The Ecology of Sex Part 5: Sexual Selection

Michael Noonan

Biol 417: Evolutionary Ecology

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Review

Review

Last lecture we covered how, all else being equal, the ESS is to invest equally in sons and daughters (Fisher, 1958)... but how in the real world all else *is not* equal and most real populations deviate from 50:50 sex ratios.

When condition affects the fitness of one sex more than the other there should be a correlation between parental condition and offspring sex ratio.

Local competition for mates and resources can influence sex ratios when the offspring of different sexes have a differential contribution to local competition.

Today we'll cover two important consequence of male/female phenotypes: sexual selection and intrasexual competition.

Sex and fitness

With sexual reproduction, an organism needs to choose a suitable mate with which to mix it's genes.

This selection process can have a substantial impact on fitness.

If a male horse choses to mate with a fertile female, their offspring is a normal foal.

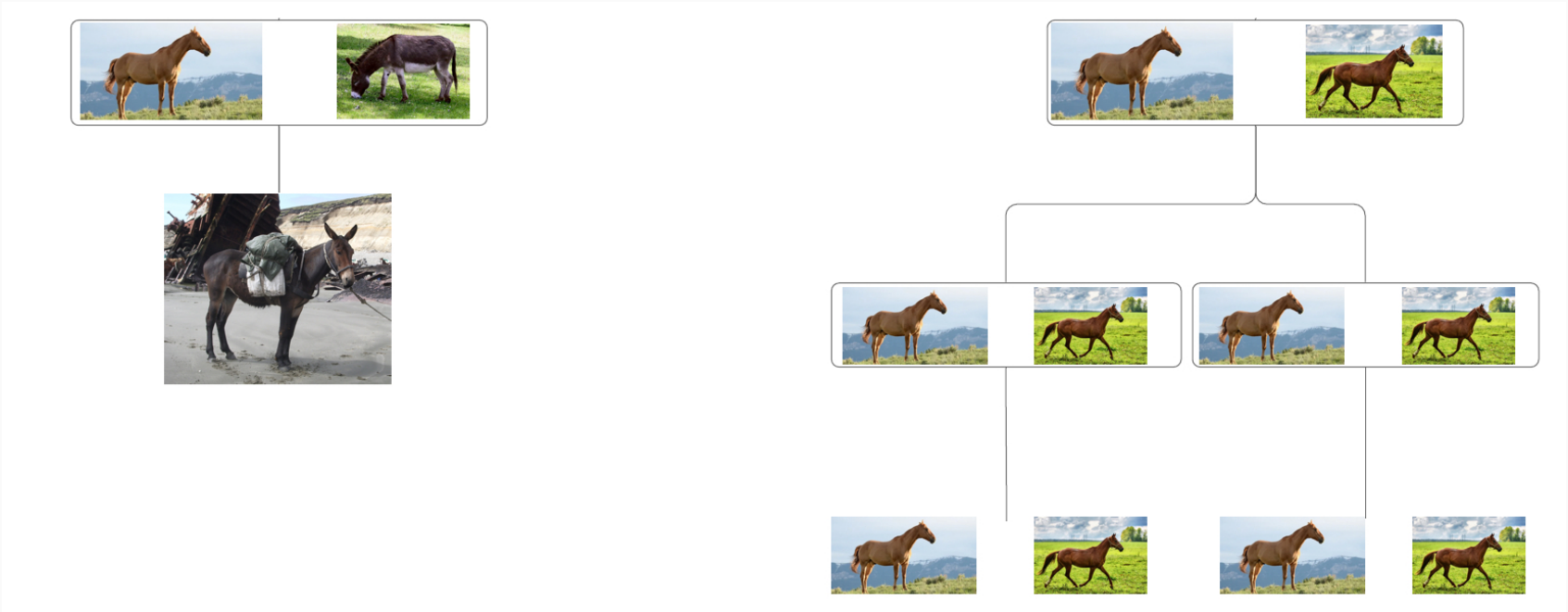
Source: Wikipedia

If a male horse choses to mate with a female donkey, their offspring is an infertile mule.

Source: Wikipedia

Sex and fitness cont.

Those individuals that make the best choices will contribute more to future generations.



Sex and fitness cont.

This leads to two important phenomena:

1. **Sexual selection**: Individuals should exhibit a preference for higher quality mates, and that preference can be inherited.

2. **Intrasexual competition**: Within sexes there will be competition for access to the best mates of the opposite sex.

The relative importance of these in shaping a species' evolutionary trajectory will depend in large part on ecological conditions (e.g., population density, resource abundance, predation, parasitism, etc.)

Intrasexual Competition

Elephant seals

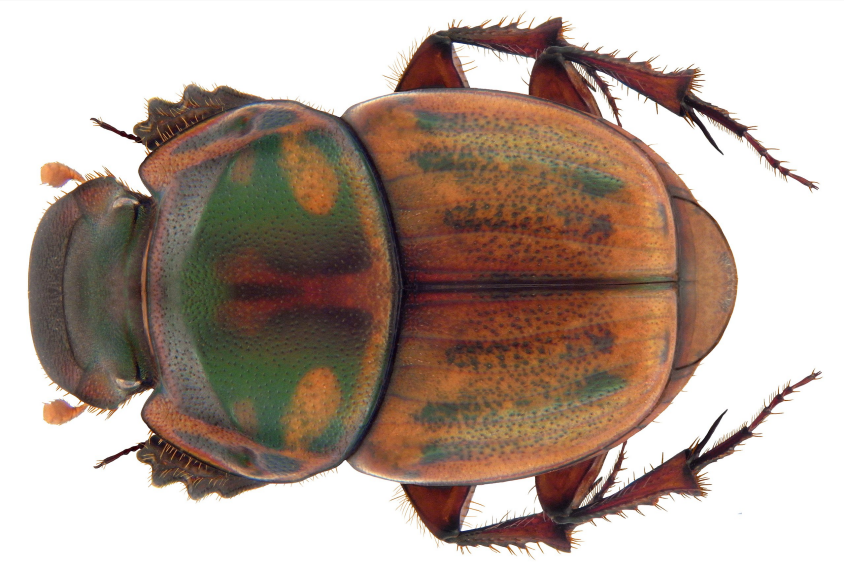
Elephant seal (*Mirounga angustirostris*) females 'haul out' in large groups on shore to give birth and mate.

Because females aggregate in space, males can defend access to multiple females, resulting in selection for fighting prowess.

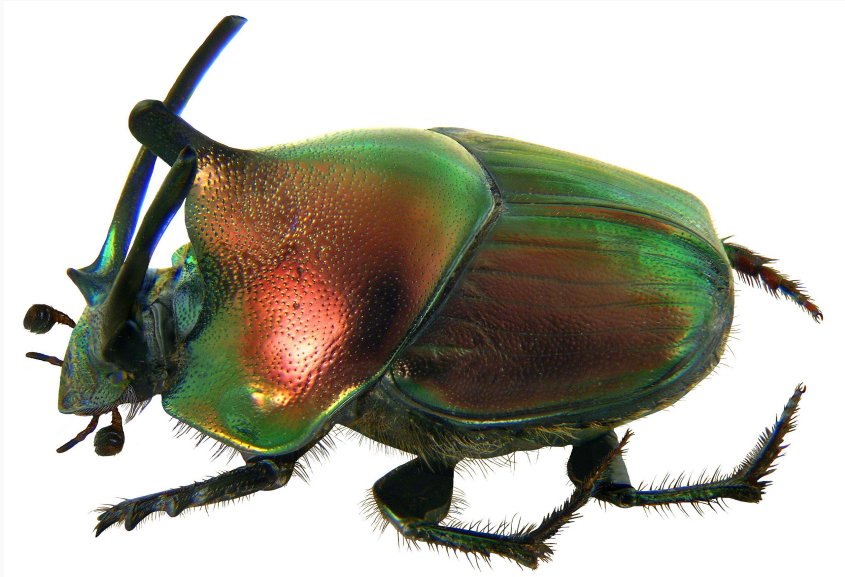
Davies *et al.* (2012)

Density, sex ratios, and competition

In some species of *Onthophagus spp.* dung beetles males have horns, in others they don't.



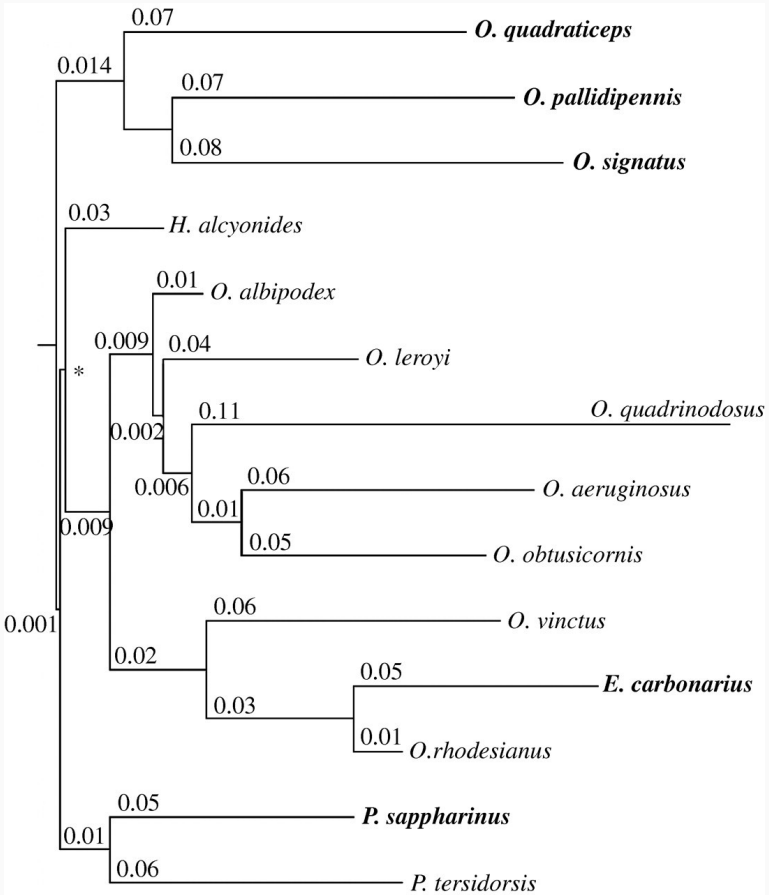
Source: Wikipedia



Source: Wikipedia

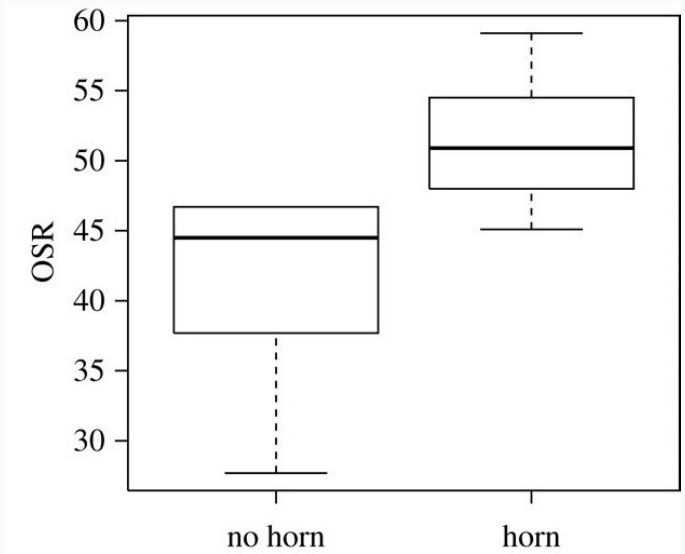
Density, sex ratios, and competition

Pomfret & Knell (2008) used comparative methods to explore the relationship between ornamentation, sex ratios and pop. density.



Pomfret & Knell (2008)

Males with horns tended to be from species with male-biased sex ratios (i.e., females were the rare sex).



Pomfret & Knell (2008)

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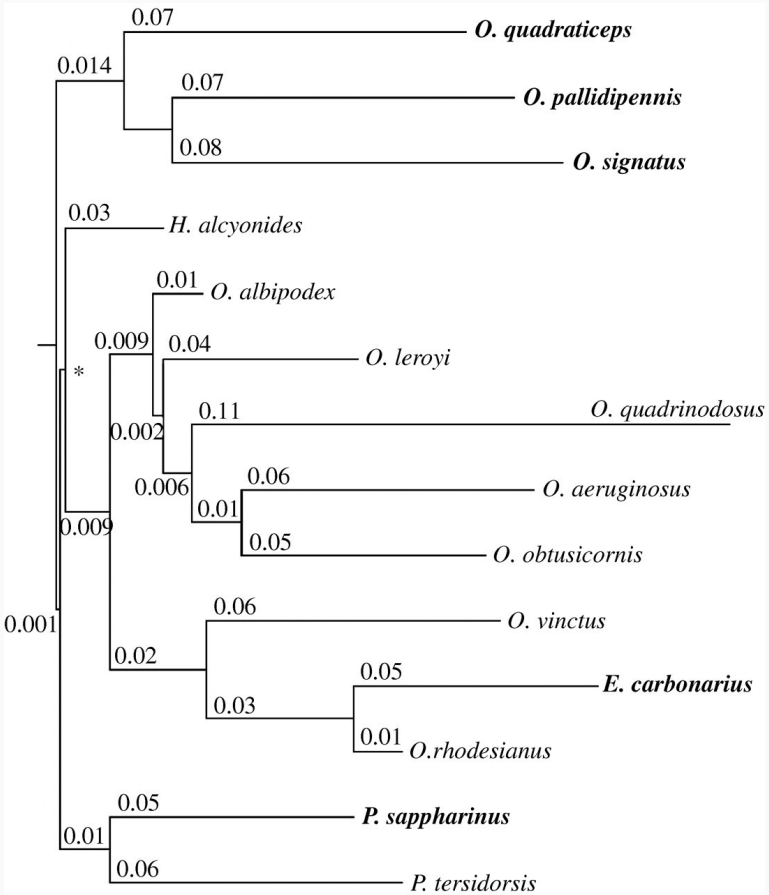
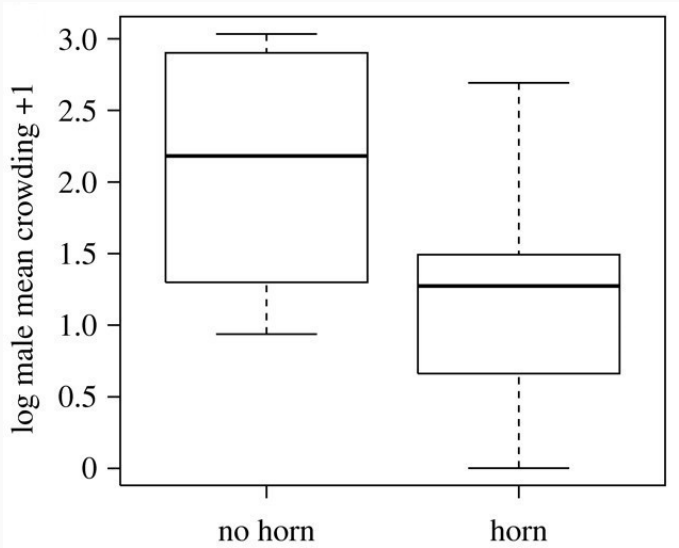


Pomfret & Knell (2008)

Males without horns tended to be from species with high pop. densities (i.e., scramble competition?).



Pomfret & Knell (2008)

Intrasexual Competition Take Homes

Intrasexual selection is a well documented phenomena with a simple evolutionary mechanism ($\uparrow$ mates $\rightarrow$ $\uparrow$ fitness).

...but traits related to intra sexual competition are expensive to maintain (e.g., horns/antlers, large body sizes, neural tissue supporting song, territorial defense, etc.).

Ecological conditions will determine the extent to which selection will favour traits linked to intrasexual competition (defendability of females, sex ratio, pop. density, etc.).

Sexual Selection

Sexual Selection

Male gametes are cheap to produce and males tend to exhibited limited choosiness.

Ophrys apifera

Source: Wikipedia

Because female gametes are more expensive to produce, females tend to be the choosier sex.

Lekking sage grouse

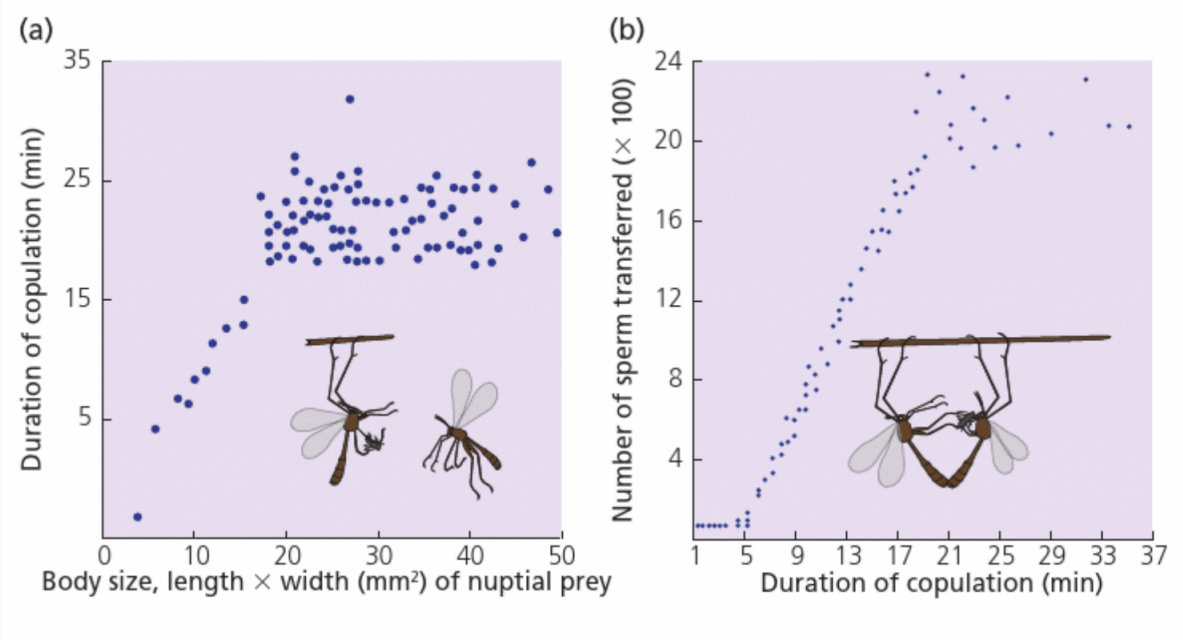
Source: Wikipedia

... but what do females gain from being choosy (i.e., 'Why')?

Direct benefits

Many females select mates based on direct benefits that can improve the survival of their offspring (e.g., food, shelter, territory).

The duration of copulation in hanging flies (*Hylobittacus apicalis*) depends on the size of nuptial gift.

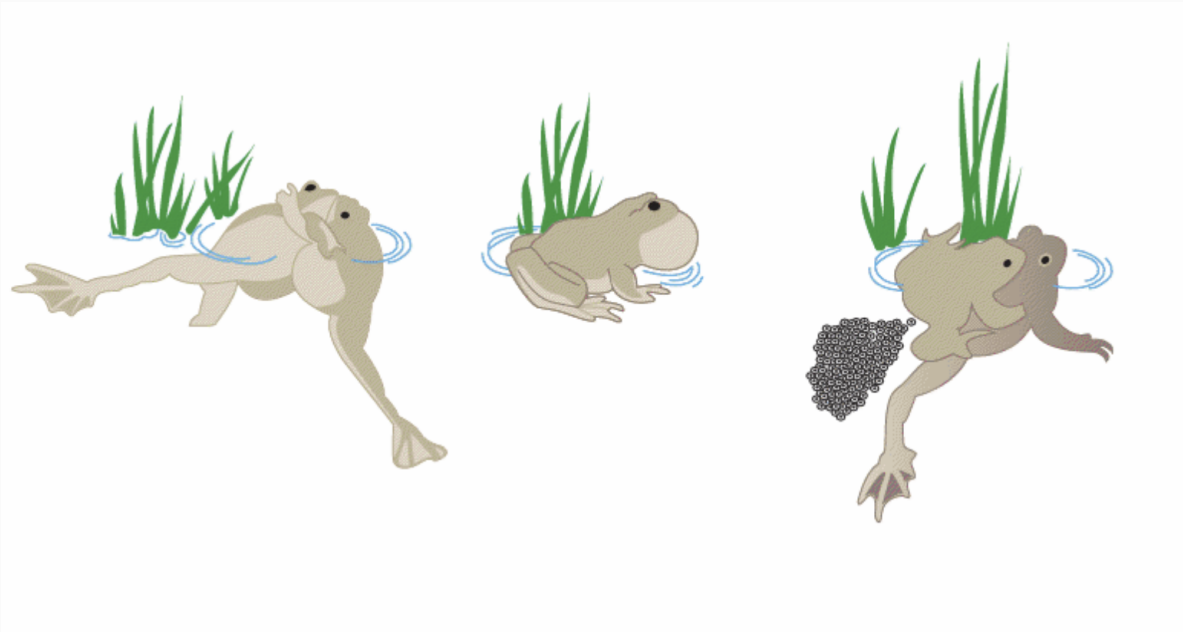


Davies *et al.* (2012)

Direct benefits

Many females select mates based on direct benefits that can improve the survival of their offspring (e.g., food, shelter, territory).

NA bullfrog (*Rana catesbeiana*) males defend access to good egg-laying locations.



Davies *et al.* (2012)

Direct benefits ?

Source: Wikipedia

Direct benefits ?

Male sage grouse aggregate in mating arenas.

Females copulate with male(s) of their choosing, and then leave to raise their young on their own.

Source: Wikipedia

The only thing that lekking sage grouse males provide females is genetic material.

In these systems there is dramatic asymmetry in male reproductive success that is driven entirely by female choice.

Genetic benefits

How can female choice evolve in the absence of direct benefits?

1. **Good genes**: There is a correlation between female preference and male genetic quality.

2. **Sexy sons**: There is a correlation between female preference and the trait females prefer.

Good genes

Source: University of Exeter

Smith (1956) exposed female fruit flies (*D. subobscura*) to either inbred or outbred males.

Females from both groups laid ca. the same number of eggs, but for inbred males, only 264 of the eggs were fertile vs. 1134 for outbred males.

The large fitness advantage provided by mating with outbred males should lead to selection for female choice.

When placed in a bottle for 1-hour, 90% of trials with outbred males led to copulation vs. 50% for inbred males (i.e., females selecting for males with higher quality genes).

Sexy sons

Even in the absence of any fitness benefit, female preference can lead to runaway selection (Fisher, 1958).

Consider a situation where a female with a completely random preference chooses a male with that trait (ornamentation, colouration, size, etc...).

All of their male offspring will inherit the preferred trait and the female offspring will inherit the preference.

Over evolutionary time, male fitness gets tied to a trait with no adaptive benefit beyond improving attractiveness to females.

Sexy sons

Source: Wikipedia

Female long-tailed widowbirds (*Euplectes progne*) prefer males with extremely long tails.

In the absence of female choice, males prefer smaller tails (large tail size is not adaptive).

Male tail size is linked to fitness through female choice.

Sexual Selection Take Homes

With sexual reproduction, an organism needs to choose a suitable mate with which to mix it's genes and this choice can have a substantial impact on fitness.

Ecological conditions will determine the extent to which selection will favour traits linked to intrasexual competition (defendability of females, sex ratio, pop. density, etc.).

Sexual selection can favour the evolution of traits without any adaptive benefit.

Sexual selection and intraspecific competition have an important consequence that we will cover next lecture: Mating Systems.

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