

HEB 1330: Primate Social Behavior

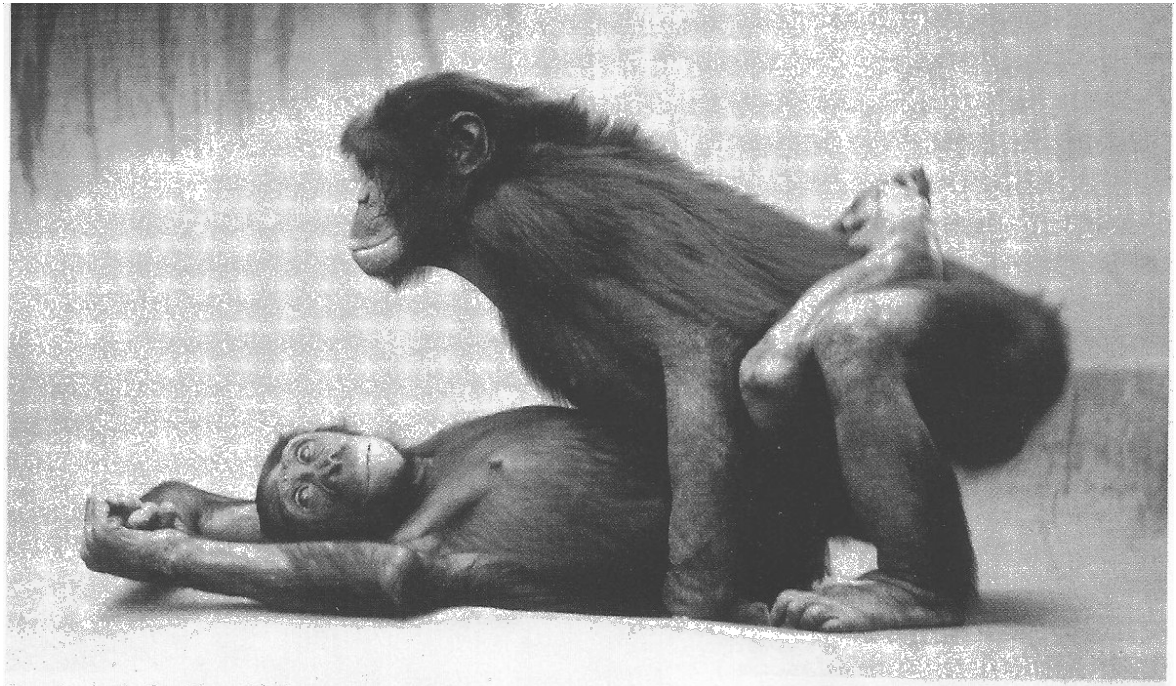
September 17th 2020

Sexual selection and the evolution of mating systems



Overview

- 1) General principles of sexual selection
- 2) Why are males bigger?
- 3) Diversity in mating systems
- 4) Sperm competition

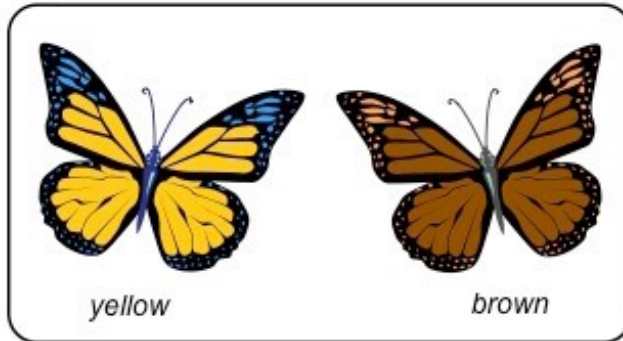


Reading: Lukas & Clutton-Brock (2013)

Natural Selection

1

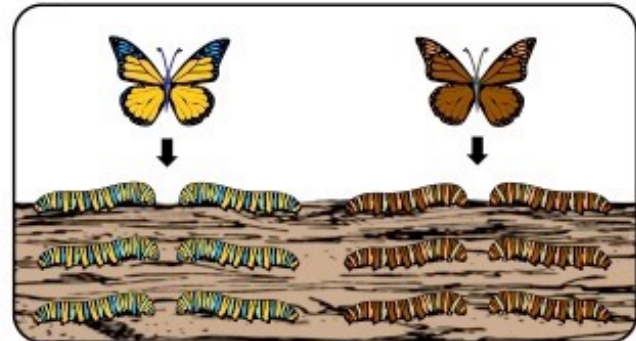
Variation



There is genetic variation within a population which can be inherited

2

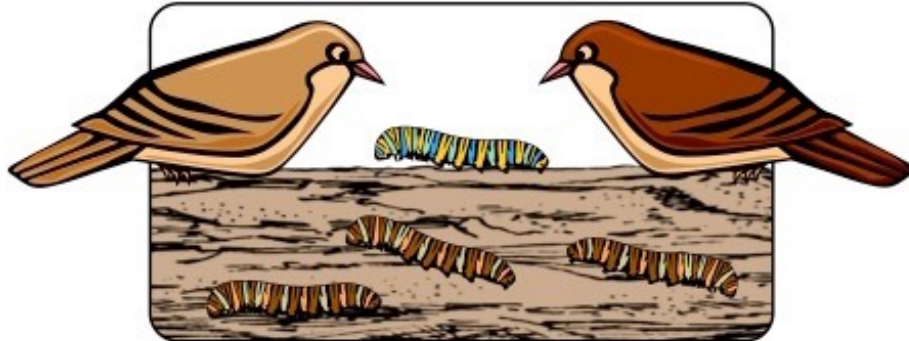
Competition



Overproduction of offspring leads to competition for survival

3

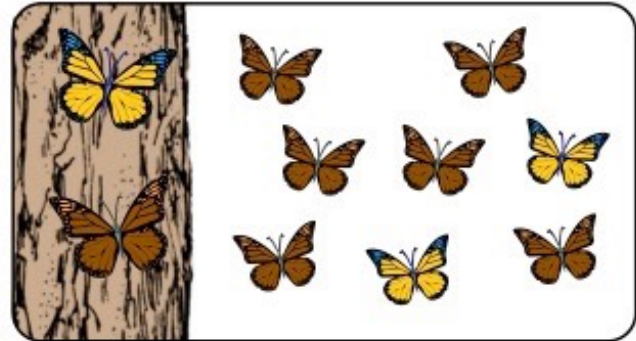
Adaptations



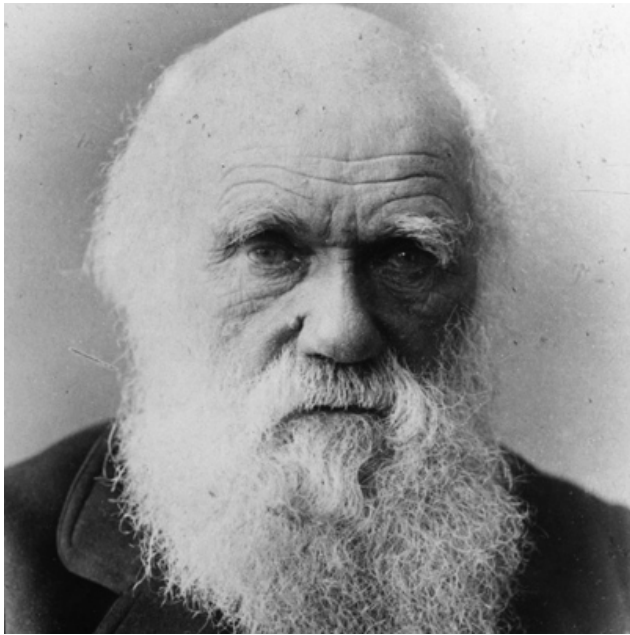
Individuals with beneficial adaptations are more likely to survive to pass on their genes

4

Selection



Over many generations, there is a change in allele frequency (evolution)



"The sight of a feather in a peacock's tail, whenever I gaze at it, makes me sick!"

-Charles Darwin, in a letter to botanist Asa Gray, April 3, 1860



Darwin's problems



Darwin's problems



Problems with Natural Selection

We expect traits to be beneficial or neutral with respect to fitness

What about traits that are conspicuous and seemingly detrimental to survival?

How do we explain the evolution of these traits?



How could these tails help in survival?



Problems with Natural Selection

‘Problematic traits’: Secondary Sexual Characteristics



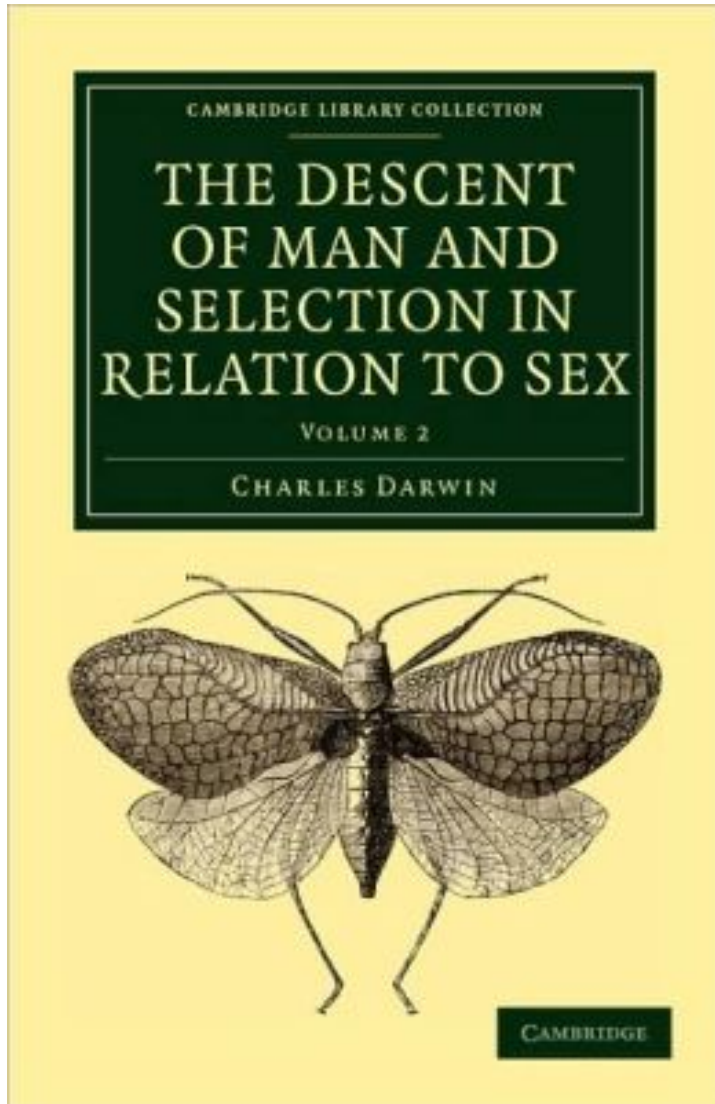
Traits that distinguish the sexes but are not necessary for reproduction

Group discussion

- 1) Watch video with another example of such a trait
- 2) Discuss in the group how to explain the evolution of these traits?
- 3) Try to condense the discussions outcome into 1 or 2 sentence and write it and paste it into the chat

How do we explain the evolution of these traits?

Sexual Selection

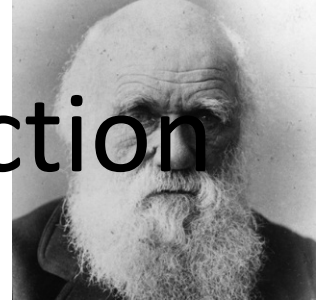


“... the advantage which certain individuals have over other individuals of the same sex and species, in exclusive relation to reproduction.”

-Darwin 1871



Darwin's Theory of Sexual Selection



Reduced survivorship by males with elaborate structures is compensated by their advantage in reproductive success

Individual differences in reproductive success



Intrasexual selection

competition of individuals within a sex for access to the other sex

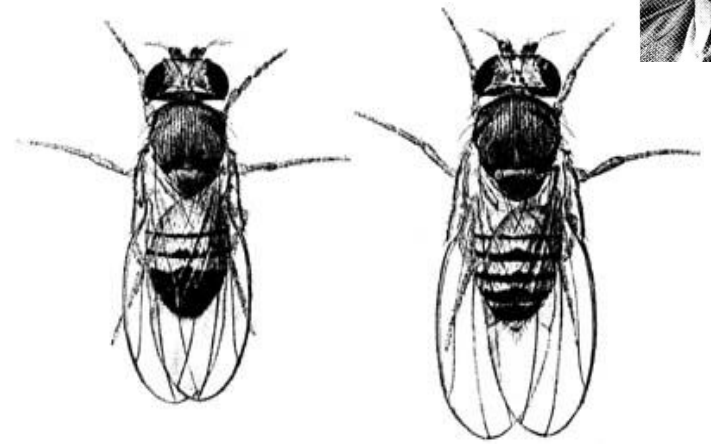
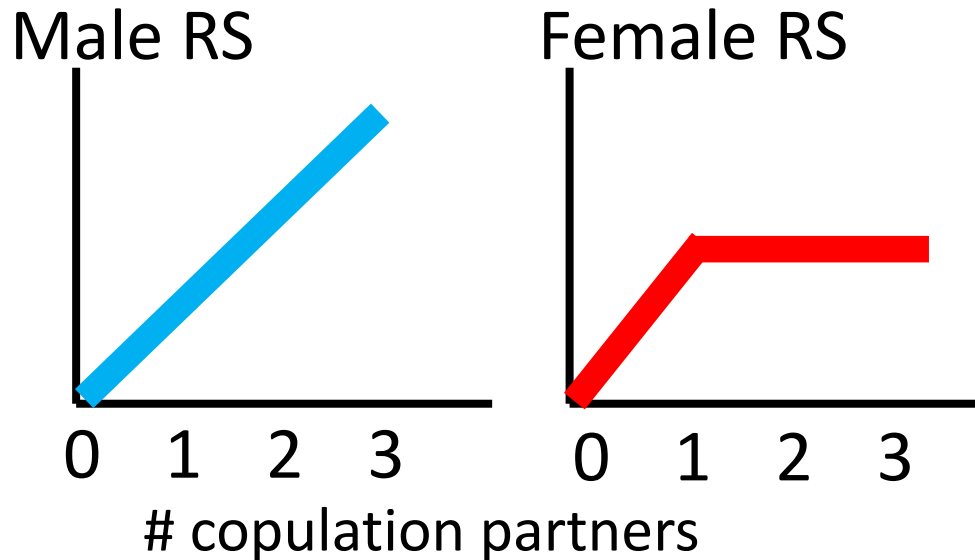
eg. male-male competition

Intersexual selection

differential preferences that one sex has of members of the other sex

eg. female choice...sexual coercion¹¹

Bateman Principle (1948)



fruit-flies in test-tubes

- (1) Male RS is more limited by number of partners
- (2) Male RS is potentially higher

How does the average reproductive success from females compare to males?



Cayo Santiago, Puerto Rico

Dubuc et al (2014) *Behav Ecol*



N = 275



N = 211

	<i>Female</i>		<i>Male</i>
Mean LRS	3.7		3.6
RS range	0-16		0-47
Variance LRS	22.3	<	58.5
No offspring	4.5%		17.5%

LRS = Lifetime Reproductive Success

→ Males have a higher variance in reproductive success

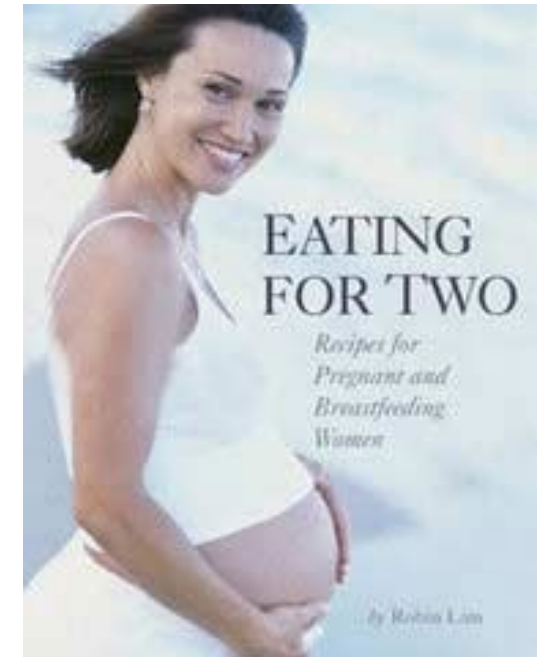
Cayo Santiago, Puerto Rico

A scanning electron micrograph (SEM) showing a large, textured, reddish-brown spherical cell, likely an egg, surrounded by numerous smaller, tadpole-shaped sperm cells. The sperm cells have long, thin tails and oval heads. The background is black.

Sperm is cheap. Eggs are expensive.

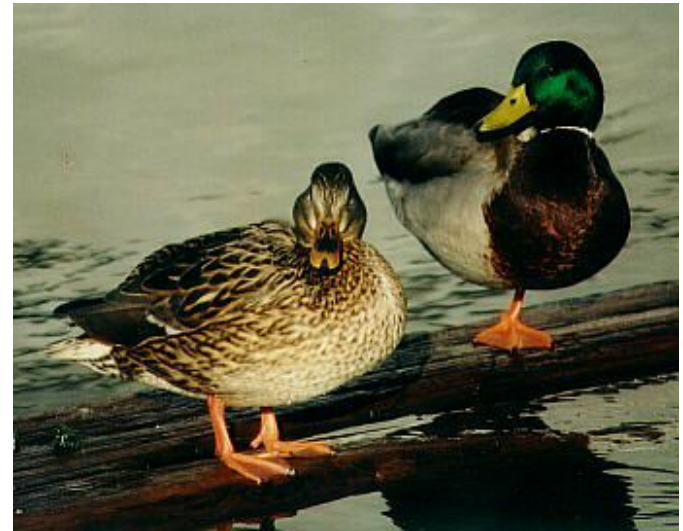
Male and female reproductive success

- Female reproduction
 - costly and time-consuming
 - limited by access to food
- Male reproduction
 - cheap (sperm)
 - limited by access to females



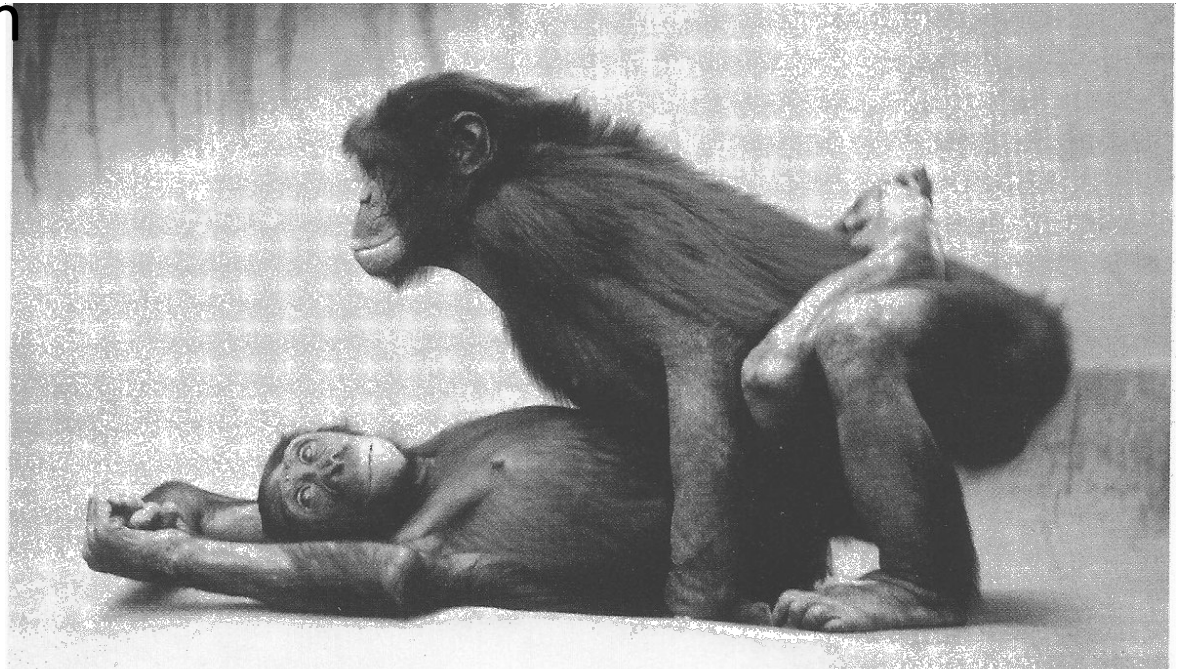
- Selection over access to other sex usually stronger in males
- Strong male-male competition over the access to females

Females as the “Ecological Sex”



Overview

- 1) General principles of sexual selection
- 2) Why are Males Bigger?
- 3) Evolution of mating systems
- 4) Sperm competition



Sexual Dimorphism

♂ body size

♀ body size



♂ canine size

♀ canine size



Sexual Dimorphism



Why do males in some species invest into fighting power?



Cayo Santiago, Puerto Rico

21

Dubuc et al (2014) *Behav Ecol*



	<i>Female</i>		<i>Male</i>
Mean LRS	3.7		3.6
RS range	0-16		0-47
Variance LRS	22.3	<	58.5
No offspring	4.5%		17.5%

- Males have a higher variance in reproductive success
- Intensifies selection for male fighting ability



Mating Systems

Group structure in relation to sexual behavior



monogamy



polygyny



polyandry



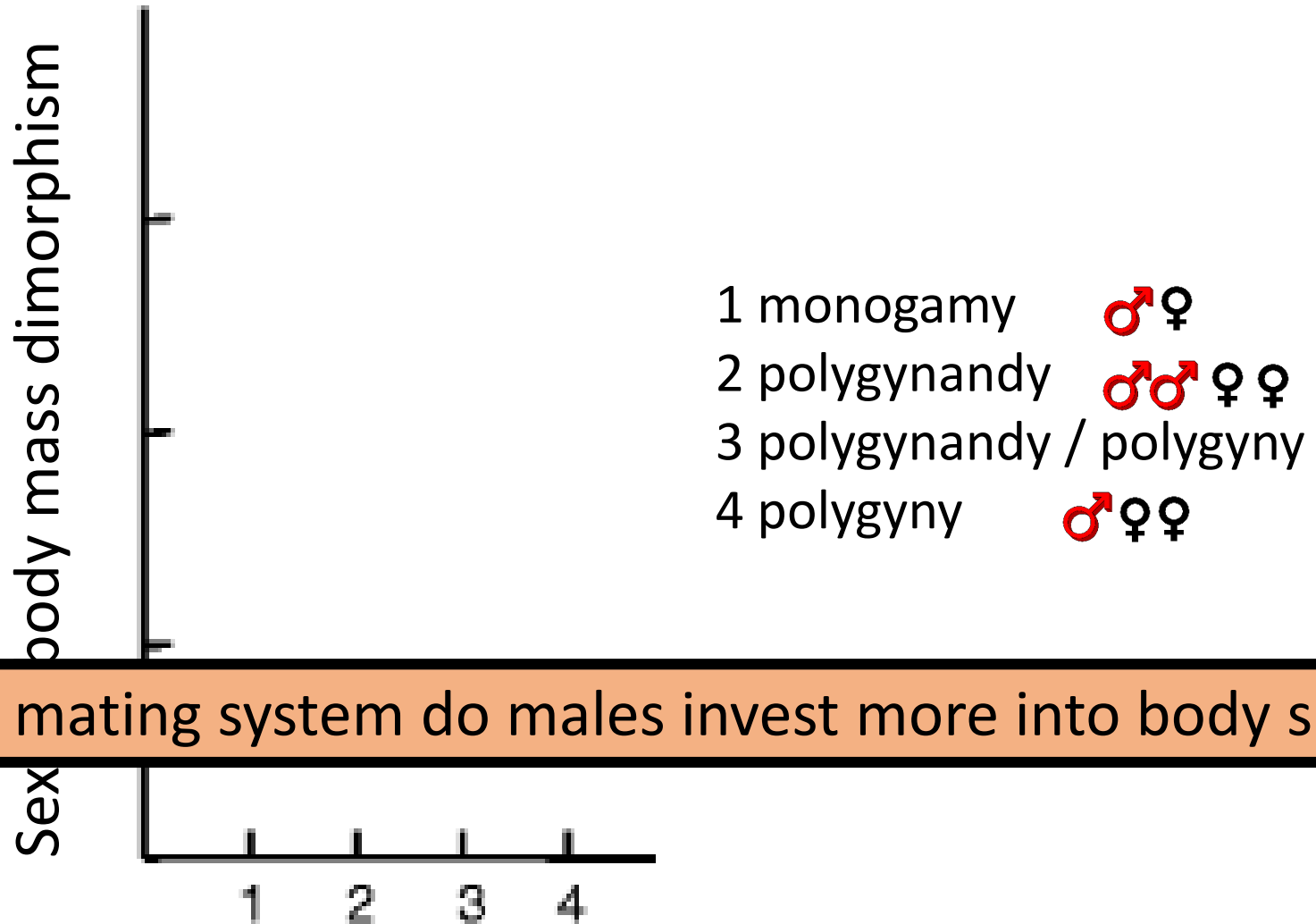
polygynandry



polygamy

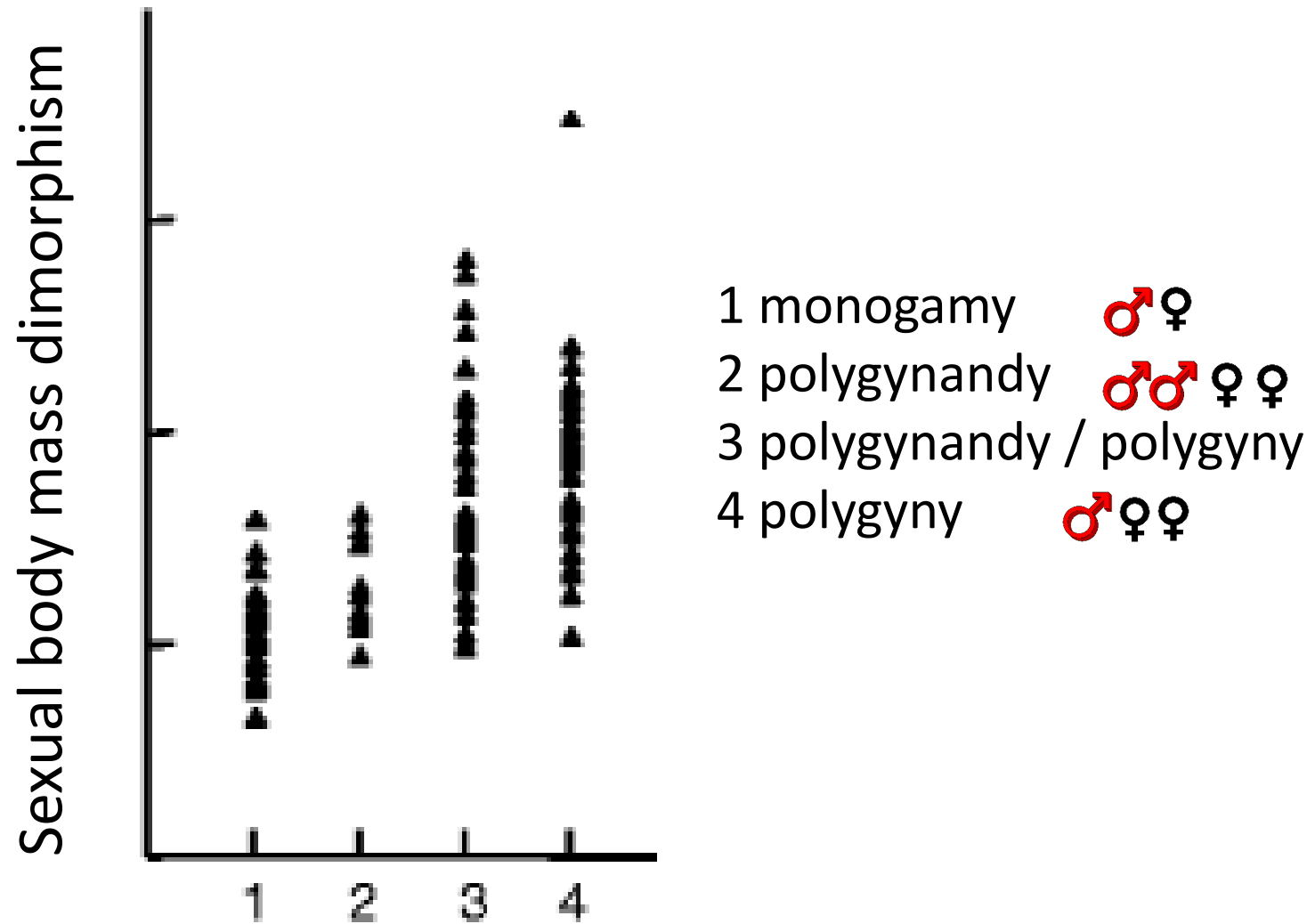
promiscuity

Mating System and Dimorphism



In which mating system do males invest more into body size?

Mating System and Dimorphism



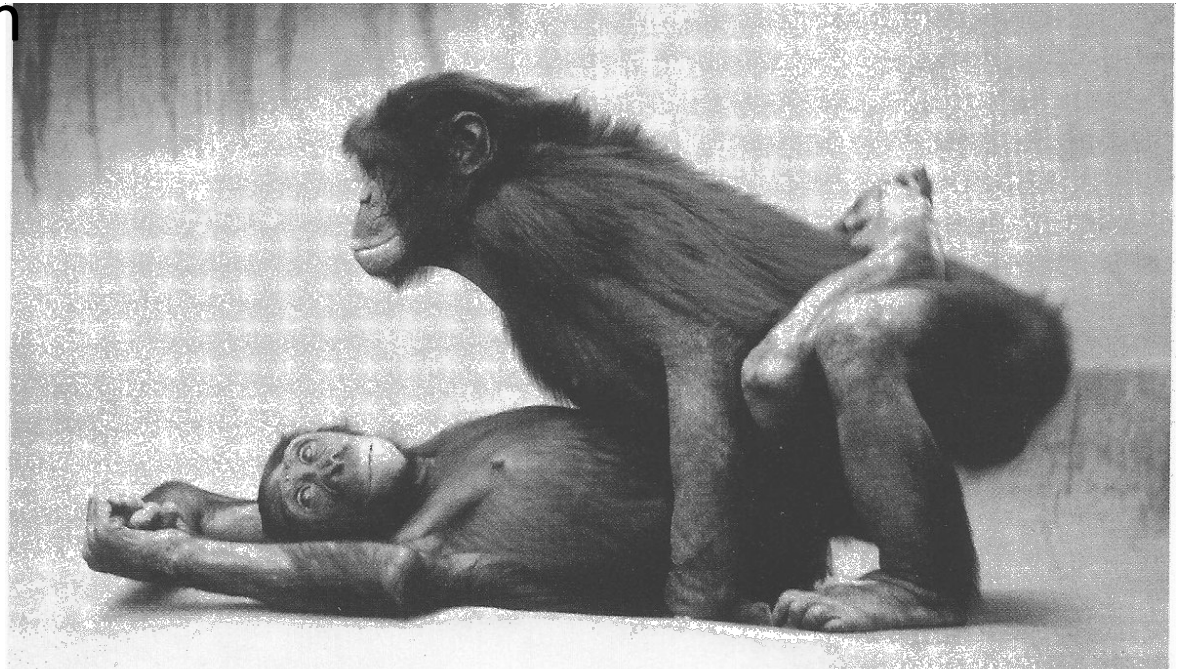


Why are males bigger?

- Higher variance in male than female lifetime reproductive success intensifies selection for male fighting ability
- The more females a single male can monopolize, the stronger this selection

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Mating Systems



monogamy



polygyny



polyandry




polygynandry



- A Mating systems when females solitary
- B Mating systems when females group-living

Solitary females

Male strategy 

♀

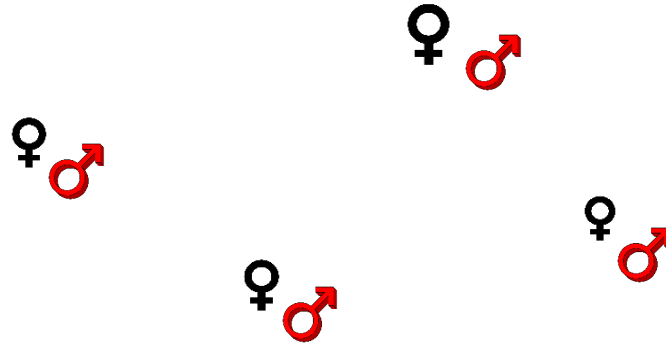
♀

♀

♀

Solitary females

Male strategy ♂



join a single female → monogamy

Solitary females




join a single female → **monogamy**

- high levels of male investment
 - >territory defense/ offspring raising (e.g. infant carrying)/ infanticide protection
- lack of strong sexual dimorphism
- paternity certainty (social versus mating monogamy)

Male strategy ♂

Solitary females

Male strategy 

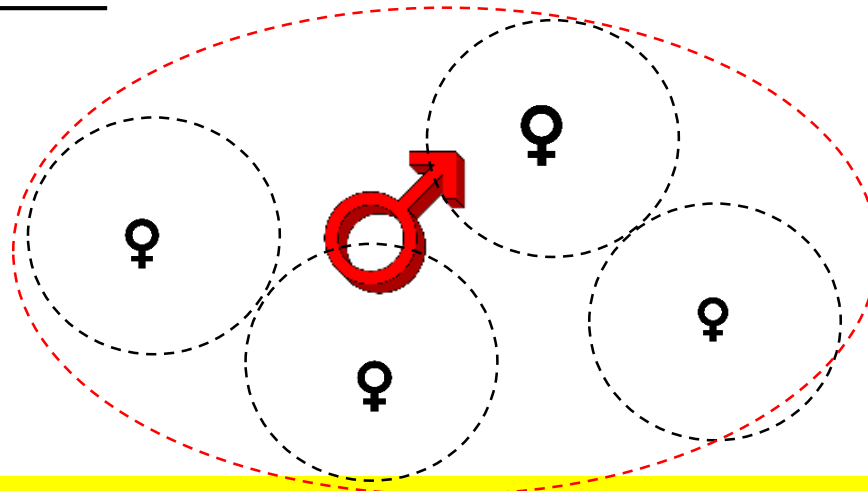
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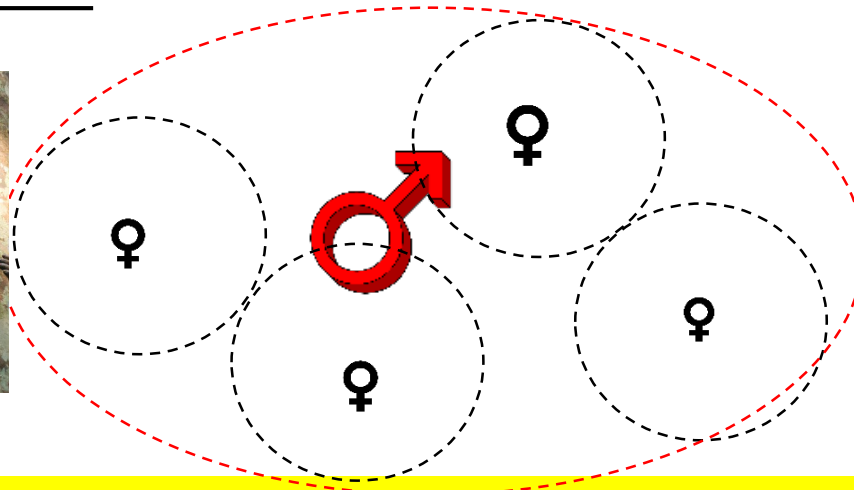
Solitary females



repel competitors from territory including several females → **polygyny**

Male strategy ♂

Solitary females




repel competitors from territory including -
several females → **polygyny**

- extreme levels of sexual dimorphism
- associated with different morphotype (arrested development)

Male strategy ♂

Solitary females

Male strategy 

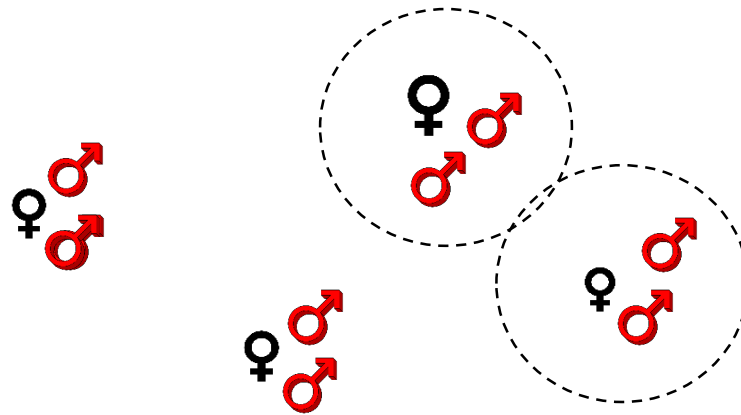
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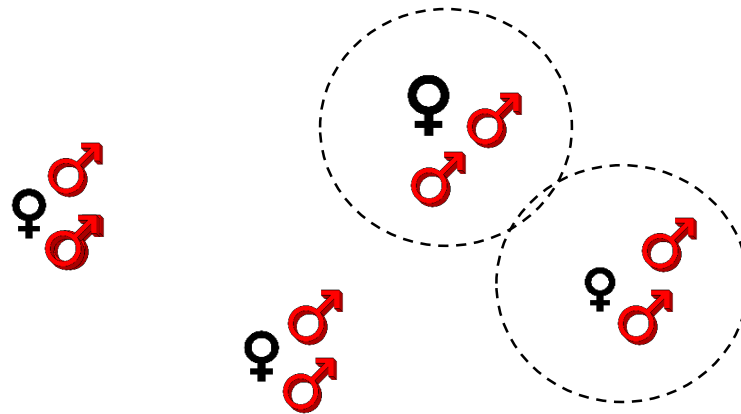
Solitary females



join forces with other males to help raise female's offspring → **polyandry**

Male strategy ♂

Solitary females




join forces with other males to help raise female's offspring → **polyandry**

- multiple males single breeding female
- in callitrichids: male infant carrying and high female reproductive rate
- in gibbons: more common in low quality habitats / tolerance of second male due to contribution to resource and female defense

Male strategy ♂

Solitary females

Male strategy 

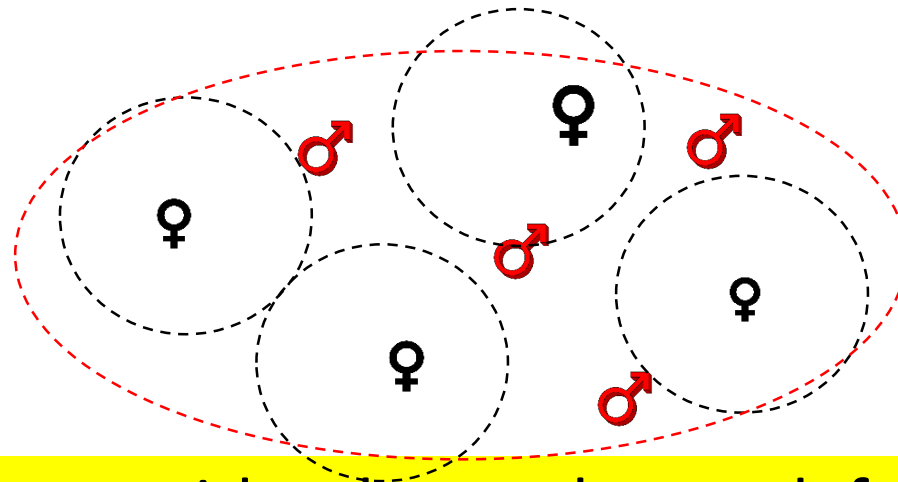
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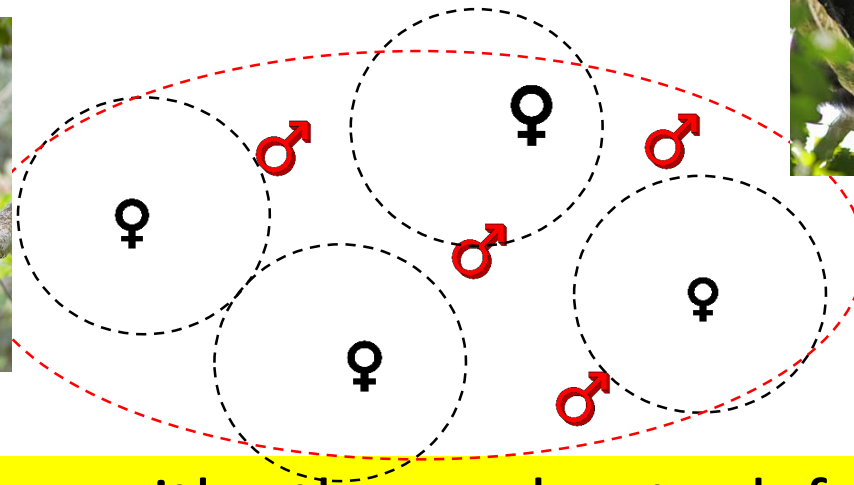
Solitary females



join forces with other males to defend territory including several females →
polygynandry

Male strategy ♂

Solitary females

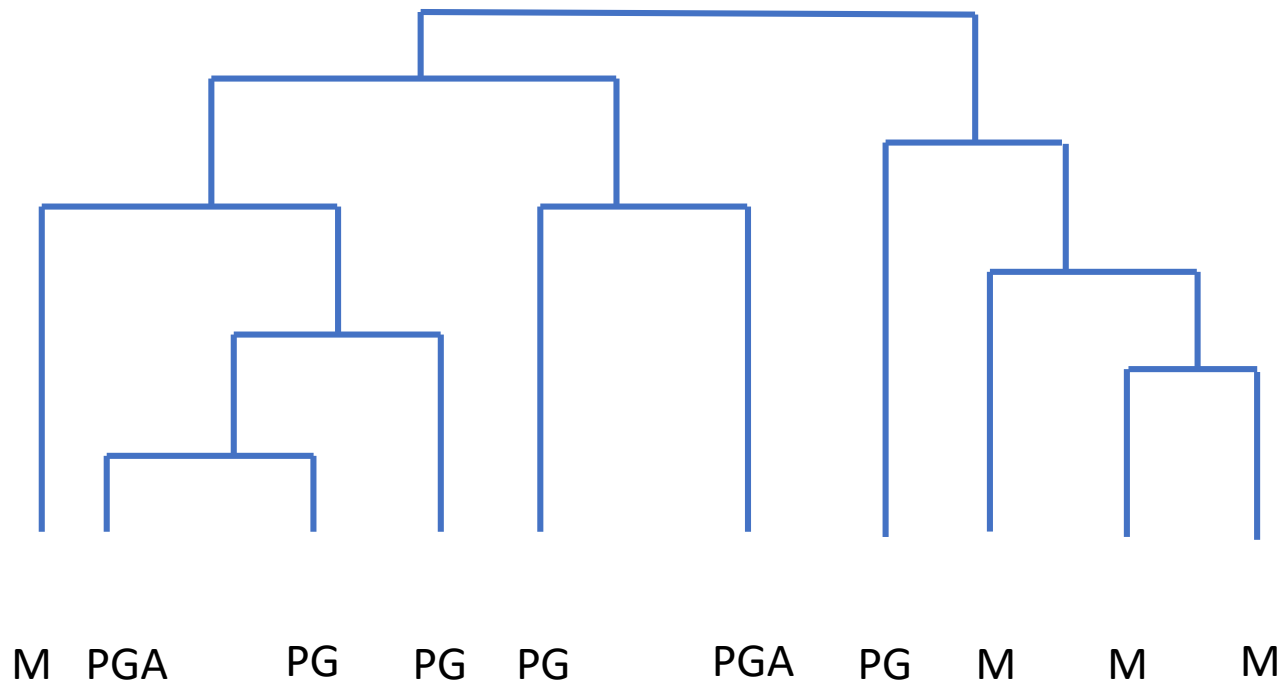


join forces with other males to defend territory including several females → **polygynandry**

- defense of territory (collective action problem)
- females not always solitary (fission-fusion)

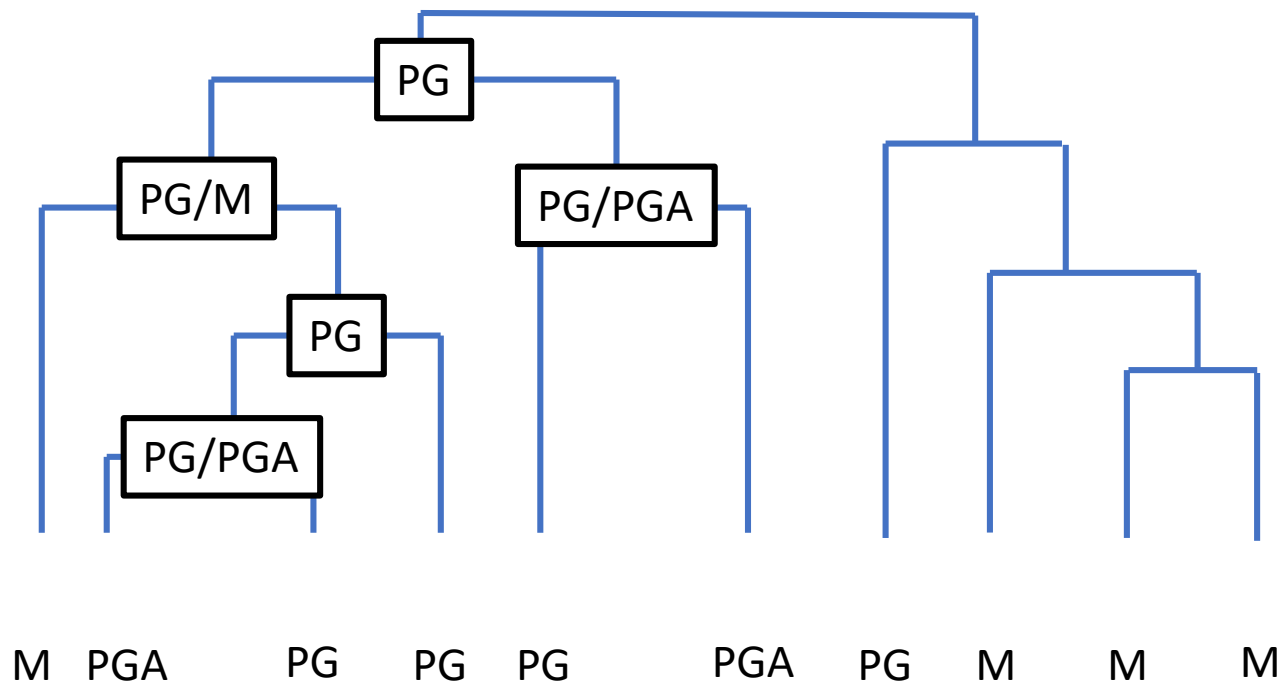
Male strategy ♂

Phylogenetic inference



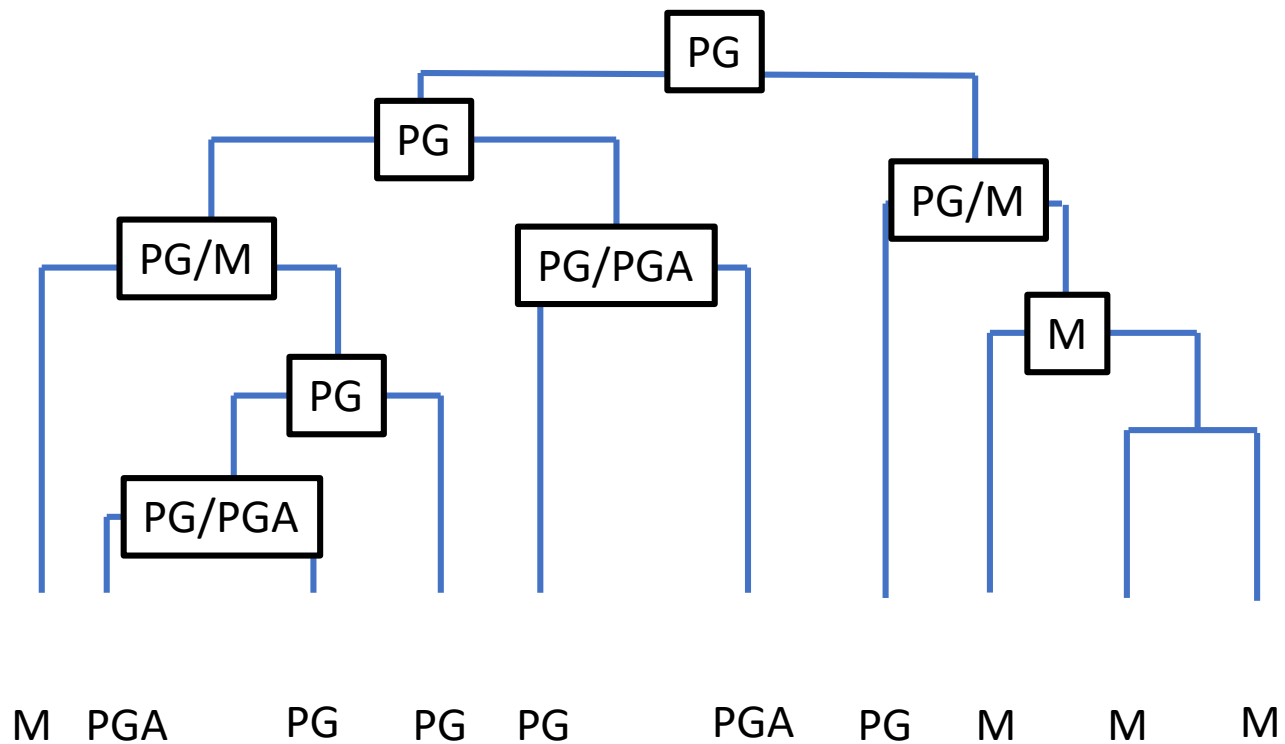
What is the most likely ancestral mating system here?

Phylogenetic inference



What is the most likely ancestral mating system here?

Phylogenetic inference



What is the most likely ancestral mating system here?



- solitary
- group-living
- social monogamy

Does paternal care lead to social monogamy?
When do we see paternal care?

Group-living females



single-male multi-female



– polygyny



Group-living females



single-male multi-female



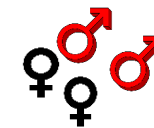
multi-male-multi-female



– polygyny



– polygynandry



Group-living females



single-male multi-female

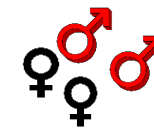
– polygyny



female group size etc

multi-male-multi-female

– polygynandry



Mating system exercise

Group discussion (5 minutes)

- 1) Look at the 3 pairs of skull
- 2) Discuss in the group what characteristics of the mating system you would expect and the person with birthday closest to today reports back into group

Why are males bigger?

Species 1



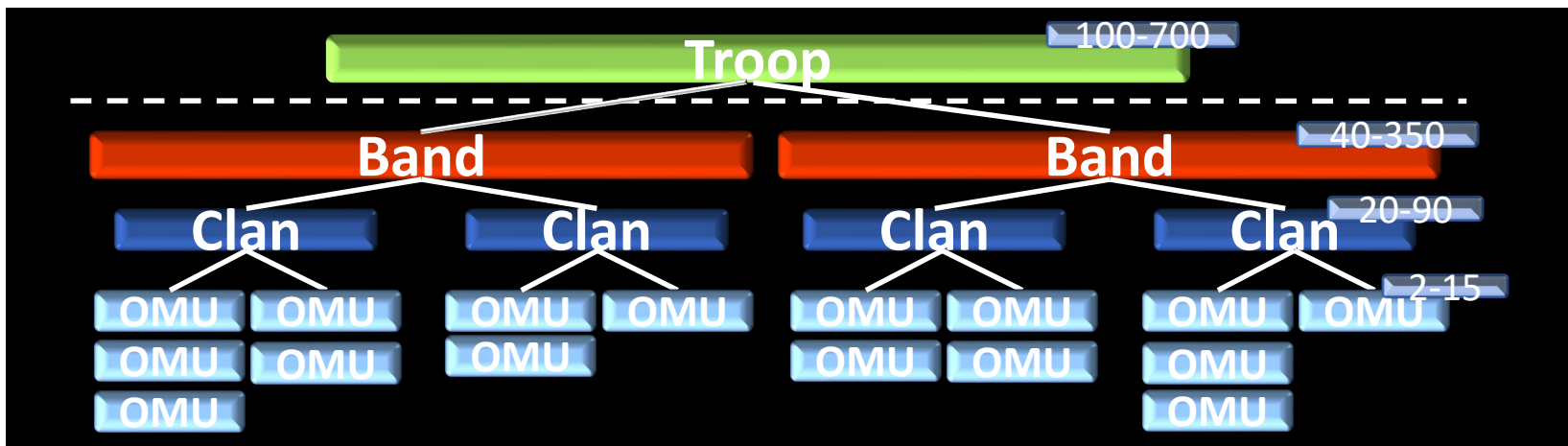
Species 2



Species 3



Multilevel-societies





DIVERSITY IN MATING/SOCIAL SYSTEM



Pre-copulatory competition

- Male competition over access to females

Post-copulatory competition

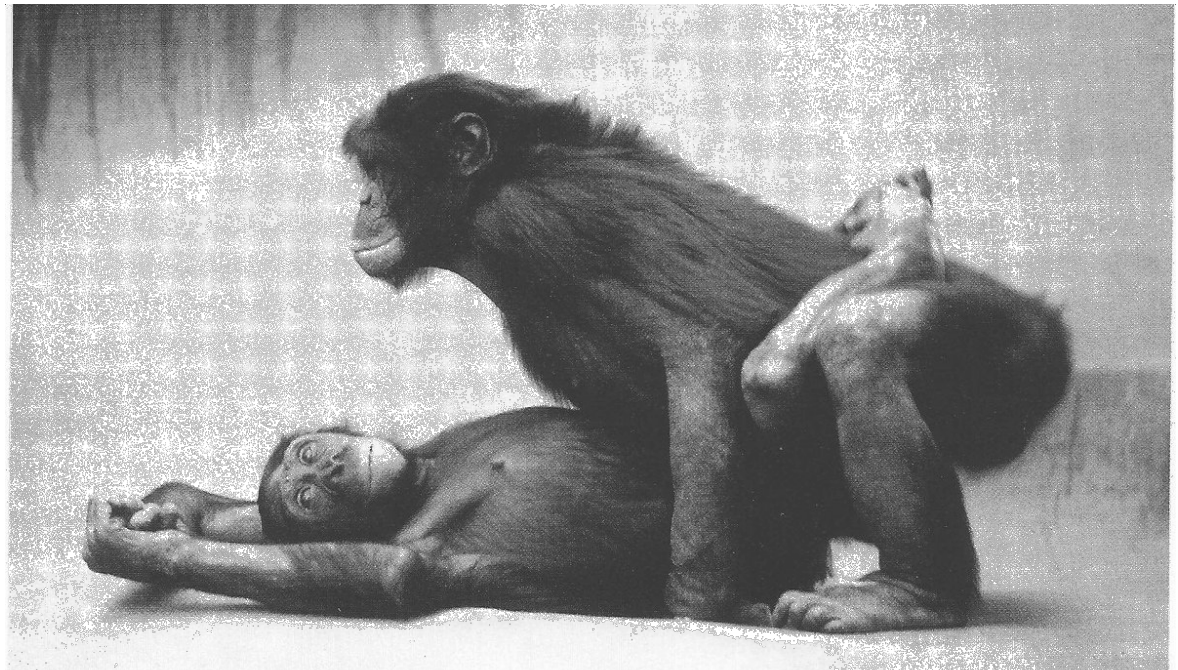
- Sperm competition

MORPHOLOGY

- Sexual dimorphism
- Testes size
- ...

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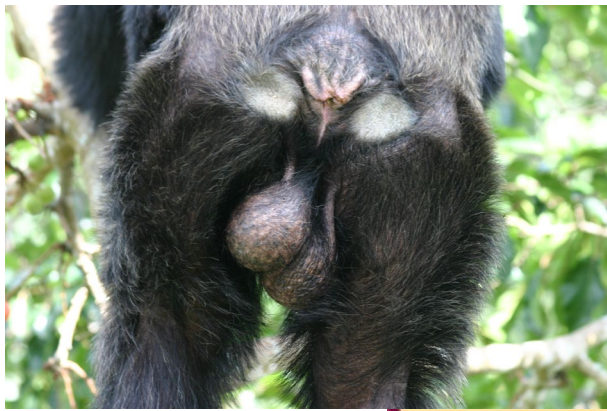


Sperm Competition

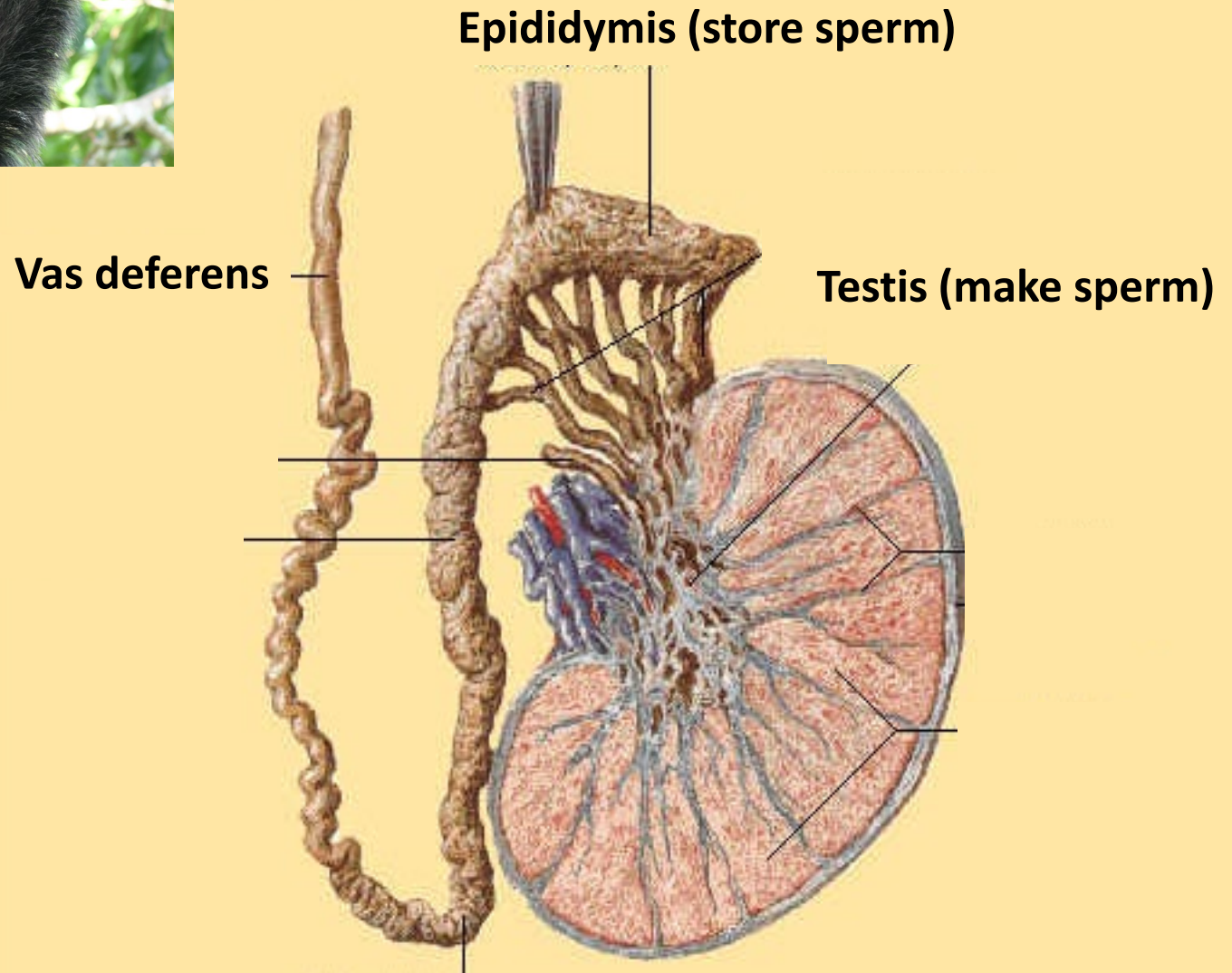
“competition among sperm of two or more males for the fertilization of a single female”

- occurs in species with multi-male mating
- like buying tickets for a raffle
- results in both morphological and behavioral adaptations

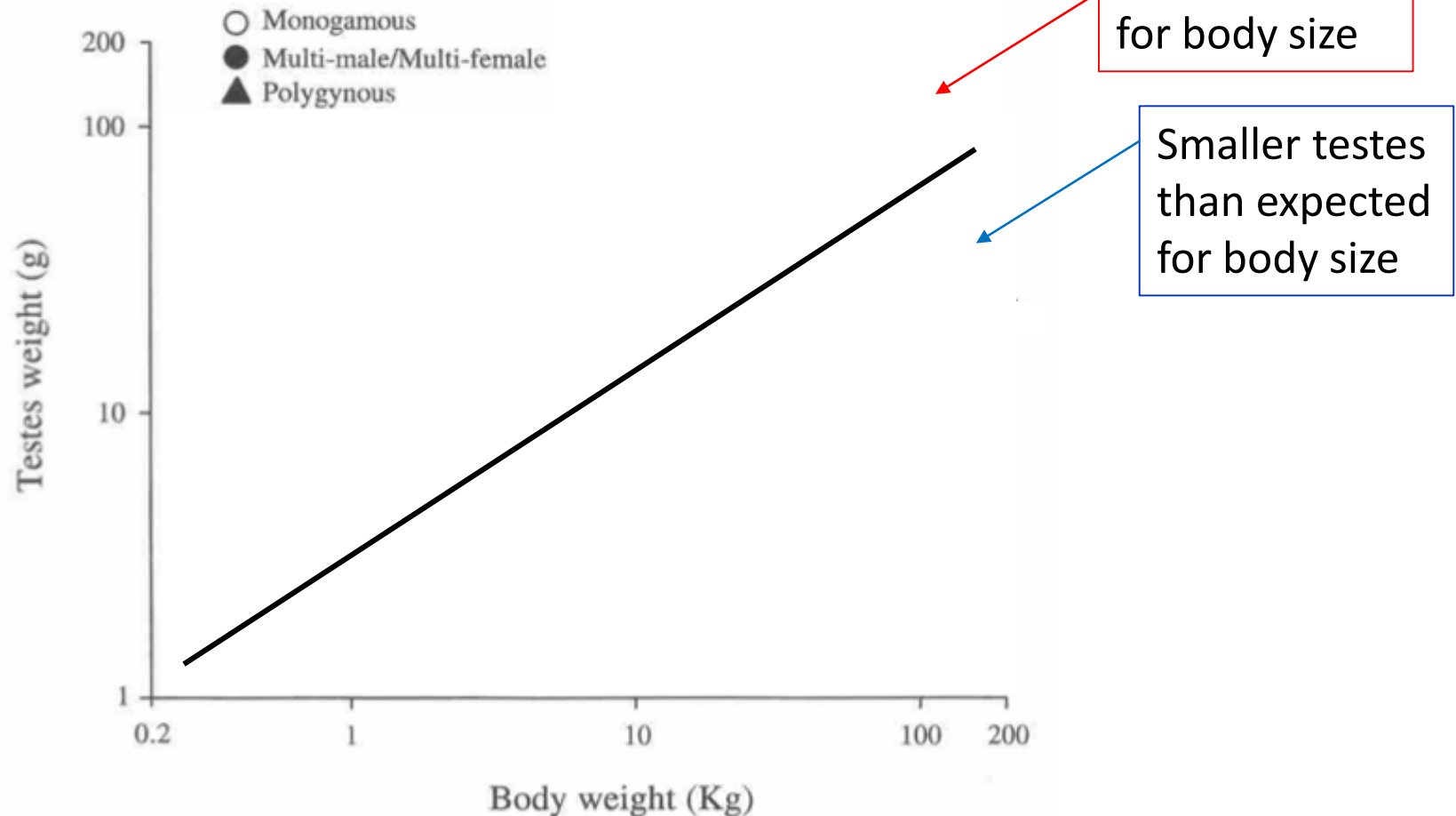




Bigger testes make more sperm

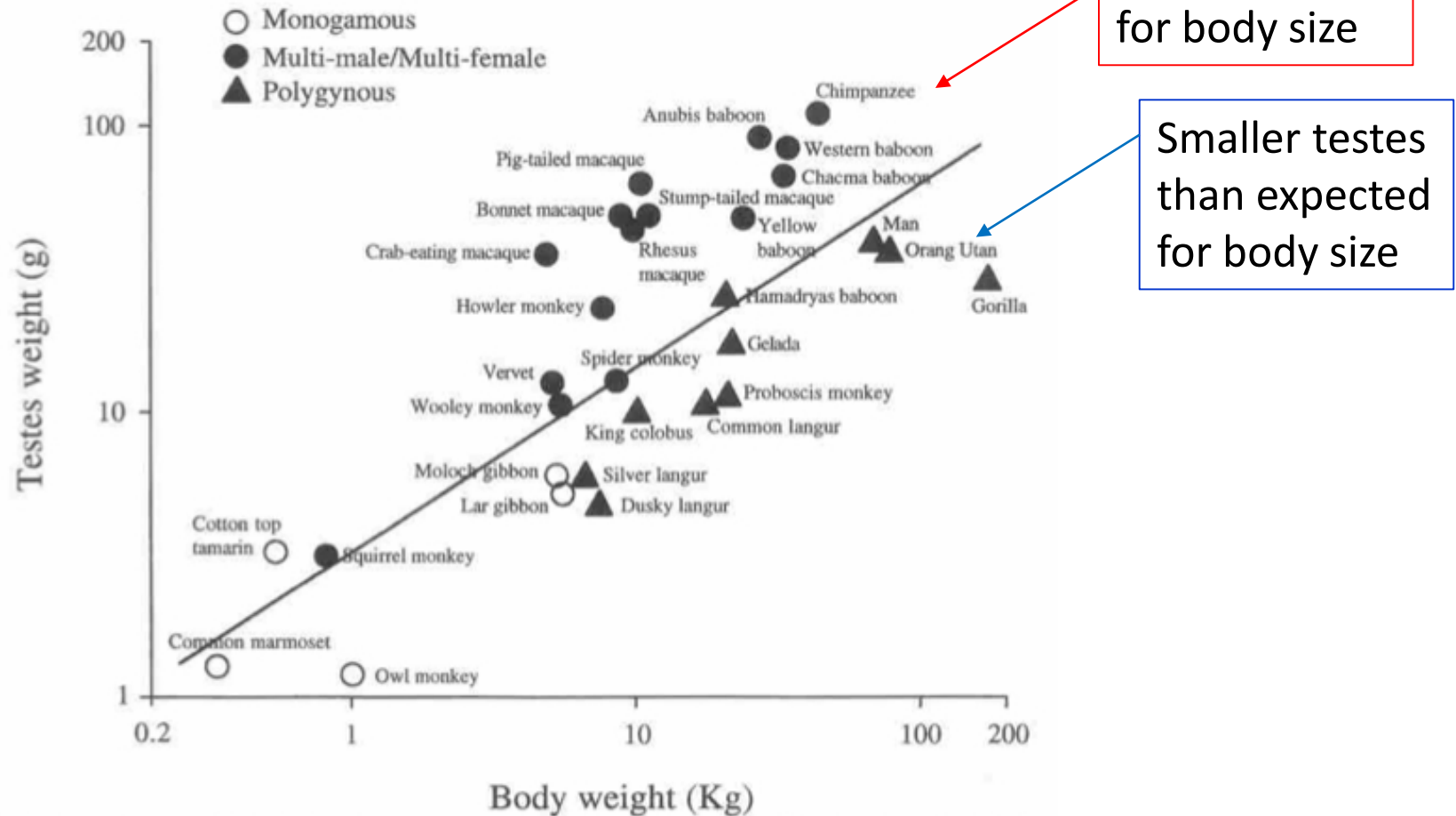


Testes size



Where do monogamous, polygynous, multi-male-multi-female species fall in relation to average line?

Testes size



Testis size as adaptations to multi-male mating

Testes size

Chimpanzee

Brain

Testis

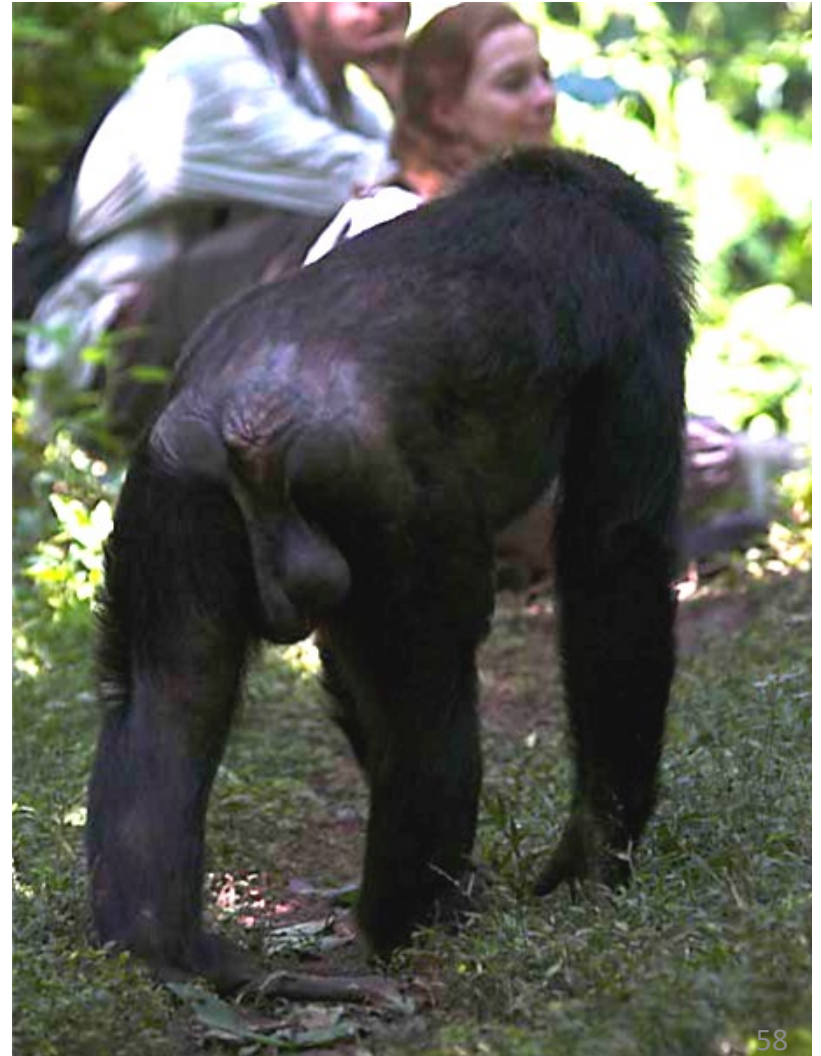


Testes size

Gorilla: one male mating



Chimpanzee: multi-male mating





DIVERSITY IN MATING/SOCIAL SYSTEM

A thick blue vertical line is positioned to the left of the two yellow boxes.

Pre-copulatory competition

- Male competition over access to females

Post-copulatory competition

- Sperm competition

MORPHOLOGY

- Sexual dimorphism
- Testes size
- ...