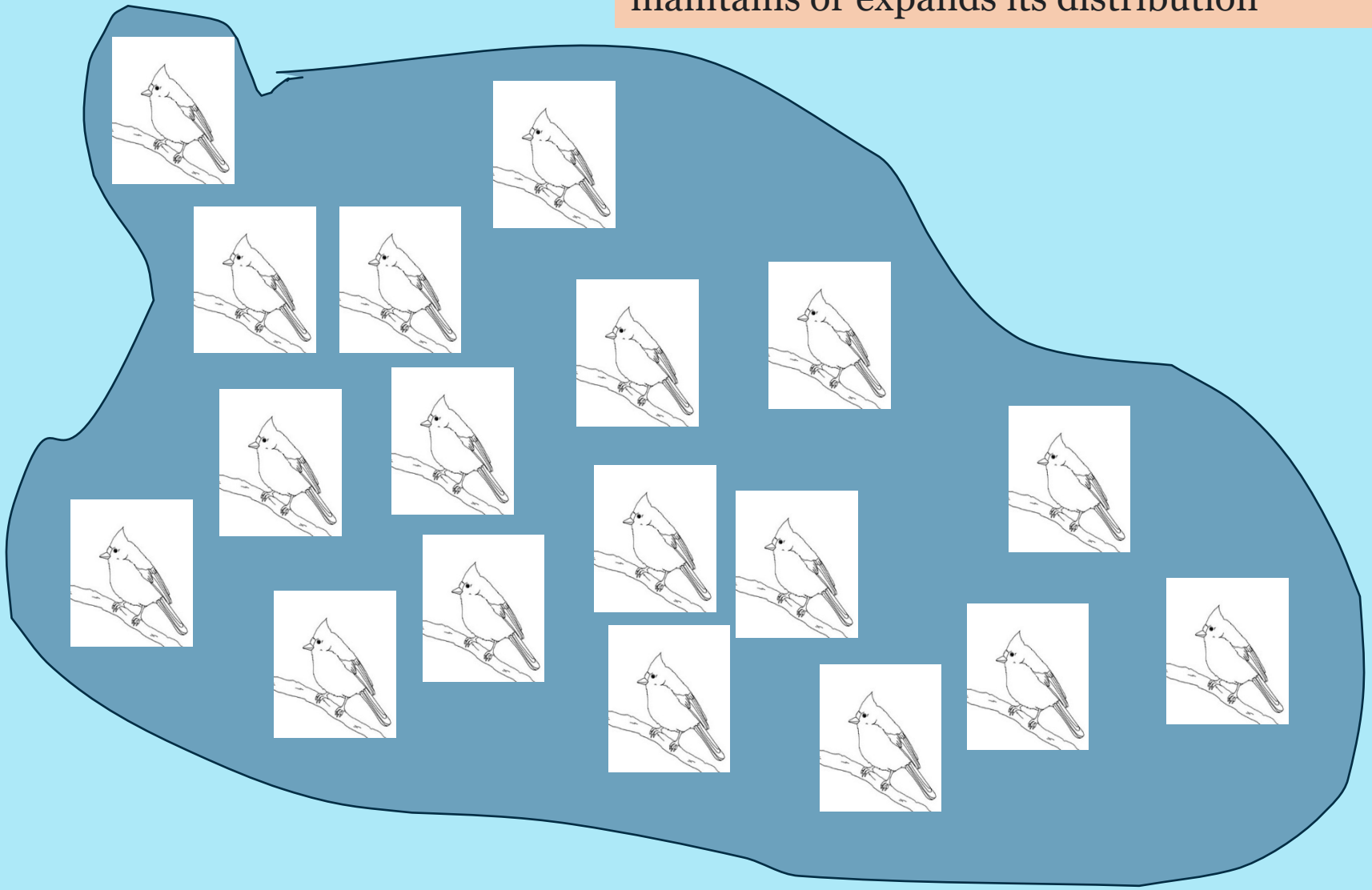
DISPERSAL

Dispersal – processes by which a species maintains or expands its distribution

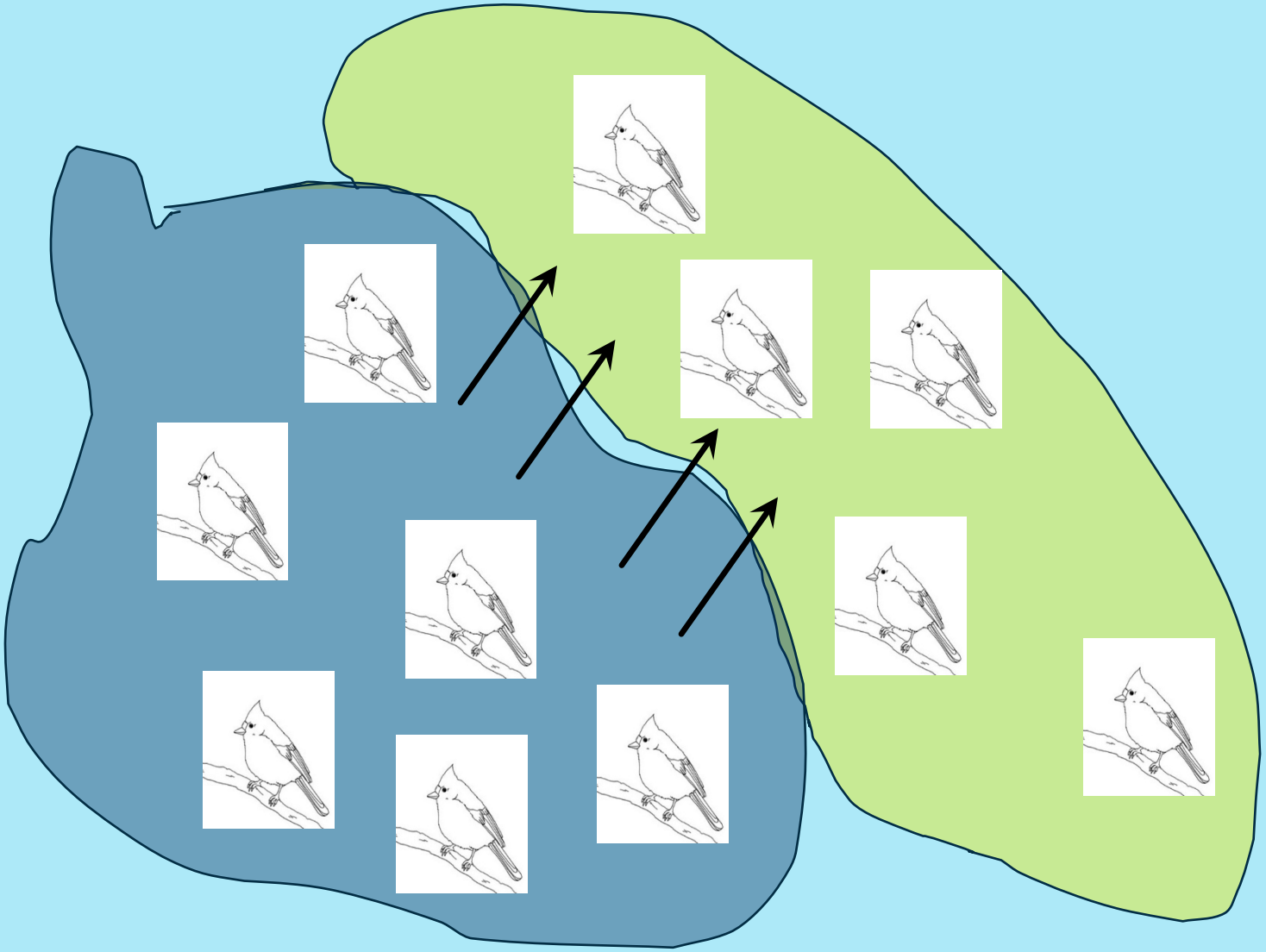


DISPERSAL

Dispersal – processes by which a species maintains or expands its distribution



DISPERSAL
INTO NEW HABITAT



THE TITMICE STORY

THE TITMOUSE STORY

How did 2 titmice species get to Travis County, Texas

From Australia in

~47 million years ?

- Short Answer:
  - Change over time, selection, dispersal

- **Long Answer:**
  - **Change over time, selection, dispersal**

TITMICE

- All know of hybrid titmice
- What I want to talk about:
  - Why are hybrids important in a discussion of speciation?
  - Where are hybrid titmice found?
  - How are hybrid titmice identified?

HYBRIDS IN GENERAL

HYBRIDS

- ~ 16% of the 10,000 species have hybridized (1,600 species)

- Some hybrids fare better than others
  - Some may not be healthy and live to adulthood
  - Some are sterile (e.g. mules)
  - Many are a “1-offs” – presumably unsuccessful individuals

- Observable Traits (**phenotype**)
  - Usually, intermediate
  - Any combination possible
    - Identical – completely different

HYBRID EXAMPLES

- Melanerpes woodpeckers
  - Red-bellied X Golden-fronted
- Dryobates woodpeckers
  - Downy X Ladder-backed
- Orioles
  - Baltimore X Bullock's
- Meadowlarks
  - Western X Eastern
- Chickadees
  - Black-capped X Boreal
  - Black-capped X Mountain
  - Black-capped X Carolina
  - etc

HYBRID EXAMPLES

- Screech Owls
  - Western X Eastern
  - Gray phase/Red phase
- Golden-winged X Blue-winged Warbler
  - Brewster's
  - Lawrence's
- Yellow-rumped Warbler
  - Audubon's
  - Myrtle
  - Black-fronted
  - Goldman's
- Ducks
- Hummingbirds

TITMICE OF NORTH AMERICA

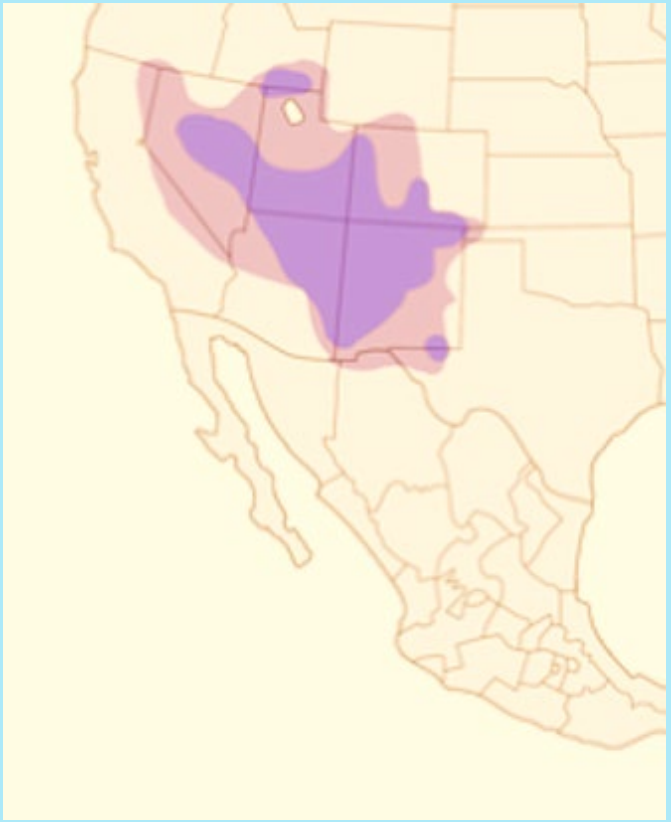
TITMICE OF NORTH AMERICA

Split 1998

Oak

Juniper

Bridled



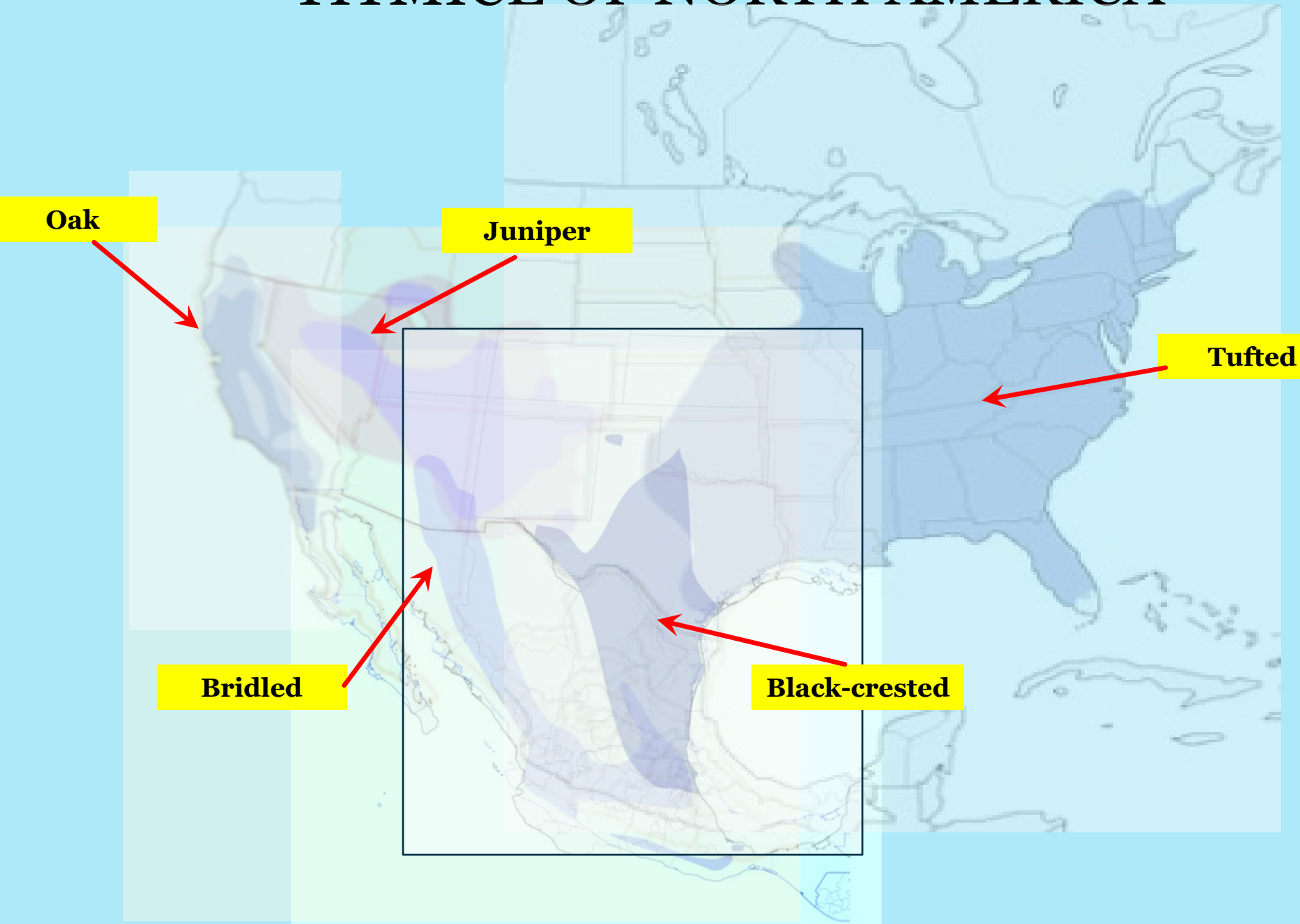
TITMICE OF NORTH AMERICA

Lumped 1982
Split 2002

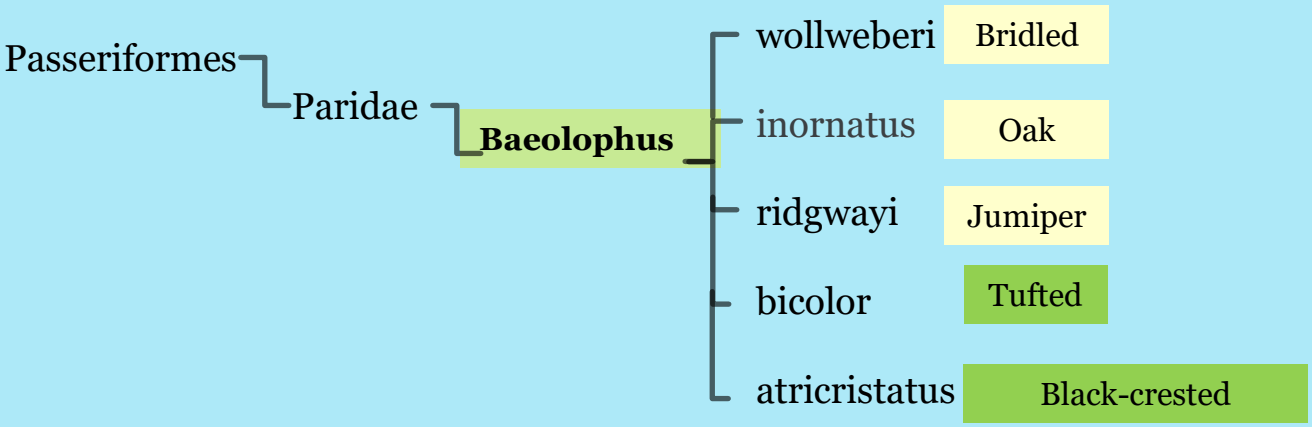
Black-crested

Tufted

TITMICE OF NORTH AMERICA



SIMPLIFIED LINEAGE OF NORTH AMERICAN TITMICE



HYBRIDS

- Titmice
  - Tufted X Black-crested
  - Oak X Juniper
  - Others ?

THE TITMOUSE STORY

- Passerines
- Australia
- ~47 million years
- Travis County
- Beauty
- Speciation

Small Random Changes

+ Lots of Time

= Evolution

Small Random Changes

+ Lots of Time

+ Selection

= Evolution

SELECTION
"METHINKS IT IS LIKE A WEASEL"

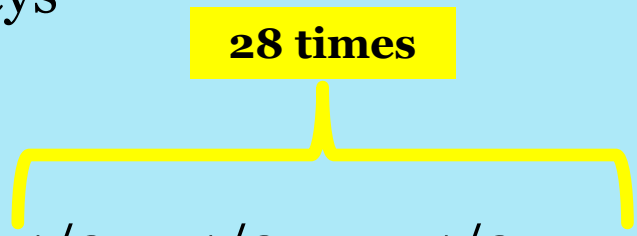
- Infinite monkey theorem –
  - Room full of monkeys
  - Typewriters
  - Random
  - Enough time
  - = *Hamlet*

- **Richard Dawkins** – not likely over the entire lifespan of universe (~14 billion years)

- Smaller task
  - Type "methinks it is like a weasel" (from *Hamlet*)
  - Ignore case (upper or lower)
  - No punctuation

SELECTIoN
"METHINKS IT IS LIKE A WEASEL"

- "Methinks it is like a weasel"
- 28 characters
- Spacebar + 26 letters = 27 typewriter keys



- Chance of hitting correct key = 1/27
- Chance of hitting all correctly in order = 1/27 x 1/27 x.... 1/27
- = 0.000000000000000000000000000000001
- 10^{-40}
- Write Hamlet .....much, much, much less chance
- Age of universe: 436,117,076,640,000,000 seconds
- 4.3×10^{17}

WHAT IF
THE MONKEYS GET A TRAINER?

- Room full of monkeys & typewriters
- Type first 28 characters – random
  - **DAOIDJHFO IAHEFOIOU YIOHK JIEIO**
- Next round – copy the first round
  - **DAOIDJHFO IAHEFOIOU YIOHK JIEIO**
- Most are just copies
- But monkeys make mistakes
  - **DAOIDJHFO IADEFOIOU CIOHK JIEIO**
- Trainer **selects** phrase that most resembles “me thinks…….”
- Monkeys copy that phrase
- Etc…….

DAWKIN'S SIMULATION

- 1985 Maintosh simulation
  - 1st random phrase
  - **WDLMNLT DTJBKWIRZREZLMQCO P**
- After 1 turn (trainer selects phrase most resembling "…weasel")
  - **WDLMNLT DTJBSWIRZREZLMQCO P**
- After 10 turns
  - **MDLDMNLS ITJISWHRZREZ MECS P**
- After 20 turns
  - **MELDINLS IT ISWPRKE Z WECSEL**
- After 30 turns
  - **METHINGS IT ISWLIKE B WECSEL**
- After 40 turns
  - **METHINKS IT IS LIKE I WEASEL**
- After 43 turns (11 seconds)
  - **METHINKS IT IS LIKE A WEASEL**

EVOLUTION:
IS NOT JUST RANDOM !!!

Small random changes (mutations)

+

Selection

+

Time (cumulative processes)

=

BIG CHANGES !!!!!!

Small Random Changes
(mutations)

+ Lots of Time
(a cumulative process)

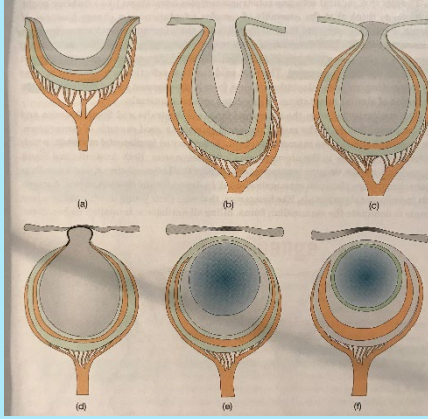
+ Selection
(helpful mutations are called **adaptations**)

= Evolution
(big changes over time)

EVOLUTION EXAMPLE: THE EYE

- Is every change (adaptation) useful ?
- Argument: what good is 5% of an eye?
- Darwin said: 5% of an eye much more useful than 0%
- Many invertebrates – have simple light-sensitive spots

EVOLUTION EXAMPLE: THE EYE



1. More sensitive spot = more useful than not
2. Depression forms = direction of light source
3. Depression deepens = directional info enhanced
4. Depression deepens further = pinhole camera effect
5. Transparent cover = protection
6. Lens forms = focus

EVOLUTION EXAMPLE: THE EYE

Eyes may have evolved ~40 times

https://en.wikipedia.org/wiki/Evolution_of_the_eye

EYE EVOLUTION

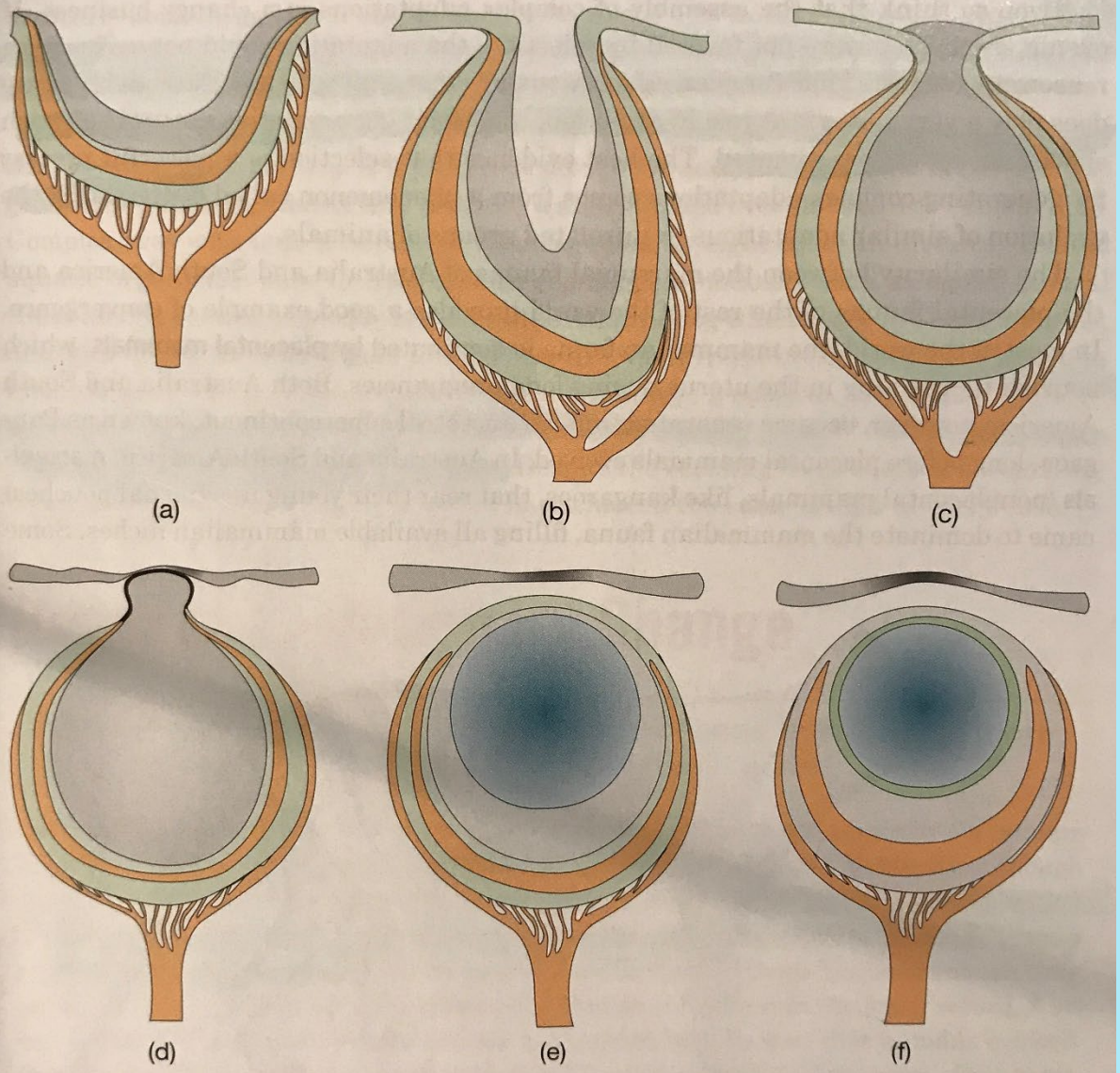
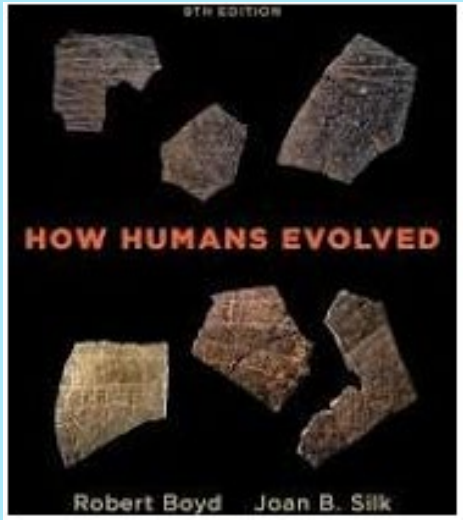


FIGURE 1.15

Living gastropod mollusks illustrate all of the intermediate steps between a simple eye cup and a camera-type eye. (a) The eye pit of a limpet, *Patella* sp.; (b) the eye cup of Beyrich's slit shell, *Pleurotomaria beyrichii*; (c) the pinhole eye of a California abalone, *Haliotis* sp.; (d) the closed eye of a turban shell, *Turbo creniferus*; (e) the lens eye of the spiny dye-murex, *Murex brandaris*; (f) the lens eye of the Atlantic dog whelk, *Nucella lapillus*. (Lens is shaded in e and f.)



How Humans Evolved,
Boyd, Robert;
Silk, John B.

THE EVOLUTION OF EYES: MAJOR STEPS

"Ocular evolution is an immense topic, and I do not expect to cover all the details of this process in this manuscript. I will present some concepts about some of the major steps in the evolutionary process to stimulate your thinking about this interesting and complex topic. In the prebiotic soup, vision was not inevitable. Eyes were not preordained. Nor were their shapes, sizes, or current physiology. Sight is an evolutionary gift but it was not ineluctable. The existence of eyes is so basic to our profession that we often do not consider how and why vision appeared or evolved on earth at all. Although vision is a principal sensory modality for at least three major phyla and is present in three or four more phyla, there are other sensory mechanisms that could have been and were occasionally selected instead. Some animals rely on other sensory mechanisms such as audition, echolocation, or olfaction that are much more effective in their particular niche than would be vision. We may not believe those sensory mechanisms to be as robust as vision, but the creatures using those skills would argue otherwise. Why does vision exist at all? And why is it so dominant at least in the number of species that rely upon it for their principal sensory mechanism? How did vision begin? What were the important steps in the evolution of eyes? How did eyes differentiate along their various paths, and why?"

I.R. Schwab

https://www.nature.com/articles/eye2017226