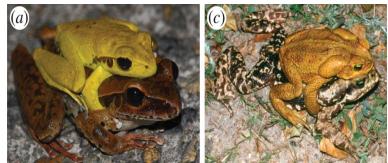

Sexual Selection

Introduction to Evolution and Scientific Inquiry
Dr. Spielman; spielman@rowan.edu

Sexual dimorphism



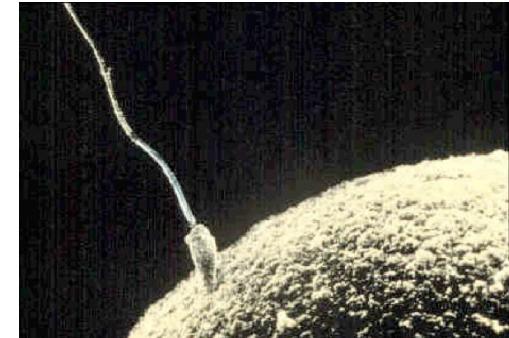
What kinds of species do NOT have sexual dimorphism?



Parental investment

- Time, resources, etc. that benefits ones' offspring **at a cost** to parents' ability to invest in other components of fitness
- Examples in humans:
 - Child rearing
 - Pregnancy
 - **Anisogamy:** Sperm vs. egg production have different physiological costs

→ Females have higher gamete investment compared to males!



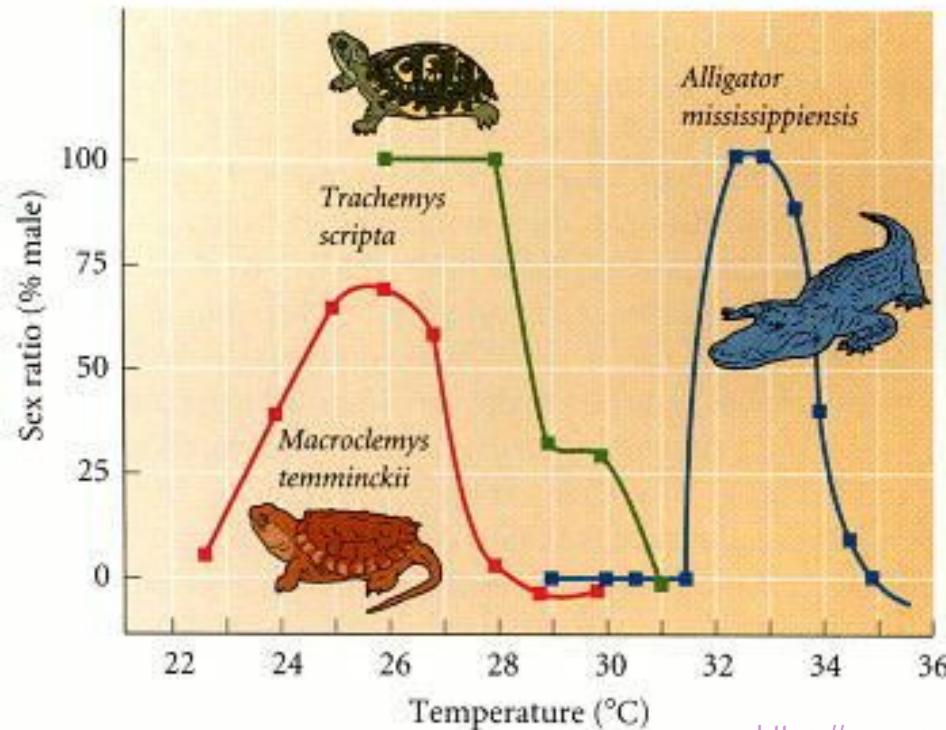
<http://www.pdimages.com/03709.html-ssi>



Biological sex is defined by gamete investment

- Females are the sex with **the higher gamete (and often parental) investment**
 - In humans, females are the **homogametic sex (XX)**
 - In birds, females are the **heterogametic sex (ZW)**
- Males are the sex with **the lower gamete (and often parental) investment**
 - In humans, males are the **heterogametic sex (XY)**
 - In birds, males are the **homogametic sex (ZZ)**
 -

A brief aside: Sex is not always genetically determined!



Parental Investment Theory

Developed by R. L. Trivers (major contributor to early animal behavior research*):

- The sex with the **higher** parental investment will be **choosy** when selecting a mate
- The sex with the **lower** parental investment will have to **compete** for a mate

Role reversals

- Pipefishes and seahorses
 - Males do all parental care
 - Females make eggs faster than males can brood them
 - Male brooders become **limiting resource**
 - **THEREFORE**, Males should be “choosy”



- Jacana and Phalarope birds
 - Male cryptic, female showy



Sexual Selection

A “special case” of natural selection that acts on an individual’s ability to successfully copulate and reproduce

Two broad flavors:

- Male-male competition (intrasexual selection)
- Female choice (intersexual selection)
 - Note: these would be reversed intra/inter for “role reversal” species!!

Darwin says...

“Sexual selection...depends, not on a struggle for existence, but on a struggle between the males for possession of the females; the result is not death to the unsuccessful competitor, but few or no offspring.”

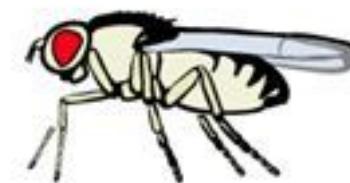
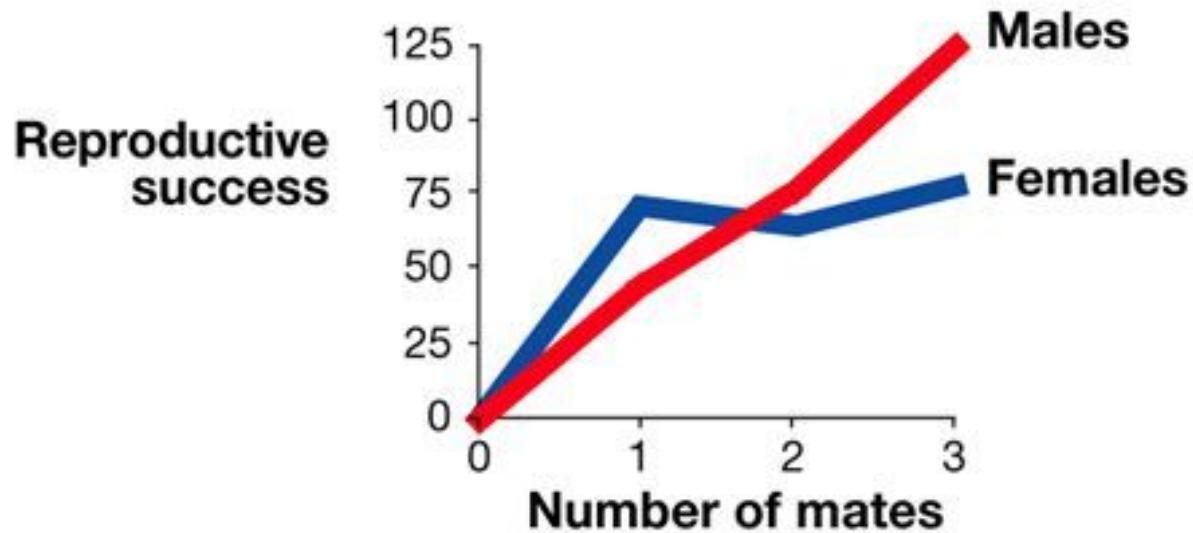
- The Origin of the Species, ch. 4

Bateman's experiments on sexual selection (1948)

Experiment with *Drosophila* (fruit flies) to study sex differences in *reproductive success*:

- Individuals allowed to mate multiple times in a population
- Reproductive success measured as number of offspring

Bateman's results



Bateman AJ (1948). Intra-sexual selection in *Drosophila*. *Heredity* 2: 349–368.

Male-male competition

"[M]ale alligators have been described as fighting, bellowing, and whirling round, like Indians in a wardance, for the possession of the females; male salmons have been seen fighting all day long; male stag-beetles often bear wounds from the huge mandibles of other males."

- The Origin of the Species, ch. 4

Intrasexual selection: Male-male competition

- Body size differences
- “Weapons”, horns, etc.
- Sperm competition



<https://www.youtube.com/watch?v=Gy0yuOSUEs>

<https://twitter.com/NatureisScary/status/1158922457371303936>

Female choice

“The rock-thrush of Guiana, birds of paradise, and some others, congregate; and successive males display their gorgeous plumage and perform strange antics before the females, which standing by as spectators, at last choose the most attractive partner.”

- The Origin of the Species, ch. 4

Intersexual selection: Female choice

- The coolest version is **the lek (lekking)**
 - Males gather in a round and display to female(s)
 - <https://www.youtube.com/watch?v=cLnbiTkj1TQ&t=7s>
- Wingmen:
 - <https://www.youtube.com/watch?v=1zxJPQIFFI>
 - *How does this differ from other examples of male-male competition?*

Some species offer “nuptial gifts”

- A mating food packet! Very common in insects (and spiders..)
 - <https://www.youtube.com/watch?v=Yb9L873qgCg>
- Adaptive value of gift giving
 - Entices female to mate in the first place
 - Can protect against female cannibalism (!)
 - Maximizes duration of copulation - keep going until meal is over



Study: Does gift-giving increase fitness?

"The nuptial prey gift in the spider *Pisaura mirabilis* has been suggested to function as a male protection against sexual cannibalism during courtship and mating. This hypothesis...was tested in a laboratory experiment with sexually inexperienced males and females."

Means (SD) and ranges of weight of the nuptial prey gift (field cricket *Gryllus bimaculatus*)

Group	Treatment	Weight (mg)		
		Mean	Range	n
0	No gift	—	—	20
S	Small gift	4.4 (1.4)	2.3–7.7	20
M	Medium gift	13.5 (1.6)	10.4–15.7	21
L	Large gift	25.4 (2.0)	22.7–29.1	21

Experimental results

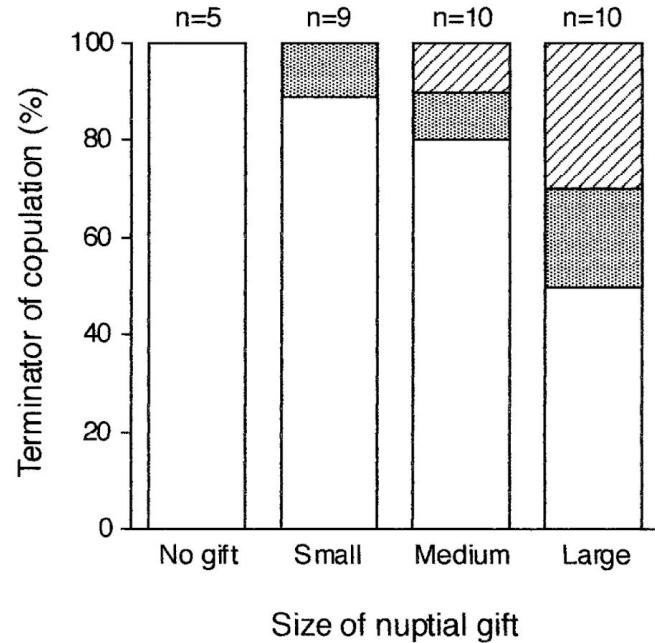


Figure 1

Copulations terminated by the female (open bars) and by the male (shaded bars) in relation to size of the nuptial gift. In four cases (striped bars) it was impossible to decide who ended the copulation (n = number of continuously observed copulations).

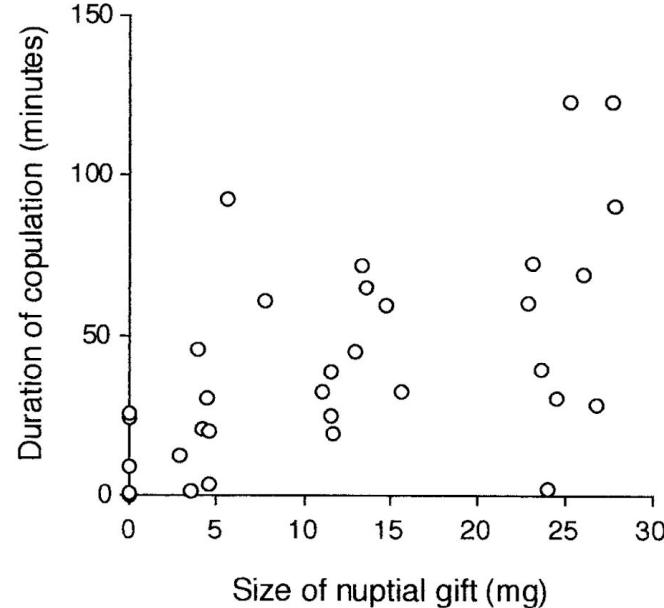
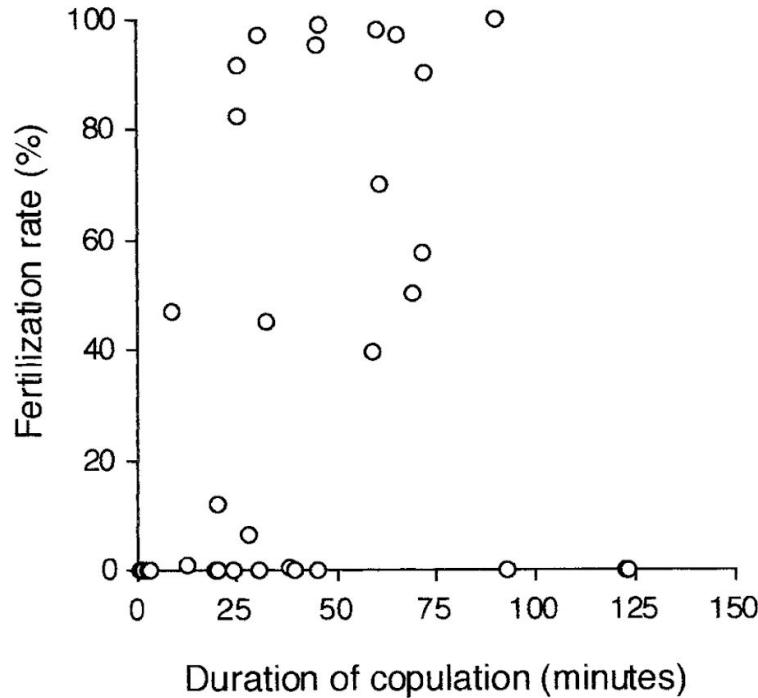


Figure 2

Relationship between size of the nuptial gift and duration of copulation (Spearman correlation, $r_s = .63$, $p = .0003$, $n = 34$). Only accomplished copulations are included.

Is the response variable ("duration of copulation") a meaningful measurement?



What's good for reproduction can be bad for survival



<https://www.youtube.com/watch?v=UoUL-jGgU1I>

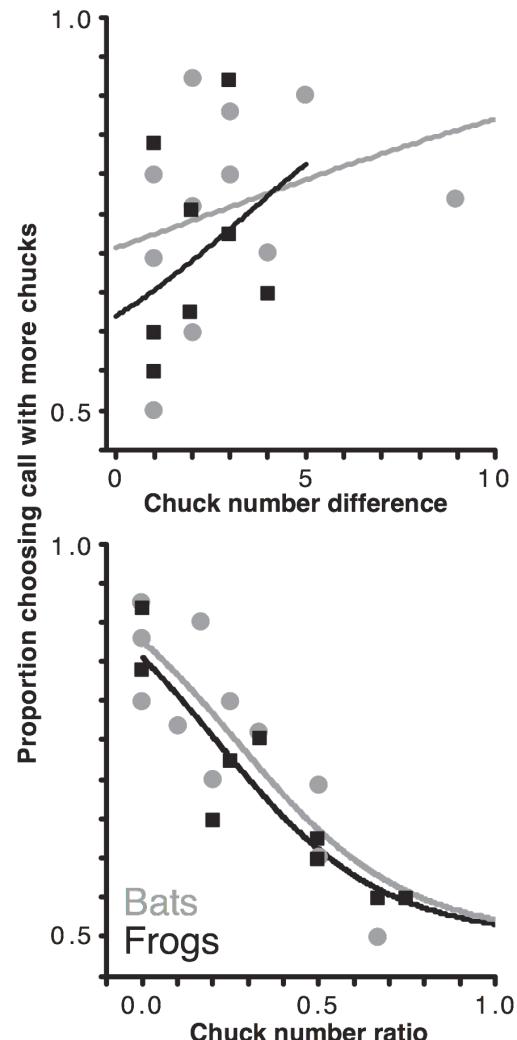


More chucks = more mates

...but also...

More chucks = more bats eat you.

10.1126/science.1205623



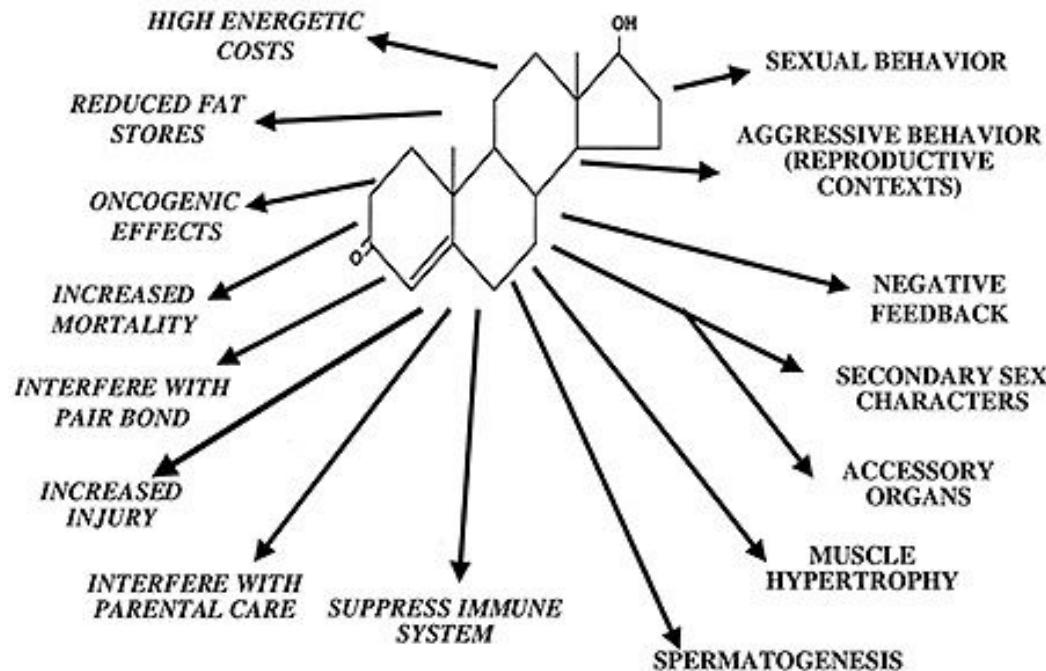
Sexually selected traits often come with *costs*

- Male ornamentation is energetically and physiologically expensive = **less fit per natural selection**
- Male ornamentation increases probability of mating = **more fit per sexual selection**

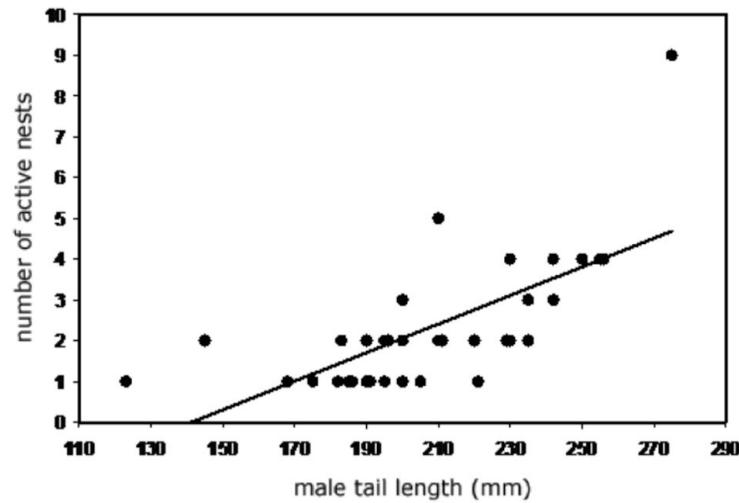
→ **Trade-off** between reproductive success and survival

A key tradeoff for males: testosterone

TESTOSTERONE



Do females prefer long tails in males?



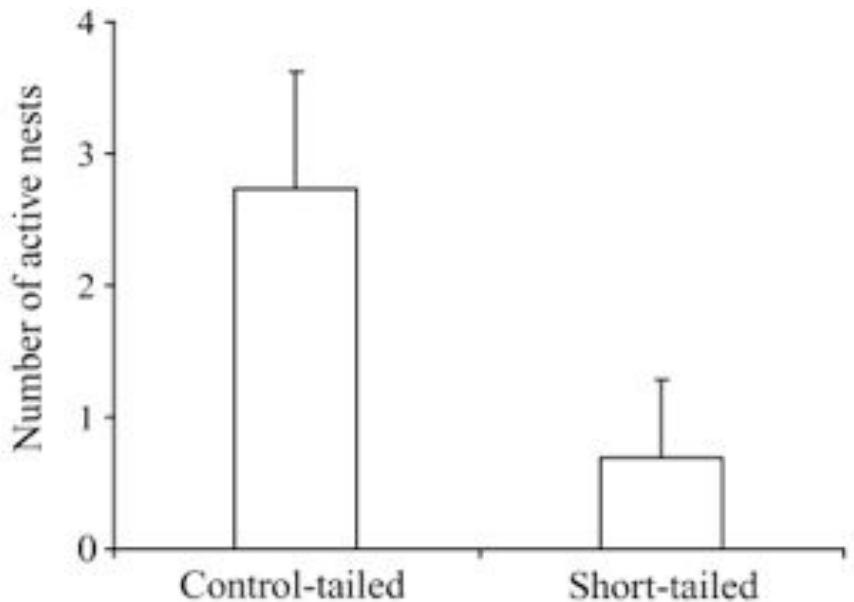
Widowbird male



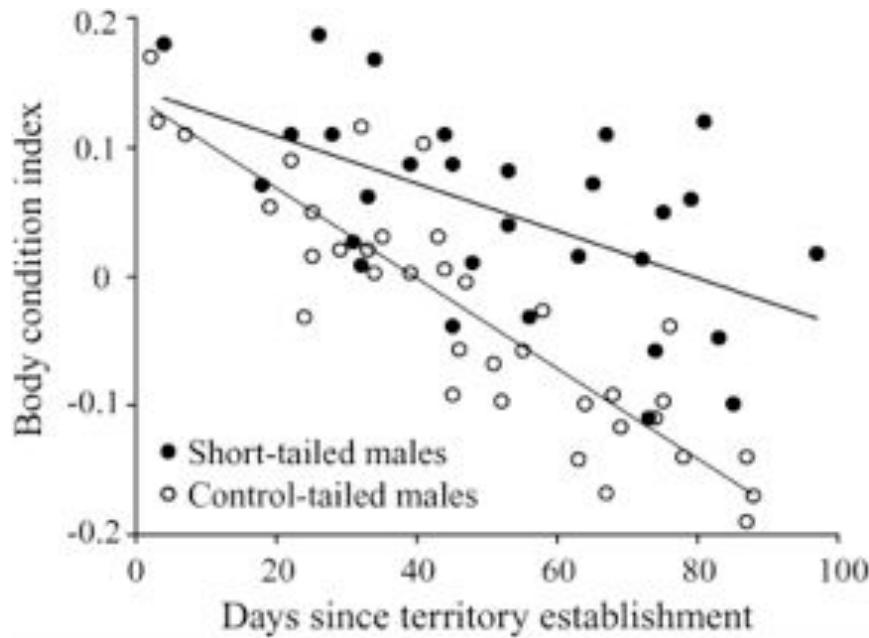
Widowbird female

- Experiment to test *female choice*:
 - Two groups of widowbird males, one with regular tails and one with shortened (cut) tails.
 - Measured mating success in each group

Results



Control (long tails - unaltered)
have more reproductive success



But, long tails have WORSE bodily
condition (survival disadvantage)

The “good genes” hypothesis might explain the evolution of costly male traits and female choice

- If a male can sustain costly exaggerated traits, it must have excellent fitness stemming from “**good genes**”
- Costly features are selected for since they “come with” other benefits
 - Reduced parasite load, for example
- If a female chooses an exaggerated male, your children will have increased fitness, and exaggerated trait will be passed on

Honest signaling/communication

If costly traits *actually* do convey high genetic quality, then the signal is honest.

If costly traits *do not* convey high genetic quality, the signal is dishonest (an example of communication cheating)

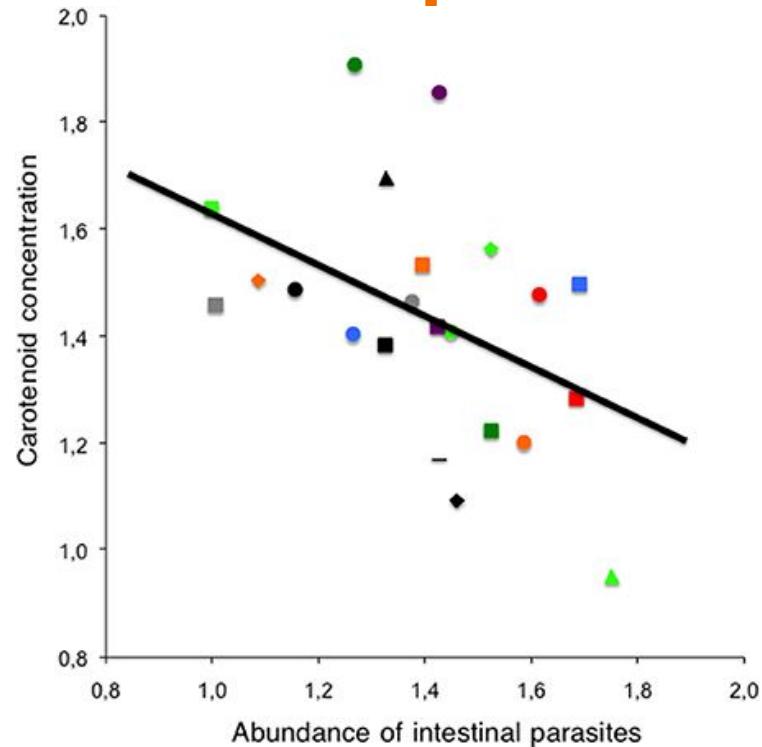
The good genes hypothesis depends on honest signaling

Example of honest signaling

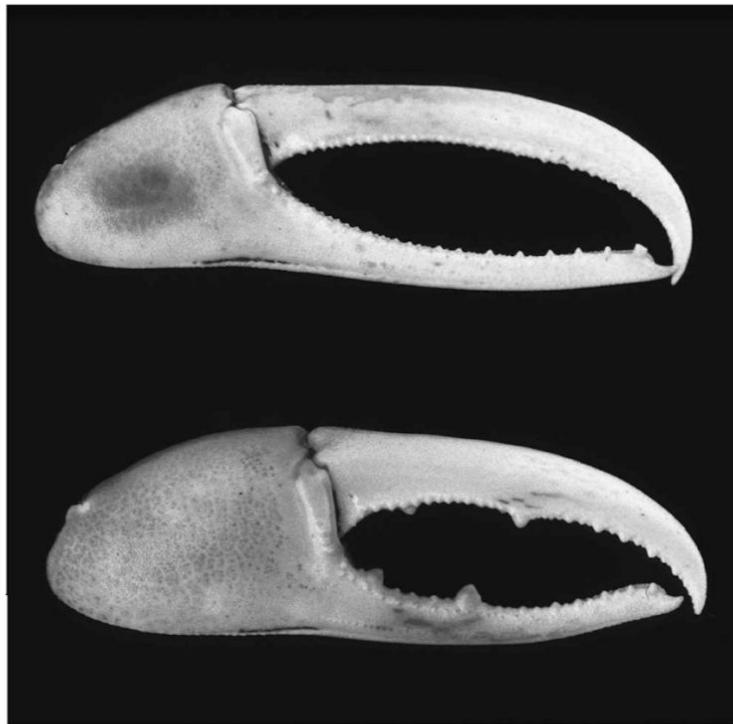


"Carotenoids"

Higher carotenoid consumption is negatively correlated with parasite load across bird species



An hypothesized example of dishonest signaling



<https://royalsocietypublishing.org/doi/abs/10.1098/rspb.2000.1062>