comic by
Rosemary Mosco
(Bird and Moon)

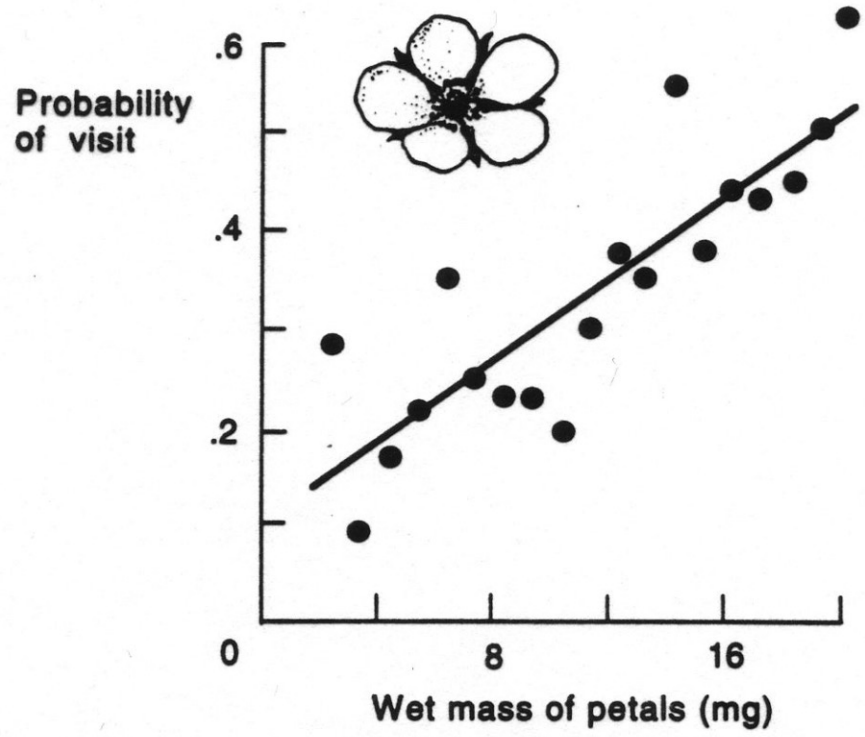
Reminder: essay due tomorrow

Learning goals for today

- Know adaptive and non-adaptive explanations for how mate choice preferences evolve. How would you distinguish between these competing explanations in real life?

Sexual selection is:

A nonrandom association between a trait and mating success



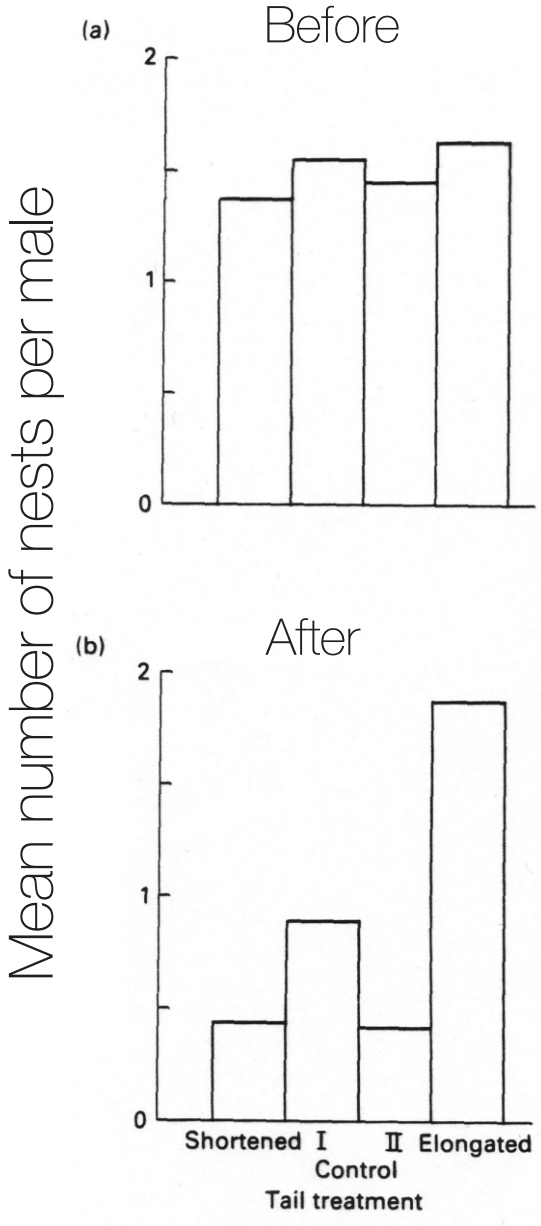
Two mechanisms of sexual selection

1) male-male competition / female-female competition
2) mate choice (female choice of males / male choice of females)

2 kinds of mate choice

1) based directly on resources that are provided
2) based on ornaments / displays

Example of nonrandom association between a display trait and mating success



"Lichtenstein, who was a good observer, assured Rudolphi that the female widow-bird disowns the male when robbed of the long tail-feathers with which he is ornamented during the breeding season"
-Darwin, The Descent of Man

http://www.astrocape.org.za/entrip/?C=S%3BO=A

How could female preference for costly traits evolve?

http://www.astrocape.org.za/entrip/?C=S%3BO=A

5) Evolution of preference based on ornaments

What benefits can the female gain?

A) NONE! Preference is nonadaptive, arbitrary

- Fisher runaway process
- Latent preferences / sensory exploitation

B) SOME! Preference is adaptive

- Direct natural selection on the preference
- Indirect natural selection (”good genes”)

http://tv.yahoo.com/show/39817/photos/10

The Fisher process

1. Imagine a population with an initial bias in the female population: a slight, genetically-based tendency to prefer males having a slightly elaborated trait, such as a long tail. Imagine also some genetically-based variation in males in tail length.

2. Assume no natural selection on this preference. Females preferring long tails produce no more nor fewer offspring than females who do not prefer long tails.

3. Males with longer tails will then experience slightly higher mating success.

4. The sons of such matings will inherit long tails and also the genes causing a preference for longer tails. This establishes a nonrandom association in the population (a genetic correlation) between genes for tails and preferences.

5. Because of the bias in favor of longer tails, these sons will have higher than average mating success, which indirectly favors the genes for the preference.

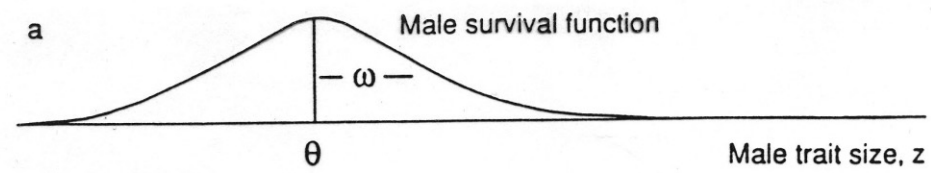
6. This self-reinforcing process favors ever-longer tails and preferences for longer tails until the mating advantage to males is counteracted by the costs of the trait. -> reaches equilibrium

The Fisher process

Totally bizarre to think about, but could explain how a trait could evolve to a degree that seriously impairs male survival without selection favoring it.

Illustration of the Fisher process at equilibrium

Males survive best that have a moderate trait value



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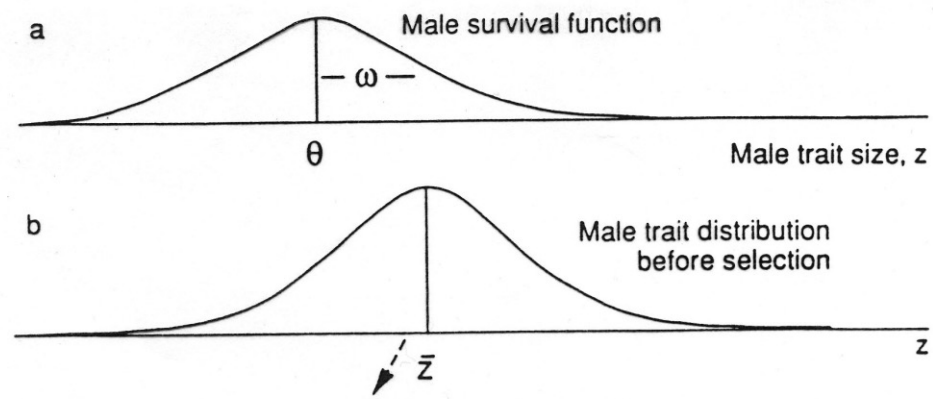
The equilibrium trait value in the male is greater than this



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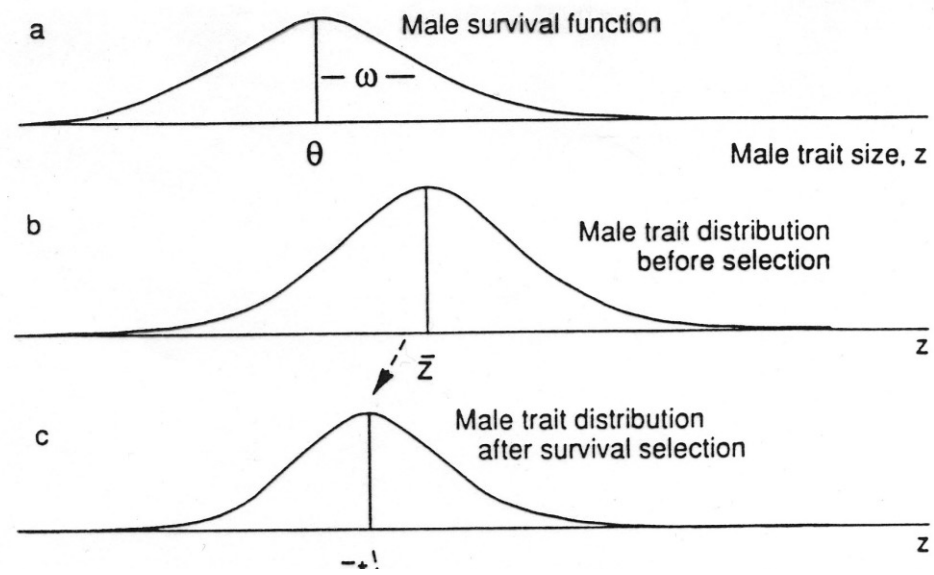
Survival selection favors the moderate male each generation



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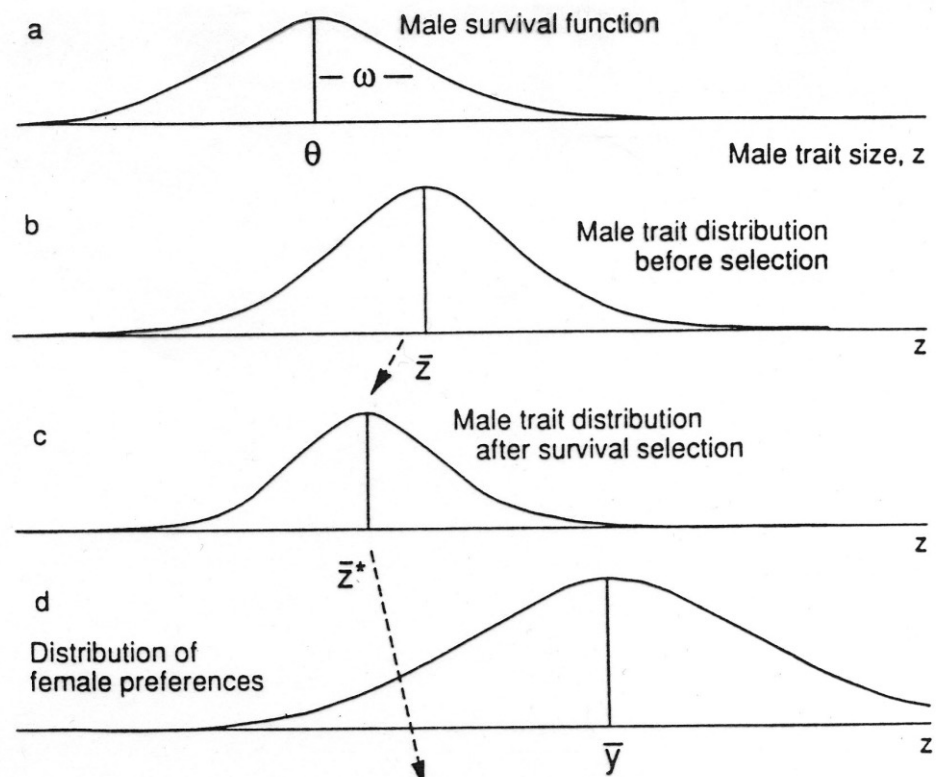
Males with a large trait value are most attractive to females



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Males survive best that have a moderate trait value

The equilibrium trait value in the male is greater than this

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Males with a large trait value are most attractive to females

The mating advantage of the large trait value offsets the survival disadvantage, which maintains the male mean above the survival optimum

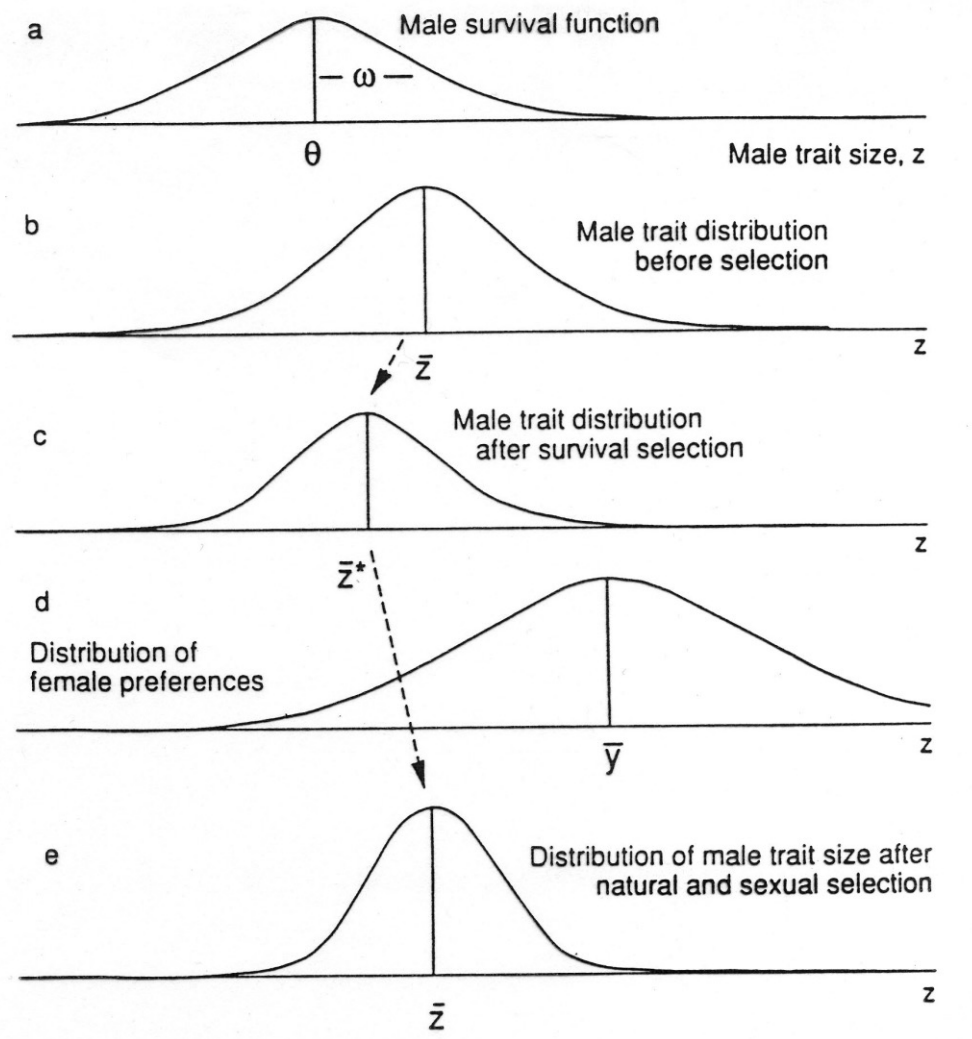
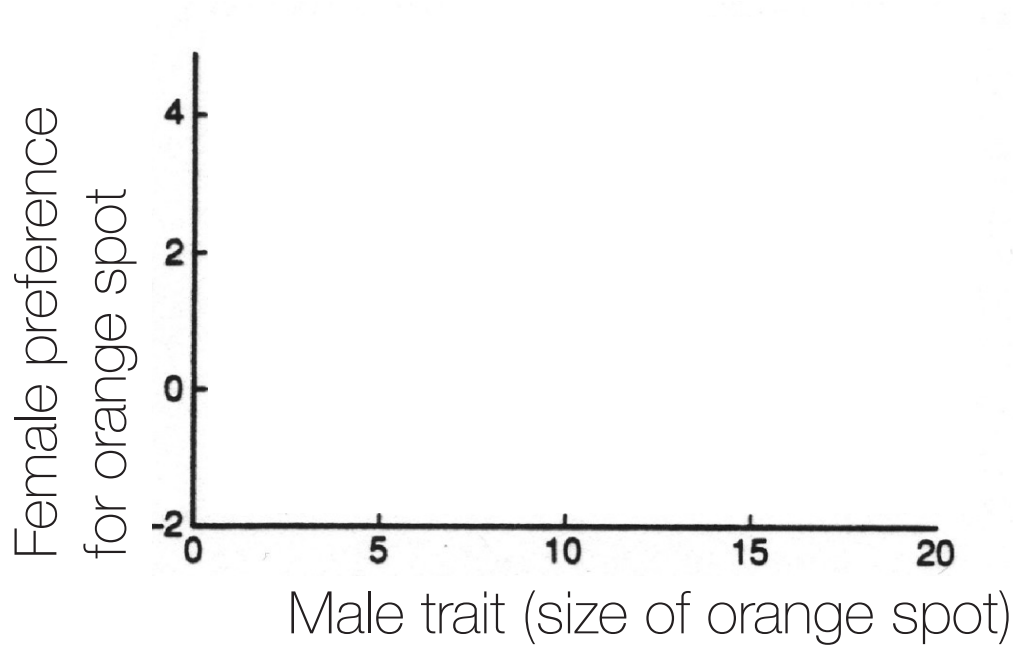


Figure 2.3.1 Graphic representation of the maintenance of an equilibrium size of the male trait by a balance between natural and sexual selection in Landes (1981) polygenic model of the Fisher process. For explanation, see text. (Modified from Maynard Smith 1982)

Evidence for Fisher runaway process?

http://www.practicalfishkeeping.co.uk/pfk/pages/item.php?news=889



Evidence for Fisher runaway process?

Male trait and female preference often evolve in tandem among populations

This is a prediction of Fisher's hypothesis (although other hypotheses make the same prediction)

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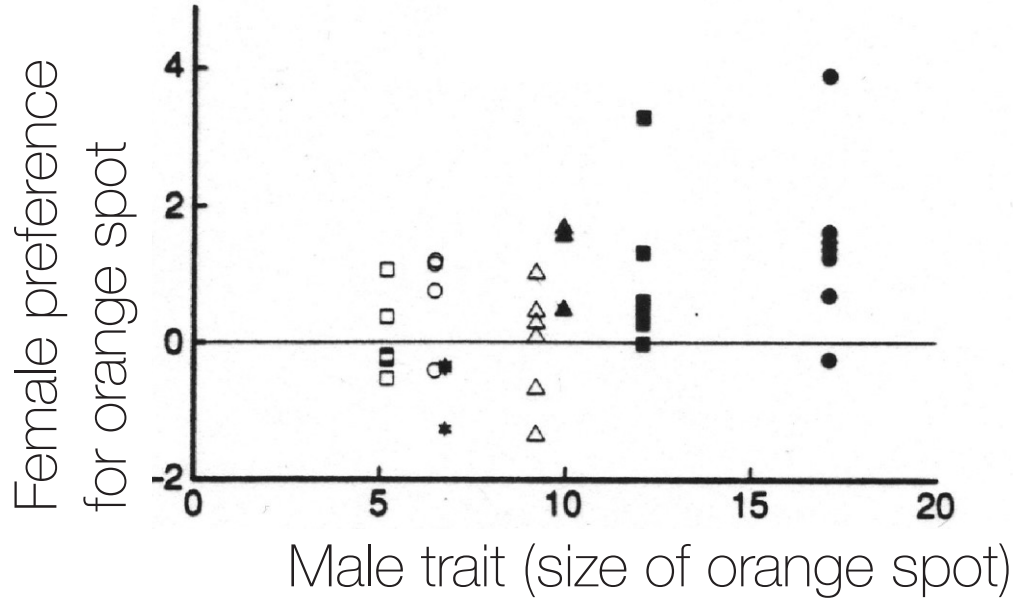


Sensory exploitation hypothesis

Females have a sensory system that is shaped by natural selection

Could be attracted to a male trait that does not exist (yet)

Aka prexisting bias

Mutation that produces a rudimentary version of this male display trait would then be favored

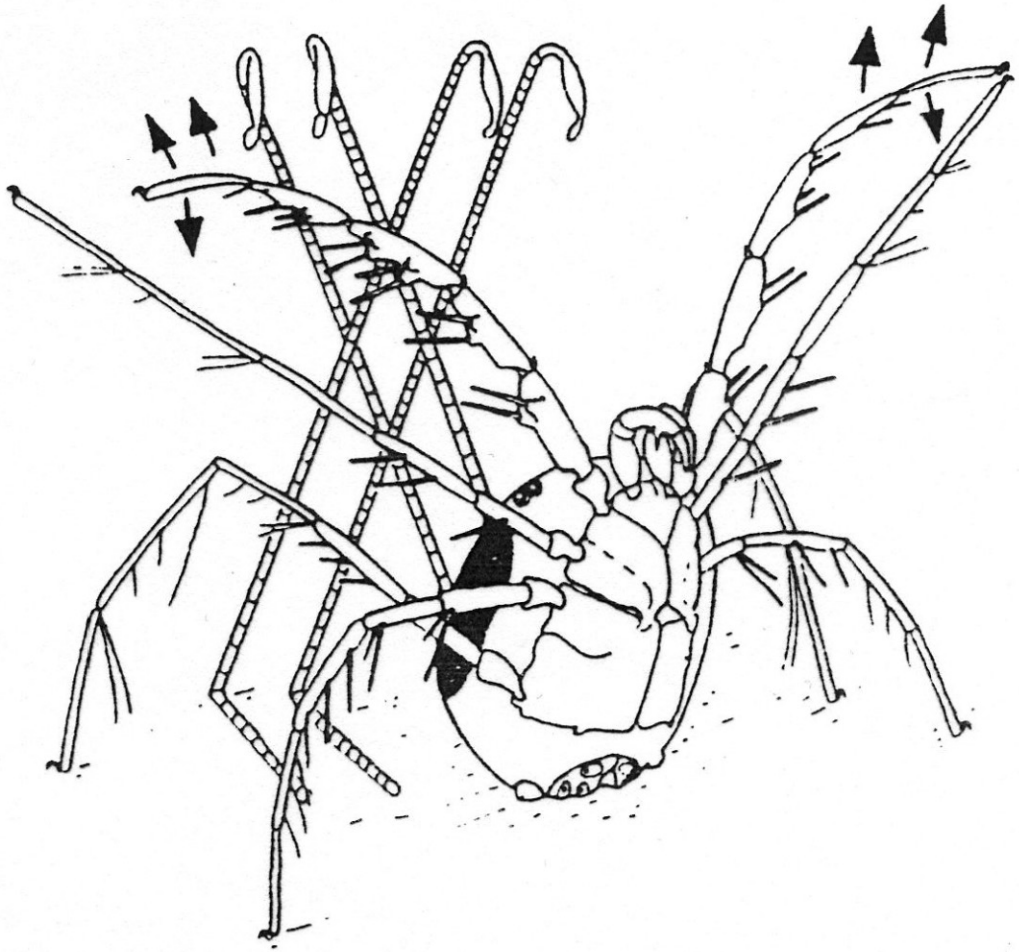
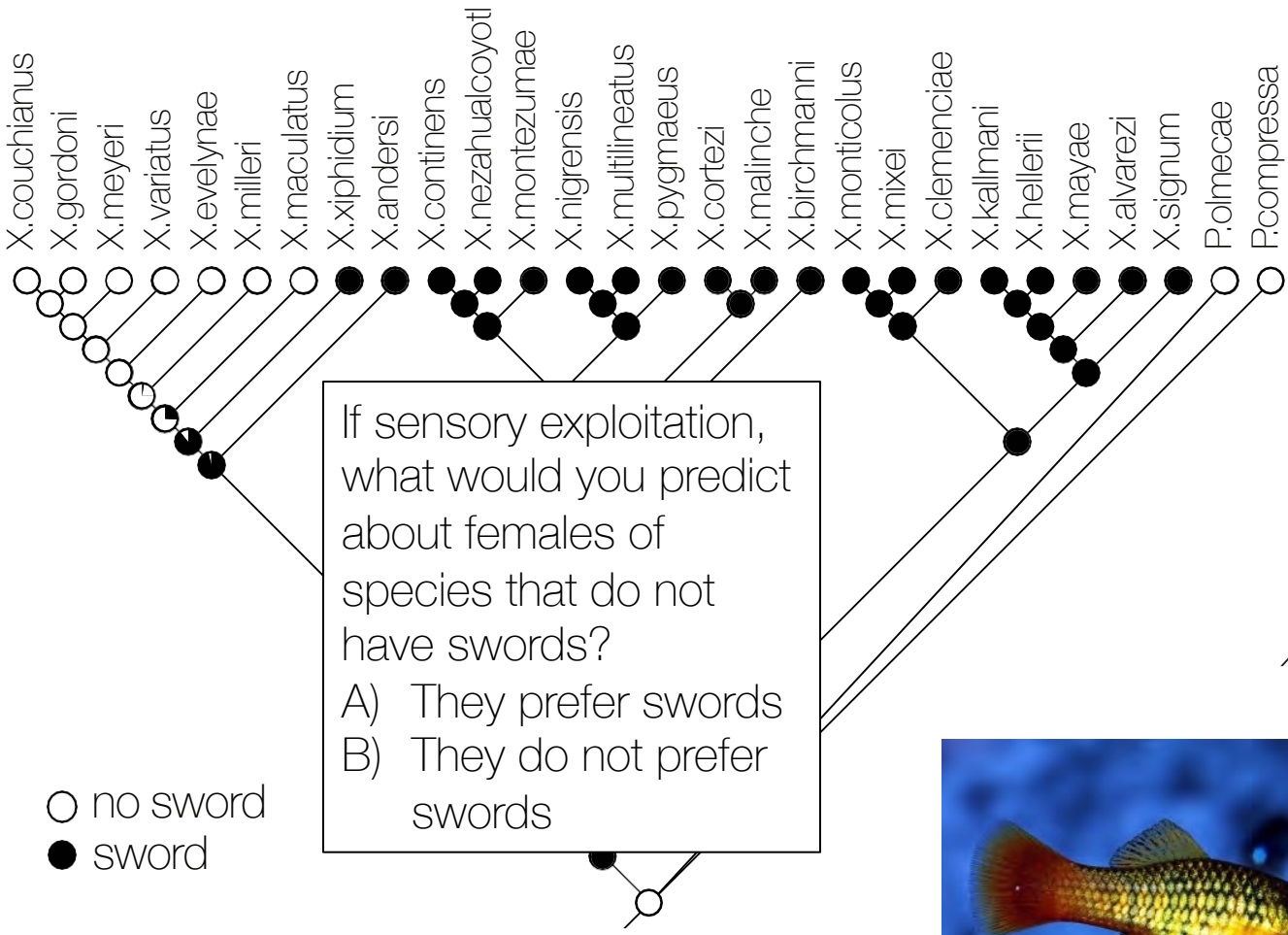


Figure 2. Male *Unionicola* ('brown-eye' sp.) in front of a newly deposited group of spermatophores; arrows indicate trembling motion of legs.

http://www.flickr.com/photos/70259473@N00/875110682/

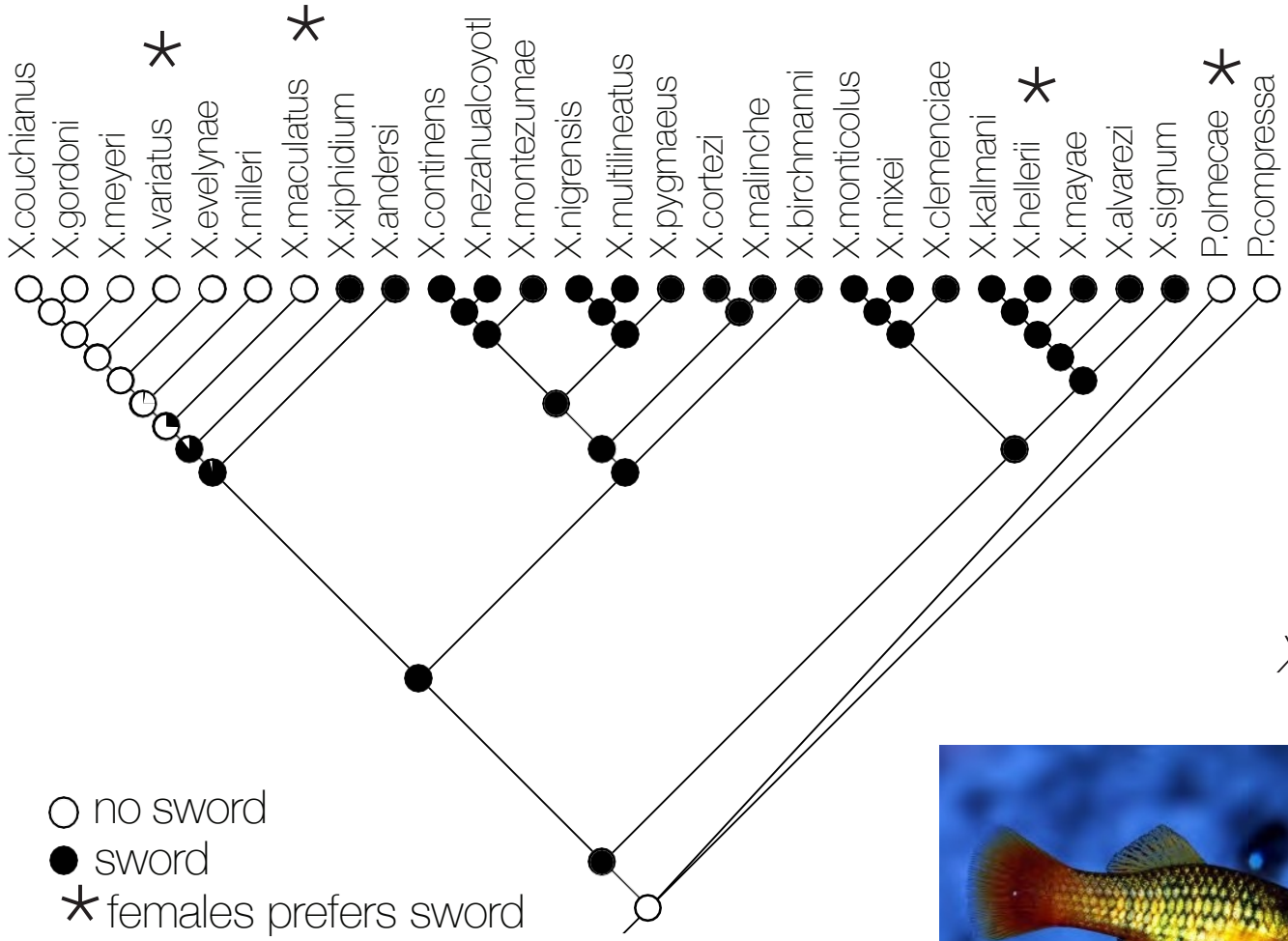


Priapella

Xiphophorus

Basolo (2005) *Proc. Roy. Soc. Lond. B. Biol. Sci*
Kang et al. (2013) *BMC Evolutionary Biology*

Female preference for swords in swordless species



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5) Evolution of preference based on ornaments

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Assumptions of hypotheses of direct vs indirect advantage

Direct:

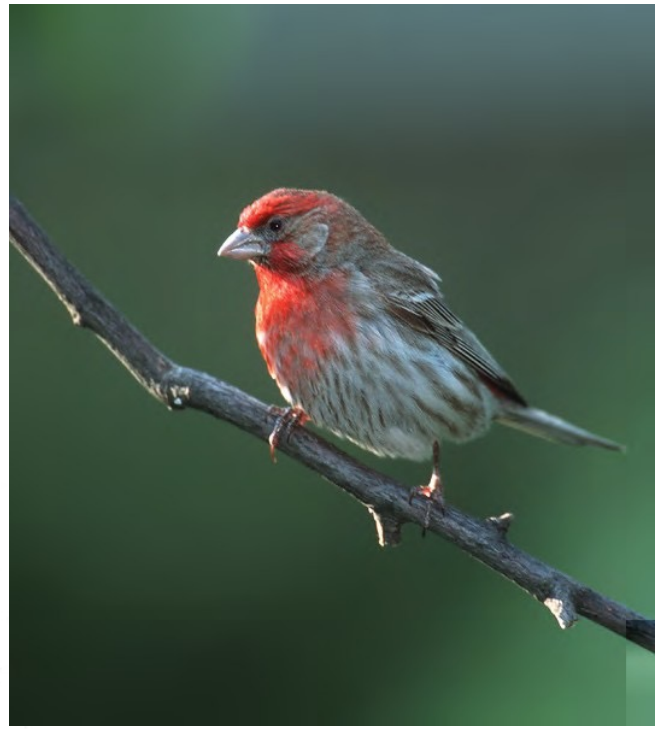
- Males vary in their “quality” or “condition”.
- Males vary in a secondary sexual trait preferred by females.
- Degree of male ornamentation and male quality/condition are positively correlated (“honest indicator”, expected to evolve only if male trait is costly).
- Females who choose males having higher ornamentation obtain direct benefits (higher survival, more & better conditioned offspring) via his higher than average quality (fewer STDs, better paternal care).

Indirect:

- Males vary in their “quality” or “condition”.
- Variation in male quality is heritable (“good genes”).
- Males vary in a secondary sexual trait preferred by females
- Degree of male ornamentation and male quality/condition are positively correlated (“honest indicator”, expected to evolve only if male trait is costly).
- Females who choose males having higher ornamentation obtain indirect benefits (offspring inherit good genes, and so have higher survival and reproductive success)

Is this evidence for:

A) Direct advantage only
B) Indirect advantage only
C) Direct and indirect advantage



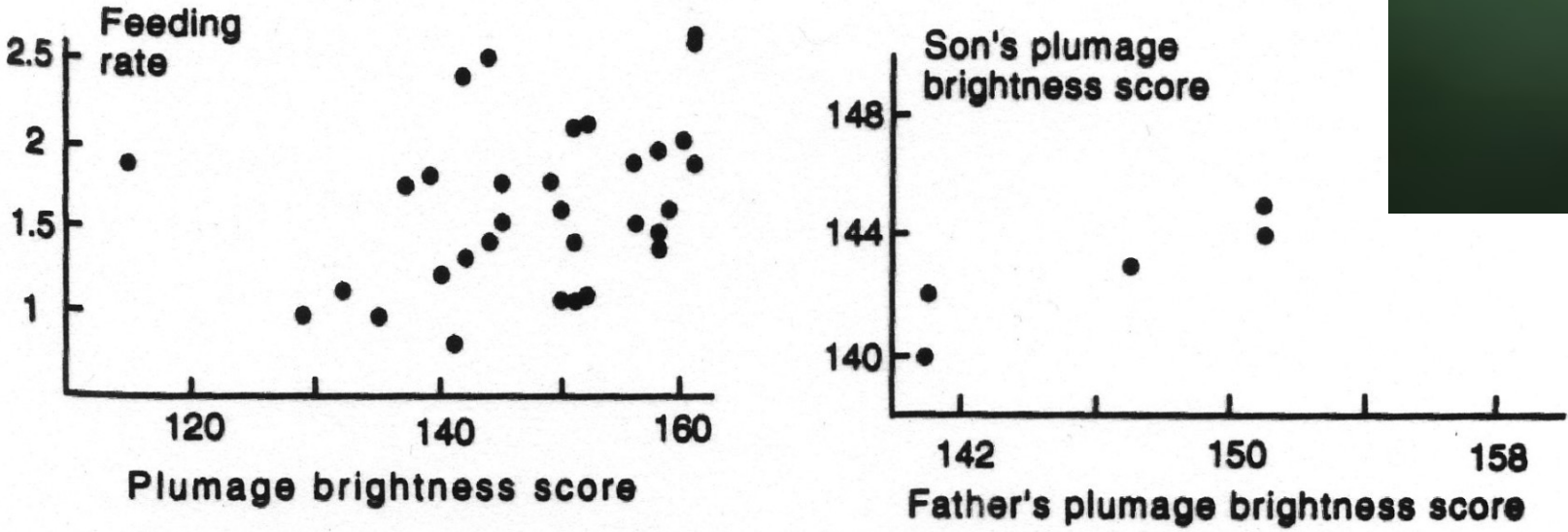
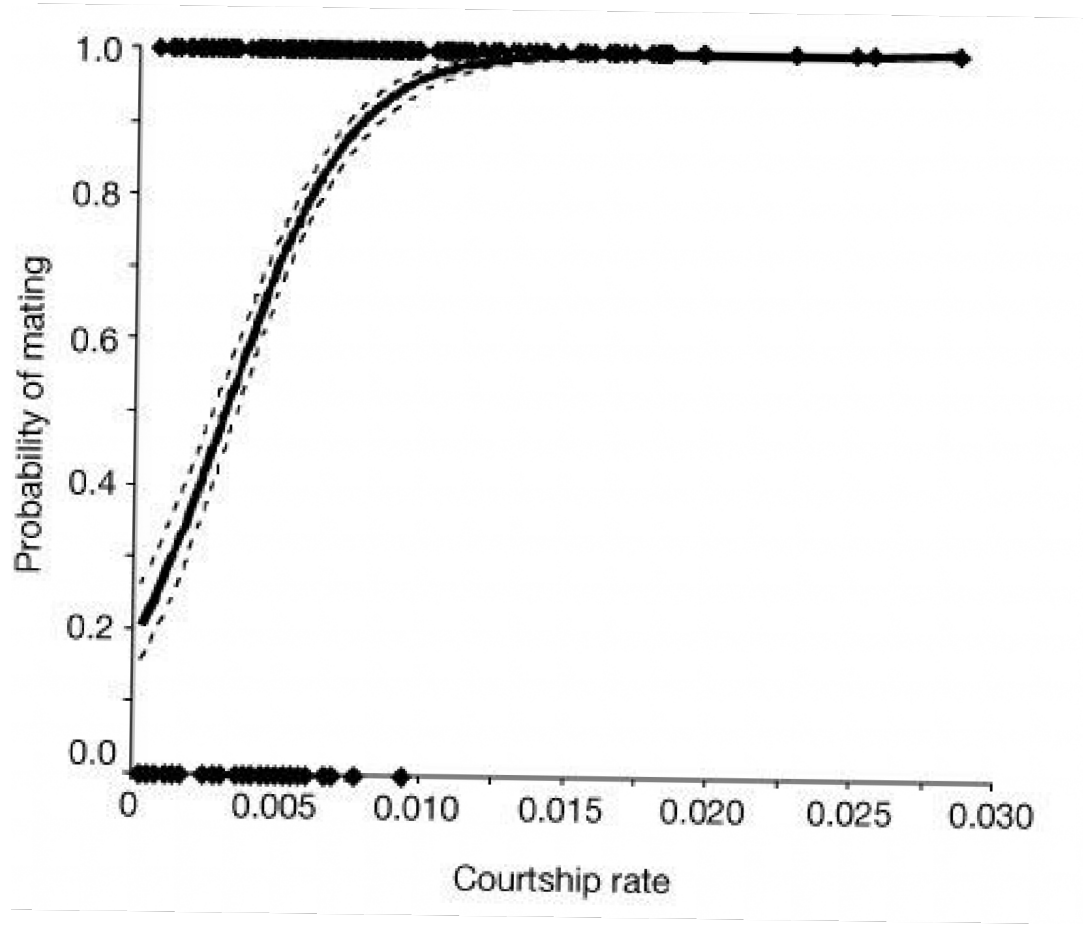


Figure 13.6.1 *Left*: The rate of chick feeding by male house finches *Carpodacus mexicanus* increases with male plumage brightness. *Right*: The plumage brightness of one-year-old males is correlated with the brightness of the father. (After Hill 1991)

Evidence for an indirect advantage of female preference

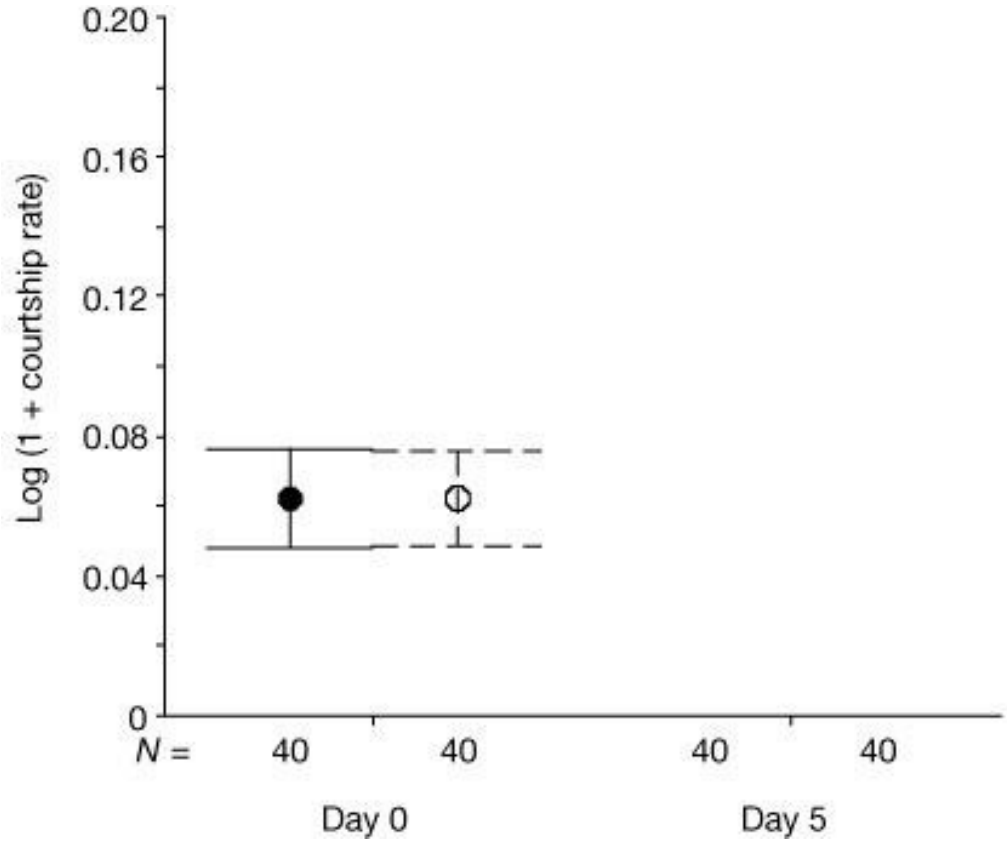
Males of the species court by tapping females at her back using head and forelegs.

Mating success increases with courtship rate, and so the trait is “preferred” by females.



Kotiaho et al (2001) Nature

What do you expect if degree of male display trait and male condition are positively correlated ("honest indicator")?

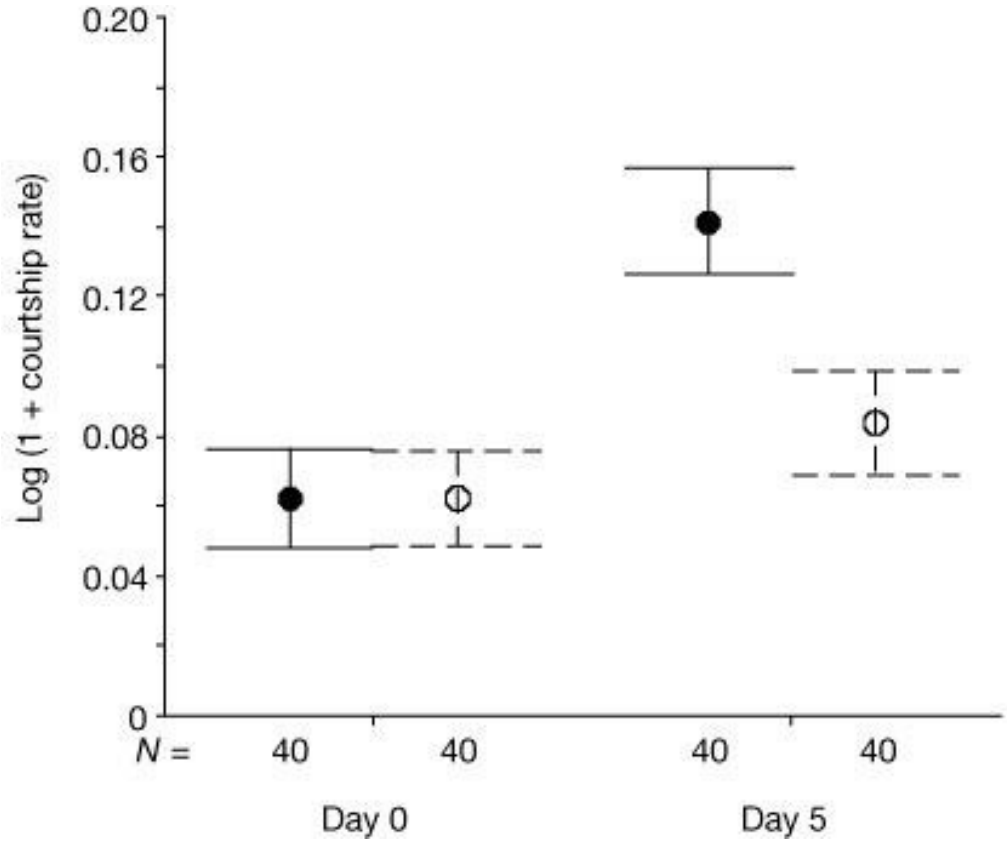


Left, mean ± s.e. of courtship rate per minute (log + 1 transformed); right, the same after five days of manipulation of food availability. Solid symbols, constant food treatment; open symbols, no food treatment.

Kotiaho et al (2001) Nature

http://gallery.photo.net/photo/7077136-md.jpg

What do you expect if degree of male display trait and male condition are positively correlated ("honest indicator")?



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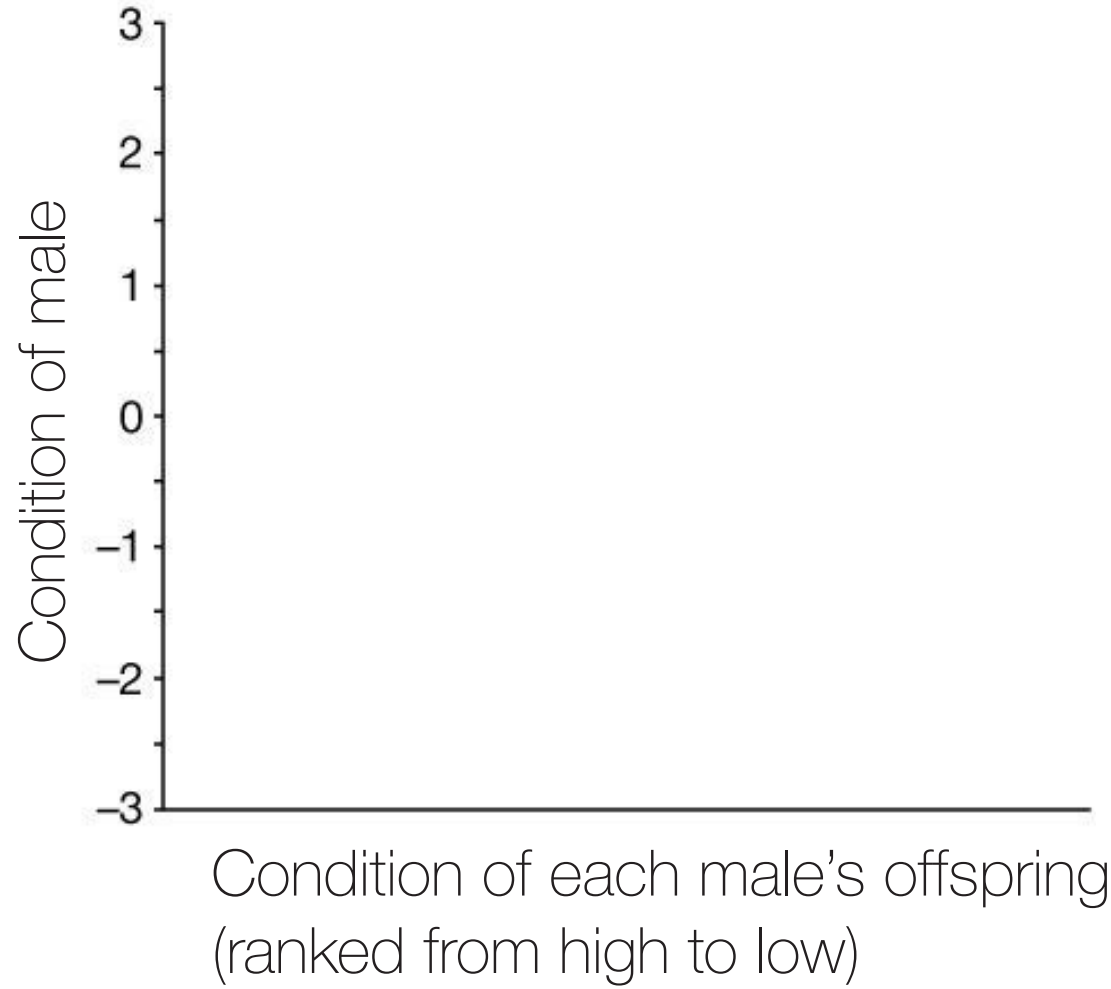
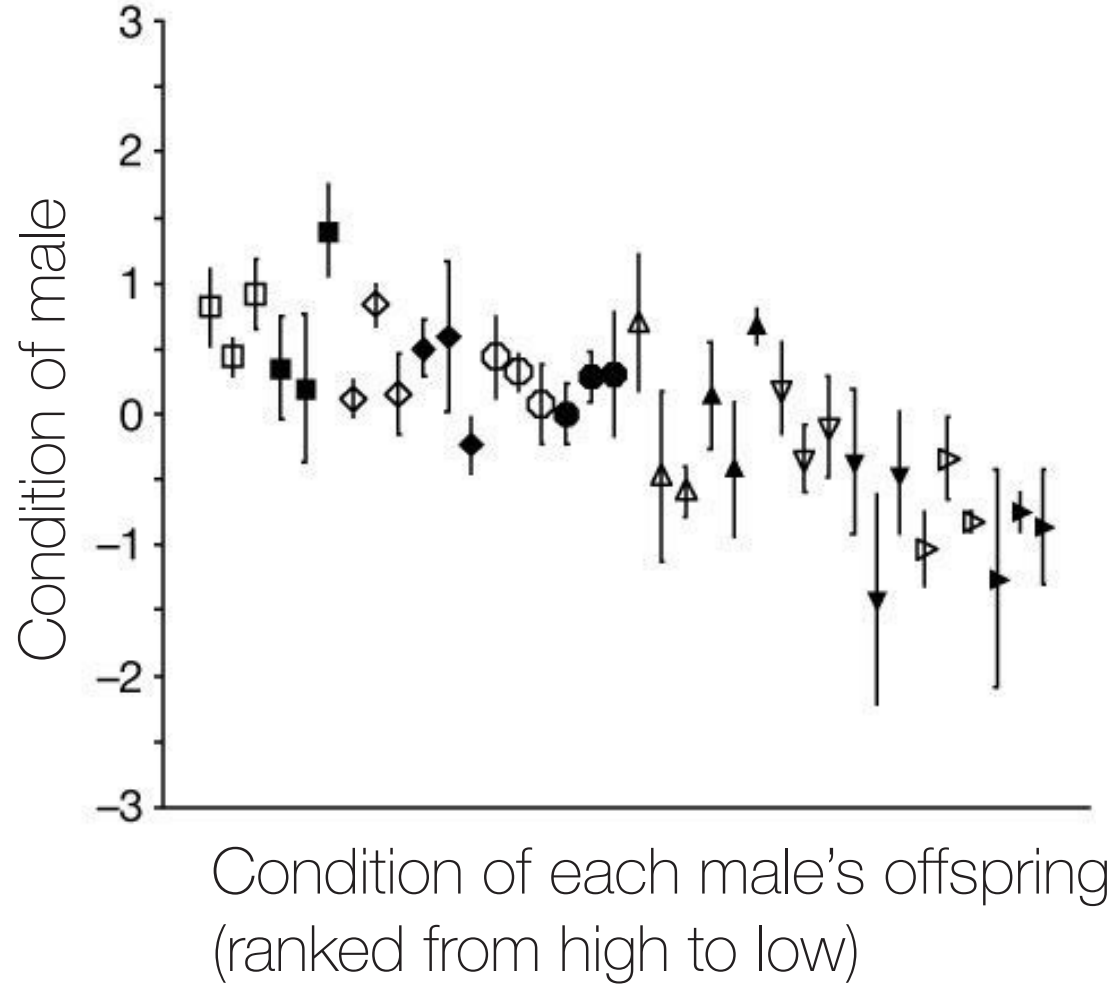
What do you expect if variation in male quality is heritable ("good genes")?



Kotiaho et al (2001) Nature

Conclusion:
Condition is heritable
females mating with high-courting males transmit high condition to their offspring



Kotiaho et al (2001) Nature

The evolution of female preference for male ornaments

Interim conclusion:

There are several hypotheses for the evolution of female preferences for male traits. None has been conclusively ruled out by data.

Some make similar predictions, making it difficult to tease apart the most important cause.

6) Example exam questions

Define and give an example of sexual selection.

Distinguish briefly: natural selection and sexual selection.

Explain the difference between sexual selection differential and sexual selection gradient. What do they measure and why might the numbers they yield be different?

Two types of hypotheses have been put forth to explain the evolution of an extravagant male trait by female choice: 1) the male trait and the female preference evolved jointly to an equilibrium determined by the intensities of natural and sexual selection; 2) female preference evolved as a by-product of natural selection on the female sensory system well before the male trait evolved. Devise a realistic test to distinguish between these two hypotheses. Explain your methods.

Explain why sexual selection in most species is stronger on males than on females. Under what circumstances might this trend be reversed?

In theory, how might extravagant male traits and female preferences for extravagant traits evolve in the absence of any natural or sexual selection on females?