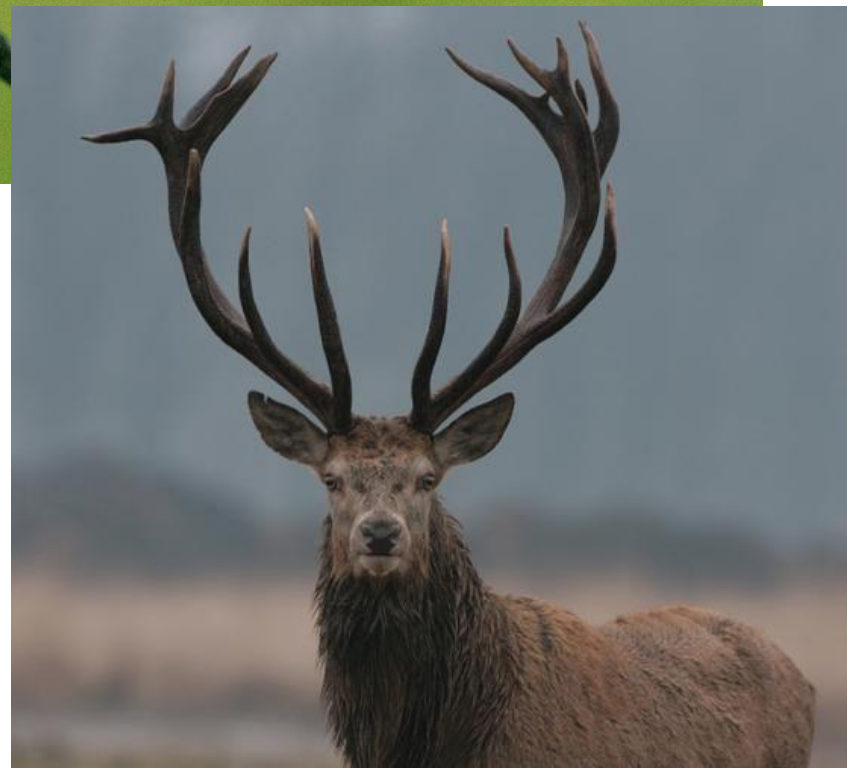
SEXUAL SELECTION

LS2201

Anindita Bhadra

Mismatched partners?

Costly Jewels



Costly Jewels

Many species of animals have mate choice.

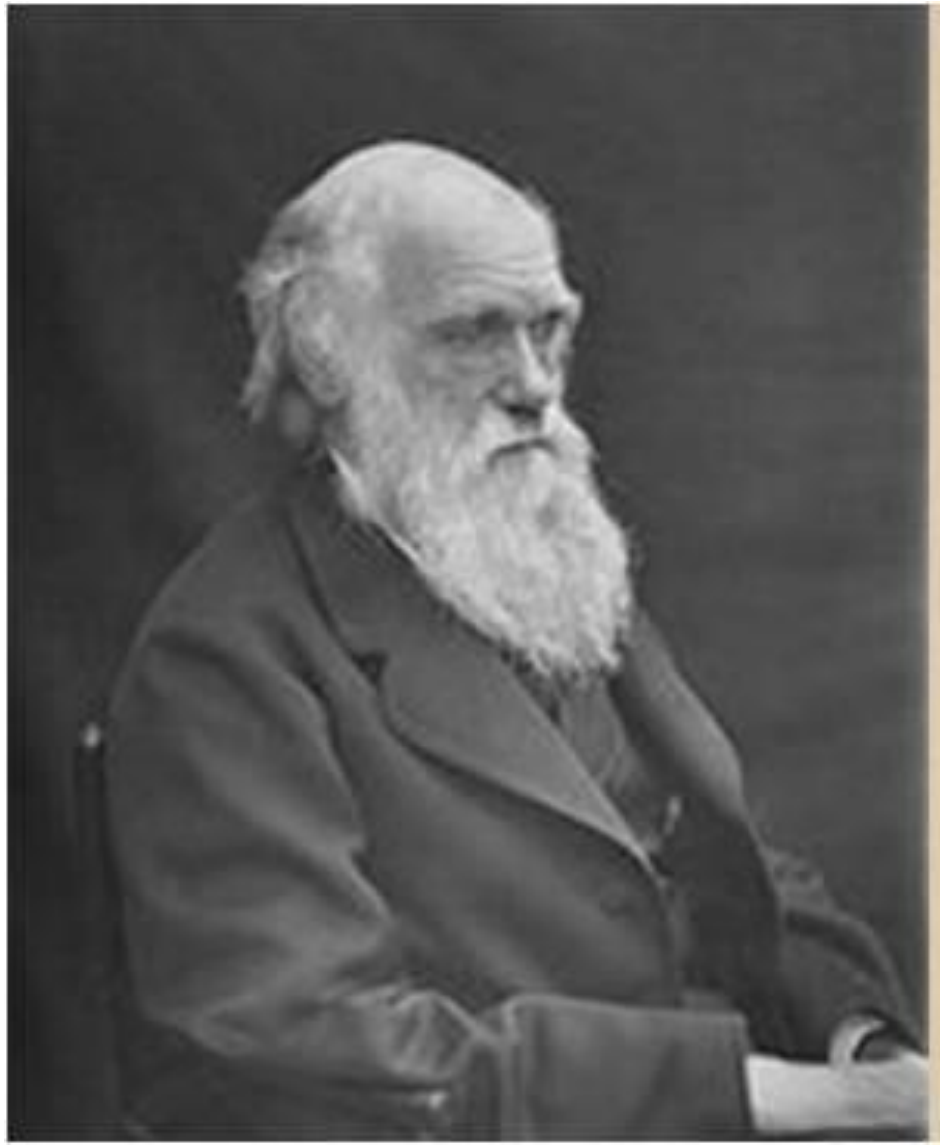
Mate choice is typically seen in species where females choose males for mating.

Female mate choice often drives selection for costly sexual displays or behaviours in the males.

Male mate choice, on the other hand, is comparatively rare.

Typically, the choice of mates lies with the sex that invests more in the offspring.

Sexual Selection Theory (1871)



THE

DESCENT OF MAN,

AND

SELECTION IN RELATION TO SEX.

BY

CHARLES DARWIN, M.A., F.R.S., Etc.

Sexual Selection Theory

Charles Darwin originally proposed that the so-called secondary sexual characteristics of male animals evolved because females preferred to mate with individuals that had those features.

He defined this idea as depending on “the advantage which certain individuals have over other individuals of the same sex and species solely in respect of reproduction”.

He said, that sexual selection “depends not on the struggle for existence, but on the struggle between males for possession of females.”

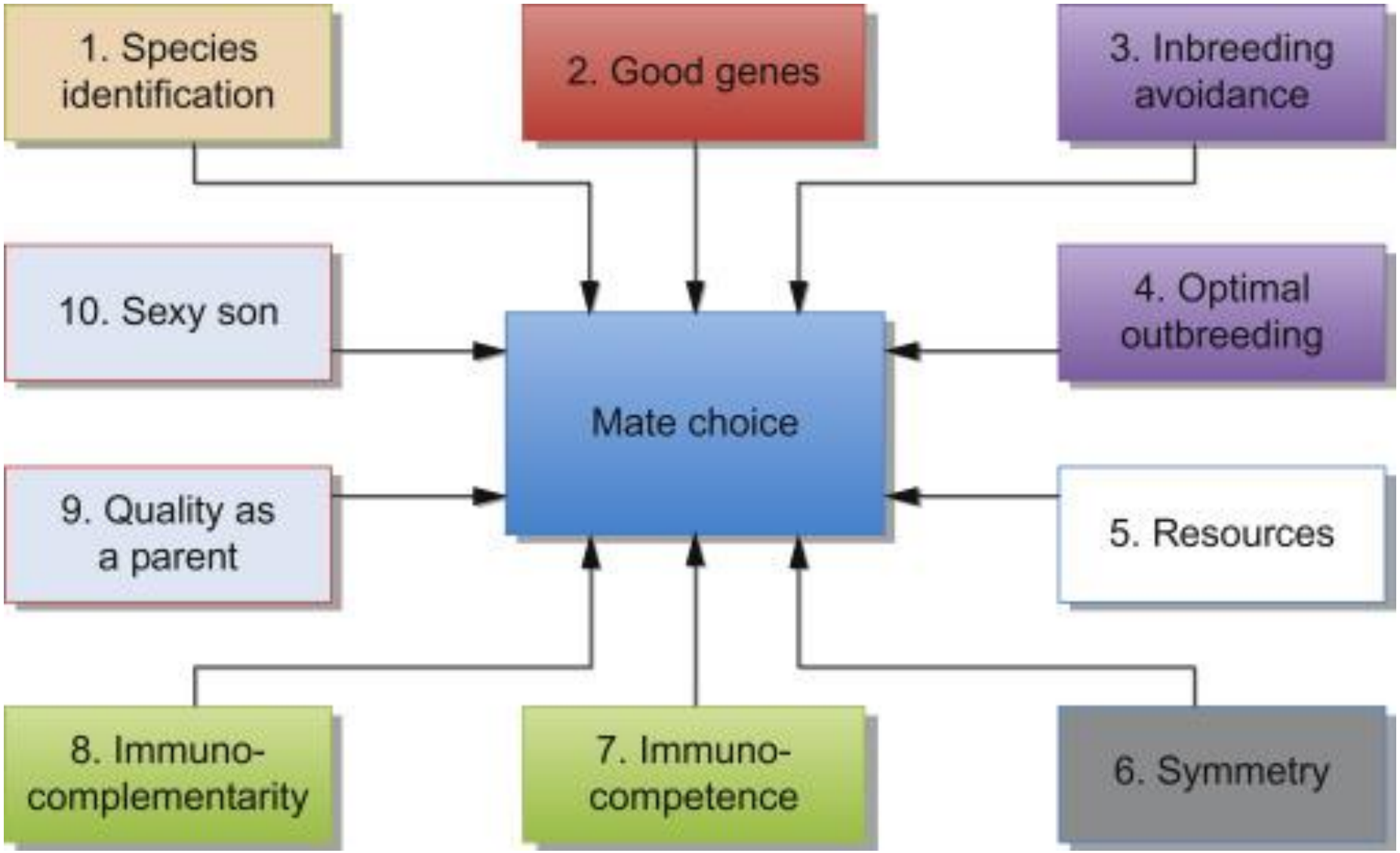
Sexual Selection Theory

Sexual selection is not a subcategory of natural selection, as Darwin made very clear: it arises from differences in mating success, whereas natural selection is due to variance in all other fitness components.

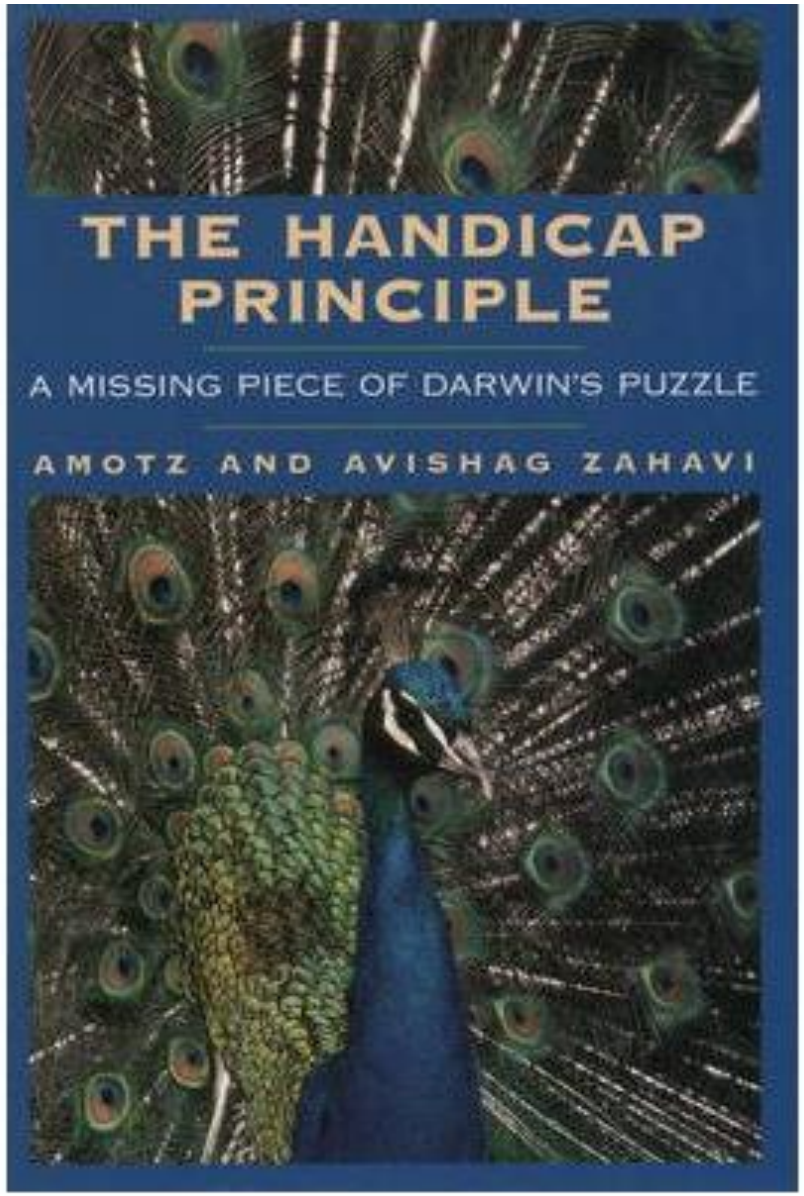
What Darwin apparently did not clearly appreciate, however, is that sexual selection is often stronger than natural selection, as it frequently drives trait values beyond their naturally selected optima.

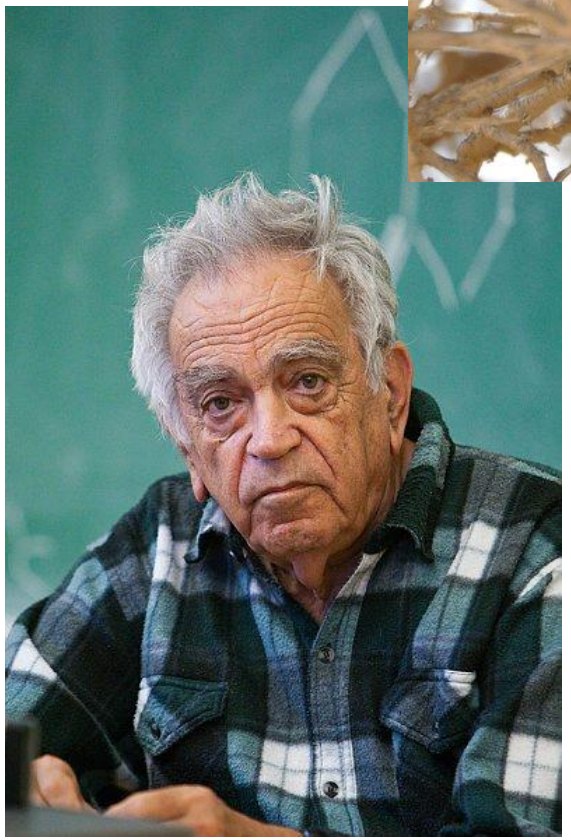
This occurs even though sexual selection largely acts on only half the population (usually males), a situation that has been referred to as the quantitative paradox of sexual selection.

Why Mate Choice?



The Handicap Principle





Amotz Zahavi

Mating Systems

Monogamy

Social monogamy is the behavioural pairing of a single male with a single female.

Some species engage in serial monogamy and extra-pair copulations.

WHY?

Mating Systems

Polygyny

Resource Defense Polygyny: groups of females are attracted to a resource — males then compete for territorial possession of the resource, and, by extension, mating priority with females at the resource (Beletsky 1994). Thus, individual males form territories centered on resources needed for successful mating (McCracken 1981).

Mating Systems

Polygyny

Harems: a defended group of females associated with one male. Females may initially associate in a harem for group defense, or they may be herded together by a male. Males compete for control of the groups. Harems typically exhibit a dominance hierarchy among the females in the group.

Mating Systems

Polygyny

Leks: an aggregation of males that are each seeking to attract a mate. Within a lek, males typically perform sexual displays. Unlike most other mating systems, leks are not associated with resources. Aggregations of males may be near particularly attractive females or in areas where females are likely to travel.

Mating Systems

Polyandry

Resource Defense Polyandry: an aggregation of males that are competing for females. In the Spotted Sandpiper, females control resources, which in turn controls male mating associations (Oring et al. 1994).

Mating Systems

Polyandry

Cooperative Polyandry: The Galapagos hawk exhibits cooperative polyandry. In this case all males in the group copulate with the female and all participate in brood provisioning (Fabborg et al. 1995).

Mating Systems

Polygynandry

In polygynandrous groups, multiple females and males mate with each other, and males may care for the broods of several females. Chimpanzees and bonobos rely on this strategy — it allows groups of males and females to live together and spend less time being concerned with mate competition.

Mating Systems

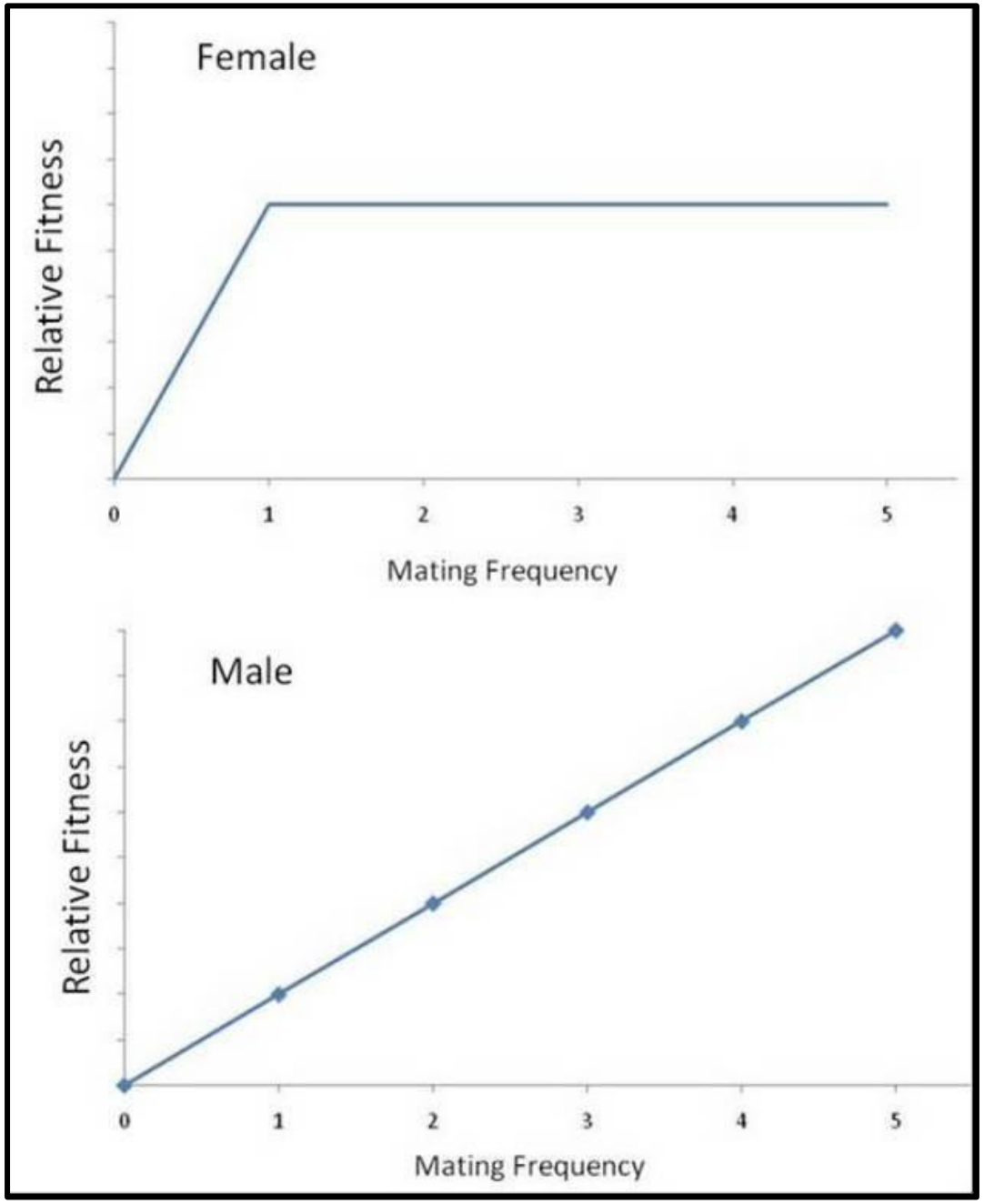
Promiscuity

In promiscuity there are no pair bonds, and males and females, although sometimes choosy, often seem to mate randomly. As it is typically more advantageous for one or both sexes to pick their mate, promiscuity may occur in species for which the environment is unpredictable (Birkhead 2000, Burton 2002).

Bateman's Principle

Females almost always invest more energy into producing offspring than males, and therefore, in most species, females are a limiting resource over which the other sex will compete.

After one mating, if female mating frequency increases, the relative fitness remains constant, as the sperm from one mating is adequate to fertilize all the female's eggs. In males, as mating frequency increases relative fitness also increases proportionally.



Male mate choice

When present, it is often based on traits that correlate with high fertility in females.

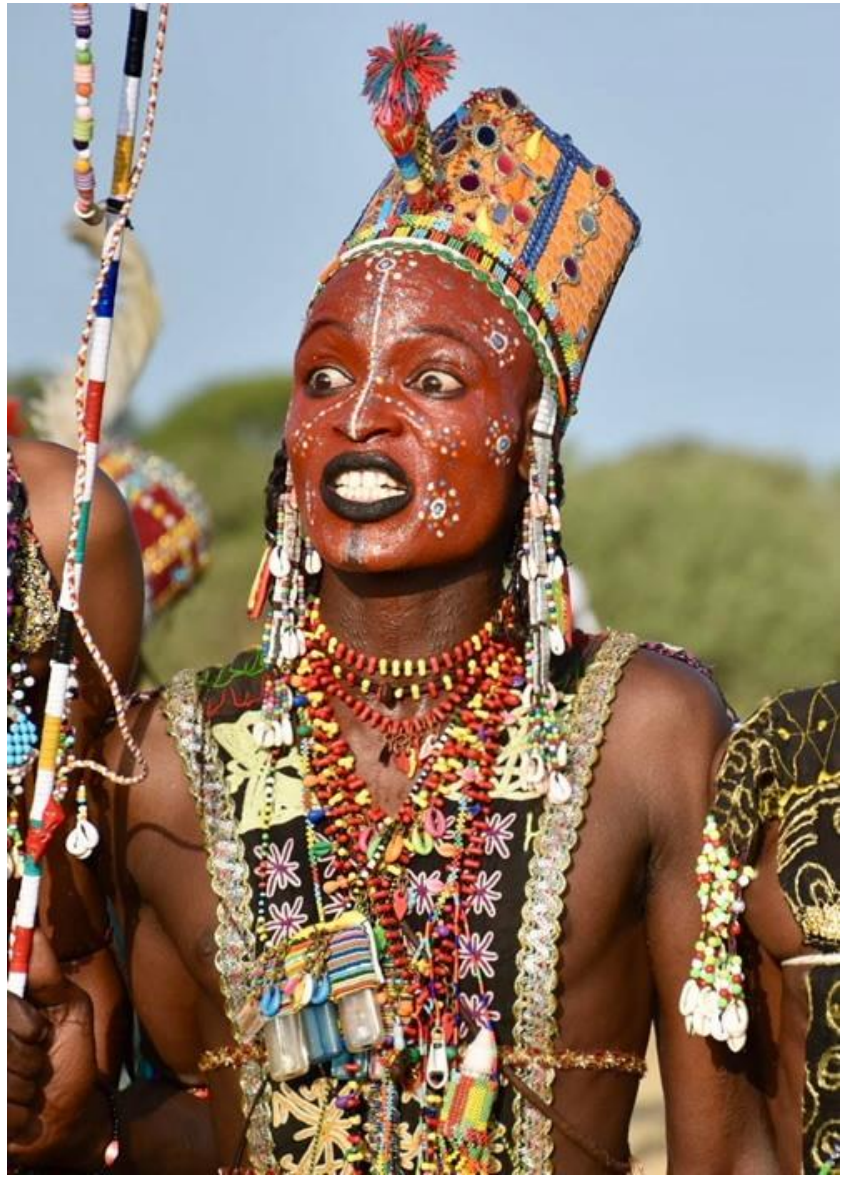
Some traits preferred by males include large body size, readiness to mate, virginity, etc.

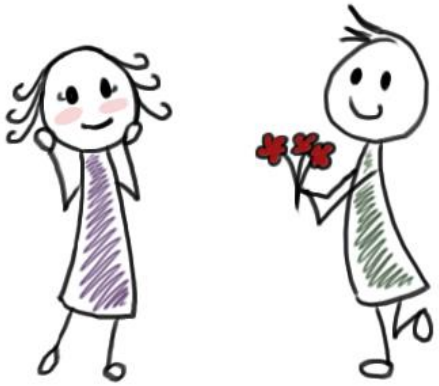
The traits that have been reported as ornaments for females—while still bearing the hallmarks of secondary sexual characteristics—tend to be more subtle than male ornaments.

Male mate choice exists in varied taxa, from insects to primates.

Do modern day humans show "mate choice"?

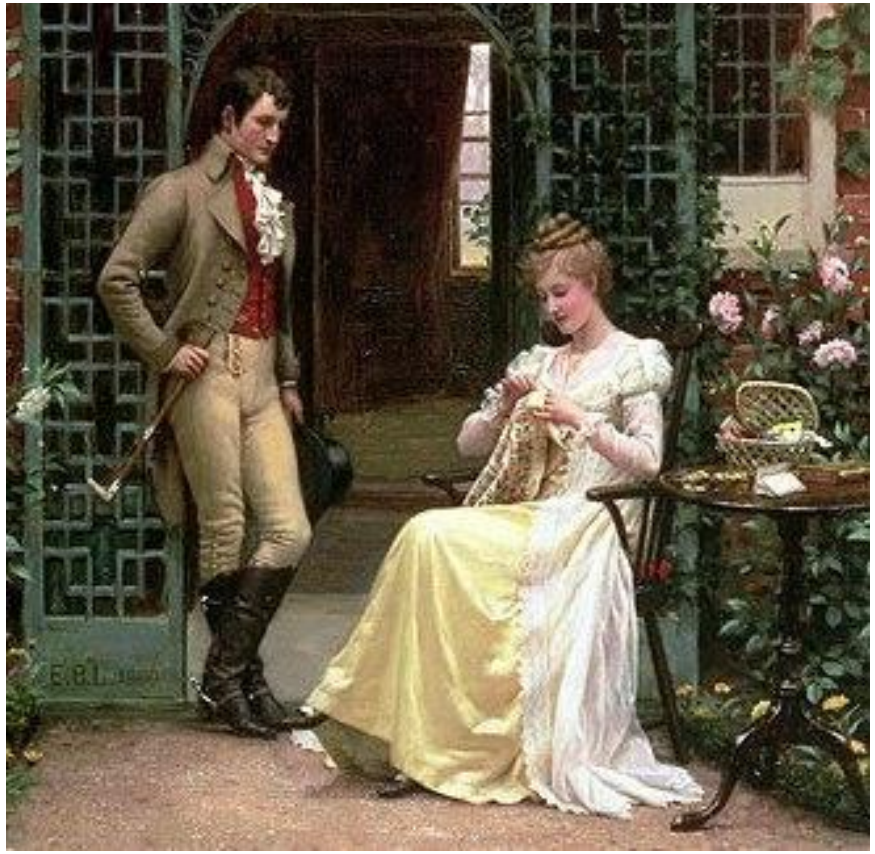
Human mate choice

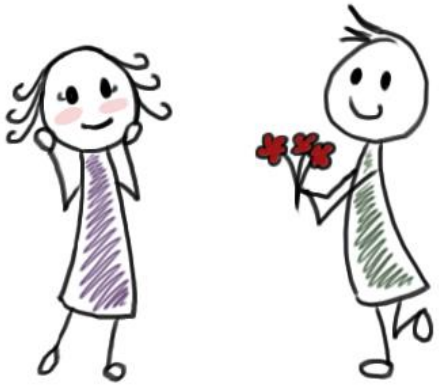




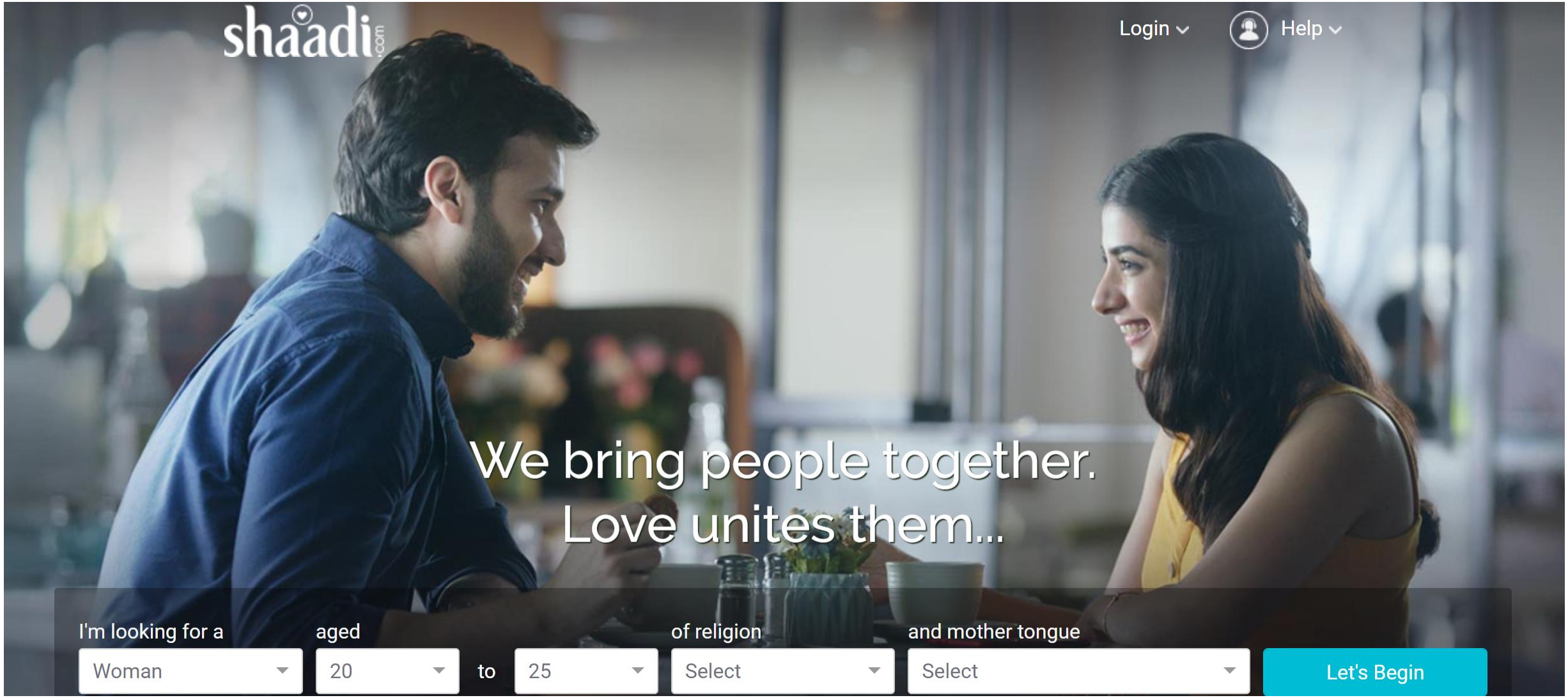
White teeth, a long and sharp nose, and big eyes are considered major beauty ideals by the Wodaabe. The males dress up and enter a beauty pageant where they perform elaborate chants and dances. The young girls watch and select the best as mates.

Human mate choice





Human mate choice – how do we choose?



The Peacock's Tale

Males display in groups – they form leks.

Males spread their tales when females are near.

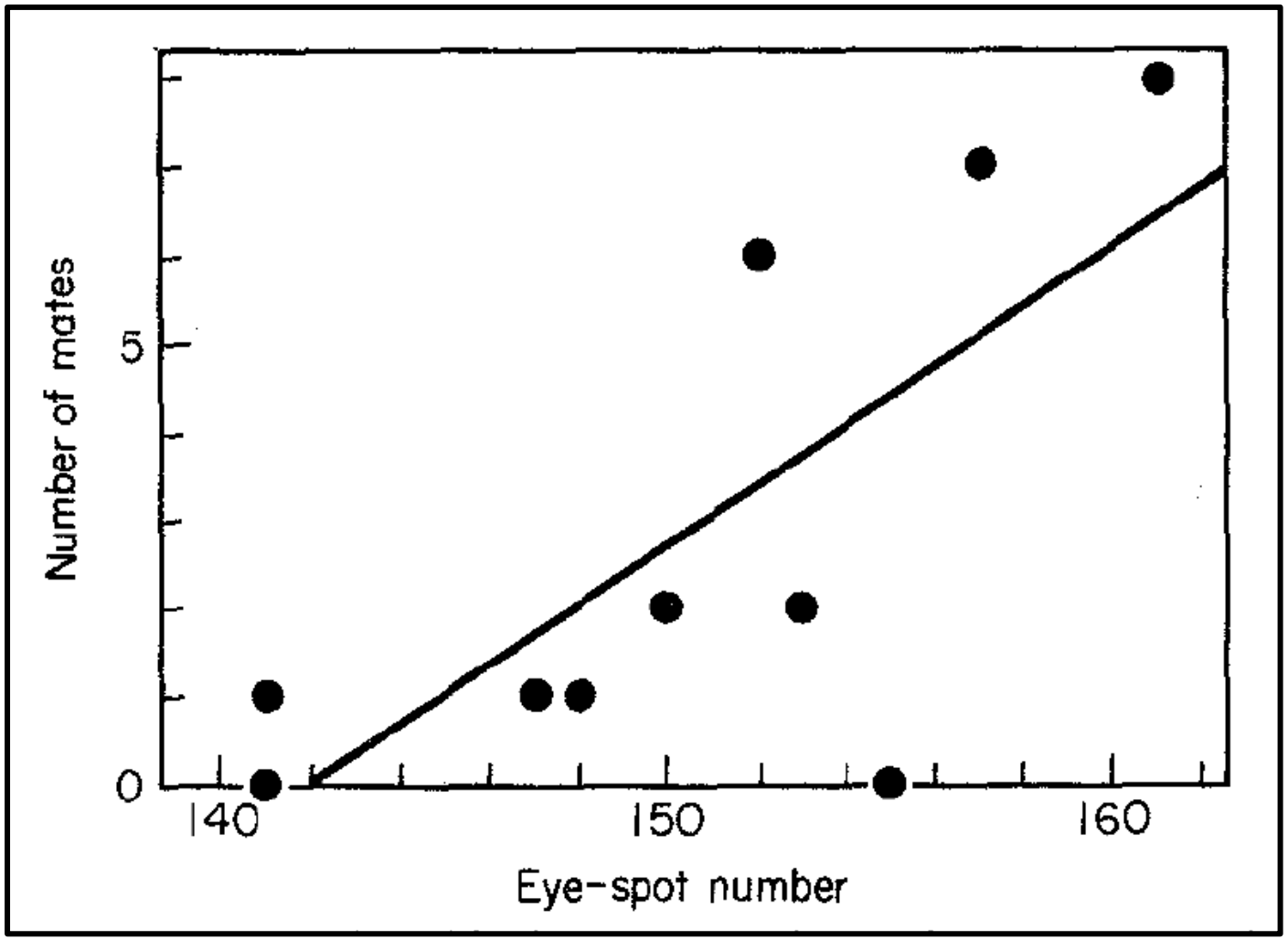
Males called out until females approached the lek.

In successful copulation attempts, females squatted in front of the chosen male and allowed it to mount.

Females visited more than one lek site. A female mated once a day.

Males attempted to disrupt the mating attempts of other males.

The Peacock's Tale

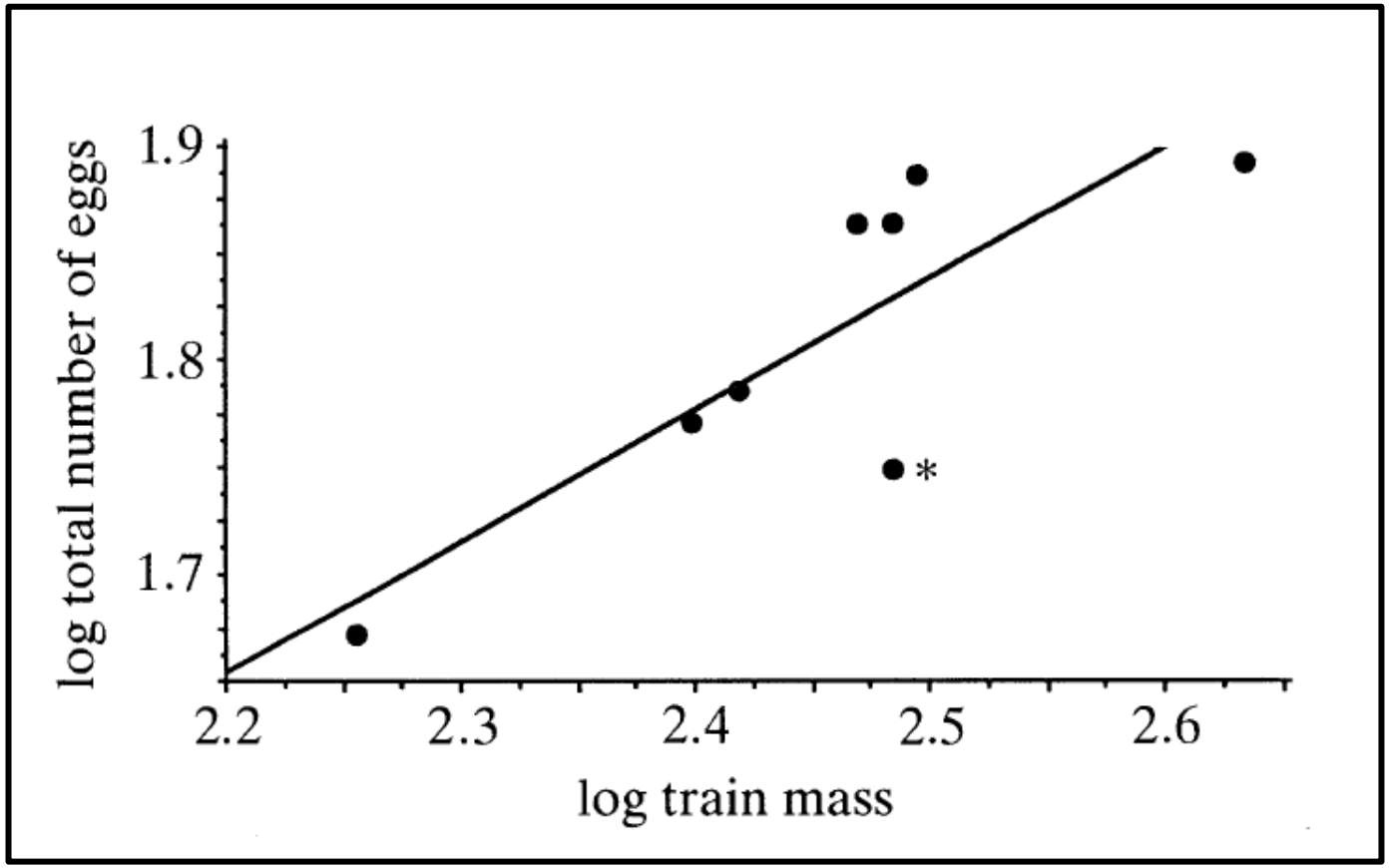


33 copulations observed.

The most successful male mated 12 times, with 8 different females.

The no. of mates obtained by a male was positively correlated with the no. of eyespots on its train.

The Peacock's Tale



The differential investment shown by females in egg production therefore results in males with elaborate trains fathering more chicks.

Male behaviour did not influence male mating success in the field.

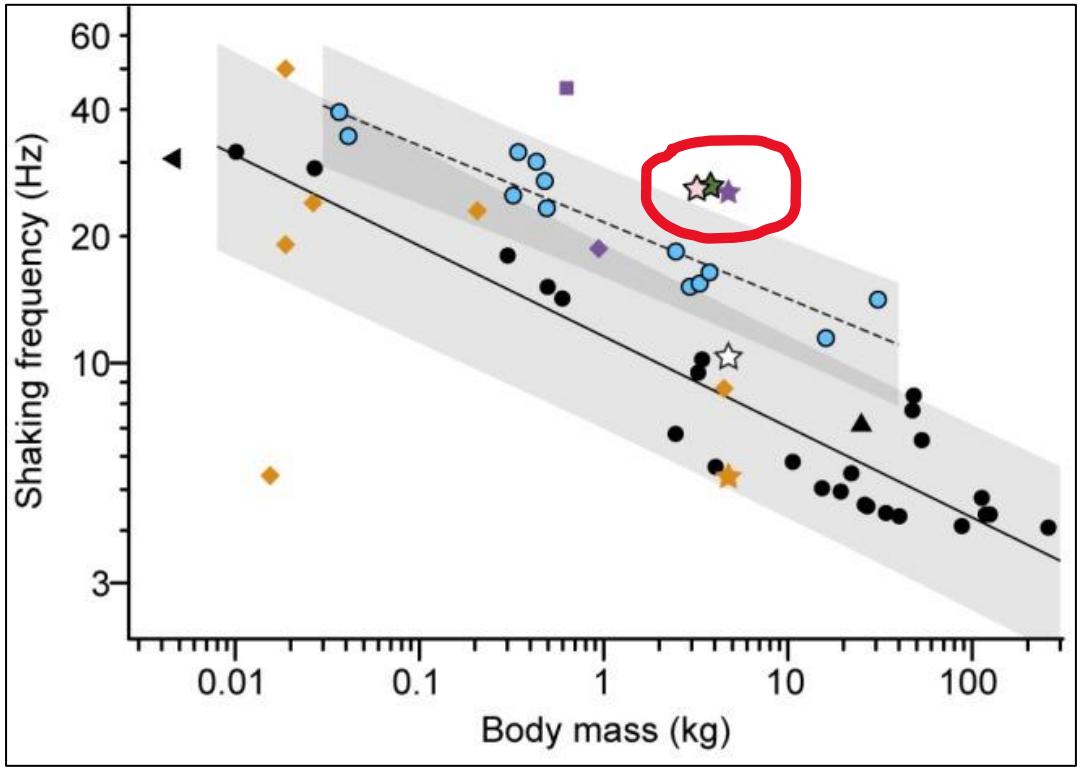
The Peacock's Tale

PLoS One. 2016; 11(4): e0152759.
Published online 2016 Apr 27. doi: 10.1371/journal.pone.0152759
PMCID: PMC484775
PMID: 2711938

Biomechanics of the Peacock's Display: How Feather Structure and Resonance Influence Multimodal Signaling

Roslyn Dakin,[1,*] Owen McCrossan,[2] James F. Hare,[3] Robert Montgomerie,[4] and Suzanne Amador Kane[5,*]

Daniel Osorio, Editor



The Peacock’s Tale

Our national bird

Research on the peacock’s tail happened in England and then the USA.

The Cost of Sex

The cost of sexual reproduction

Sexual reproduction does not necessarily always increase variation.

- Selection can build more variation than one would expect in a population in which genes are well mixed.
- Sex reduces variation by mixing together genes from different parents.
- This problem arises in the case of a single gene whenever heterozygotes are less fit, on average, than homozygotes, or have fitness close to that of the least-fit homozygote.
- The problem also arises in more complicated cases involving multiple genes whenever those genes interact in such a way that intermediate genotypes have lower fitness than the average of the extreme genotypes.

The cost of sexual reproduction

Producing variable offspring can hinder the evolution of sex.

- Even when sex does restore genetic variation, producing more variable offspring does not necessarily promote the evolution of sex.
- Parents that have survived to reproduce tend to have genomes that are fairly well adapted to their environments. Mixing two genomes through sex and genetic recombination tends to produce offspring that are less fit, simply because a mixture of genes from both parents has no guarantee of functioning as well as the parents' original gene sets. This reduction in fitness caused by sex and recombination is referred to as the "**recombination load**"

The cost of sexual reproduction

Sex can be too costly to evolve

- To reproduce sexually, an individual must take the time and energy to switch from mitosis to meiosis (this step is especially relevant in single-celled organisms); it must find a willing mate; and it must risk contracting sexually transmitted diseases.
- An individual that reproduces sexually passes only half of its genes to its offspring, whereas it would have transmitted 100% of its genes to progeny that were produced asexually – the **two-fold cost of sex**.
- Some organisms like aphids and daphnia reproduce asexually when resources are abundant and switch to sex only at the end of the season, when the potential for asexual reproduction is limited and when potential mates are more available.

Why Sex?

Sex is costly, but common.

Even though asexual lineages do arise, they rarely persist for long periods of evolutionary time.

Many species can reproduce both sexually and asexually, without the frequency of asexuality increasing and eliminating sexual reproduction altogether.

WHY?

The cost of sexual reproduction

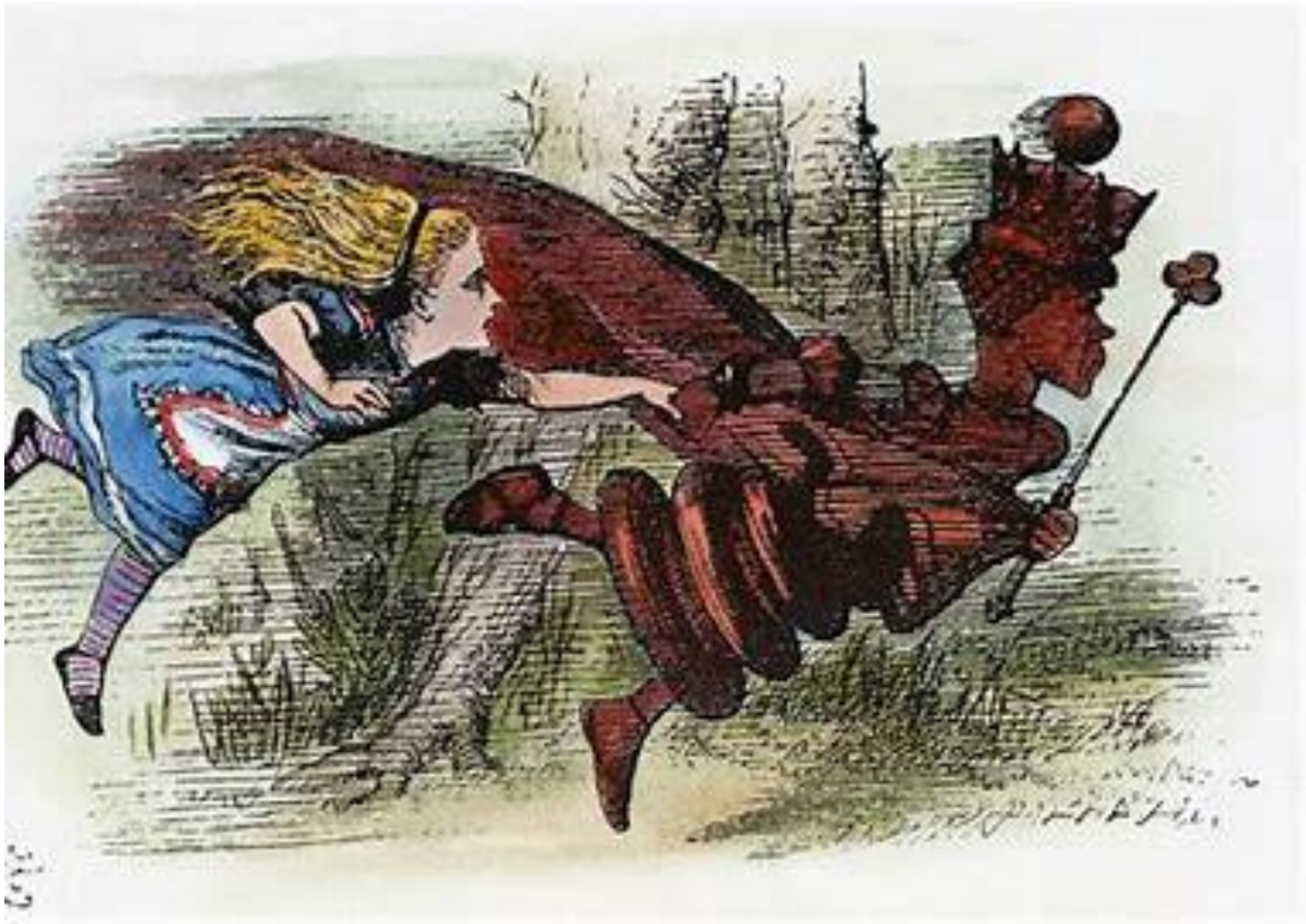
Sex evolves when selection changes over time

- When the genetic associations built up by past selection are no longer favourable, sex and recombination can improve the fitness of offspring, thereby turning the recombination load into an advantage.

- Thus, sex evolves when the environment changes rapidly.

- **Red Queen Hypothesis**

The Red Queen



"Now, here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!"

The Red Queen
Through the looking glass
Lewis Carroll

Leigh Van Valen (1973)

The cost of sexual reproduction

Sex Evolves When Selection Changes Over Space

Sex Evolves When Organisms Are Less Adapted to Their Environment

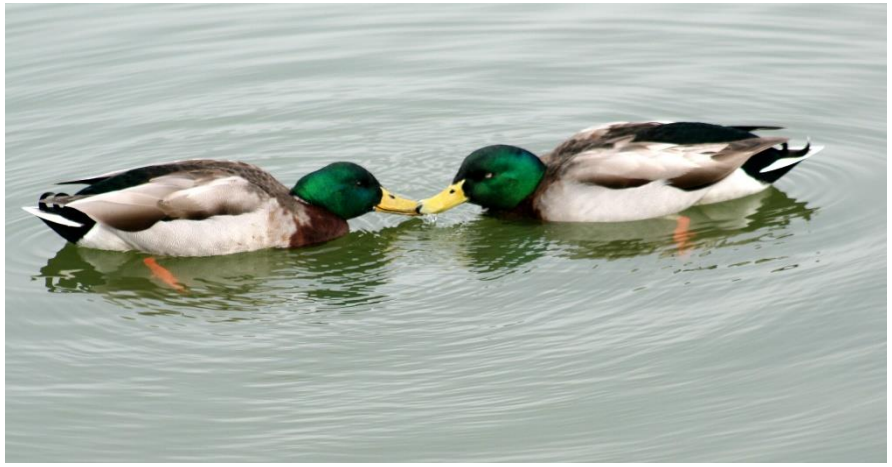
Sex Evolves When Populations Are Finite

Sex evolves due to indiscriminate sexual acts

Sex evolves due to sociality

Queer Animals

Homosexuality occurs across the animal kingdom, in hundreds of species



Why homosexuality?

- Lack of mates
- Practice
- Overt sexual activity
- Social bonding
- Population control
- Related advantages of the genes leading to homosexuality in relatives

Why homosexuality?

Research articles

A test of genetic models for the evolutionary maintenance of same-sex sexual behaviour

Jessica L. Hoskins, Michael G. Ritchie, and Nathan W. Bailey

Published: 22 June 2015 | https://doi.org/10.1098/rspb.2015.0429

Abstract

The evolutionary maintenance of same-sex sexual behaviour (SSB) has received increasing attention because it is perceived to be an evolutionary paradox. The genetic basis of SSB is almost wholly unknown in non-human animals, though this is key to understanding its persistence. Recent theoretical work has yielded broadly applicable predictions centred on two genetic models for SSB: overdominance and sexual antagonism. Using *Drosophila melanogaster*, we assayed natural genetic variation for

Males with a genetic makeup associated with high levels of SSB produced female offspring with higher fecundity. This suggests that genes associated with SSB could be persisting in the population because they confer a fitness advantage in females, despite being reproductively harmful to males.

Why homosexuality?

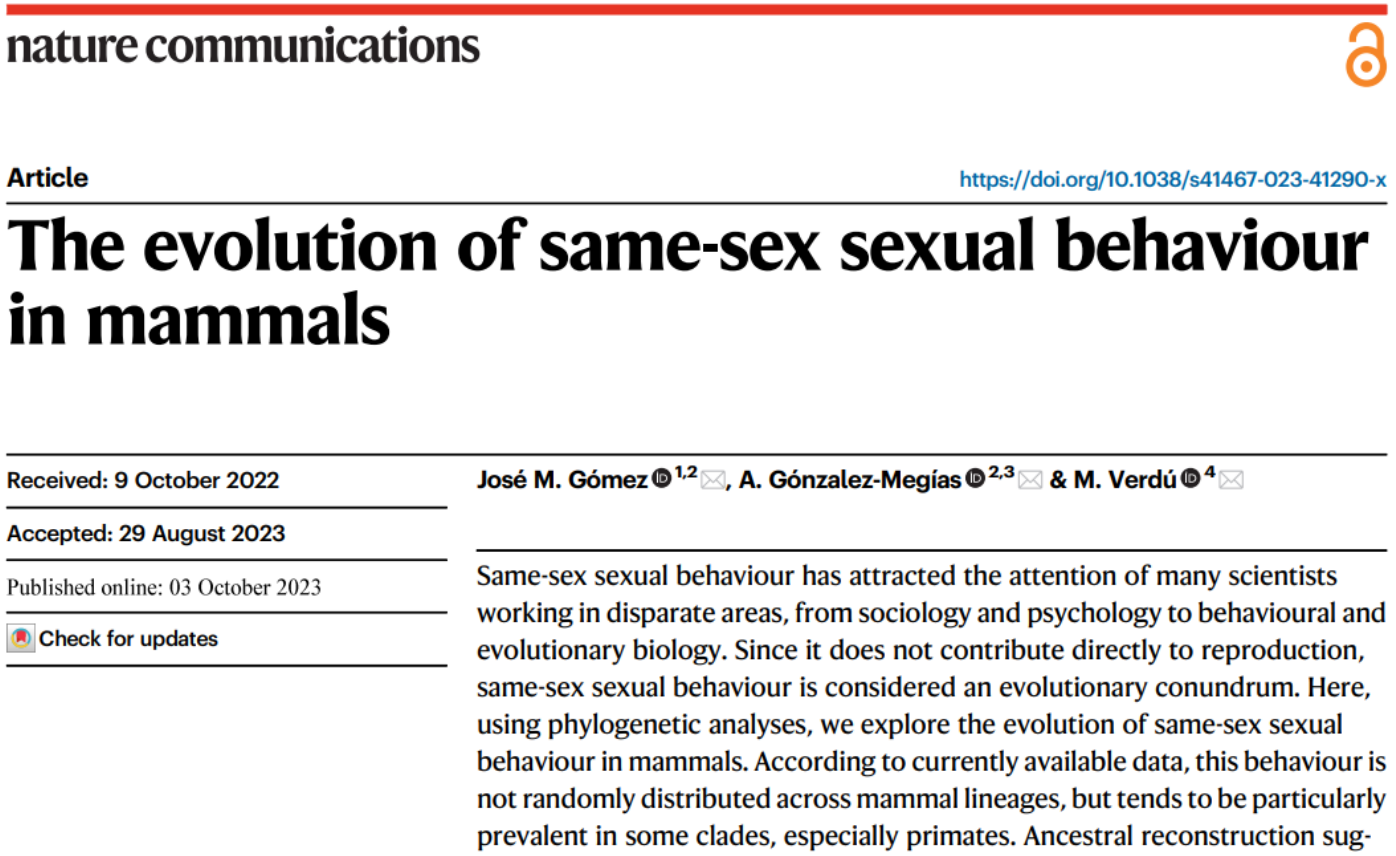
Long-term pairing of unrelated female Laysan albatross: cooperation may have arisen as a result of a skewed sex ratio in this species. 31% of Laysan albatross pairs on Oahu were female–female, and the overall sex ratio was 59% females as a result of female-biased immigration. Female–female pairs fledged fewer offspring than male–female pairs, but this was a better alternative than not breeding.

Why homosexuality?

51 species of primates (~10%), from lemurs to great apes, show same-sex sexual behaviour.

Over 500 species have been documented to show SSB (Gomez et al, 2023).

261 species were used in a phylogenetic analysis.



nature communications

Article

https://doi.org/10.1038/s41467-023-41290-x

The evolution of same-sex sexual behaviour in mammals

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Accepted: 29 August 2023

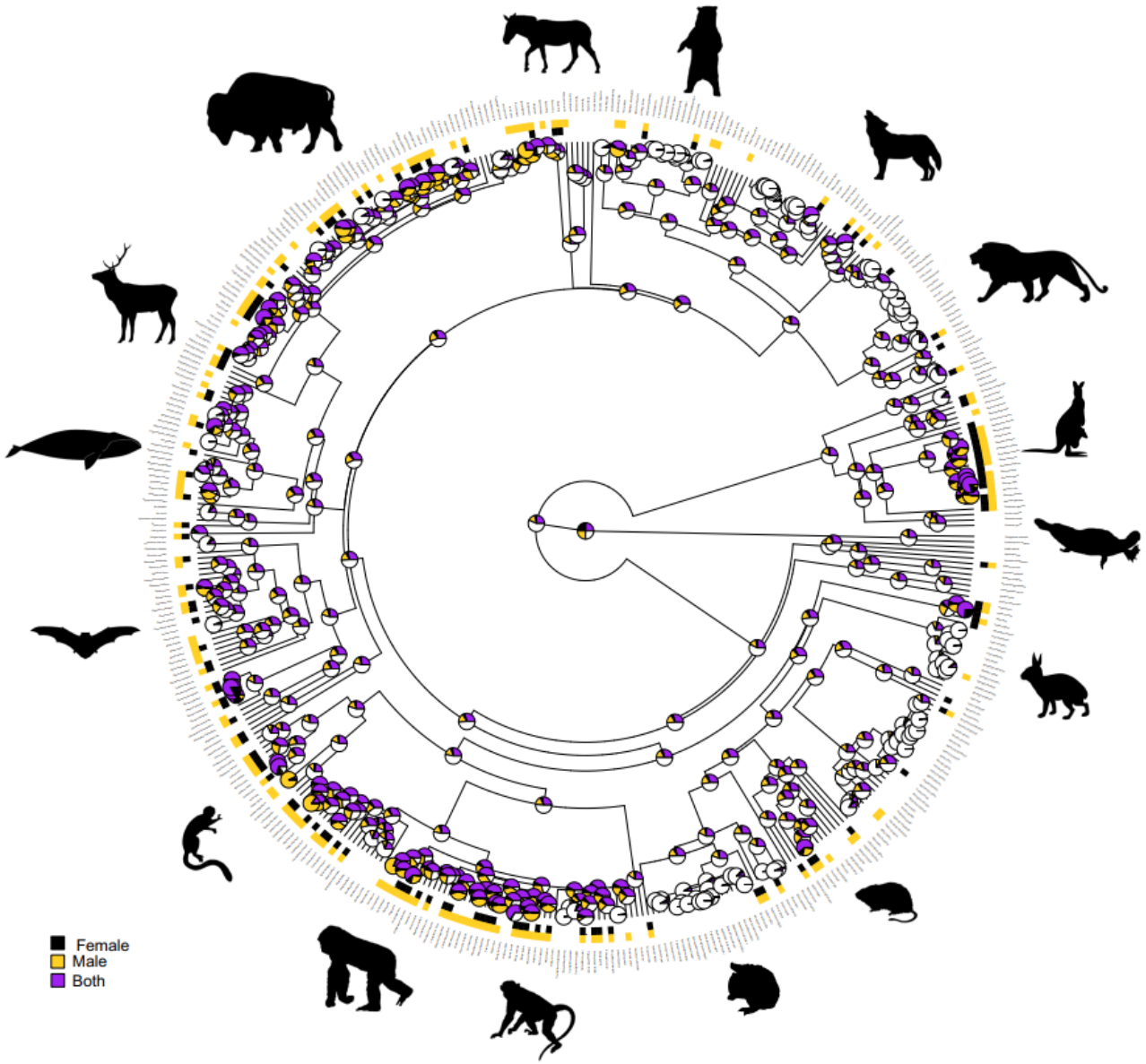
Published online: 03 October 2023

Check for updates

José M. Gómez [1,2], A. Gónzalez-Megías [2,3] & M. Verdú [4]

Same-sex sexual behaviour has attracted the attention of many scientists working in disparate areas, from sociology and psychology to behavioural and evolutionary biology. Since it does not contribute directly to reproduction, same-sex sexual behaviour is considered an evolutionary conundrum. Here, using phylogenetic analyses, we explore the evolution of same-sex sexual behaviour in mammals. According to currently available data, this behaviour is not randomly distributed across mammal lineages, but tends to be particularly prevalent in some clades, especially primates. Ancestral reconstruction sug-

Why homosexuality?



Multiple origins of SSB across mammalian species.

50% of mammalian families demonstrate SSB.

Correlation between SSB and sociality.

This study finds support for the evolution of SSB due to its role in increasing social bonding.