

Lifetime Learning Institute, August 11, 2021



Sexual Selection and Bird Evolution

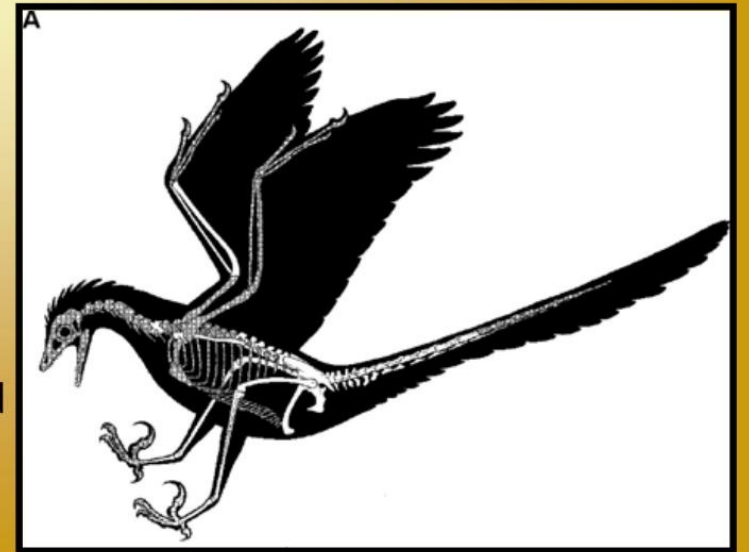
Larry Cartwright
prowarbler@verizon.net

Some Background: A Look at Natural Selection

- Natural selection is the process by which members of a population adapt to the environment
- Some individuals have traits better suited to survival than others
 - ✓ Those with favorable traits are more likely to reproduce and pass these traits onto their offspring
 - ✓ Until the traits become more prevalent in the population of the species
- Over time, the accumulation of these traits can give rise to new species

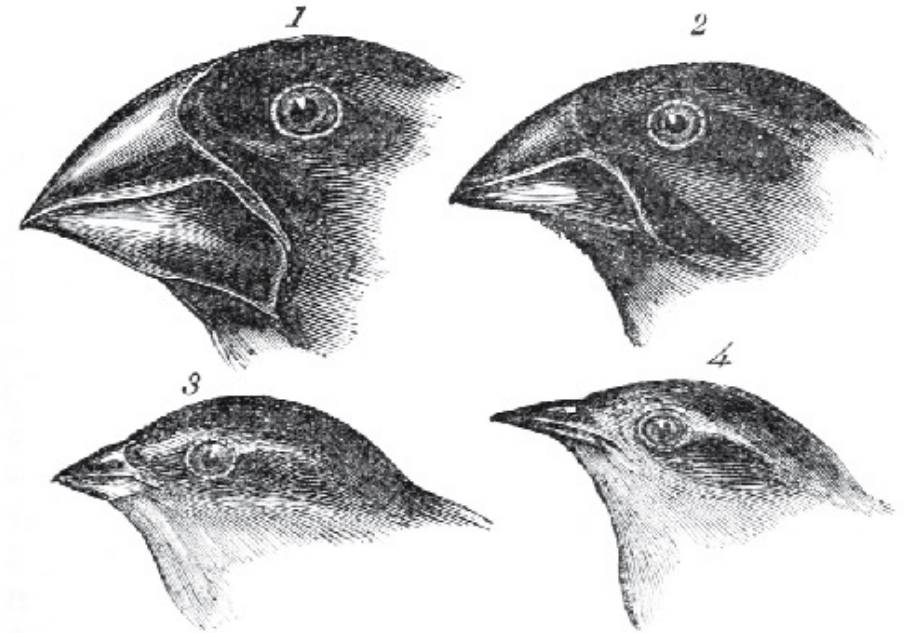
Evolution of birds

- Adapted for flight – very successful adaptation
- Evolved from two-legged dinosaurs called theropods.
- Often called feathered dinosaurs



An Example of Natural Selection

- ❑ Darwin noted that all finch species on the Galapagos Islands seemed related
 - ✓ And likely evolved from the same colonizer mainland finch species
 - ✓ But there was a significant difference in beak sizes and shapes among the species
- ❑ Darwin theorized that bills evolved
 - ✓ To exploit different size seeds rather than just compete for a limited single size seed
 - ✓ Other finches adapted to eating insects
 - ✓ Which enhanced survival, and resulted in the creation of new species



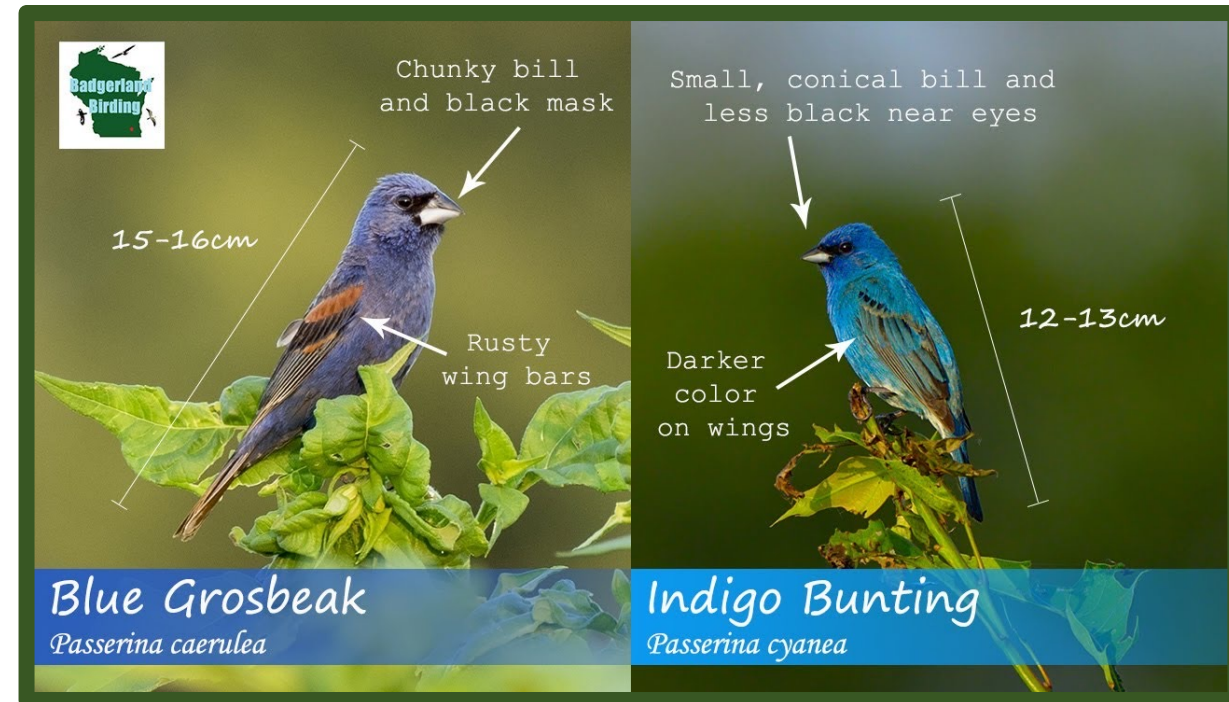
1. *Geospiza magnirostris*
3. *Geospiza parvula*

2. *Geospiza fortis*
4. *Certhidea olivacea*

Finches from Galápagos Archipelago

A More Local Example of Natural Selection

- ❑ Indigo Buntings and Blue Grosbeaks are related species with much in common
- ❑ Both breed in the eastern U. S. in weedy fields containing scattered trees
 - ✓ And both winter in Central America
- ❑ They consume insects during breeding season and seeds primarily in winter
 - ✓ But the grosbeak's larger bill allows it to exploit bigger seeds than the bunting
 - ✓ Reducing competition for food resources between the two species and enhancing survival for both



Natural Selection Summary

- ❑ **Natural selection is the process whereby traits that improve survival**
 - ✓ Accumulate in a population by these traits being passed on to offspring
 - ✓ Through a higher rate of reproductive success
- ❑ **Natural selection is the driving force behind evolution**
 - ✓ And sometimes leads to the development of new species
- ❑ **Only beneficial traits should be passed on through natural selection**

Natural Selection

Adaptation

- A body part, feature, or behavior that helps a living thing survive and function better in its environment
- Happens through natural selection



Now a Question

- If only traits that promote survival are passed down through natural selection
 - ✓ What possible benefit could the long tail on this male Booted Racket-tail convey?
- The club-like structures on the tail's end could be an actual detriment to survival
 - ✓ Hindering the bird's ability to fly by producing an inordinate amount of drag
 - ✓ And causing excessive energy expenditure to stay airborne
 - ✓ And making predator avoidance more difficult than need be



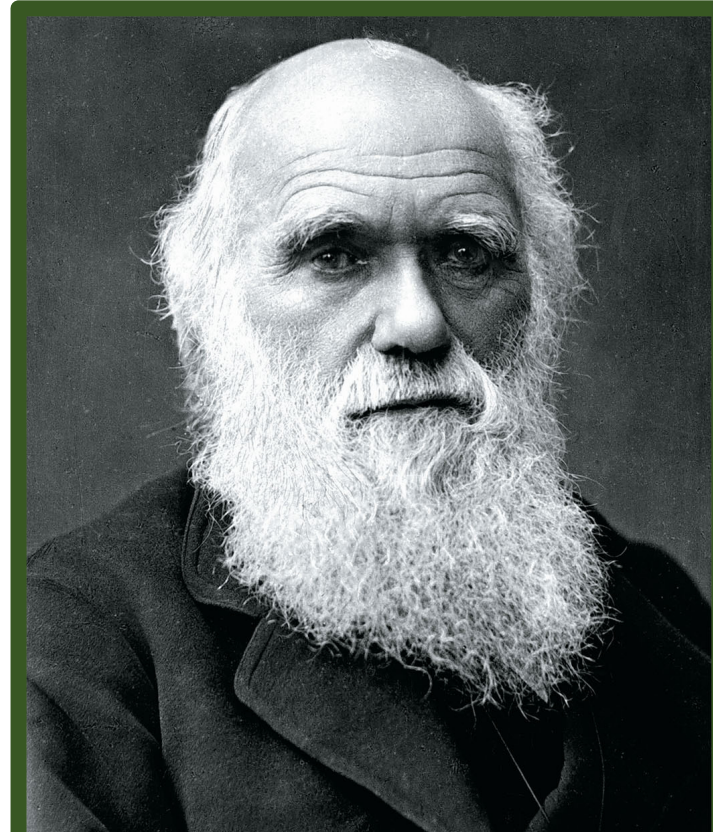
The Mystery Deepens

- But there are numerous avian species bearing excessively long tails
- Like this male Resplendent Quetzal from Central America
 - ✓ That has no genetic relationship to hummingbirds like the Booted Racket-tail
- Why would unrelated species evolve tails that hinder streamlined flight?
 - ✓ The answer Charles Darwin would say is because of sexual selection



Darwin Explains

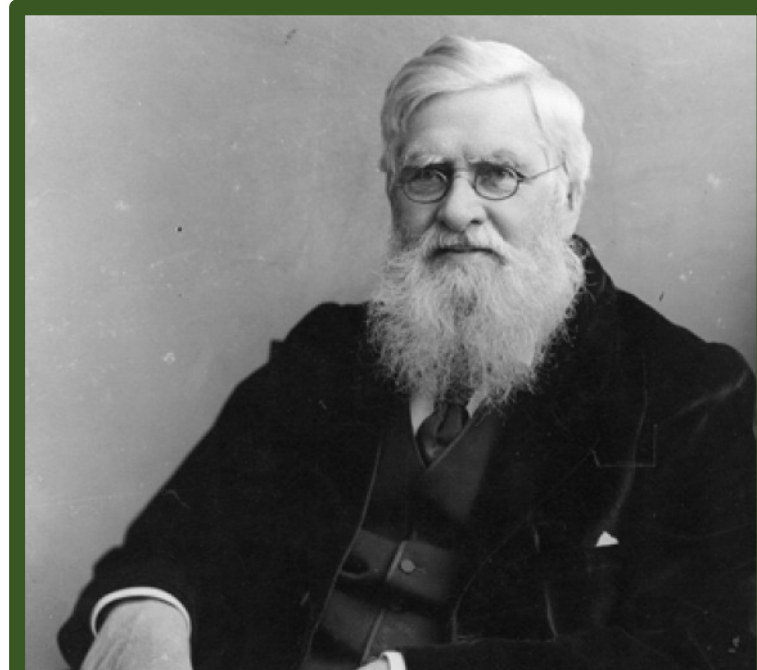
- ❑ Darwin first proposed sexual selection to explain non-survival adaptations in *The Origin of Species (1859)*
 - ✓ Dividing sexual selection into male-to-male competition and female choice
- ❑ Males compete with other males for access to females
 - ✓ And females choose those males with whom they want to breed
 - ✓ Using male ornamentation as one criteria
- ❑ Differences in the appearance of the sexes is largely due to sexual selection



Charles Darwin

Wallace Replies

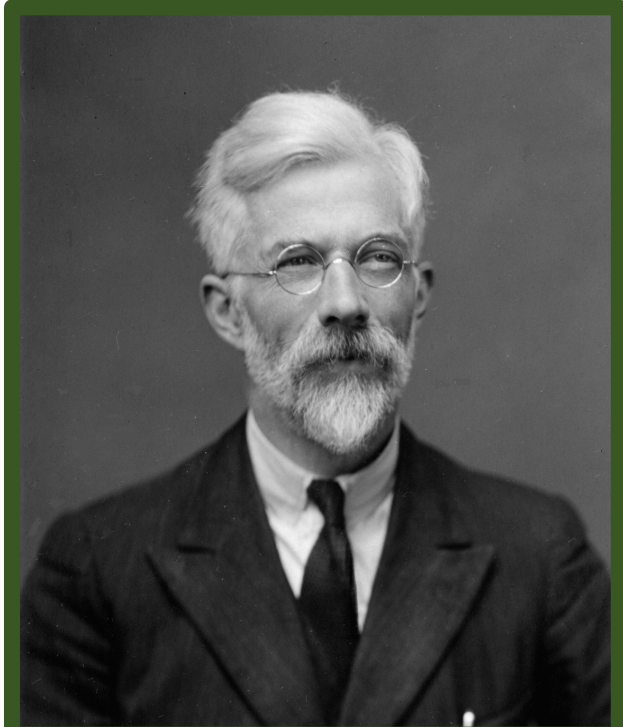
- Darwin applied these principles broadly to cover a wide range of species
 - ✓ Which were not universally accepted
- Naturalist Alfred Russel Wallace felt that sexual selection only played a minor role
- He argued that male competition could easily be explained by natural selection
- He also stated that females would have to possess an aesthetic sense
 - ✓ To pick males based on ornamentation
 - ✓ A trait that species like insects do not possess



Alfred Russel Wallace is best known for independently developing a theory of evolution through natural selection

New Concepts of Sexual Selection

- ❑ Then Ronald Fisher in *The Genetical Theory of Natural Selection (1930)* discussed new ideas on sexual selection
- ❑ He maintained that sexual selection accelerated the development of an ornamental trait
 - ✓ Causing the preferred male trait and the female desire for it to increase together in a positive runaway cycle
 - ✓ The process develops unchecked at increasing speed until the trait becomes exaggerated in proportions
 - ✓ And ceases only when practical constraints limit further exaggeration



Ronald Fisher was a statistician, geneticist, and evolutionary biologist

Sexual Selection and Evolutionary Extremism

- ❑ Fisher stated that the result of the runaway exaggeration of an ornament
 - ✓ Would be extreme sexual dimorphism
 - ✓ Meaning that the appearance of male and female would be extremely different
- ❑ Let's take the Long-tailed Widowbird for example
 - ✓ A polygynous grassland bird from Africa
 - ✓ With males breeding with up to five females simultaneously
- ❑ Note the difference between the male in the foreground and the female



The tail of the male Long-tailed Widowbird can be up to 20 inches in length and has no beneficial survival function. However, females are attracted to this ornamental trait, a prime example of sexual selection

Testing Sexual Selection in Birds

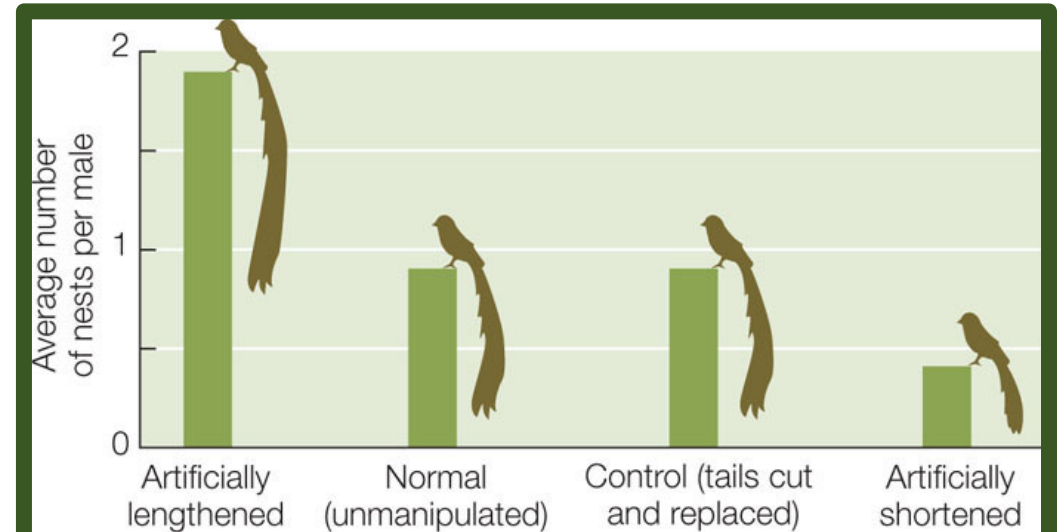
- ❑ A team conducted research on Long-tailed Widowbirds in Kenya
 - ✓ From Nov 1981 to March 1982
- ❑ They selected 9 groups of 4 males each
 - ✓ Having equal tail lengths and territory quality
 - ✓ And cut the tails of some to about 6 inches
 - ✓ While gluing these pieces of tail to other birds, extending tail length by 10 inches and making it longer than found naturally
 - ✓ The tail length of other males were not manipulated in length and used as a control group



A male Long-tailed Widowbird in flight

And the Test Results Shows that Size Matters

- ❑ **Males with artificially elongated tails were the most successful**
 - ✓ And added double the number of nests than males whose tails stayed the same
 - ✓ And quadruple the number of nests than males with artificially shortened tails
- ❑ **The results showed that females made the choice in mates based on tail length**
 - ✓ Even though males with elongated tails made fewer display flights than other males
 - ✓ And were likely laboring under the increased weight and drag of the elongated tail



The Kenyan study showed that additional nesting females were secured by those males with artificially enhanced longer tails

It's Not all in the Tail: The Birds-of-Paradise of New Guinea

In the case of the King-of-Saxony Bird-of-Paradise, two elongated feathers emanate from the male's head



A seemingly useless ornamental trait that his drab female partner finds irresistibly appealing



Sometimes it's on the Body

- ❑ **The male Greater Bird-of-Paradise sports elongated flank feathers**
 - ✓ That add nothing to flight capabilities
 - ✓ But look incredibly beautiful
- ❑ **As an extra attraction, two extended tail feathers project from the body**
 - ✓ Forming what appears to be little wires
 - ✓ That increase in size as the bird ages
- ❑ **Females assemble at a lek where multiple males are displaying**
 - ✓ And choose males based on how impressively these attributes are displayed



It's Wattles for Some Cotingas in South America

- ❑ The White Bellbird is found mostly in the Guianas
- ❑ The male has as a bizarre ornament called a wattle
 - ✓ that extends from the base of the bill
 - ✓ That he uses to attract females during courtship displays
- ❑ It's not unique among this group of birds in the Cotinga family
 - ✓ Except the trait possibly gets odder in appearance in two other species



Bellbirds and Wattles Galore

The Three-wattled Bellbird from Central America is not content with a single wattle. He has three of them



While the Bearded Bellbird in Trinidad, Venezuela, Guyana, and eastern Brazil boasts a whole throatful of wattles



And Chest Wattles on Umbrellabirds

- ❑ The Long-wattled Umbrellabird is a Cotinga found in Columbia and Ecuador
 - ✓ Where it resides in the foothills on the Pacific slope of the Andes
- ❑ The male attracts a mate with a large wattle extending from his chest
 - ✓ That is supplemented with a sexy crest
- ❑ These ornamental traits have no other function than for display
 - ✓ But the bird can retract the wattle, so it doesn't snag on branches
 - ✓ Reducing its hindrance [to basic survival](#)



And There is Even a Foot Fetish

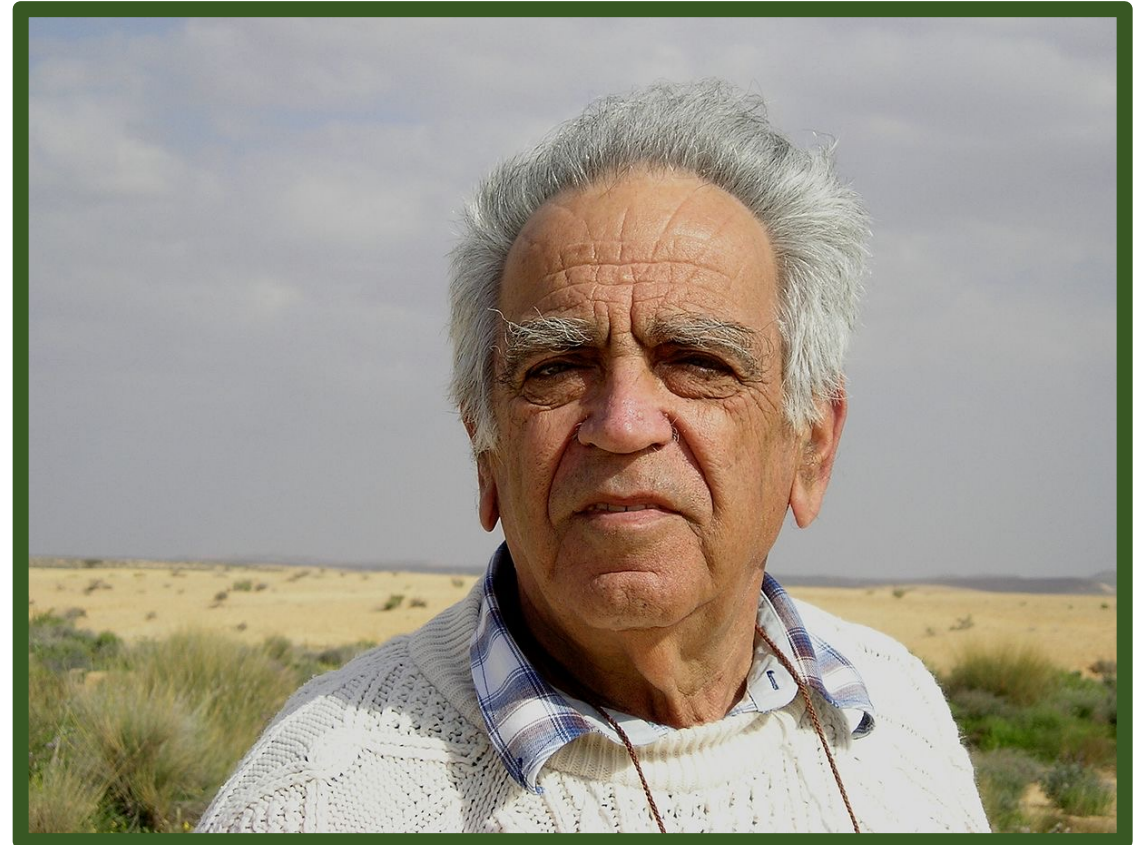
- ❑ The Blue-footed Booby is a famous attraction on the Galapagos Islands
- ✓ The blue feet are found on both sexes
 - ✓ A trait that is not excessively exaggerated like a long tail, odd plumage, or wattles
 - ✓ And is not apparently detrimental to an individual's survivability
- ❑ Studies indicate that females select males with the brightest blue feet
 - ✓ And males prefer females exhibiting the same trait



The courtship ritual of the Blue-footed Booby partly consists of displaying their blue feet to each other

Maybe It's More Fitness Than Beauty

- ❑ In 1975, Israeli biologist Amotz Zahavi proposed the “handicap principle”
 - ✓ That stated that exaggerated behavior or morphological traits indicated fitness
- ❑ In sexual selection, a female could interpret a male's seemingly debilitating trait as a sign of health and fitness
- ❑ The idea is that sexually selected traits function like conspicuous consumption
 - ✓ If a male can afford to possess a huge ornament like a long tail and still function
 - ✓ He must be quite a catch!



Exaggerated Ornaments are not Mandatory

- ❑ Let's go back to the bellbirds
- ❑ I haven't mentioned the Bare-throated Bellbird
 - ✓ Residing in the Atlantic Forest of eastern Brazil and southeastern Paraguay
- ❑ And that's because unlike other bellbirds
 - ✓ Male Bare-throats have no wattles
- ❑ In the absence of exaggerated ornaments, what other traits do females use to judge male fitness?



For the male Bare-throated Bellbird, perhaps the colorful green throat replaces the wattles as a sign of fitness

There is Extreme Dancing as Courtship Display

- ❑ It's almost human!
- ❑ As started by the Contours in their hit 1962 song
 - ✓ *Do you Love Me (Now that I can Dance)*
 - ✓ You broke my heart
'Cause I couldn't dance
You didn't even want me around
And now I'm back
To let you know
I can really shake 'em down
 - ✓ Do you love me? Now that I can dance



Sexual Selection and Dancing

- ❑ Birds that use dancing as a communal courtship display are often polygynous
- ❑ Ornaments may or may not be employed as part of the dance ritual
- ❑ Greater Prairie-Chickens from the western United States
 - ✓ Have inflatable areas of skin called gular air sacs
 - ✓ And erectable head feathers called pinnae
- ❑ Males gather on leks to use competitive dancing to [attract females](#)



The inflatable gular sacs and erectable pinnae likely supplement the Greater Prairie-Chicken's dancing skills in his ability to attract females

The Red-capped Manakin is a Dancing Fool

- ❑ The Red-capped Manakin lacks any notable physical traits
 - ✓ Just a black body and a red head
- ❑ But what he lacks in ornaments, he makes up in his dancing performance
- ❑ The Red-capped Manakin resides in Central America and the Pacific slope of Columbia and Ecuador
 - ✓ Where the males attempt to attract females with an amazing dance routine
 - ✓ By doing a backwards slide resembling the [Michael Jackson moonwalk](#)



These Manakins Are the Most Creative Dancers

- ❑ Male Swallow-tailed, or Blue, Manakins even dance together to attract a mate
 - ✓ In the Atlantic Forest of Brazil and Paraguay
 - ✓ Have fun and may the best man, [er, male win](#)
- ❑ But the oddest of all may be the Club-winged Manakin
 - ✓ That inhabits the Pacific slope of the Andes in Columbia and Ecuador
 - ✓ The male clicks his wings together to emit sound to prove his fitness to females
 - ✓ Ornithologist Kim Bostwick explains how [this all works](#)



A male Club-winged Manakin courtship dances for a female

Dancing Cranes

- ❑ Dancing is not confined to polygynous birds like prairie-chickens or manakins
- ❑ Large monogynous birds in the crane family put on a good routine as well
 - ✓ And both sexes dance
 - ✓ Possibly to cement the pair bond
- ❑ Birding tour groups offer winter tours to Hokkaido, Japan
 - ✓ To witness the dancing displays of the resident population of Red-crowned Cranes
 - ✓ Which is the second rarest of the 15 worldwide crane species



Red-crowned Cranes dancing in Hokkaido, Japan.
The sexes are similar among all species of crane

Sexual Selection and Elaborate Construction

- ❑ This is a male Satin Bowerbird from the coastal rainforest area of eastern Australia
- ❑ He is a glossy indigo color and has no fancy morphological ornamentation
 - ✓ Nor an elaborate dance routine compared to manakins
- ❑ He shows his fitness through his amazing construction abilities



The Bower

- ❑ The male Satin Bowerbird erects two parallel walls of sticks called a bower
 - ✓ With a little floor between the walls where the female can watch him display
- ❑ He then decorates the area surrounding the bower with colorful blue objects
 - ✓ Away from human habitation, these items include blue parrot feathers, flowers, and snail shells
 - ✓ But near towns, human made decorations like blue bottle caps, straws, and plastic utensils are frequently used



And Boy Meets Girl

- ❑ **When a female bowerbird comes to inspect his work**
 - ✓ The male puts on a display while holding one of the blue objects
- ❑ **If the female likes what she sees, the couple will mate**
 - ✓ And she will go off to build a nest and prepare to raise young alone
 - ✓ While the male prepares for the arrival of another female
- ❑ **The bower is so important for the male, he maintains it year round**



A Bowerbird Comparison

- ❑ **These are Flame Bowerbirds from New Guinea**
 - ✓ The colorful male is on the left
- ❑ **His bower is smaller than the Satin Bowerbird and has fewer decorations**
- ❑ **The most elaborate and showy bowers are made by the drabest males**
 - ✓ Suggesting compensatory adjustment between plumage brightness and bower complexity
 - ✓ That is driven by intense sexual selection from the females



If You Build it, She Will Come

- ❑ **The Marsh Wren is a polygynous songbird where the sexes look alike**
 - ✓ A male may have two or more females nesting in his territory
- ❑ **Females are initially attracted to a male's territory by song**
 - ✓ But song alone is inadequate
- ❑ **The male will construct up to six dummy nests**
 - ✓ And the female will determine the male's fitness to breed based on his territory quality and nest building skills



Sexual Selection and Song Repertoire

- ❑ **The Northern Mockingbird is a well-known songster in the suburbs**
 - ✓ That can imitate a variety of bird songs
- ❑ **Songbirds sing for two reasons**
 - ✓ To warn conspecific males to stay out of the singer's territory and to attract females
- ❑ **Female mockingbirds appear to judge male fitness based on repertoire size**
 - ✓ The more birds he can imitate, the more appealing he becomes to her
 - ✓ When mated, they will form a monogynous pair bond and raise the young together



Testing Male Fitness Based on Song Repertoire

- ❑ Like Mockingbirds, male Song Sparrows have a varied repertoire
 - ✓ And have a monogynous breeding strategy
- ❑ In studies on Song Sparrows, males with larger repertoires had a larger song control nucleus in the brain
 - ✓ And showed better body condition
 - ✓ Plus had a lower heterophil (antibody) to lymphocyte (immune cell) ratio in the blood
 - ✓ That indicated better immune health
 - ✓ Suggesting that females can assess male health based on song variability



Sexually-dimorphic Migrants

The Cape May Warbler breeds in northern coniferous forests and winters in the Caribbean. This is the male



The less colorful female would appear to have plumage, song, and territory quality to judge a male's breeding fitness



Sexually-monomorphic Migrants

The Tennessee Warbler also breeds in northern forests and winters in Central and South America. This is a male



The female looks virtually the same. Perhaps plumage is not as critical a factor in her selection of mates



Observations and Comments

- I noticed while doing this research
 - ✓ That male birds with exaggerated body ornaments like wattles on bellbirds
 - ✓ Or incredible dance displays as performed by male manakins
 - ✓ Or who build elaborate structures like male bowerbirds
 - ✓ Are generally polygynous and offer no parental care to offspring
- Since the female can expect no help from the male after copulation
 - ✓ Her choice to mate is primarily based on some physical or behavioral attribute



Birds with exaggerated traits or behavior are sexually dimorphic (males and females look dramatically different). The evolution toward this type of sexual selection in each different group likely began at the genus or family level

And an Exception

- ❑ **The male Resplendent Quetzal has an exceeding long tail**
 - ✓ And the species is sexually dimorphic
 - ✓ But male and female form a monogynous pair bond and the male offers parental care.
- ❑ **Males of all 43 species in the Trogon family (Trogonidae) are quite colorful**
 - ✓ But only the male Resplendent Quetzal has the long tail as an ornament
 - ✓ Suggesting that in this instance the development of the trait was unique to this species of trogon



Sexual Selection and Large Monogynous Birds

- Let's revisit the Blue-footed Booby and Red-crowned Crane
 - You will readily note that the booby is sexually monomorphic (sexes look alike)
 - ✓ And both species share the blue feet
 - Cranes also have similar traits
 - ✓ Both sexes dance and look extremely similar
 - It appears that sexual selection has allowed some monogynous pairs to evaluate each other's breeding fitness
 - ✓ Without resorting to evolutionary extremes



Blue-footed Booby Courtship

Sexual Selection and Reverse Dimorphism

- ❑ There is a group of polygynous birds that show reverse sexual dimorphism
 - ✓ Many of these are shorebirds like the Red Phalarope
- ❑ The female Red Phalarope mates with as many males as possible
 - ✓ And allows the males to incubate the eggs and care for the young alone
- ❑ She is larger and brighter than her male counterparts
 - ✓ And males are attracted to her plumage and display techniques



Female Red Phalarope

Summary

- Sexual selection can manifest itself in ways both ridiculous and subtle
- It can cause the evolution of morphological traits that could hinder an individual's survival
- It can cause the evolution of extreme behavior
 - ✓ Like extreme dancing or the building of elaborate structures
- Or it can be much more subtle
 - ✓ And based on song, plumage, and quality of territory, or a combination of these



The male Gray Catbird may not be the fanciest bird in the world, but some female just may like his song, looks, and his territory

Questions

