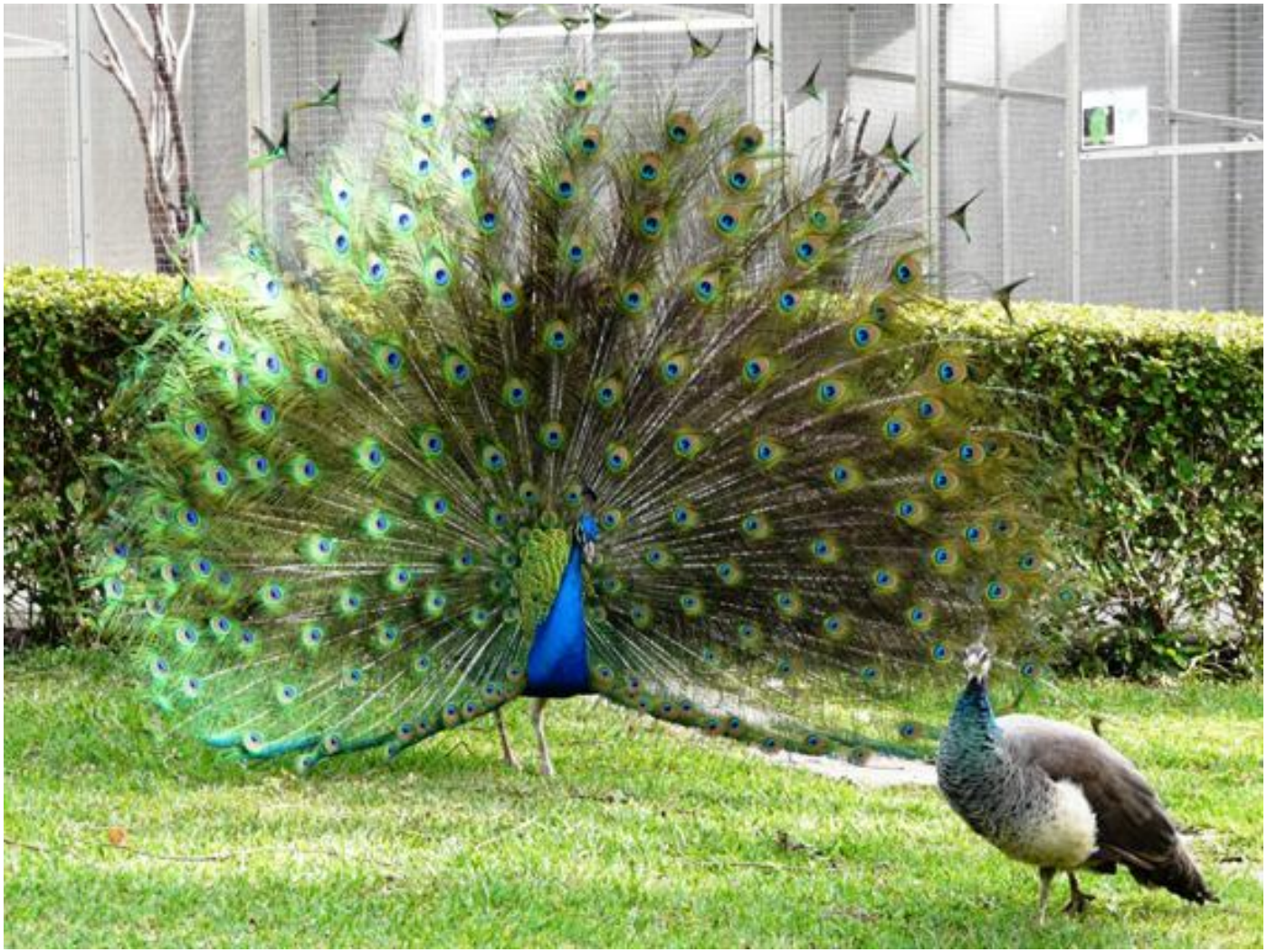
Sexual Selection

Chapter 11



Lecture Outline

- Sexual Dimorphism and Sexual Selection
- Sexual Selection on Males
  - Combat, Sperm competition and Infanticide
  - Female Choice
- Mating Systems

Sexual Dimorphism

- Difference between males and females of a species is called **Sexual Dimorphism**
- Natural selection explains adaptive traits like large beaks etc.
  - But it doesn't easily explain sexual dimorphism
  - e.g. some male ornaments could be costly in terms of survival

Sexual Dimorphism

Weapons

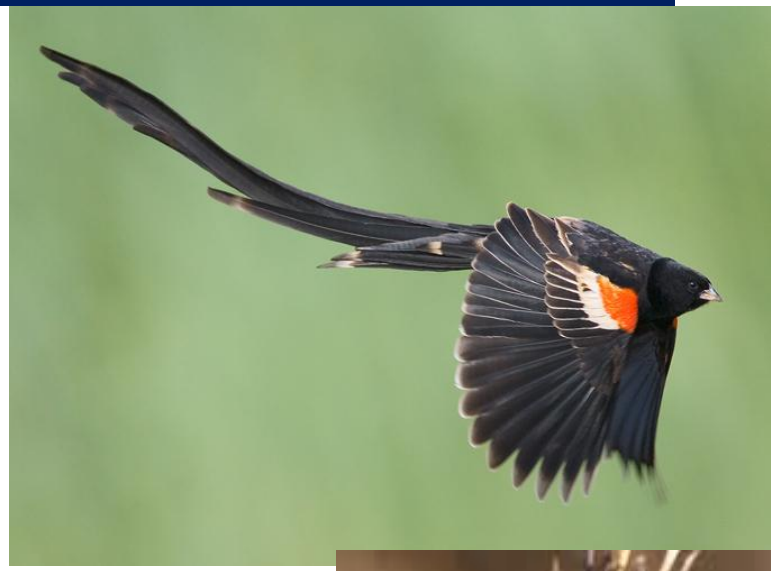
Sexual Dimorphism

Ornaments

Sexual Dimorphism

Sexual size dimorphism

Sexual Selection



- If long tail feathers improve fecundity, why do only males have them?
- How could they improve survival and fecundity in the first place?
  - Likely make males more visible to predators, and are costly in terms of energy to grow, maintain and carry around
  - Energy spent on feathers is energy that can't be spent on reproduction
  - Can't easily explain in terms of natural selection

Charles Darwin

- Individuals vary in success at surviving in reproducing
- BUT also in success at persuading members of the opposite sex to mate
- **Sexual selection** – differential reproductive success due to individual variation in success at getting mates

Asymmetries in Sexual Reproduction

- Sexual selection acts on the sexes differently
- What is the investment of each parent?
  - Varies between the sexes
  - In most cases, females make a larger **parental investment** in offspring than fathers
- Parental investment is the energy expended in producing and caring for offspring
  - Increases reproductive success of offspring
  - Reduces remaining reproductive success of parent

Asymmetries

What is the investment of each parent?

Asymmetries

- Factors limiting lifetime reproductive success are different for males vs. females
  - Female - limited by number of eggs and pregnancies, not the number of mates
    - Relatively small reproductive potential
  - Male – limited by number of mates
    - Relatively large reproductive potential
- Sexual selection will be a more potent force in male evolution

An example

Rough-skinned newt

Used molecular techniques to assess parentage and number of mates

Was mating frequency equal?

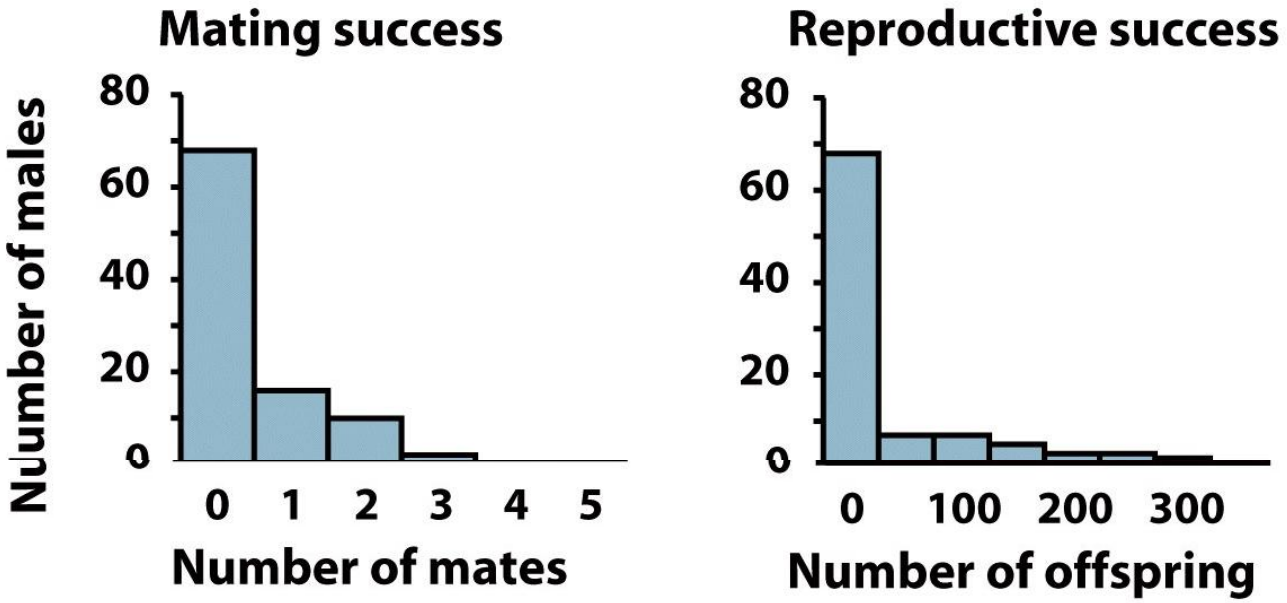


Figure 11-5b Evolutionary Analysis, 4/e

The majority of males failed to mate
Those that mated, did so just once or twice
Male show variation in the number of offspring produced

Large variation in male mating success!

Was mating frequency equal?

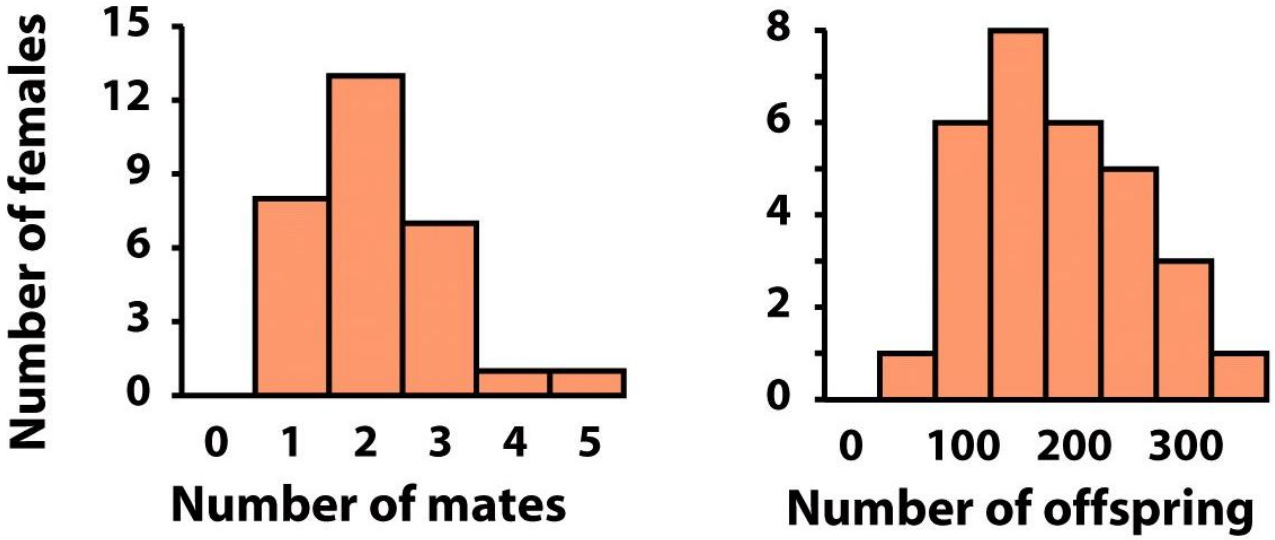


Figure 11-5b Evolutionary Analysis, 4/e

All females mated at least once, many 2-3 times
All of the females had offspring, most between 100-300

Was reproductive success limited by the number of mates?

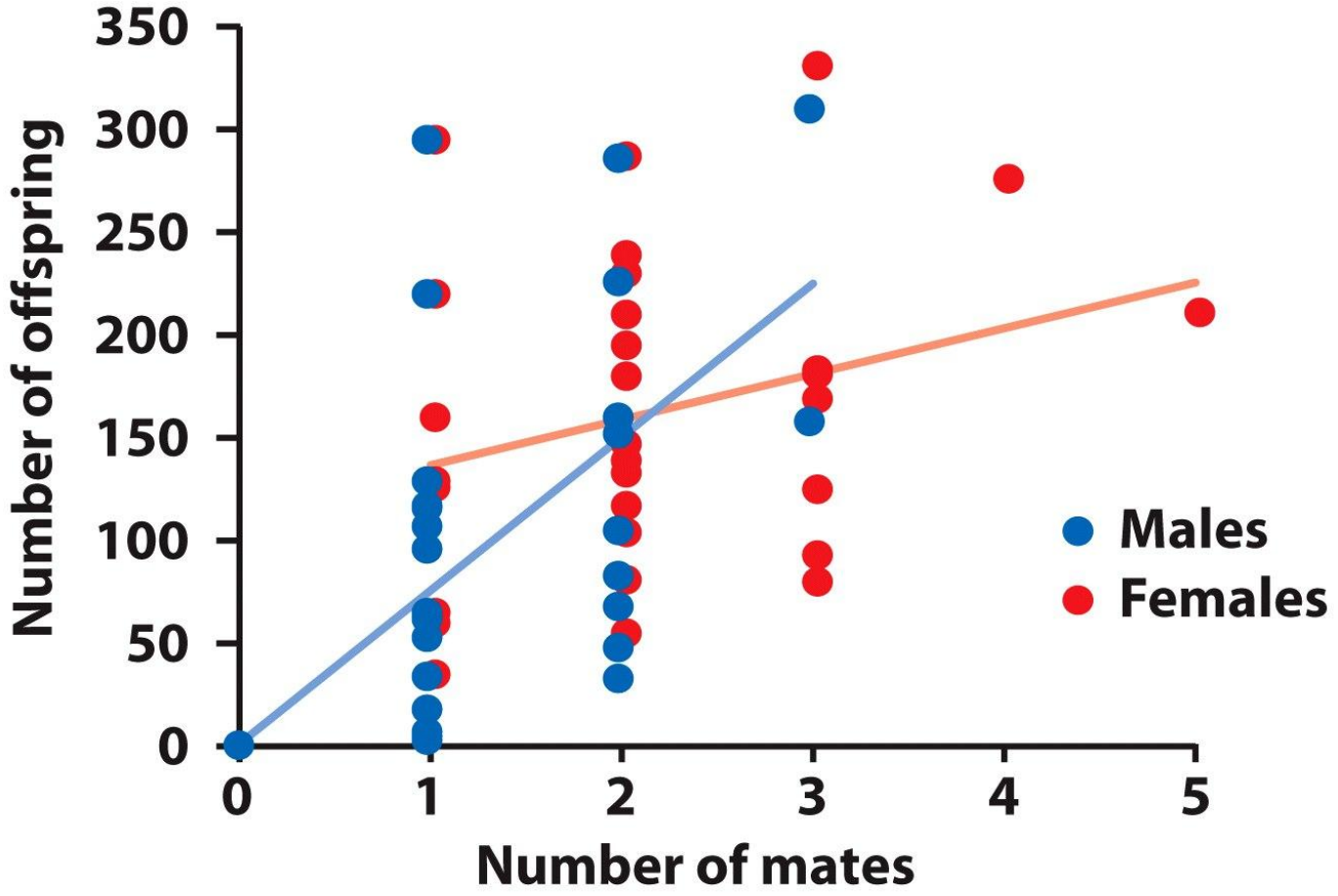


Figure 11-5c Evolutionary Analysis, 4/e

Bateman gradient

Is this always the case?

Broad-nosed pipefish (*Syngnathus typhle*)

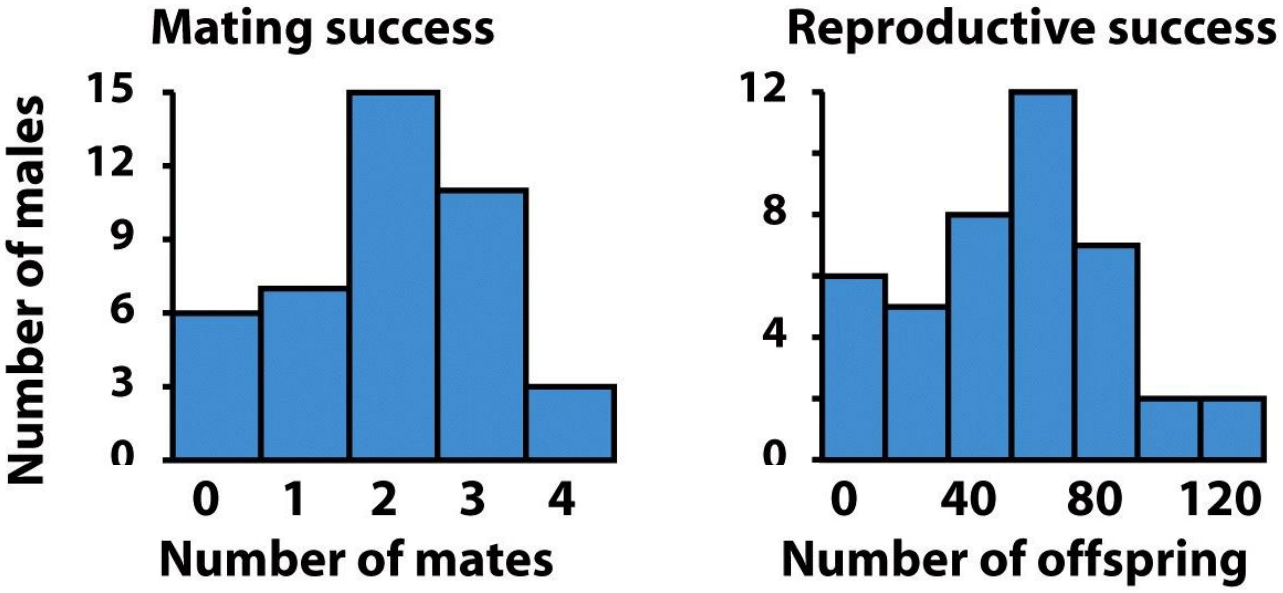
Broad-nosed pipefish

Male rears the eggs

What happens to sexual selection?

Figure 11-6a Evolutionary Analysis, 4/e

Broad nosed pipe-fish



: 11-6b Evolutionary Analysis, 4/e
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Roles of sexes are reversed

Most males succeeded in mating and most produced offspring

Broad nosed pipe-fish

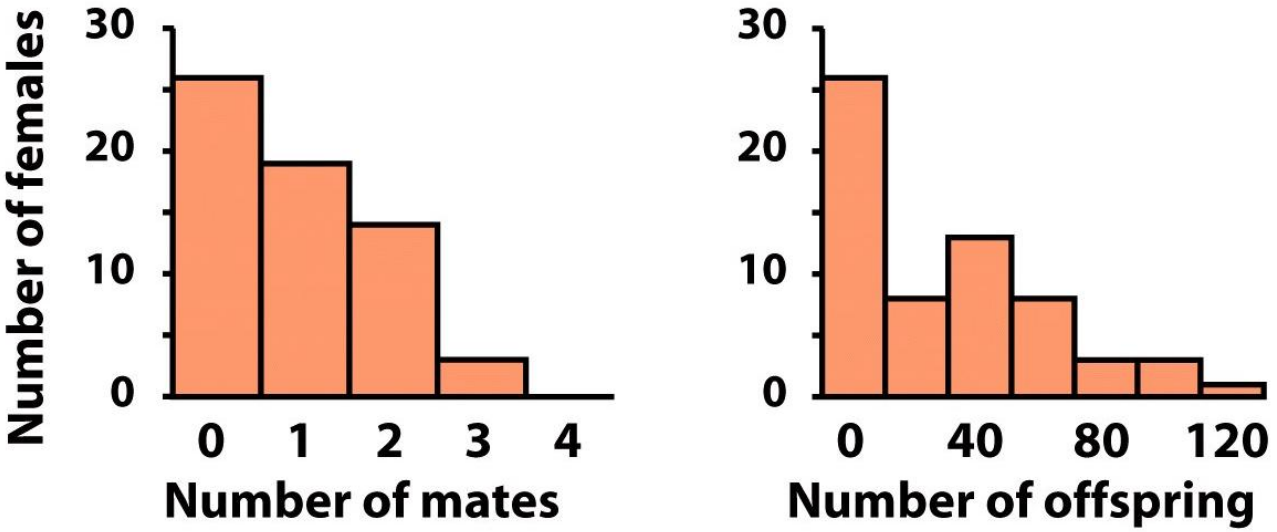


Figure 11-6b Evolutionary Analysis, 4/e

More variation in female reproductive success

Some females failed to mate and did not produce offspring

What happens to Bateman's gradient?

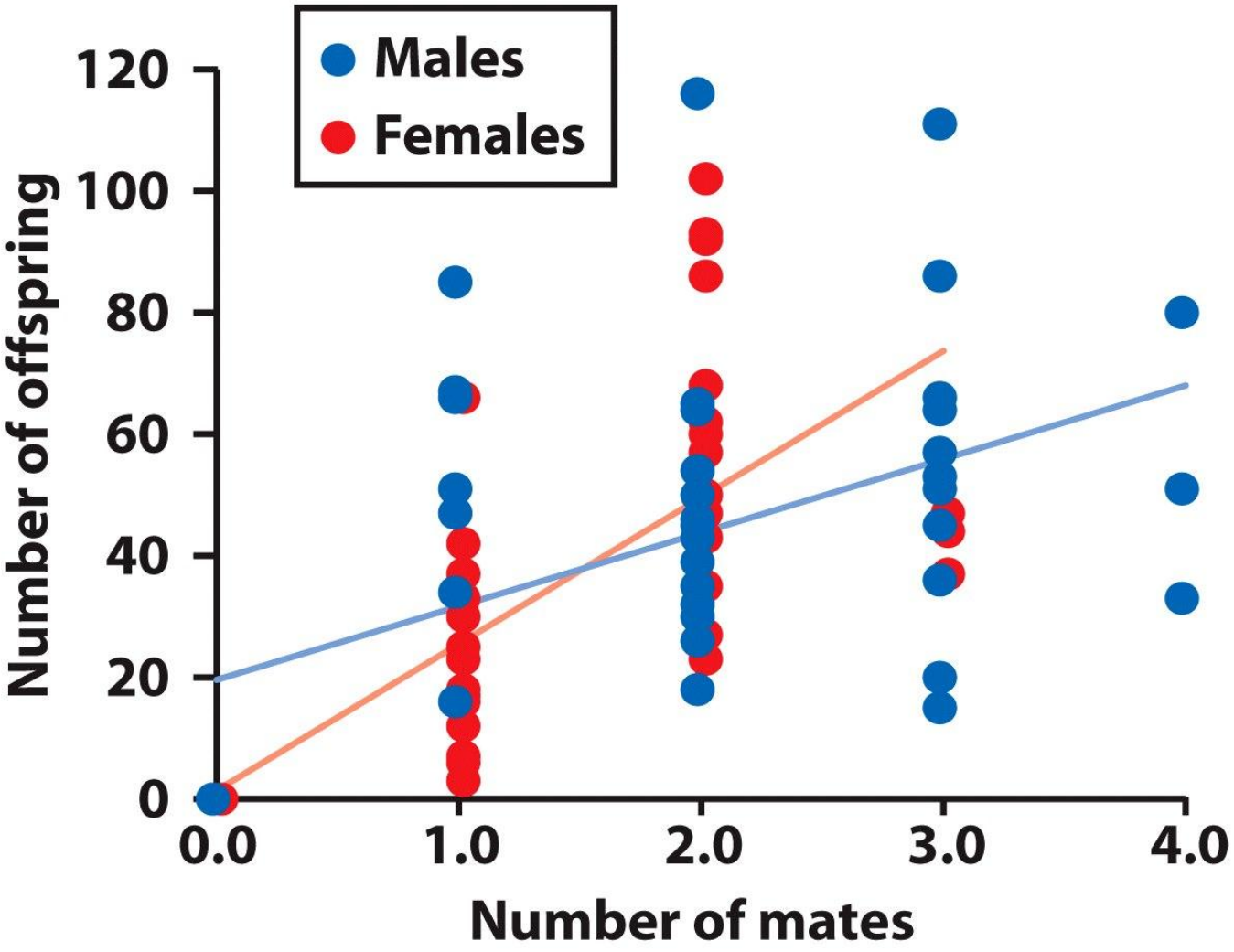


Figure 11-6c Evolutionary Analysis, 4/e

Consequences of Asymmetry

- Members of sex subject to strong sexual selection will be **competitive**
- Members of the sex subject to weak sexual selection will be **choosy**
- We see this in a large number of animal species

Sexual Selection

- **Intrasexual selection** – mating success determined by within-sex interactions
  - e.g., male-male combat over females or resources vital to mates

- **Intersexual selection** – mating success determined by between-sex interactions
  - e.g., female choice of males

Male-male competition- combat

Marine iguanas on the Galápagos Islands

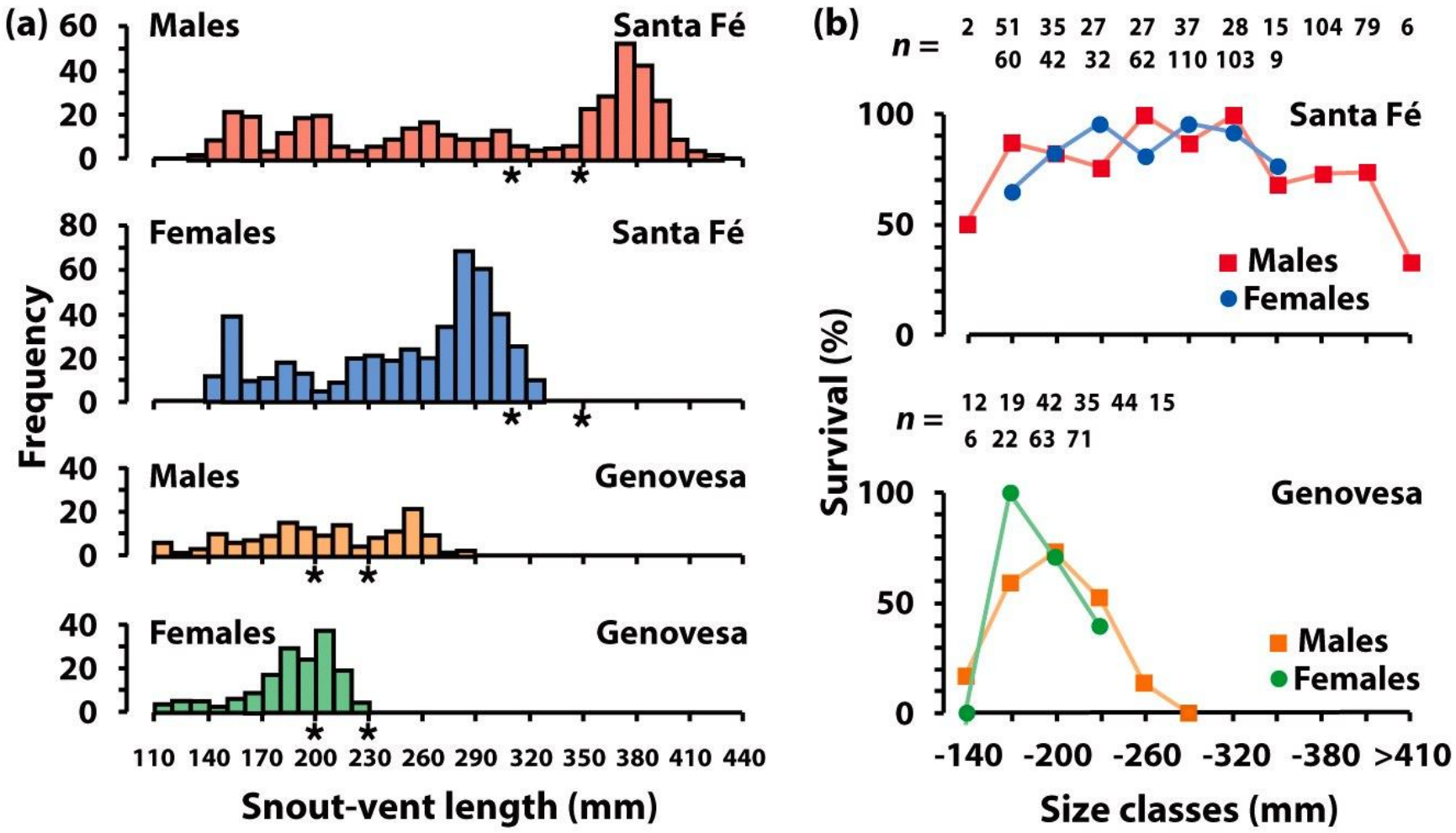
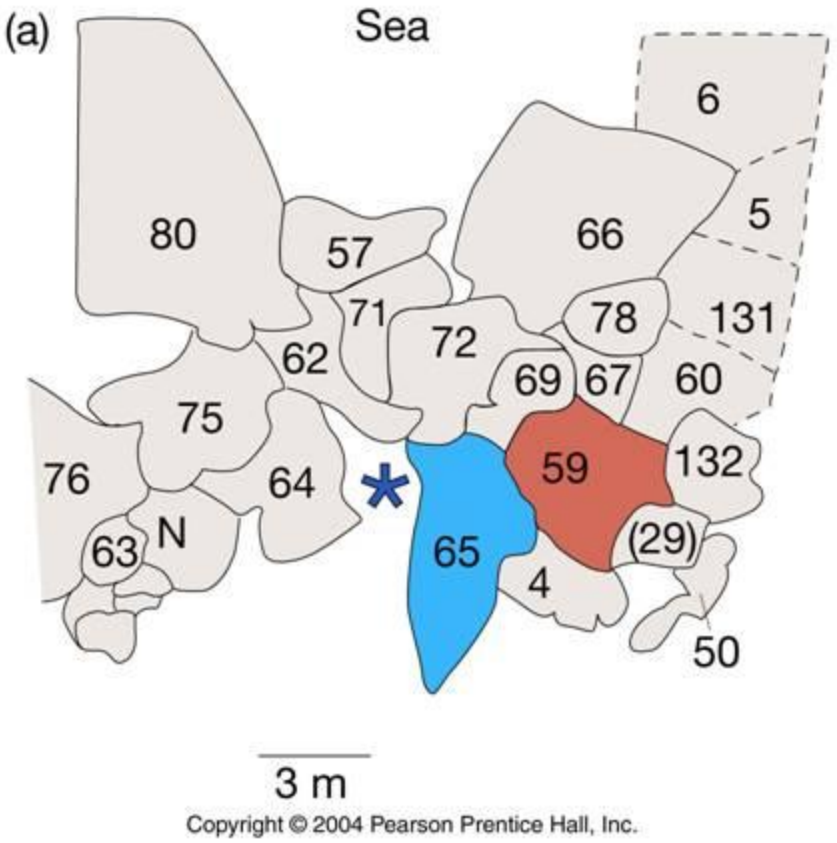


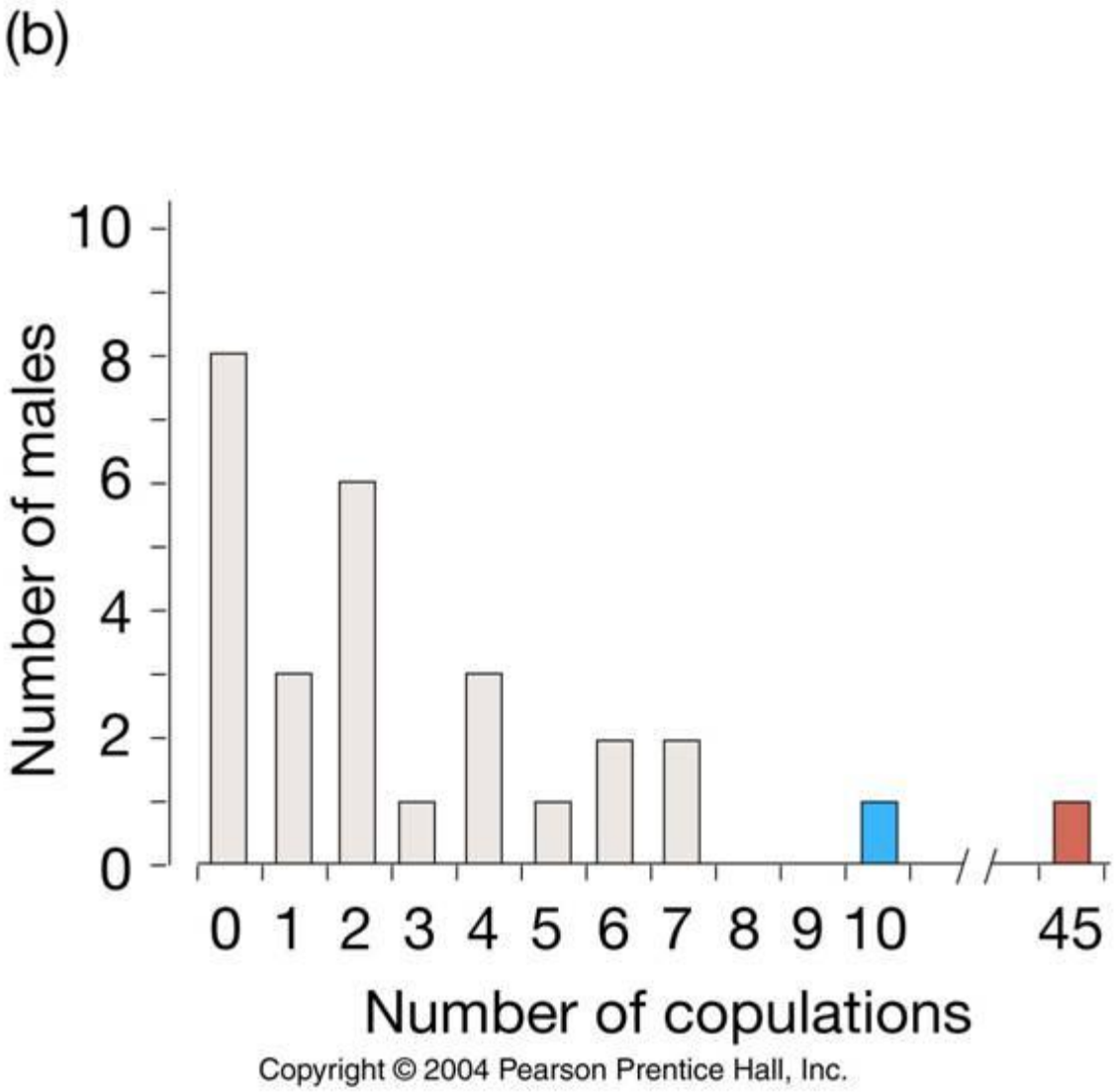
Figure 11-9 Evolutionary Analysis, 4/e

Male-male competition- combat

Males fight for territories and thus access to females



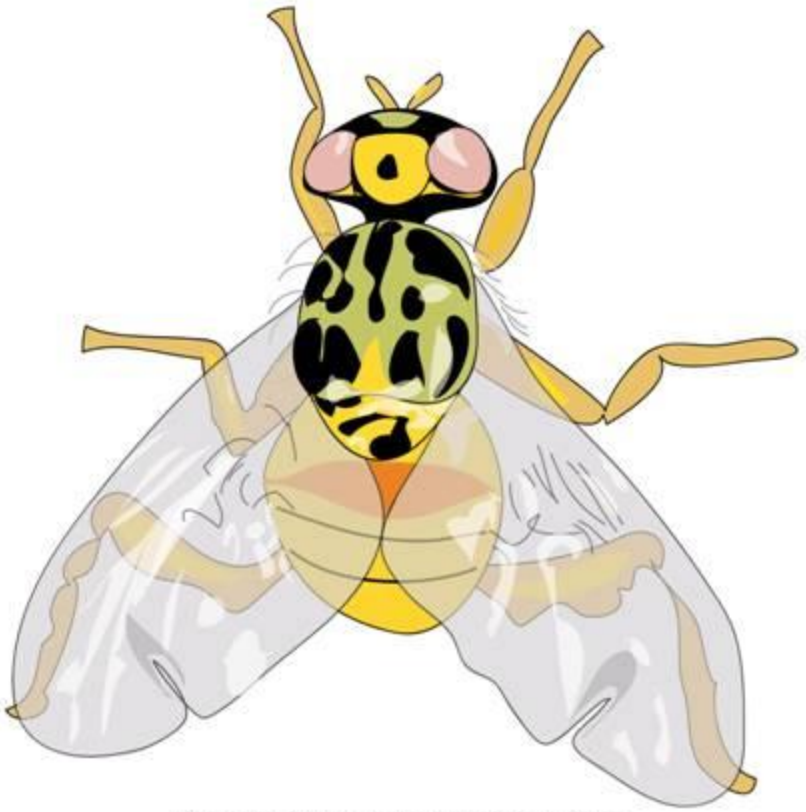
Territories and mating success

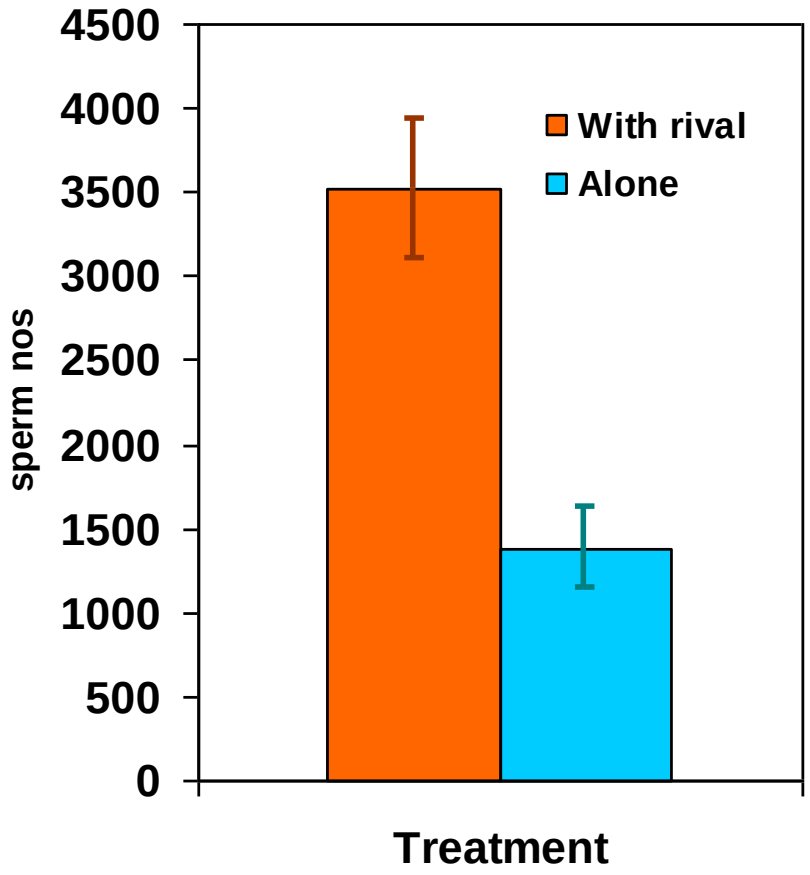


Male-male Competition: Sperm Competition

- Male-male competition doesn't stop when copulation is completed
- True determinant of reproductive success is fertilization of eggs
- Females may produce litters or clutches with multiple fathers
- Males can increase their chance of fertilization by increasing the number of sperm

Alternative strategies – sperm competition





Male-male Competition: Sperm Competition

- Mate guarding
- Prolonged copulation
- Copulatory plug
- Unattractive pheromones
- Sperm removal

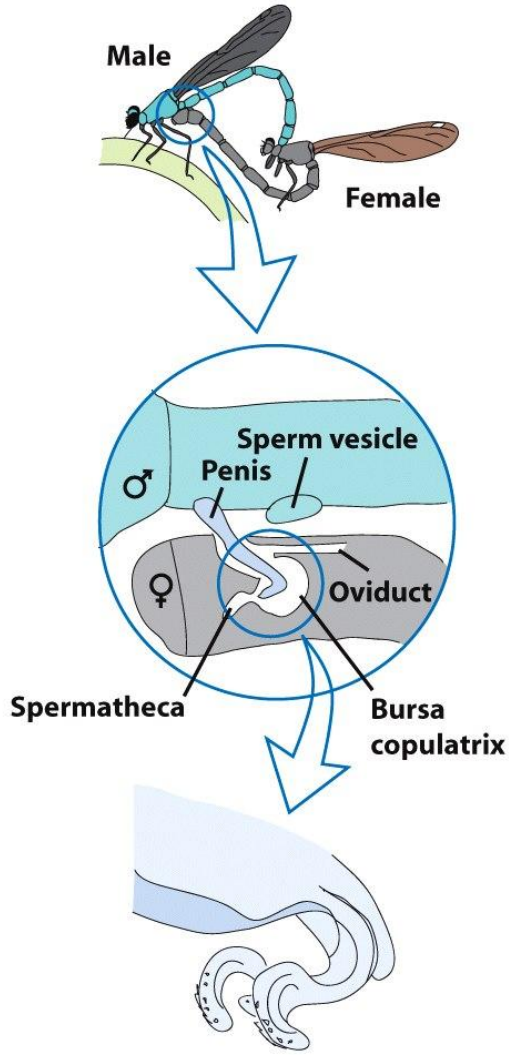


Figure 11-15 Evolutionary Analysis, 4/e

Male-male Competition: Infanticide

Figure 11-16 Evolutionary Analysis, 4/e

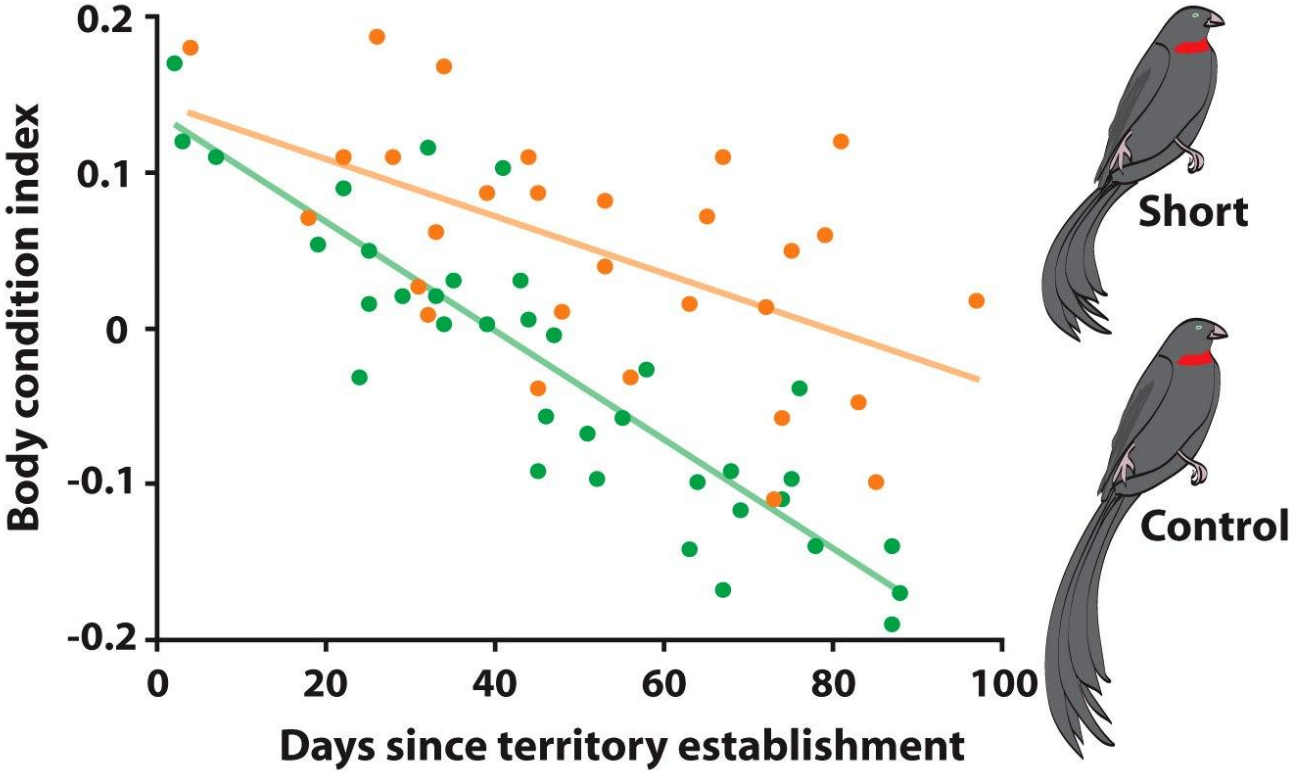
- When a new group of males takes over a pride, they typically kill existing cubs
- Pride ownership averages 2 years
- Females return to breeding condition earlier if cubs are killed
  - Increases chances that new males cubs will be weaned and independent by the time they are overthrown
- 25% of cub mortality due to infanticide

Female Choice

- Sexual selection by mate choice leads to evolution of elaborate courtship displays
  - Elaborate colour displays
  - Vocal displays
  - Dances etc.

- Are females choosy?

What happened to body condition?



- Males with longer tails (control) lost body condition much faster than short-tailed males despite spending less time flying
- Natural selection probably acts against it; likely the result of sexual selection

Do females choose?

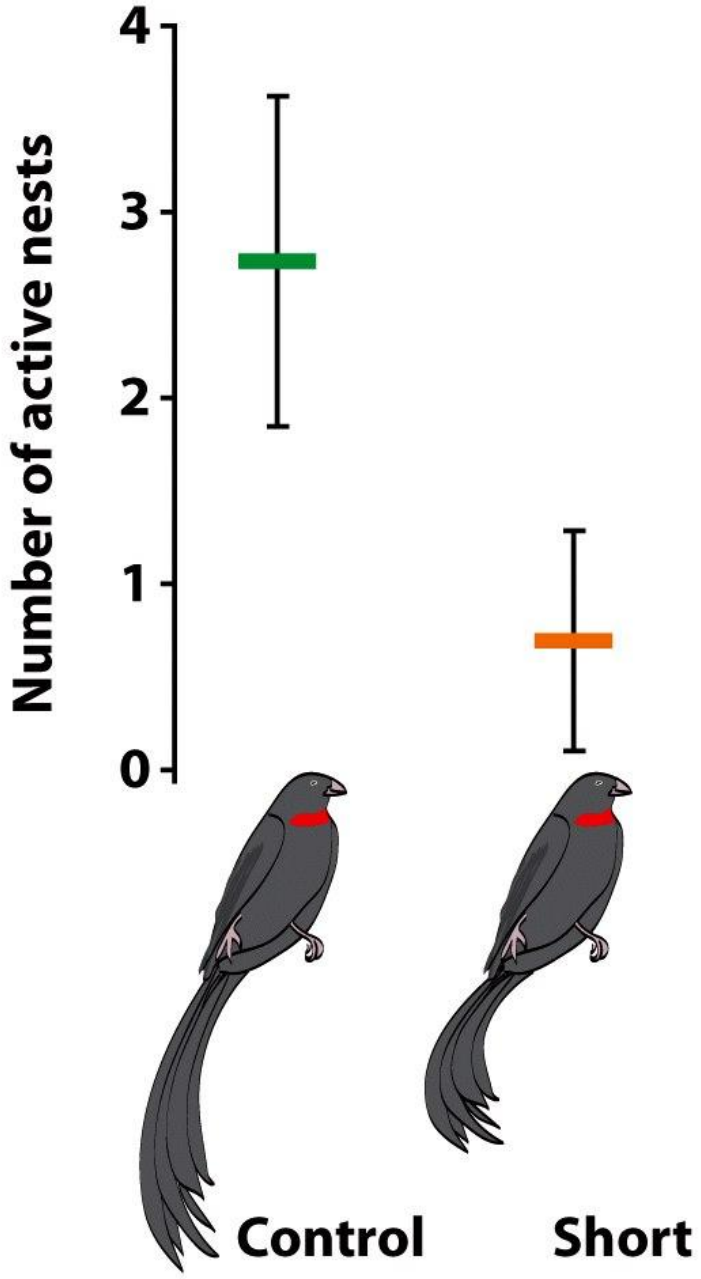


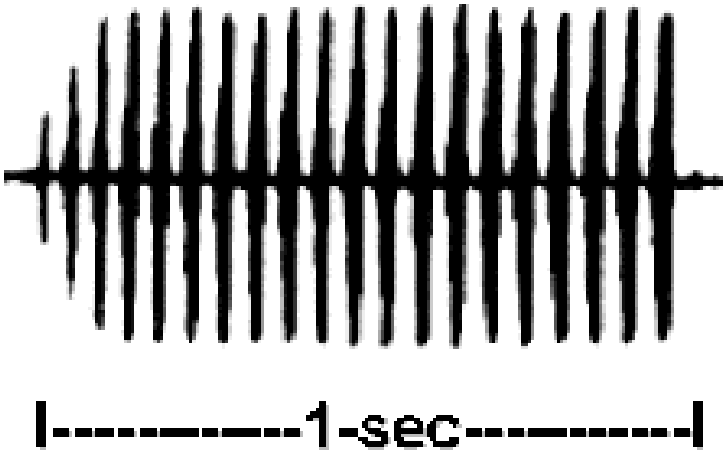
Figure 11-19 Evolutionary Analysis, 4/e

More females built nests on the territories of males with longer tails – 3x more than short-tailed males

Females actively discriminate among males

Female choice in tree frogs

Male gray treefrog
(*Hyla versicolor*)

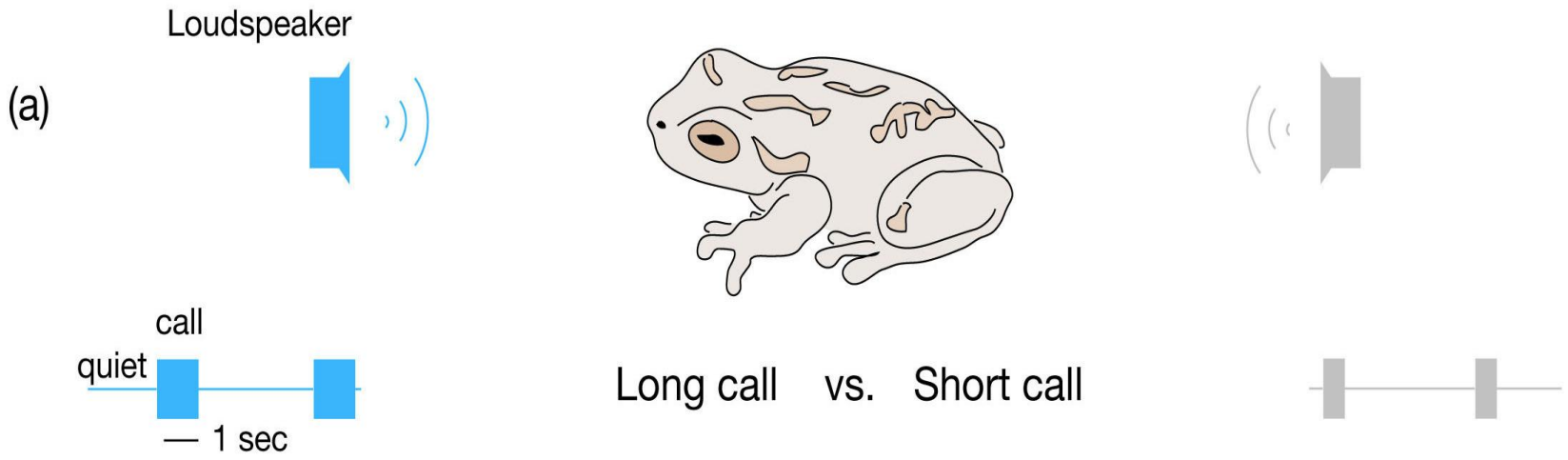


A 20-pulse call of a gray treefrog

Hypothesis: females prefer to mate with males that call longer

Choosy frogs I

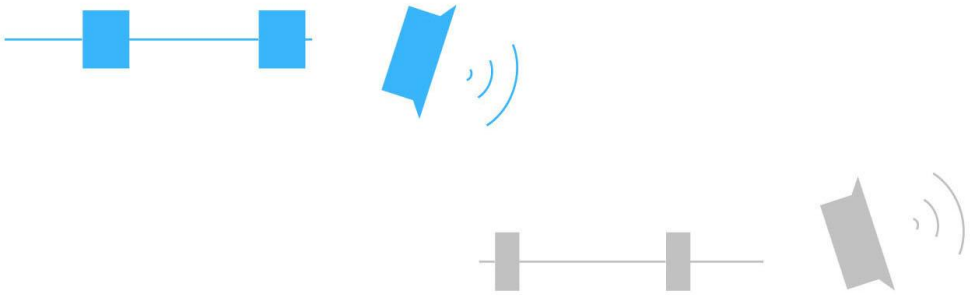
Do females gray tree frogs select their mates on the basis of their calls?

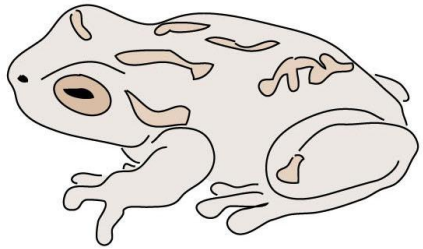


75% females preferred the longer calls

Choosy frogs II

(b)



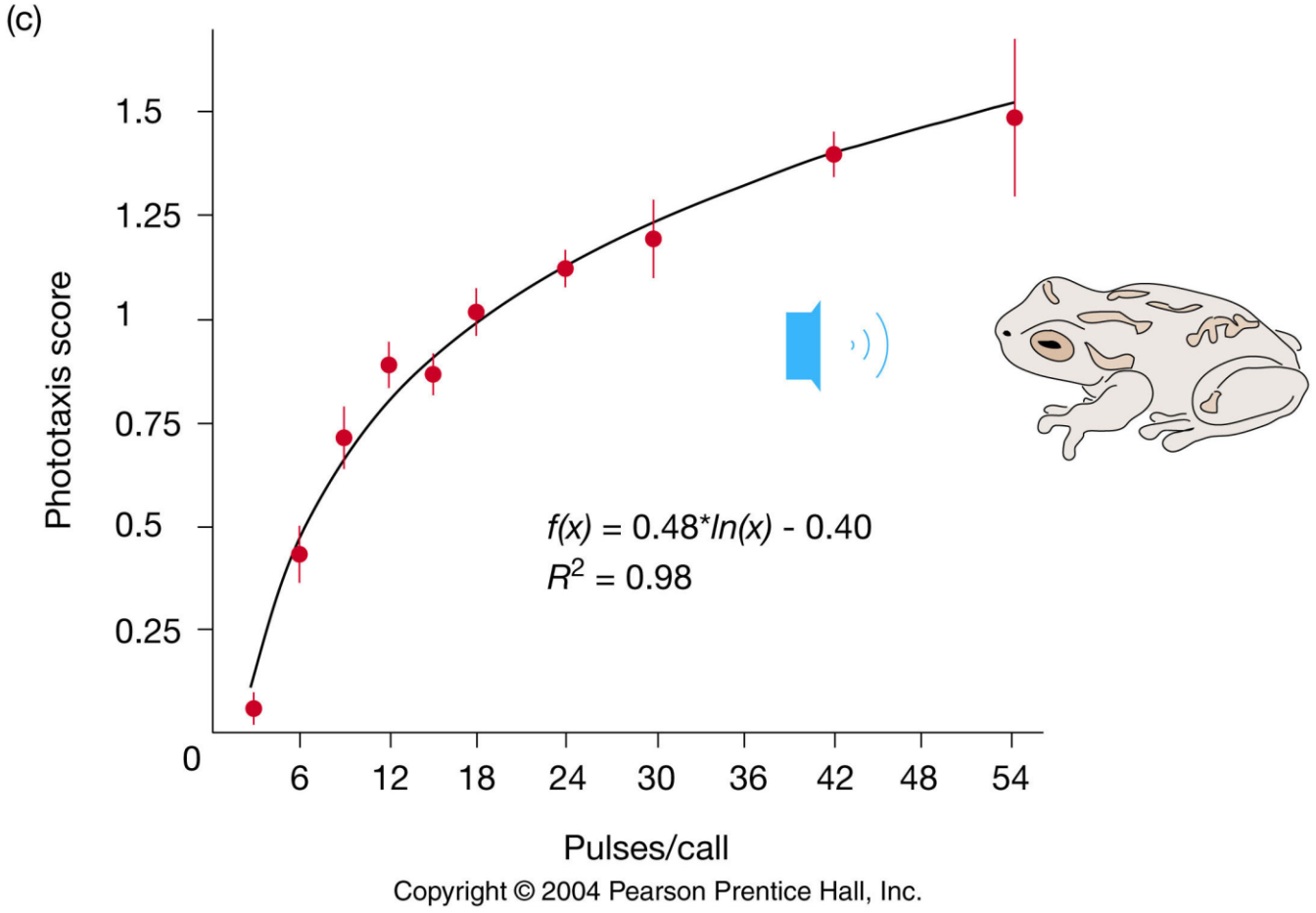


Long call vs. Short call

# Females choosing:	38	15

72% walked past the nearer speaker to reach the one with the longer call

Female choice



More selection against shorter calls

Female Choice

- Why should females be choosy?

1. Good genes
2. Better resources
3. Pre-existing sensory bias

Alternatively choice may be arbitrary

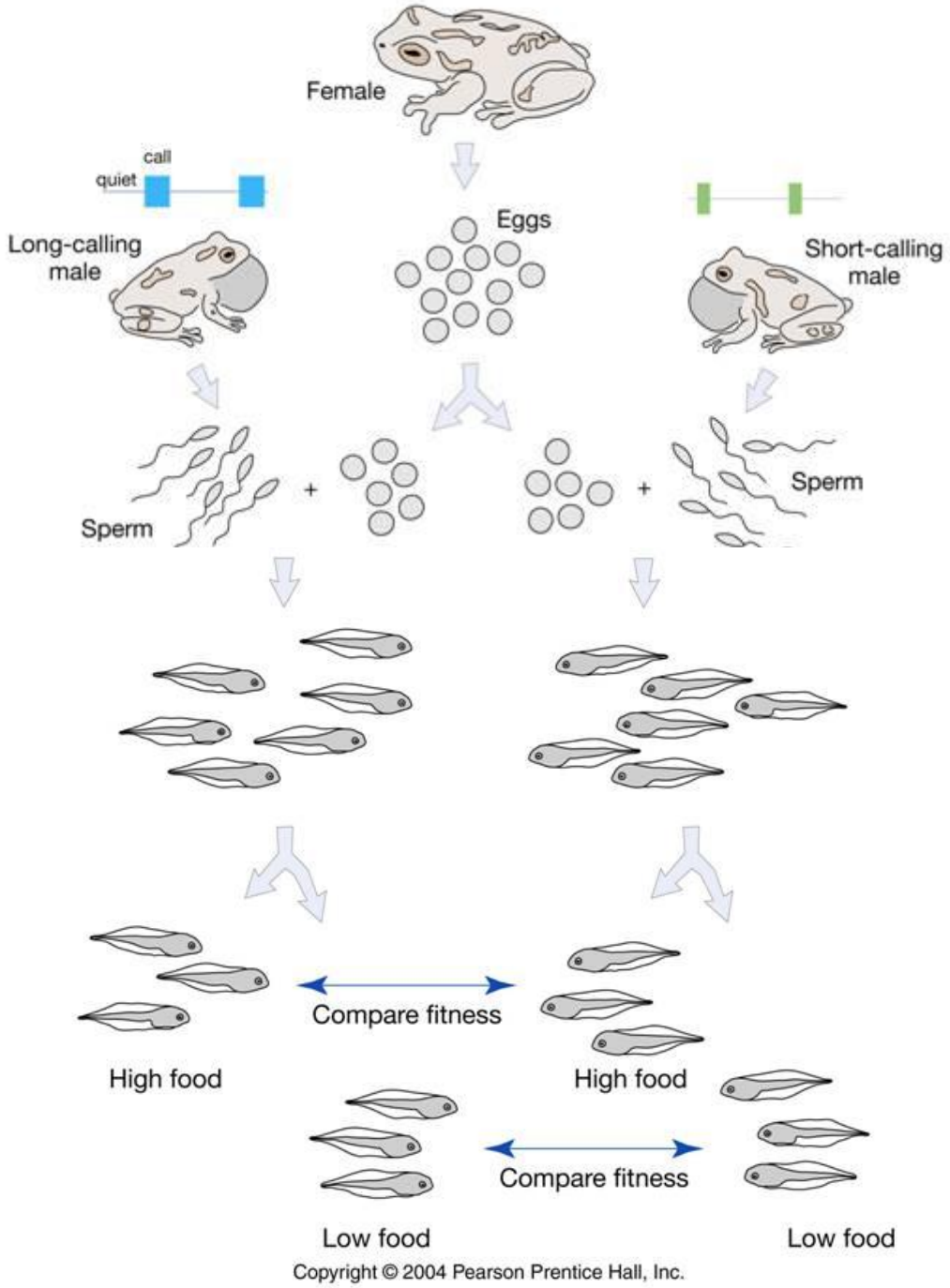
Female Choice: Good Genes

- Male displays may indicate genetic quality
  - Choosy females will secure better genes for their offspring
- In tree frogs – are the males with long calls genetically superior?

Compare fitness of half-siblings

Removes maternal effects – same mother but different fathers

Reared on either high food (generous diet) or low food (restricted diet)



Are longer calling males superior?

	1995		1996	
Fitness measures	High food	Low food	High food	Low food
Larval growth				
Time to metamorphosis				
Mass				
Larval survival				
Post-metamorphic growth				

Offspring of LC males did better in some cases (green boxes) while offspring of SC males never did better

Female Choice: Acquisition of Resources

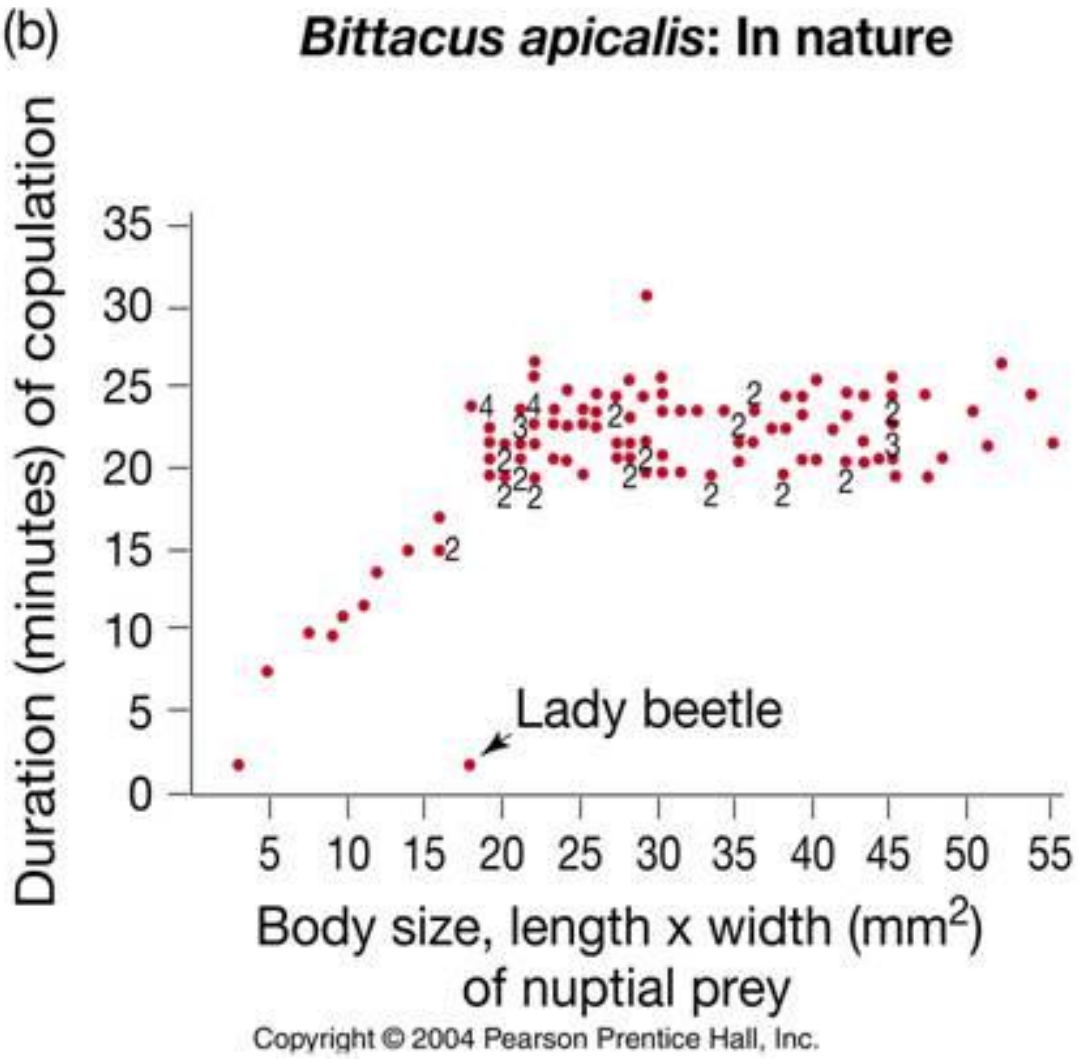
- In many species males provide resources beneficial to the female and/or her young
  - e.g. food or parental care

- Hangflies – males present female with food
  - If female accepts the prey, the pair copulates while she eats it

The larger the prey, the longer the copulation lasts and the more sperm that are transferred

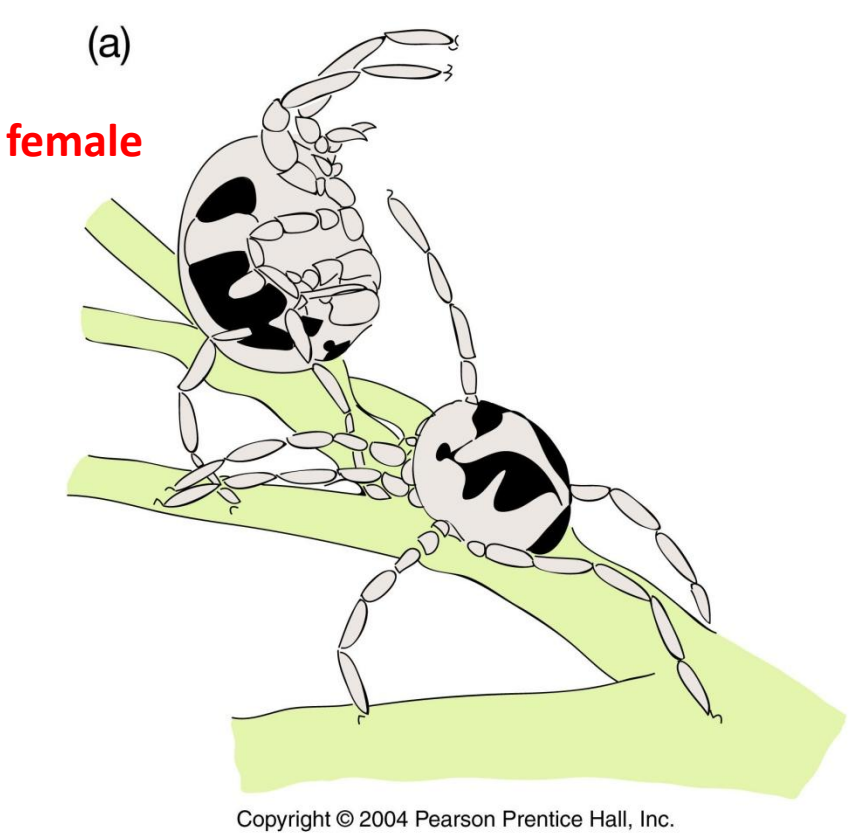
Benefit of female preference:

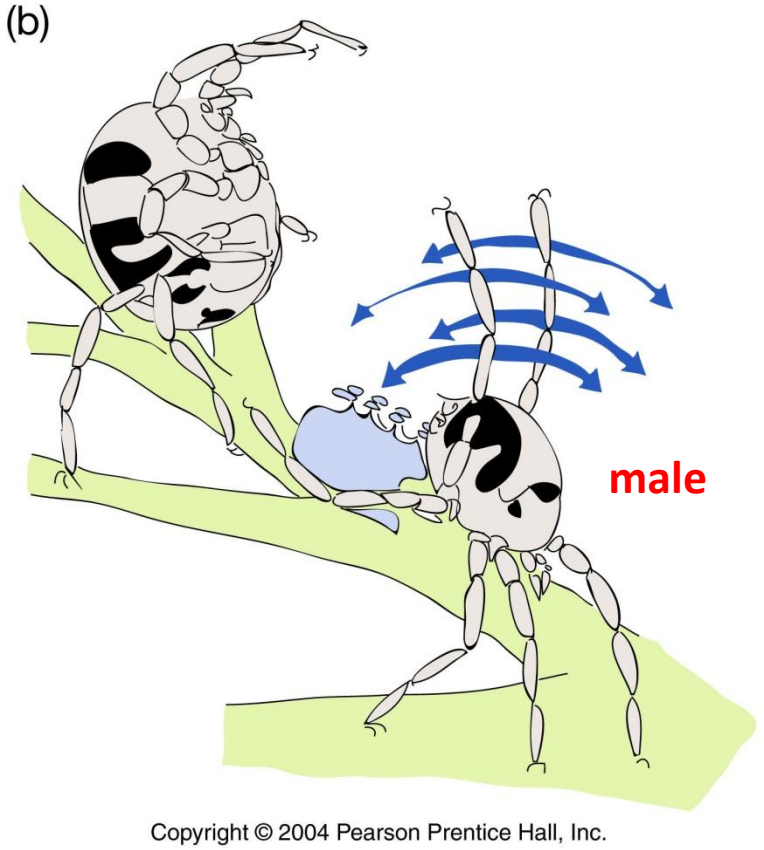
1. Nutrients to lay more eggs
2. Saves her from hunting for herself (which is dangerous)



Female Choice: Sensory Bias

- Sensory organs and nervous systems are used for things other than mate choice
- Sensory biases may make females responsive to certain cues
  - e.g. avoiding predators, finding food, identifying members of their species
  - Female mating preferences evolve first and that male mating displays follow





1. Vibration frequency of males similar to copepods
2. Behaviour of female toward male similar to behaviour towards copepods
3. Hungry females turned toward males more than well-fed females

Male courtship evolved to exploit female predatory behaviour

Arbitrary Female Choice

- **Sexy-son hypothesis**: once an advertisement is favoured by majority of females, selection will reinforce preference for fashionable trait
  - Females mating with fashionable mates will have more fashionable sons – more grandchildren
- **Runaway selection** – genetic correlation between trait and preference for that trait

Summary

- Sexual selection can explain sexual dimorphism

- Sexual selection occurs by:
  - Competition for mates (intrasexual selection)
  - Mate choice (intersexual selection)