Mechanisms of Sexual Selection

A. Mate competition

⇒ B. Mate choice

Examples of Female Choice

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<tr>
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<th>Benefits</th>
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I. Benefits of mate choice

A. Direct benefits
males offer resource

B. Indirect benefits
males offer only sperm

Direct vs. Indirect Benefits

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A. Direct benefits

1. access to breeding site
e.g., female bullfrogs enter territories of calling males, mate and lay eggs;
   females prefer certain territories and thus certain territory-holders.

why? because leech predation on young is lower in favored territories.

Assessment made partly on basis of male’s call.

bullfrog
In toads, larger toads have calls that are lower in pitch.

A. Direct benefits (cont'd)

2. access to food
e.g., male Anthidium bees defend patches of flowers, & mate in exchange for access to pollen and nectar.
Females mate preferentially with males controlling richer patches.

In hangingflies, bigger prey may result in longer copulation.

A. Direct benefits (cont'd)

3. "nuptial gifts"  
   a. food for female
      e.g., in roadrunners, males offer lizards or other snacks to females
      e.g., in hangingflies, males offer females a gift of insect prey

In hangingflies, bigger prey may result in longer copulation.

A. Direct benefits (cont'd)

3. nuptial gifts
   b. food for female's young  
      e.g., males transfer protein to female which is incorporated into eggs.
3. nuptial gifts (cont’d)
   b. food for female’s young
      e.g., in some butterflies, males ‘puddle’ and take up sodium. Sodium transferred with sperm and incorporated into eggs.

Chandreyee Mitra (Papaj lab)

Asking questions such as:
- Do females mate more with males who have puddled? How can they know?
- Do offspring of puddling males survive better?

Are butterflies attracted to each other? Do they copy other species? (at least 4 species here)

Female blister beetles eat cantharidin secretion offered by male.
- Females do not mate with males lacking secretion.
- Cantharidin ends up in female’s eggs and defends eggs from predators.

The ultimate nuptial gift...

In redback spiders, male somersaults into female’s jaws and is eaten.

Can sexual cannibalism benefit the MALE?

Part 1. Copulation Duration Effects

Pattern of sperm transfer in redback spiders: implications for sperm competition and male sacrifice

Lindsey S. E. Sear and Matthew C. R. Jewett

Department of Life Sciences, University of Toronto at Scarborough, 1260 Military Trail, Scarborough, ON, M1C 1A4, Canada
RESULTS
Cannibalism increases copulation duration
Increased duration leads to increased paternity
BUT...
Increased duration does not result in increased sperm transfer
Perhaps something in seminal fluid?

The adaptive male sacrifice hypothesis implies that males that escape and attempt to mate again are not successful.

FIELD RESULTS
The probability of finding a 2nd female is very small for a male.
Reason - high predation during mate search.

Summary
1. Males that engage in suicide copulate for a longer time.
2. Males that do not engage in suicide are unlikely to find another female.
Both factors favor suicidal behavior in males.

Firefly fellows flash in flight; females in foliage then flash to favored fellows. flashing followed by... MATING.
During mating, males transfer protein-rich spermatophore.

Can sexual cannibalism benefit the MALE?
Part 2. The Alternative
Risky mate search and male self-sacrifice in redback spiders

Mayhonne C. B. and others
Department of Neurobiology and Behavior, Cornell University, Ithaca, NY 14853, USA

Males that flash longer transfer larger spermatophores.
Females respond more to longer flashes...
... but effect disappears if females are fed to satiation.
Long flash is honest indicator of size of nuptial gift. (but what keeps it honest??)

B. Indirect Benefits
Why do females sometimes show preferences for males that offer nothing but sperm?
What indirect benefits do such males offer?

“Good Genes” Hypothesis
Females choose mates whose genes improve their offspring’s fitness.
Prediction:
Females allowed to choose males with ‘good genes’ produce more fit offspring than females not allowed to choose.

Procedure:
1. Allow Drosophila melanogaster females to choose mate(s) from among 5 males.
2. Force other females to mate with a randomly-selected male.
3. Let females lay eggs and keep track of offspring survival.

Result:
Offspring of females allowed to choose had higher survival than offspring of females not allowed to choose.
BUT...
What about male-male competition?
And why couldn’t experiment be replicated?
Some Results:
1. P females produced more litters.
2. Survival greater for P offspring.
3. P male offspring had larger home ranges.
4. P male offspring proved dominant in 12 of 16 trials.
5. P offspring built more complete nests.

(from Drickamer et al. 2000)

Evidently, females choose males with 'good genes'.
How can females determine if a male has good genes?

Hypothesis:
Males indicate their quality in some way.
They sing, they dance, they display ornaments.

Case Study: Call duration in *Hyla versicolor*

Some males have long calls:

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Some males have short calls:

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In choice tests, females prefer long calls over short calls by 3:1.

Call duration in *Hyla versicolor* and offspring viability

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<th>Low Food</th>
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<td>Larval Growth</td>
<td>Long Callers &gt; Short Callers</td>
<td>Long Callers &gt; Short Callers</td>
</tr>
<tr>
<td>Larval Survival</td>
<td>No Difference</td>
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Welch et al., 1996 data

Special case of good genes models: Species Recognition

Mating with a member of another species usually results in lower fitness.
Expect strong selection for individuals to choose mates of the right species.

Tungara frog males have a two-part call.
The *whine* is used to identify species. The *chuck* is used to identify quality of male of the same species.
A special kind of mate choice based on 'good genes':

**Genes Different Than Your Own**

Presenting, work by Kevin Oh and Alex Badyaev on mate choice and genetic complementarity in house finches.

Photos by A. Badyaev.

Individuals chose less related partners

**MONTANA 1995 - 2003**

\[ F_{st} = 8.33, \ p < 0.001 \]

Evidently, females may choose mates of high genetic quality.

But... now two more problems:

How can mate choice for 'good genes' lead to exaggerated male traits?

What prevents a male from cheating, and pretending to be of high genetic quality?

Hmm... if I look C-G-A-G-T, will she know I'm really G-T-T-G-A?

In peacocks, the eyes have it...

Former EEB student, Ed Scholes

[Links to additional resources]
Zahavi’s Handicap Hypothesis

Exaggerated male traits are essentially handicaps.

Female prefer males with these handicaps...

... because such males have demonstrated an ability to survive despite their handicaps!

At first glance, Zahavi’s idea seemed ridiculous.

Wow, how attractive am I!!

But Zahavi’s handicap model can work...

... if signals used are costly, such that only the highest quality male can pay the cost of the very longest tail.

Darn! These styrofoam antlers seemed like such a good idea...

Tail Length in Barn Swallows and Parasite Resistance

Male tails are longer than female tails.

Females prefer long-tailed males

1. Females prefer to mate with males with especially long tails.
2. Females that mated with short-tailed males were more likely to engage in extra-pair copulations.
3. Long-tailed males were more likely to engage in extra-pair copulations.

So what’s the big deal with long tails?

Long Tails as Indicator of Resistance to Parasites

Cross-fostering Experiment:
Half of progeny in a nest exchanged with progeny from other nests.
# parasitic mites surveyed on each progeny over time.
Long Tails Indicate Resistance to Parasitic Mites

**Cross-fostering results:** mite load inversely correlated with length of male’s tail, but only for biological offspring.

The “Bright Birds and Parasites” Model

1. selection favors females who choose parasite-resistant males.
2. parasite resistance difficult to assess directly, but parasitized birds have dull plumage.
3. selection favors females who choose males with bright plumage.
4. parasites evolve ways to defeat resistance.
5. selection favors females who choose males with still brighter plumage.

Coevolution between host and parasite leads to brighter and brighter males.