Mating Preferences and Sexual Selection

Individuals rarely mate at random for a number of reasons:

- Dispersal may be limited
- Individuals may or may not be able to self
- Individuals may reproduce asexually
- Individuals may compete for mates
- Individuals may choose particular mates

Non-random mating has a number of important evolutionary consequences.

In this lecture, we will focus on the evolution of mate choice and sexual selection.

Sexual Selection

"Sexual selection depends on the success of certain individuals over others of the same sex, in relation to the propagation of the species; while natural selection depends on the success of both sexes, at all ages, in relation to the general conditions of life.

The sexual struggle is of two kinds: in the one it is between the individuals of the same sex, generally the males, in order to drive away or kill their rivals, the females remaining passive; while in the other, the struggle is likewise between the individuals of the same sex, in order to excite or charm those of the opposite sex, generally the females, which no longer remain passive, but select the more agreeable partners."

-- Darwin (1871)

The Descent of Man and Selection in Relation to Sex (p. 639)

Sexual Selection: Classification

Following Darwin, two main forms of sexual selection are recognized:

(1) Intrasexual selection
(competition within a sex for the opportunity to mate)

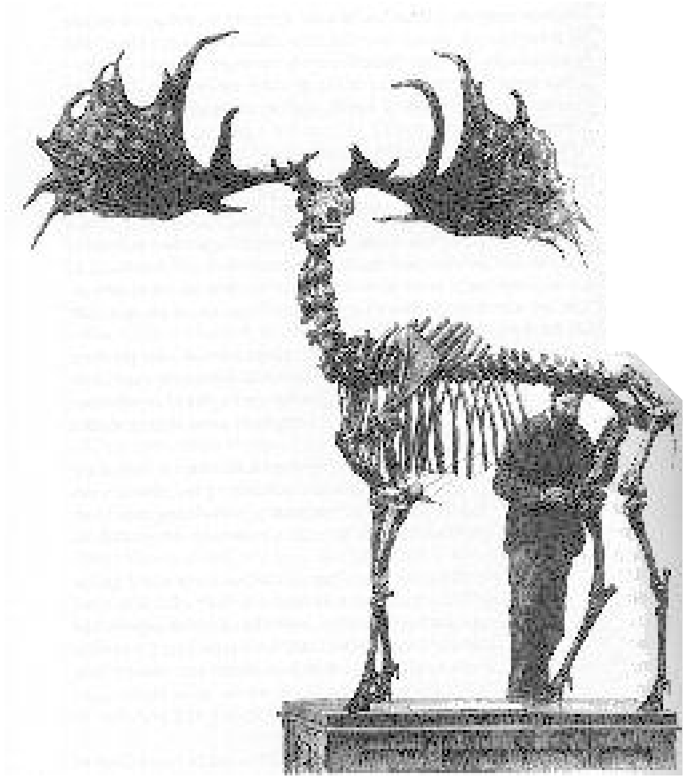
(2) Intersexual selection
(choosiness on the part of one sex for mates)

Although female-female competition and male choosiness are known, we'll focus on the more common patterns of male-male competition and female choice.

(Why might these be the more common patterns?)

(1) Intrasexual selection

Horns, antlers, tusks, spurs and other weapons provide some of the most extreme examples of sexual dimorphism.



Possible explanations:

(1) Weapons against predators

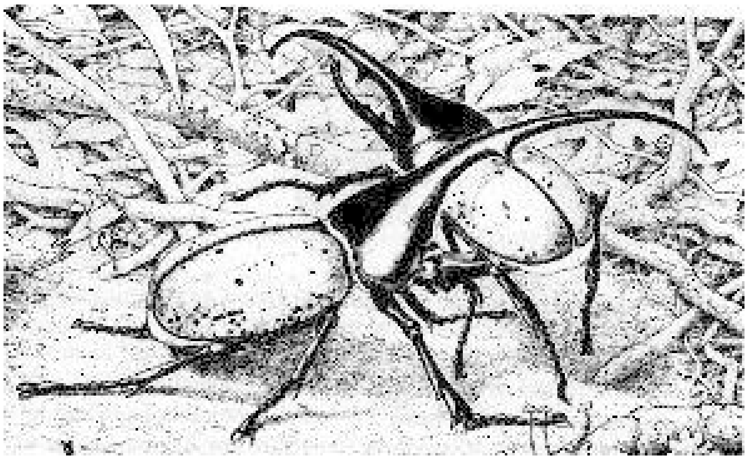
(2) Weapons against other males

(3) Indicators of male strength and fighting ability
(male-male competition)

(4) Indicators of sexual vigor and quality
(female choice)

Examples:

Barrette and Vandal (1990) studied sparring in caribou. Of 713 matches between males of different antler size, males with smaller antlers withdrew 90% of the time.



Eberhard (1979,1980) studied the use of horns in seventeen species of beetles, finding that they tend to be used either to pry a rival off his site or to lift and drop the rival to the ground.

(Topi)

"Among the explanations for sexually dimorphic horns, antlers, tusks, and spurs, the empirical support is strongest for the idea that they have evolved and are favored in males as weapons in contests over females."

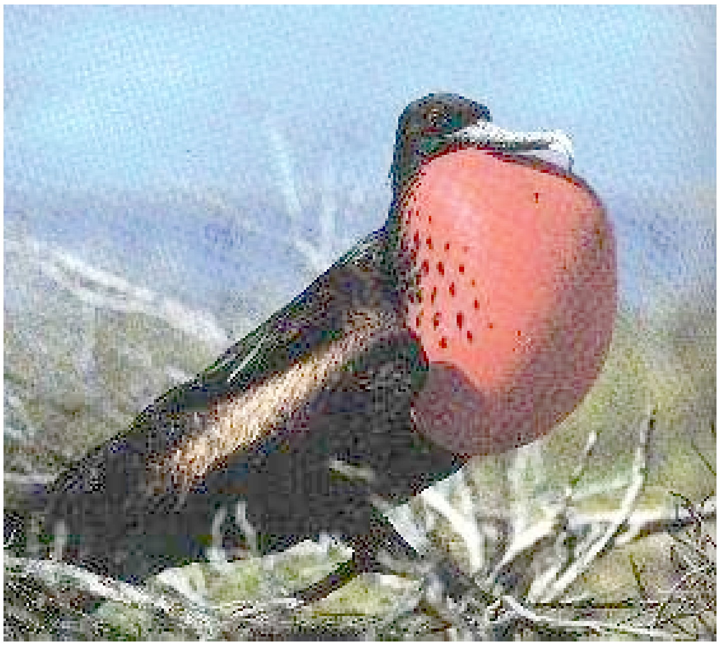
-- Andersson (1994) *Sexual Selection* (p. 314)

(2) Intersexual selection

Some of the more profoundly beautiful traits seen in nature have evolved in response to female choice.

(Peacock)

(Sage Grouse)



(Greater Frigate)

Theories for the existence of female preferences:

(2A) Female choice and male traits co-evolve
(Fisher's *Runaway Process*)

(2B) Choosy females gain *direct benefits* from their mates

(2C) Female are choosy because of a *sensory bias*

(2A) Fisher’s Runaway Process

PHASE 1: Female preferences initially evolve because they favor a trait in males that is also favored by natural selection. The offspring of choosy females are then more likely to carry the advantageous trait.

> "Whenever appreciable differences exist in a species..., there will be a tendency to select also those individuals of the opposite sex which most clearly discriminate the difference to be observed, and which most decidedly prefer the more advantageous type."
>
> -- R. A. Fisher (1930)

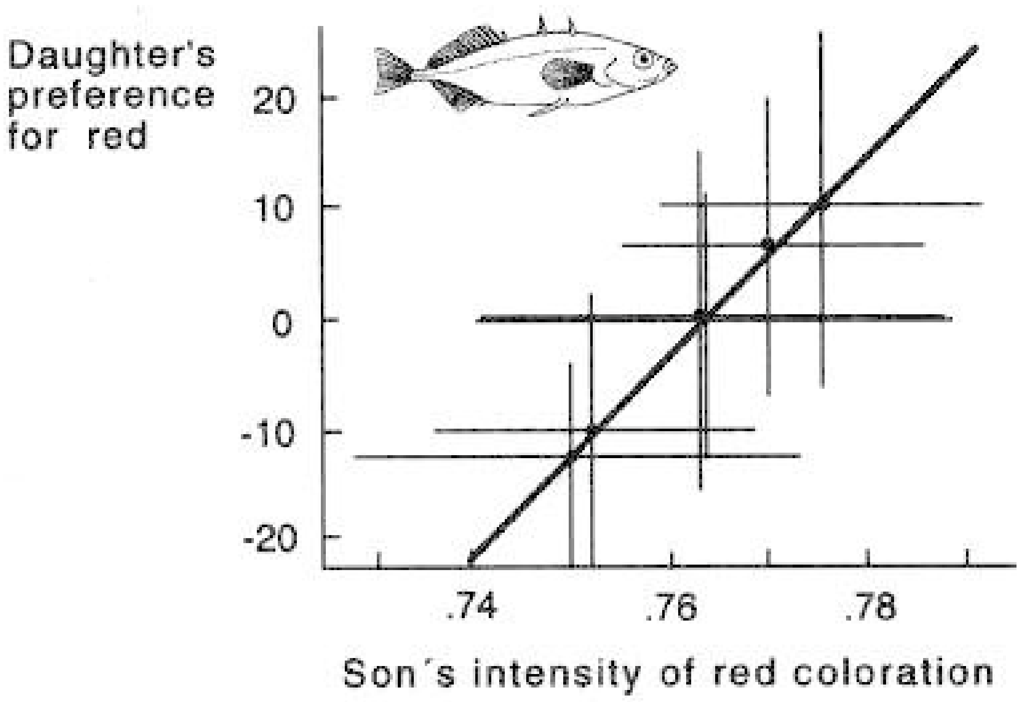
PHASE 2: Once female preferences exist, they can favor even more extreme traits in males. This can in turn favor the evolution of stronger female preferences, leading to a *runaway process*.

> "...the further development of the plumage character will still proceed, by reason of the advantage gained in sexual selection, even after it has passed the point in development at which its advantage in Natural Selection has ceased."
>
> -- R. A. Fisher (1930)

The runaway process will halt when genetic variation is exhausted or when the trait becomes so costly that natural selection balances sexual selection.

Example:

In a breeding experiment with the threespine stickleback, Bakker (1993) observed a genetic correlation between red coloration among sons and preferences for red coloration among daughters, as expected under the Fisherian process.



(2B) Direct Benefits to Choosiness

The Fisherian model of sexual selection is, however, ineffective in the face of costs to female choosiness, such as

- Time and energy in evaluating mates
- Risk of remaining unmated

Example: Engelhardt et al (1982) found that choosy female seaweed flies had reduced fertility.

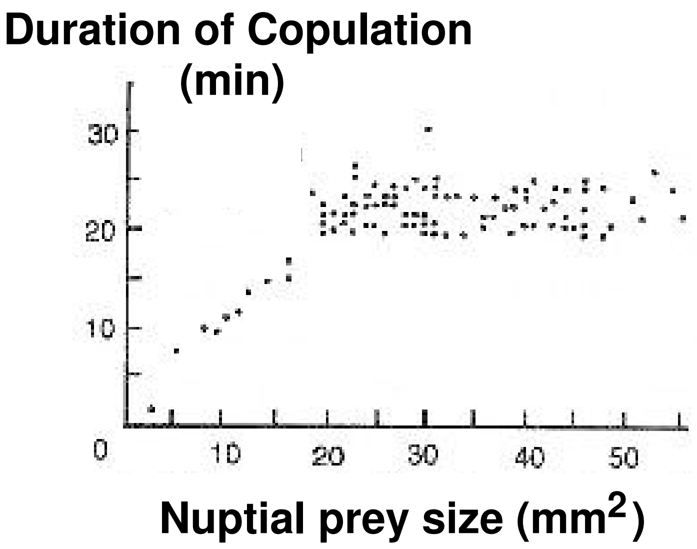
Occasionally, female preferences may be directly beneficial, such that natural selection itself favors the evolution of preferences.

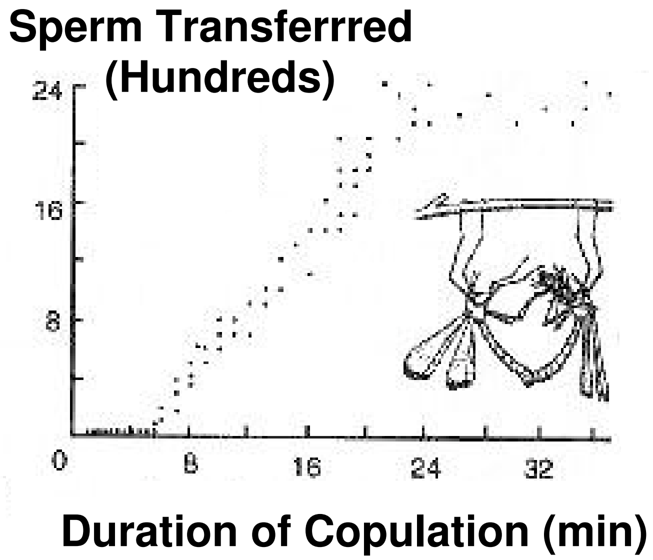
Possible benefits of being choosy:

- Lower risk of mating with the wrong species
- Mate may provide paternal care
- Mate may provide food (eg nuptial package)
- Mate may be more fecund
- May avoid diseases/parasite transmission
- Offspring may be more fit (*Good genes* hypothesis)

Examples:

Thornhill (1983) showed that female hangingflies lay more eggs with males that provide larger nuptial food gifts.





Pleszczynska (1978) showed that male lark buntings with more nest cover in their territory attracted more females and these females had higher breeding success.

(2C) Sensory Bias

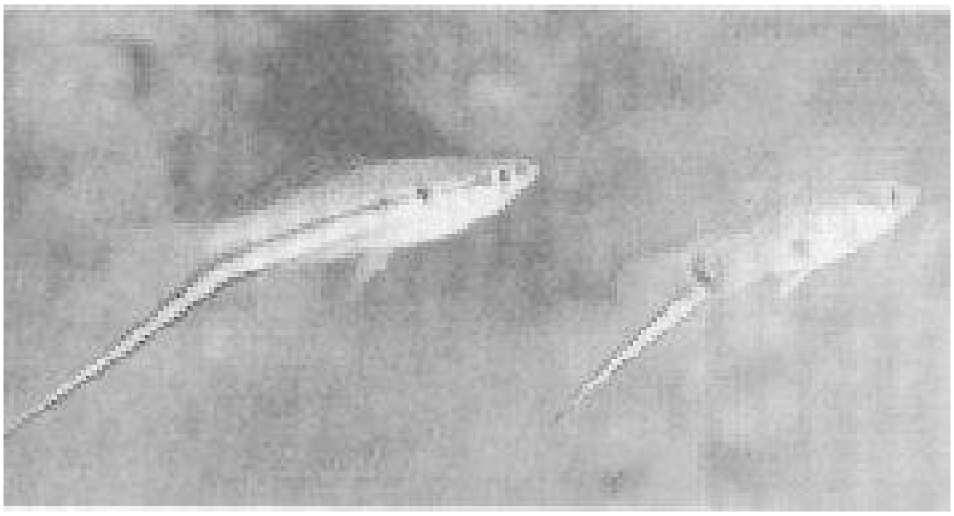
Female preferences may evolve as a correlated response to the evolution of a favored male trait or due to direct benefits of choosiness.

An alternative possibility is that female preferences are simply a side-effect (a "pleiotropic" effect) of how sensory systems have evolved.

Examples:

Searcy (1992) found that female common grackles preferred males singing an artificial repertoire with four song types even though males in this species sing only one song type.

Basolo (1990) showed that female platyfish preferred males with swords artificially attached, arguing that evolution in the sister taxa (swordtails) was shaped by this pre-existing bias for swords.



(On the left is a tropical green swordtail, on the right a southern male platyfish with a sword artificially attached.)

Mating Preferences and Sexual Selection

Regardless of how mating preferences have evolved, their presence in a population has profound influences on the evolution of morphology, behavior, and communication.

Sexual selection has undoubtedly contributed to the evolution of some of the more spectacular traits seen in the natural world (e.g. the radiant feathers of peacocks, the flashing lights of fireflies, the nightly song of crickets).

In addition, sexual selection can lead to rapid reproductive isolation of populations, thereby contributing to speciation.

For example, sexual selection has played a crucial role in the explosive radiation of Drosophila species on Hawaii (800-900 species) and of cichlids in the African Rift Lakes.

SOURCES:

Malte Andersson's (1994) book entitled Sexual Selection is a fantastic source of information about the theoretical and empirical support for various hypotheses about mate choice. Most of the examples used in this lecture are drawn from his book.

Additional pictures come from Sexual Selection (1989) by Gould and Gould.

Other web sites of interest are:

- See a cartoon about Enquist and Arak's neural network model of sensory bias.
- See a bird of paradise.
- The importance of being flashy.
- Costly signals and the handicap principle.

Assignments for week 12 (March 30-April 3):

- Read Conway Morris (1993) The fossil record and the early evolution of the Metazoa. Nature 361: 219-225. Reading must be done before your discussion group.

- Your TA will assign a question relating to Conway Morris article (answer in 1/2 page). In addition, write two questions that you would like to discuss in your section. Hand in during your discussion group.

- Read Ridley Chapter 21.

Assignments for week 13 (April 6-8):

- No discussion groups.

- Read Ridley Chapter 23.