

Dan Warden - Journey of the *Paradisaeidae* Project Summary

My project explores the evolutionary history behind the amazing *Paradisaeidae*, or Birds of Paradise (BOP). I made a pamphlet chronicling the contributing factors that have naturally created these extraordinary birds and their unique tale of evolution. The BOP are found in New Guinea, the northeastern tip of Australia, and the Moluccas Islands, an extremely biodiverse area of rainforest in the Pacific Ocean. [3] There are 39 species of the birds, honing incredible and diverse displays of plumage, long tail feathers, and both vibrant and iridescent colors the likes of which exist nowhere else on earth. They are an example of an extreme display of evolutionary sexual selection. [4]

The BOP are sedentary, living in isolated areas with an abundance of food, mainly berries, as well as a lack of predators. This unique environment has allowed their populations to thrive and evolve via pressures to reproduce, rather than solely survive. [2] The first spread of my book points out the geological factors contributing to the species diversity. The islands on which the birds live are strung along a fault line in the crust of the earth. Plate tectonics have literally separated chunks of rock, dispersing them throughout the ocean while bringing populations of the BOP along for the ride. The birds are non-migratory, given the climate, and their comfortable, sedentary nature keeps them from flying over water between islands altogether. [5] When a population is separated by water, they head down their own evolutionary path based on the preferences of the females and the attractive adaptations of males in the given population. Most species exist only on a particular island, or a particular area of that island. Their population on the northern tip of Australia is attributed to a land bridge that frequently appeared and disappeared due to sea level changes during previous ice ages, over 50,000 years ago. [5]

The next spread points out the primary indicator of sexual selection: differentiations between males and females of the same species. These differentiations are called *sexual dimorphisms*. The females are incredibly beautiful birds, though they lack the splendid attributes of the males. Females are attracted to the longer tails, extravagant plumes, and bright colors of the males, and it is their decisions that bring these adaptations to the next generation. The females keep their camouflage coat because their physical attributes are not favored in sexual selection. Breeding with mates and producing offspring, in this instance, replaces the role of survival of the fittest. [1]

The third spread shows how over many generations of female choice in sexual selection, the males have come to produce their bizarre attributes. The females have some innate preference for fancy traits, and every generation that they choose to mate with males that they deem more beautiful, these traits become exaggerated. [4] When genetics takes a random course, and new attributes pop up in a species that the females prefer, they become more and more exaggerated over time and eventually lead to the complex displays that we see today. [5] This also gives the opportunity for species a species to branch in different directions, as illustrated, given the attributes at play and the females' preference for these attributes, contributing to the wide diversity of *Paradisaeidae* species. [4]

The final spread delves into the most important factor in driving this strange case of evolution: polygamy. It is very important that the birds are polygamous, since the successful, more attractive males will reproduce with many females, while those that are less attractive will reproduce with very few or even none. This means an increased level of intensity to the selection, and that only those more extravagant attributes will pass on to the next generation, while the hereditary lines of those less splendid individuals come to an end. It greases the wheel of evolution, since unfavored adaptations can hit a dead

end in a single generation, while preferential adaptations, and the female preference, are passed down at a high proportion into each subsequent generation. [5, 1]

Birds of Paradise are a very popular subject today, due to new high-definition nature documentaries, and especially the recent video, photography, and research done by Ed Scholes and Tim Laman of the Cornell Lab of Ornithology. [5] I hope that this book illustrates the concepts and drivers behind the evolution of these amazing birds so that even the lay enthusiast can understand how they came to be. One thing I have left out in the book is the intricately choreographed courtship rituals and songs of the males, which along with their physical attributes, are acutely analyzed by the females when deciding on a mate. It is definitely something to be considered in the sexual selection evolution.

Annotated Bibliography

1. Coyne, Jerry A. "How Sex Drives Evolution." *Why Evolution Is True*. New York: Viking, 2009. N. pag. Print.

Gave accounts of sexual selection and how sexual dimorphisms are used as indicators of evolutionary sexual selection occurring in the development of species.

2. Huxley, Julian, and H.B.D. Kettlewell. "Sexual Selection." *Charles Darwin and His World*. New York: Viking, 1965. 94-101. Print.

Explained Darwin's theories and discoveries of sexual selection, evidence of its occurrence in BOP and peacocks, and how it differs from conventional examples of natural selection.

3. *Papua New Guinea's Fourth National Report to the Convention on Biological Diversity*. PNG Dept. of Environment and Conservation, 2010. Web.
<<http://www.cbd.int/doc/world/pg/pg-nr-04-en.pdf>>

Gave accounts of the biodiversity and environmental ecology in Papua New Guinea .

4. Scholes, Edwin. Structure and composition of the courtship phenotype in the bird of paradise *Parotia lawesii* (Aves: Paradisaeidae). *Zoology*, Volume 111, Issue 4, 15 July 2008, Pages 260–278 Web. <<http://dx.doi.org/10.1016/j.zool.2007.07.012>>.

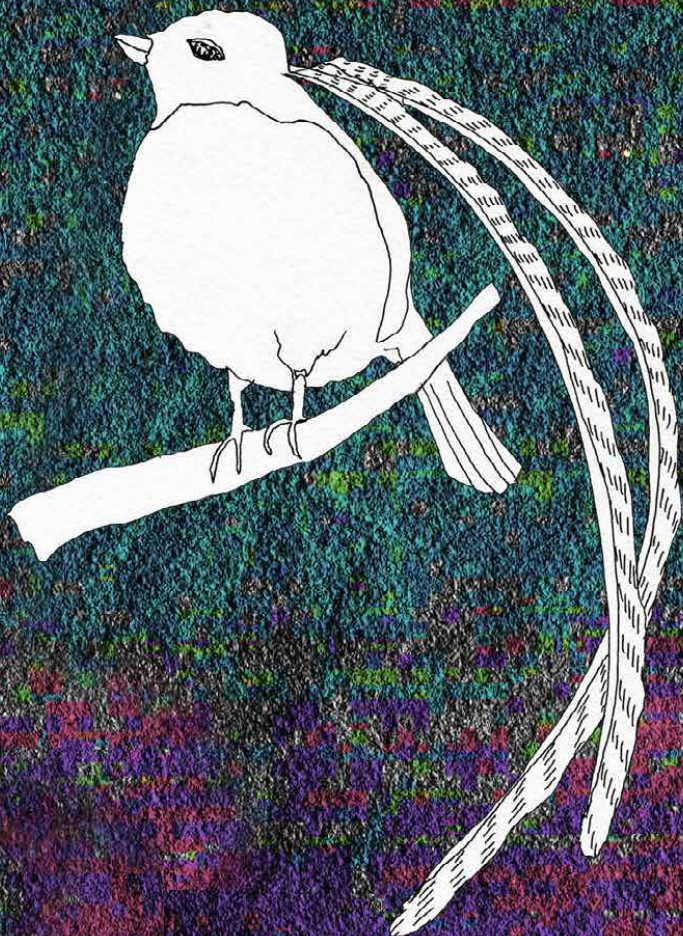
Explains causes of such diversity amongst the bird family. Also the extreme complexity and diversity of courtship displays that the males undergo, illuminating the acute attention to detail of the females and their role in driving the extravagant evolution.

5. Scholes, Ed, and Tim Laman. *Birds of Paradise Project*. Cornell Lab of Ornithology, n.d. Web. <<http://www.birdsofparadiseproject.org/>>.

Provides the bulk of information on sexual selection and females choice in the *Paradisaeidae* family, including video and photography of the birds, their courtship rituals, and their adaptations. Also explains the role of geography, isolation, and diversity in the sexual selection evolutionary process.

Journey of the
PARADISAEIDAE

- sexual selection -





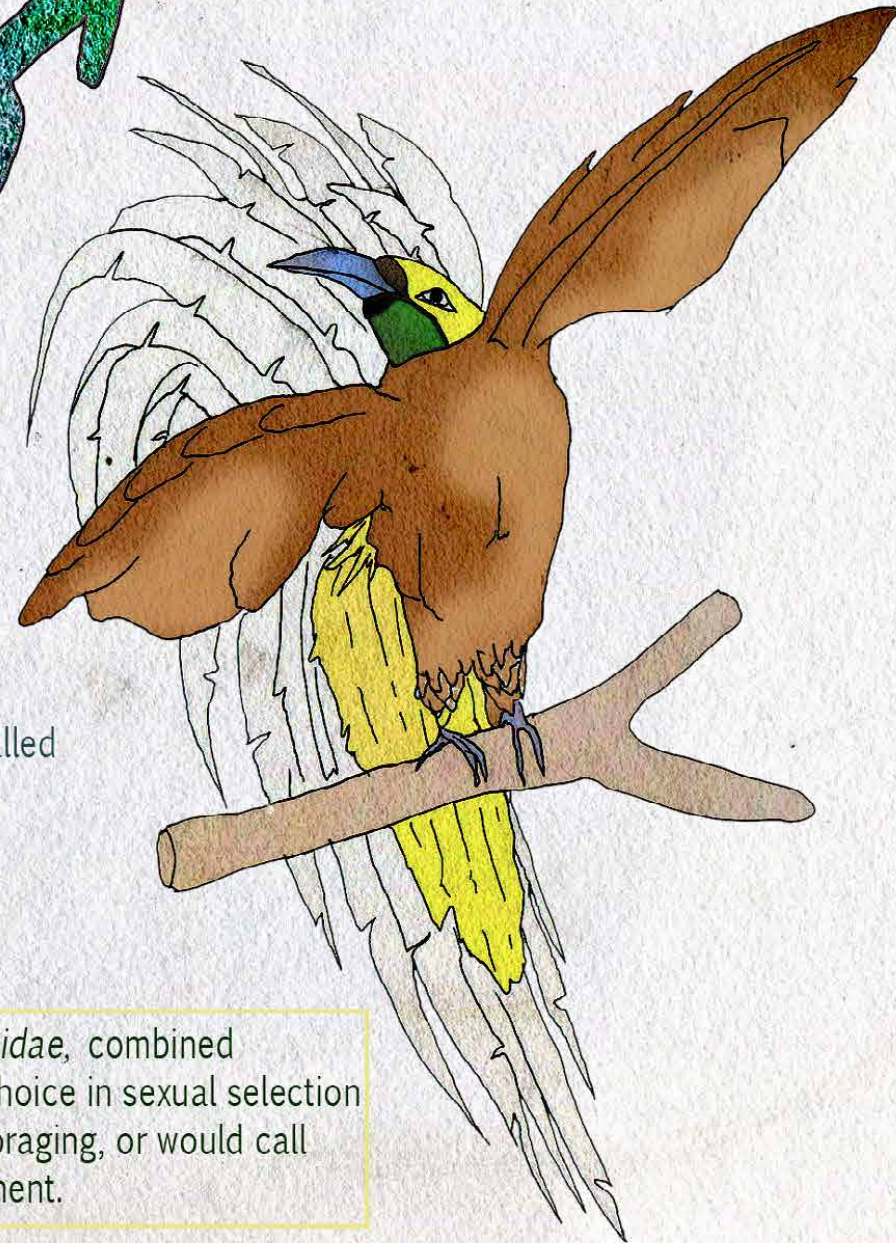
The Birds of Paradise are native to New Guinea, the northern tip of Australia, and Moluccas Islands. They are non-migratory, due to their temperate rainforest climate, nor do they fly over water. The process by which they spread across these islands was caused by geological changes over thousands of years:

Plate tectonics have shifted the earth's crust, separating the Mollucas islands from the rest of New Guinea, and bringing populations of the birds along for the ride.

Amazingly, these geological changes, along with sexual selection, have directly influenced the vast diversity of species in the Paradisaea family, by isolating particular traits and preferences to meander down their own evolutionary path.

A landbridge has appeared and dissappeared during previous ice ages, allowing the birds to cross.

Perhaps the most telling sign of sexual selection is the differentiation between males and females of the same species. The tail feathers, plumes, and bright colors may not benefit the bird's survival, but they do help it attract mates and produce offspring, which replaces the role of survival in sexual selection.



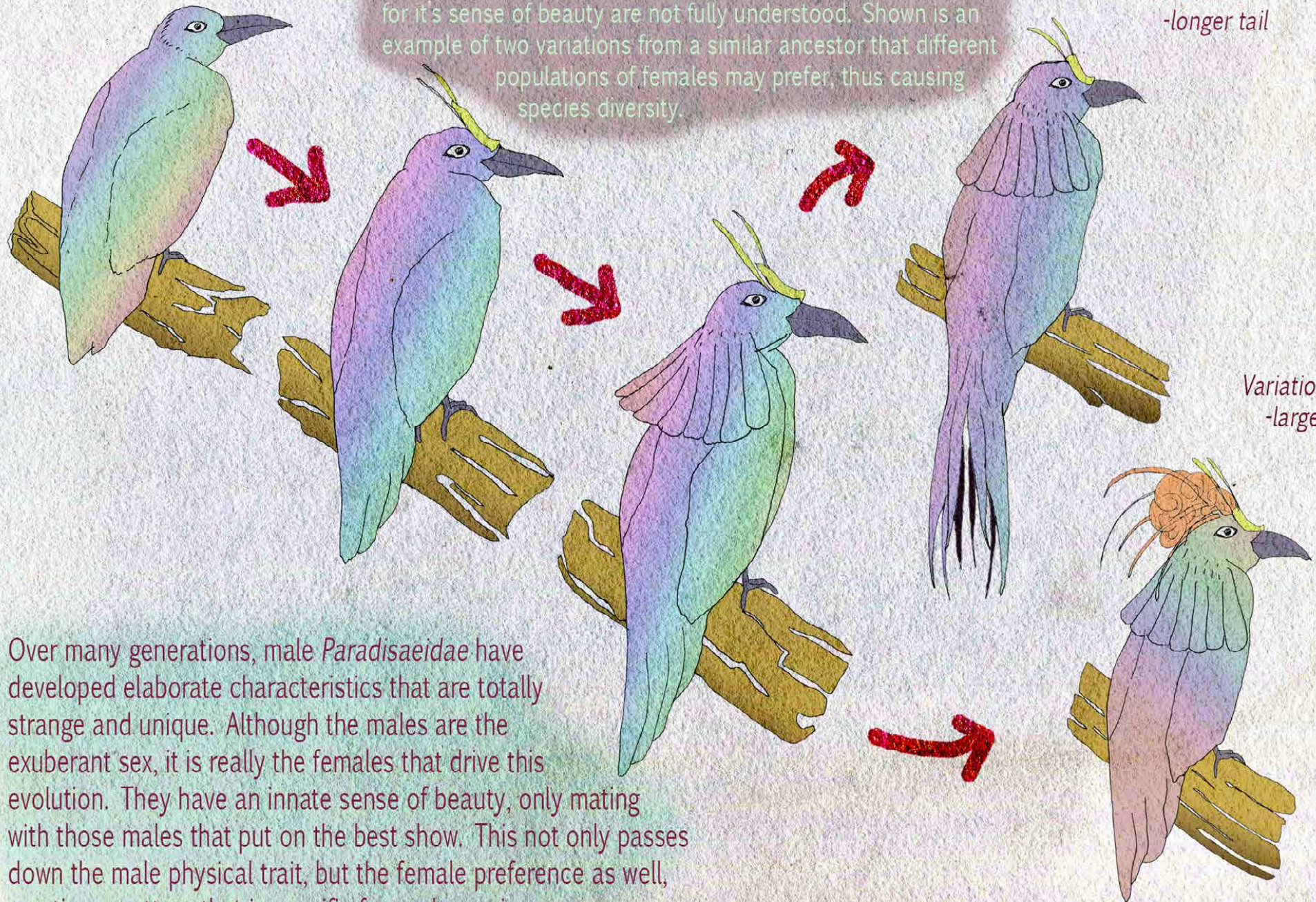
These traits that vary between sexes are called *sexual dimorphisms*.

Abundance and dispersion of berries, a common food source for *Paradisaeidae*, combined with a lack of many predators on the tropical islands, has allowed female choice in sexual selection to guide the evolution of this bird family. Attributes that hinder flight and foraging, or would call attention to predators, have a completely different purpose in this environment.

The female has an acute attention to detail, though the reasons for its sense of beauty are not fully understood. Shown is an example of two variations from a similar ancestor that different populations of females may prefer, thus causing species diversity.

Variation 1
-longer tail

Variation 2
-larger plume



Over many generations, male *Paradisaeidae* have developed elaborate characteristics that are totally strange and unique. Although the males are the exuberant sex, it is really the females that drive this evolution. They have an innate sense of beauty, only mating with those males that put on the best show. This not only passes down the male physical trait, but the female preference as well, creating a pattern that is specific for each species.

The most important factor contributing to the extraordinary evolution of the *Paradisaeidae* is the polygamous sexuality of the birds.

This means that the males with the most attractive attributes will reproduce with many females, while those that are less attractive will mate with very few or even none.



The next generation will therefore have a majority of both trait and preference, while the hereditary line of those less splendid birds will come to an end.



These birds have more than just looks. Their courtship rituals involve intense song and dance with thousands of moves, shape-shifting capabilities, and sounds that seem like they're from another planet.



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