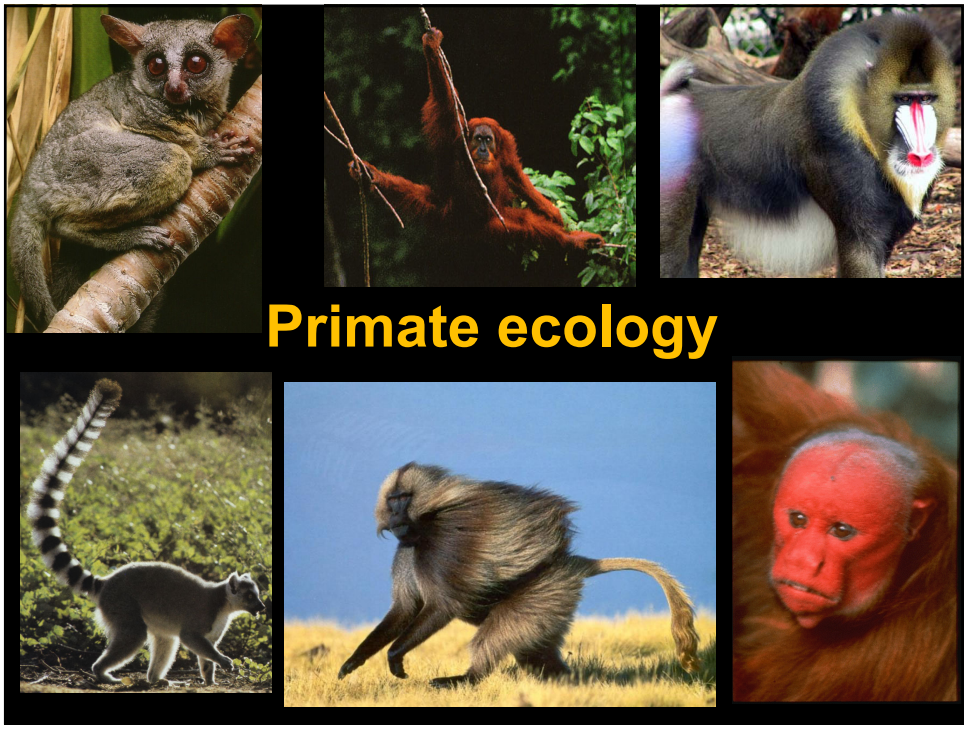


1

Primate ecology

- Study of the interrelationships of plants, animals & the physical environment in which they live

Environment ⟷ **Primates**

- Environment influences primate behavior
- Primates influence the ecology of their environments (seed dispersal, etc.)

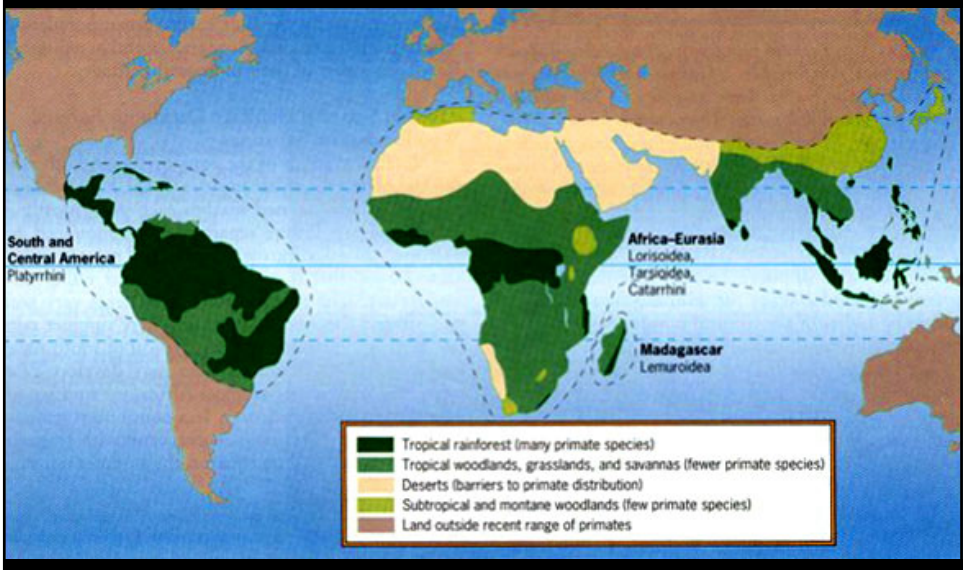
2

Topics

- Primate habitats
- Primate diets
- Primate socioecology
  - resources, predation, sociality & mating systems
- Primate behavior
  - Kin selection, altruism, culture

3

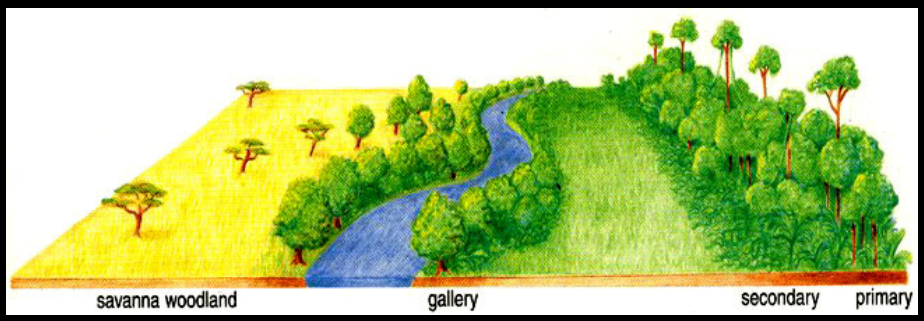
Primate habitats



4

Habitat types

- Savanna
  Grassland plains with mixed shrubs & scattered trees
- Gallery forest
  Along water
- Secondary forest
  Regenerating
- Primary forest
  Undisturbed



5

Forest structure

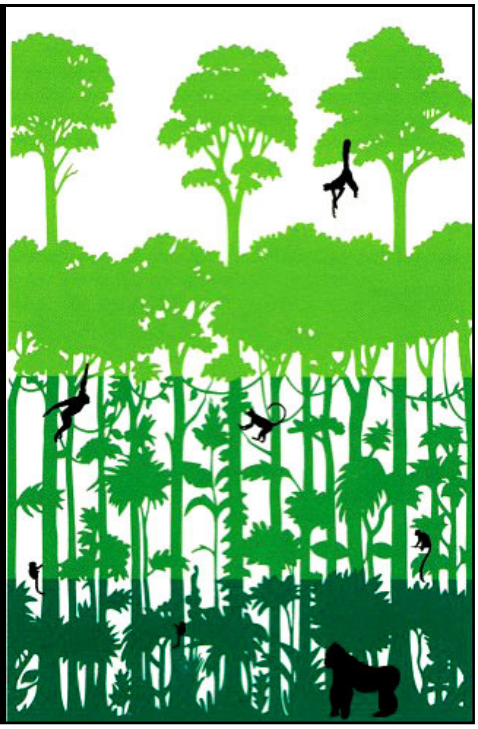
– Emergent

– Canopy

– Midlevel

– Understory

– Floor



6

Primate diets

- Animals: insects, vertebrates (faunivory)
- Fruits (frugivory)
- Seeds
- Flowers & nectar
- Leaves, stems and grass (graminivory)
- Sap and gum (gummivory)
- Underground plant parts: roots, tubers, bulbs, etc.

7

Primate socioecology

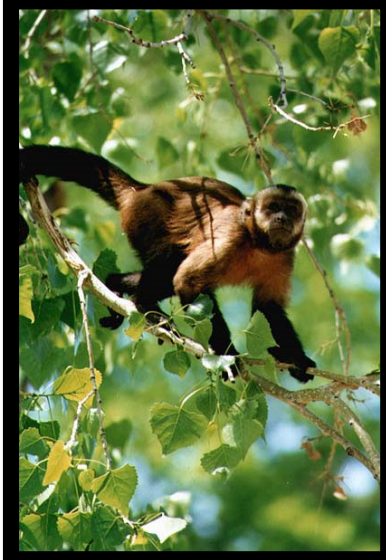
- How the interaction between individuals & the environment (both physical and social) they live in influences their social systems
- Basic model: distribution of food → distribution of females (and whether they group with kin) → distribution of males

8

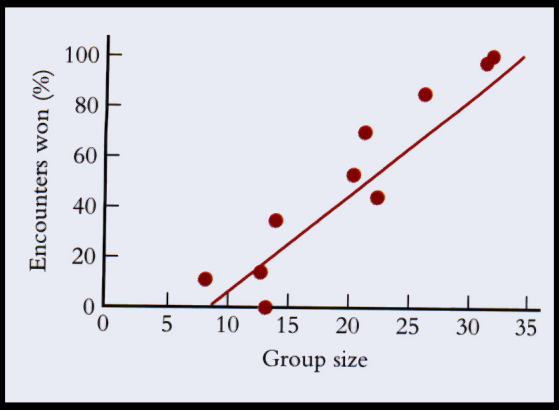
Potential benefits of group living

- Foraging benefits
  - Finding food
    - More eyes to find new food patches
    - Minimize wasted searching
    - Share information
  - Accessing food
    - Cooperate in hunting
    - Cooperate in defense or takeover of food patches

9



Brown capuchin



As group size increases, the number of encounters (conflicts) won against other groups increases.

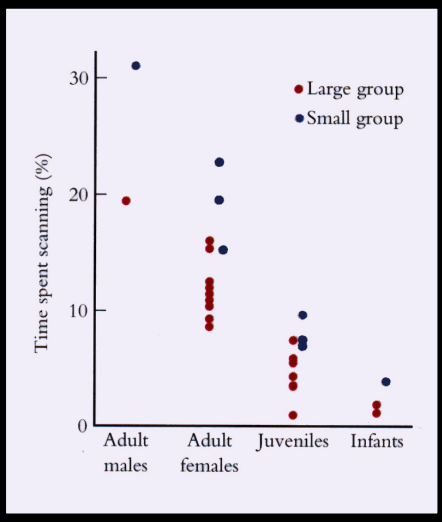
10

Potential benefits of group living

- Predation avoidance benefits
  - The “selfish herd” effect
  - The “dilution” effect
  - The “vigilance” effect
  - The “confusion” effect
  - The potential for cooperative defense

11

12



Individuals in larger groups can spend less time looking for predators

White-faced capuchin

13

Potential benefits of group living

- Social benefits
  - Learning is easier
  - Finding a mate is easier
  - Sharing information is easier
  - Assistance in rearing offspring

14

Potential costs of group living

- Increased competition over resources (food & mates)
- Increased risk of disease
- Increased conspicuousness to predators
- Increased conspicuousness to prey
- Increased chance of being cuckolded

15

How big should primate groups be?

Animals should live in groups of sizes that maximize their access to critical resources by:

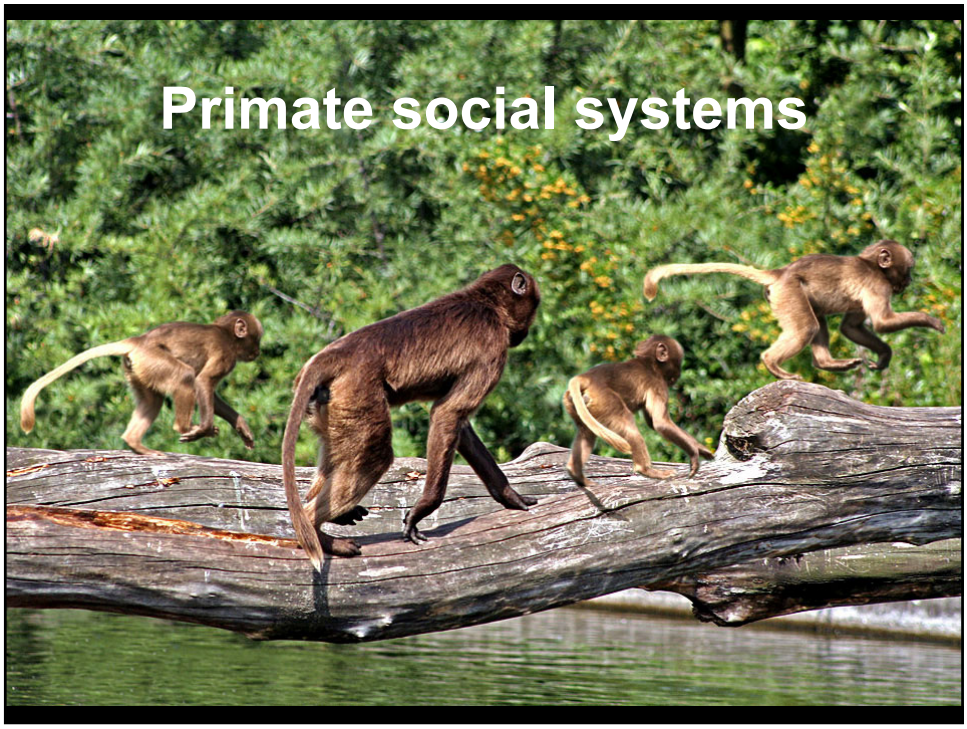
- Minimizing the amount of competition they face from other individuals in their group
- Maximizing their success in conflicts with other groups, while also
  - minimizing their risks of being preyed upon, and
  - maximizing their chances of successfully reproducing

16

General relationships

Larger groups	Smaller groups
• Terrestrial	• Arboreal
• Diurnal	• Nocturnal
• Frugivorous	• Folivorous
• Where predator density is high	• Where predator density is low

17

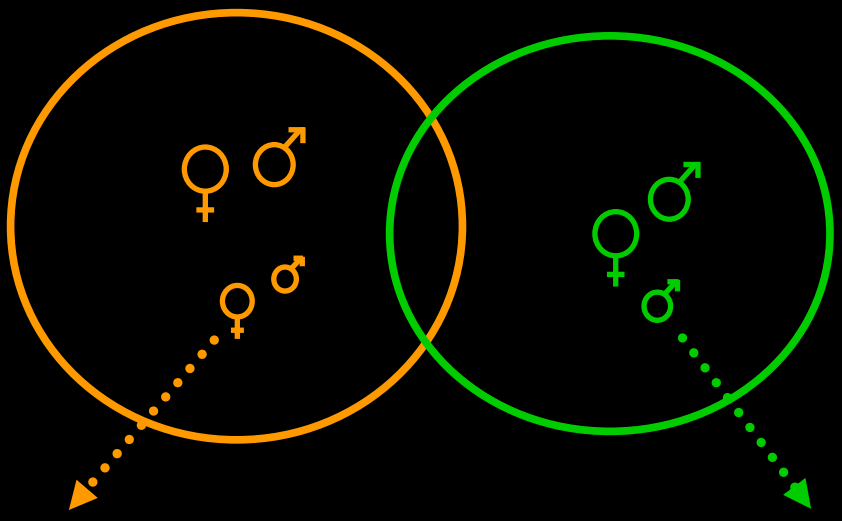


18

Elements of a social system

- Group size & composition
- Use of the environment
- Mating system
- Nature of intragroup social behavior
- Emigration pattern

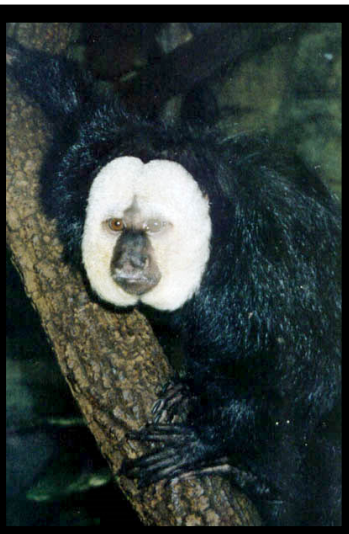
19



(A) Monogamous (?) family group

20

Indri
(lemur)



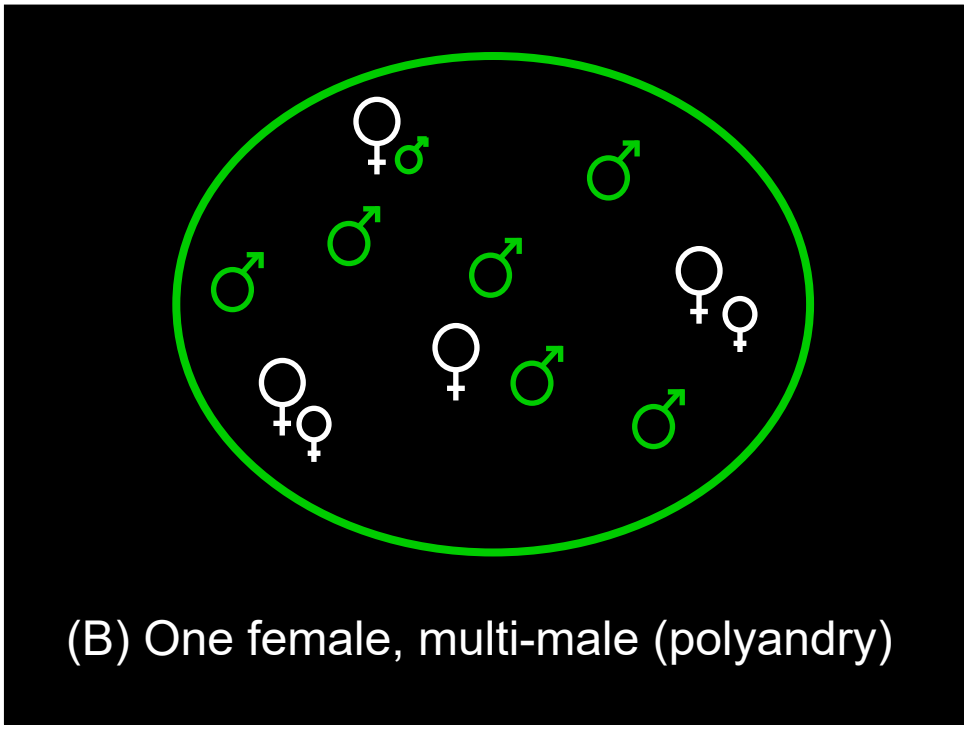
Saki
(New World
monkey)

21

Titi monkeys

Pair bonding behavior

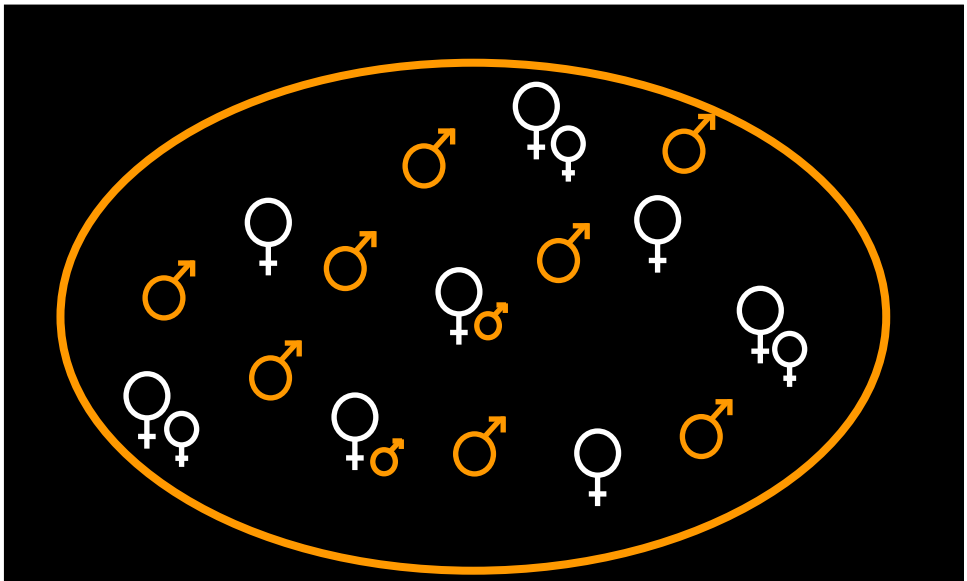
22


(B) One female, multi-male (polyandry)

23


Golden lion tamarin
One female, multi-male

24



(C) Multi-male, multi-female group

25

- Females stay in their natal group (philopatric), males emigrate
- very strong matrilineal dominance hierarchies

Vervet monkey

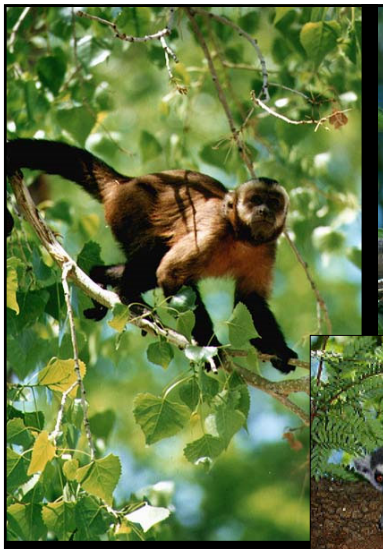
26

Red colobus monkeys

Multi-male, multi-female <u>with female emigration and male philopatry</u>

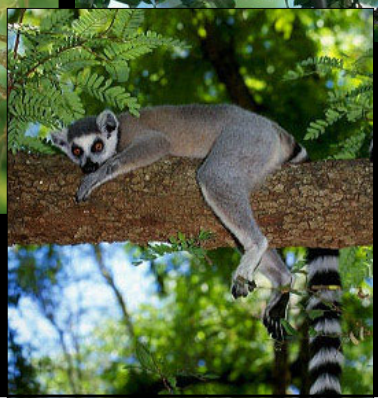
- Females non-relatives – spend little time interacting, do not form dominance hierarchies
- Males cooperate more than males usually do, form strong dominance hierarchies

27



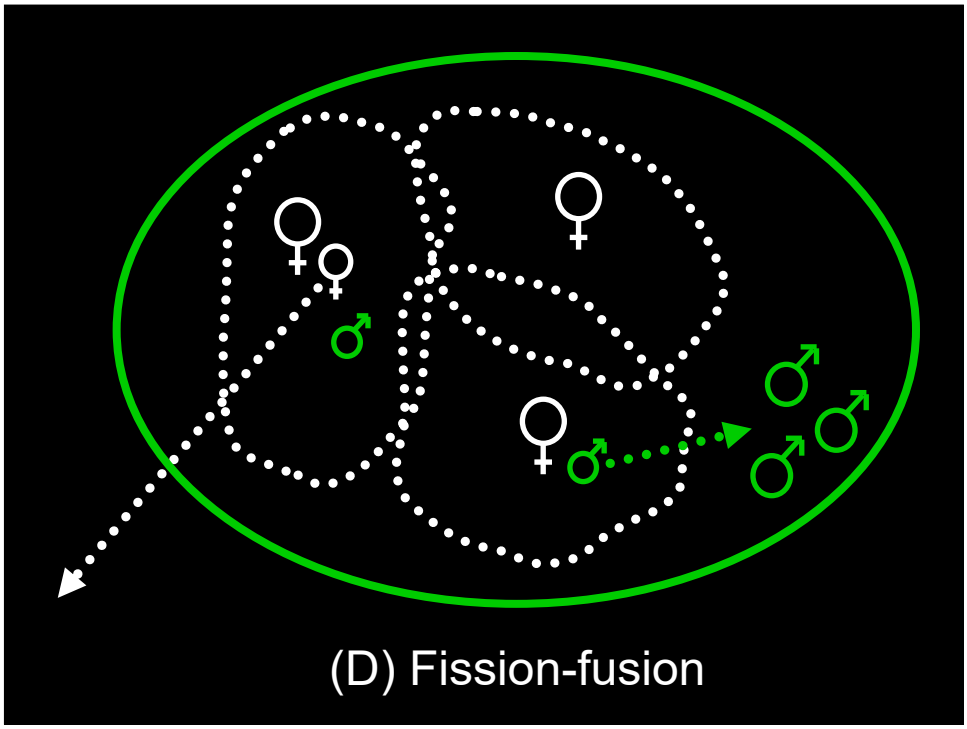
Brown capuchin

Toque macaque

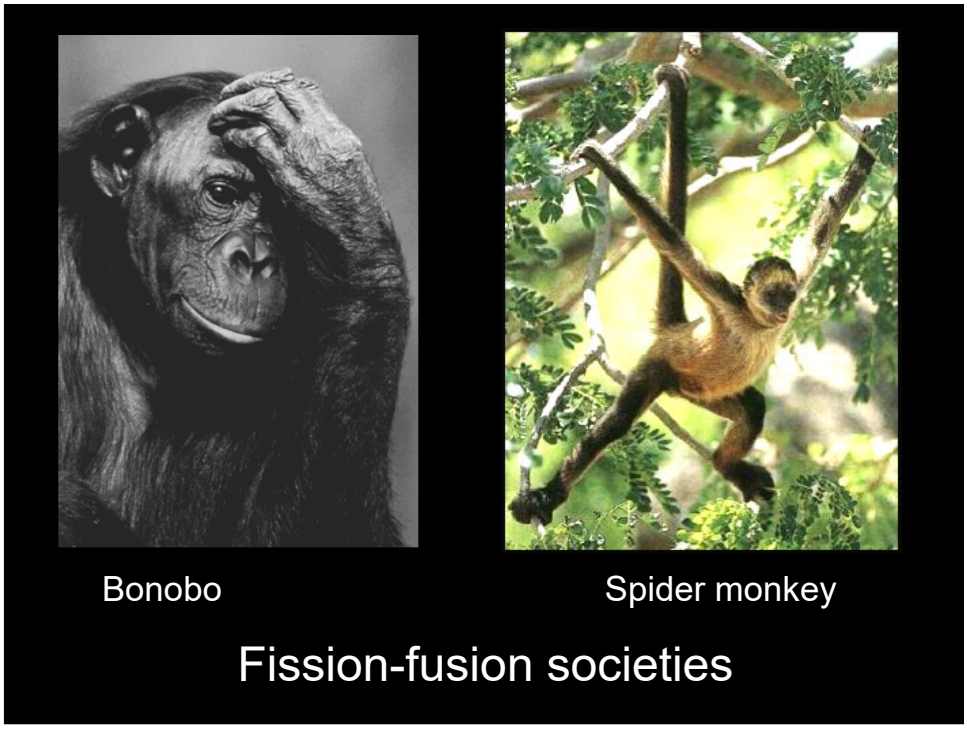


Ring-tailed lemur

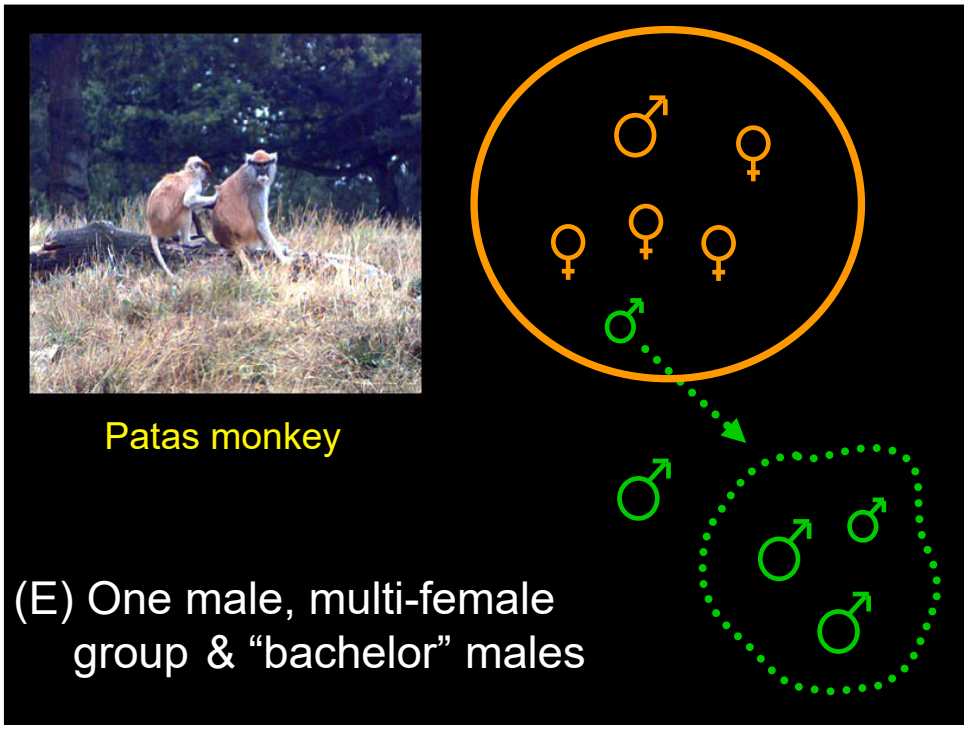
28


(D) Fission-fusion

29


Bonobo
Spider monkey
Fission-fusion societies

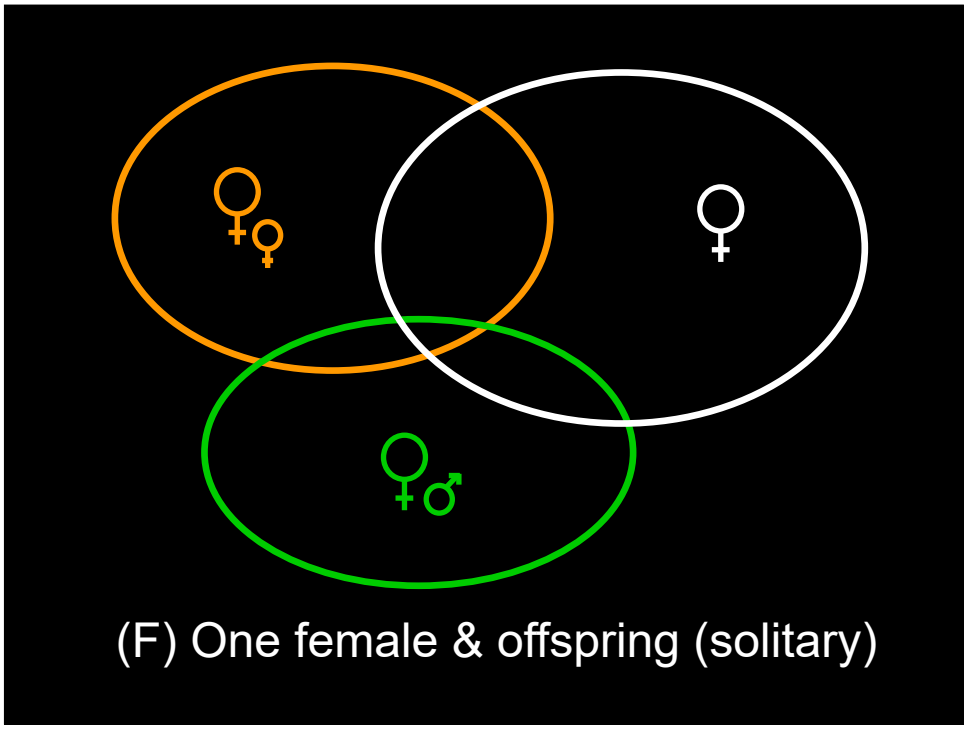
30


Patas monkey
(E) One male, multi-female group & “bachelor” males

31


hamadryas baboon
gorilla

32



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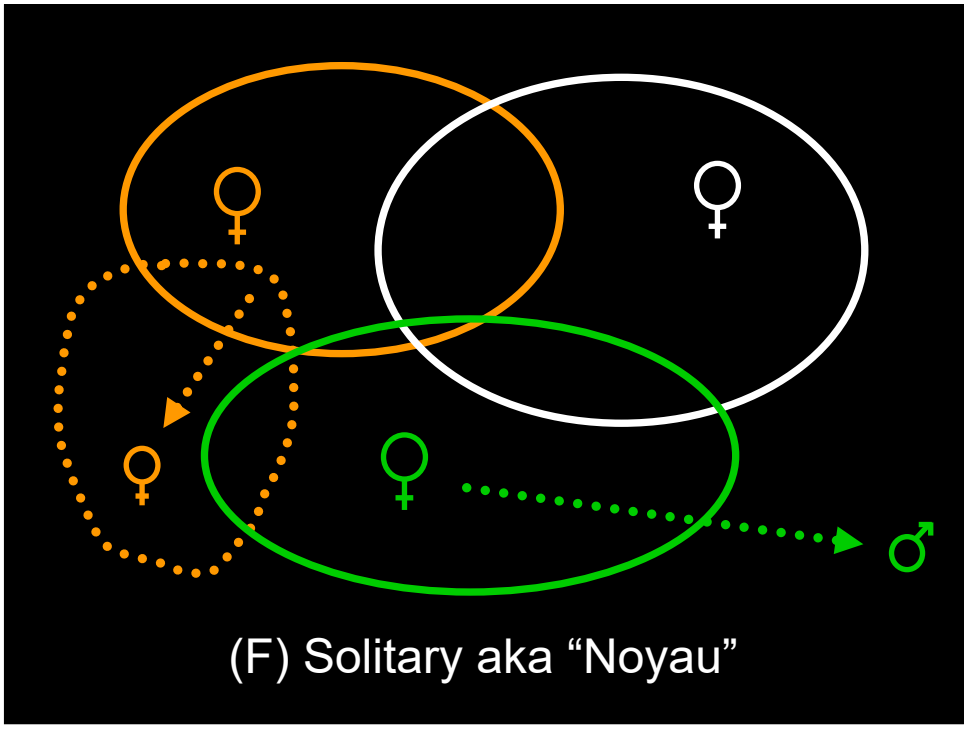

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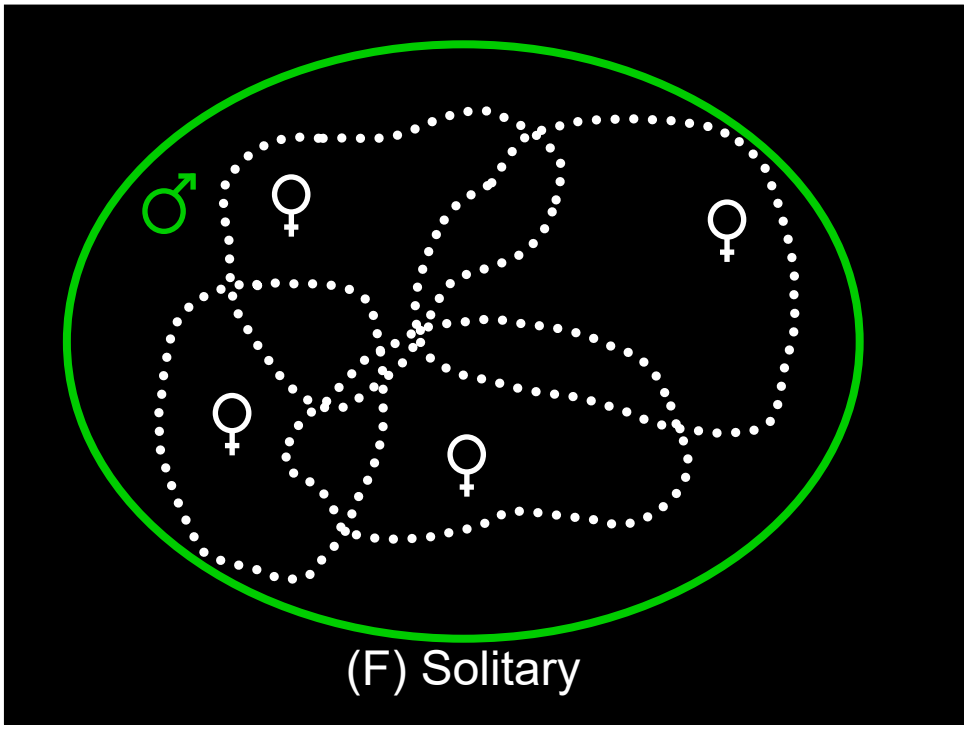

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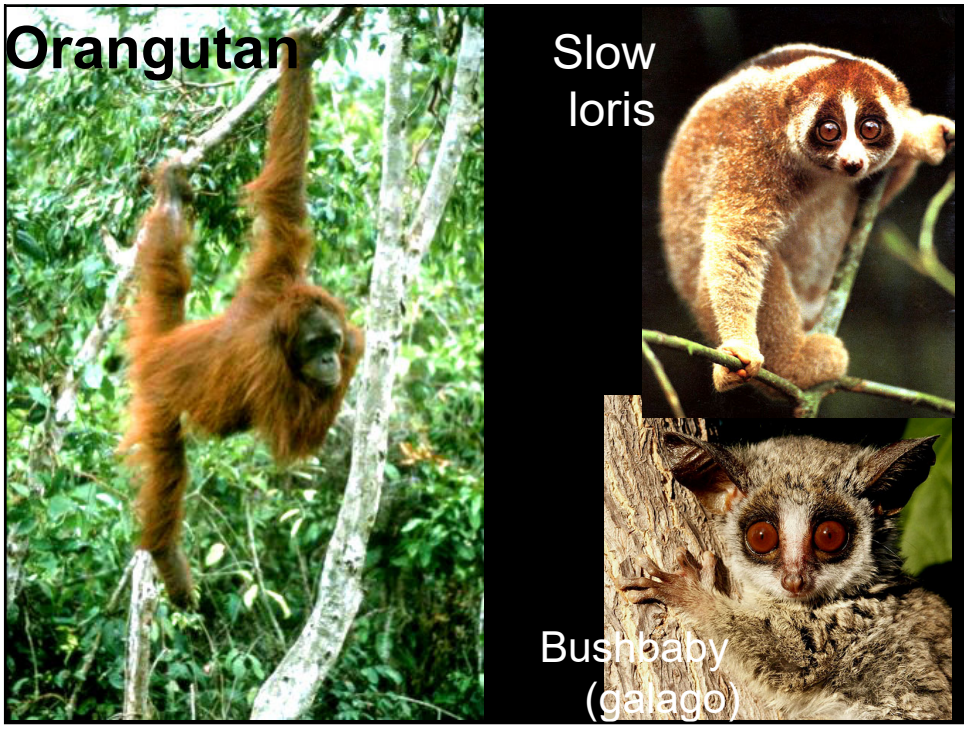


36

What do biologists mean by male and female?

- Remember: evolution is all about (differential) reproductive success
- Sexually reproducing organisms:
  - Small, energetically "cheap" gametes (sperm) ♂
  - Larger, energetically "expensive" gametes (eggs) (that need to be internally gestated in mammals) ♀
  - Differential levels of investment required
  - Often interpreted as a binary division, but…

37

"Biological sex" is not discrete nor binary

- Genetics-gonad-genitalia triad ("3G sex")
  - Diversity and variation within/across the triad
- Sex ≠ gender
  - Gender is socially constructed & varied
  - In humans, terms gender/sex or sex/gender emphasize how the two are intertwined throughout life (DuBois, 2021)
  - In non-human primates, we don't know about gender, and assume sex based on phenotype

38

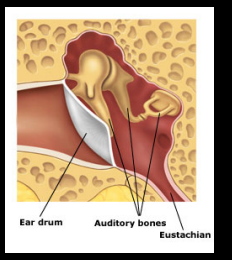
Why even bother with it?

- "… all models are wrong, but some are useful. However, the approximate nature of the model must always be borne in mind...." (G. Box, 1987)
  - Approximations are reductive by definition
  - A starting point for understanding & appreciating diversity and variation, because observations that defy expectations are often more interesting and informative
  - important not to conflate common/typical with right/worthy/proper/only way to be

39

Beware of "just so stories"

- Just because a trait is subject to a particular kind of selective pressure *now*, doesn't mean that is why it evolved!
  - exaptations (e.g. middle ear bones)
  - evolutionary by-product ("spandrel")



40

Sexual dimorphism

- Both sex and gender exist on a spectrum
- Dimorphism: differences observed across two ends of a spectrum (e.g., small-large)
- Sexual dimorphism: differences observed between sexes in a species
  - E.g. canine size, body size, coloration, behavioral repertoire
  - No difference? Monomorphic
  - More than two variants? Polymorphic

41

42

Sexual dimorphism

- The degree of sexual dimorphism in a species is usually correlated with (not necessarily caused by!) the level of male-male competition in that species
- Therefore, sexual dimorphism is also correlated with social organization (type of social group)
- Why?

43

Sexual selection

- Differential reproductive success within a sex of any species
- who social animals mate with is not random!

44

Sexual selection

- Classic views of two components to sexual selection:
- Pressure on males to gain access to mates – intrasexual selection
- Pressure on females to choose the right mate – intersexual selection

45

Intrasexual selection
male-male competition

46

Body mass sexual dimorphism index

= (female body mass / male body mass) x 100

- A larger BMSDI (closer to 100) means that males & females are of similar size & suggests a low degree of sexual dimorphism.
- A smaller BMSDI (closer to 0) means that males are larger than females & suggests a high degree of sexual dimorphism.
- Generally, a value much higher or lower than 100 suggests that the larger sex has more competition for mates.

47

Sexual dimorphism & mate competition

- *Gorilla gorilla*
  - BMSDI = 42.2
  - Males are much larger than females
  - One-male, multi-female social group structure
  - High male-male competition

48

Sexual dimorphism & mate competition

- *Hylobates lar*
  - BMSDI = 90.5
  - Males & females similar in body size (monomorphic)
  - Monogam-ish social group structure (with EPCs!)
  - Low male-male competition

49

Mandrill BMSDI: 36.4 !!!!!

50

Canine size sexual dimorphism index

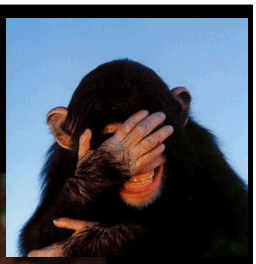
= (female canine size / male canine size) x 100

- A larger CSSDI (closer to 100) means that male & female canines are of similar size (low degree of sexual dimorphism)
- A smaller CSSDI (closer to 0) means that male canines are larger than female canines (high degree of sexual dimorphism)
- Generally, values much higher or lower than 100 suggest that the sex with the larger canines (usually males) has more competition for mates.

51

52

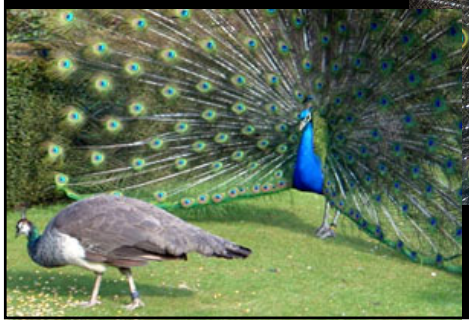
Sperm competition



53

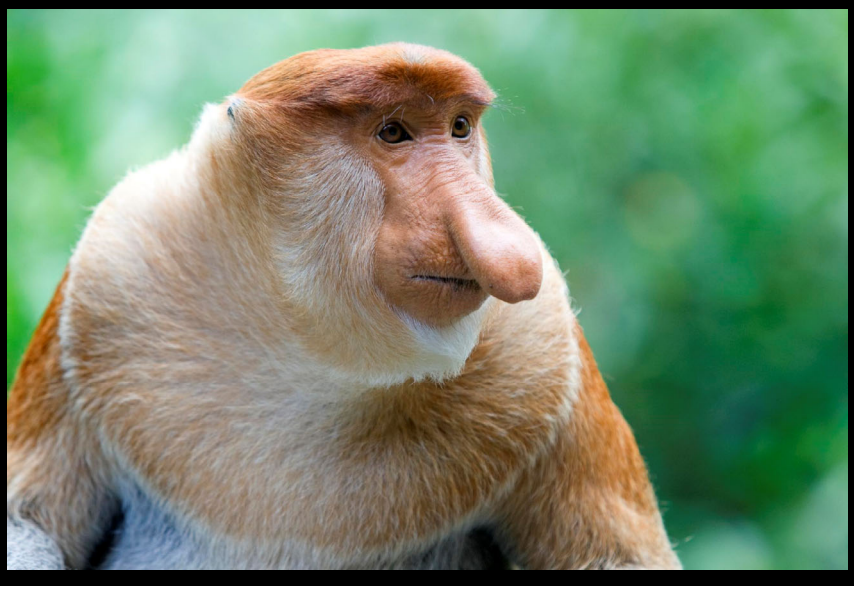
Intersexual selection

"female choice"



54

Intersexual selection
proboscis monkeys



55

Female choice

- Earlier research overwhelmingly focused on male-male competition (conspicuous, conforms to Western gender norms)
- Female choice is a major determinant of male reproductive success, even in taxa with high dimorphism and male "monopolization" of females
  - E.g. female baboons may join forces to support the group male against a challenger

56

Primate behavior

- Why do patterns of behavior (like social grooming & dominance interactions) exist?
- Why do these behaviors take the forms they do?

57

Basic assumptions

- Behavior has some genetic basis (this is NOT genetic determinism!)
- Behavior is subject to the process of evolution by natural selection in the same way as morphology

58

Altruism: An evolutionary problem?

Benefit to actor	Benefit to recipient: +	Benefit to recipient: -
+	mutualistic	selfish
-	altruistic	spiteful

59

Big question

How can seemingly altruistic behavior evolve through natural selection?

60

Kin selection

Process by which traits or behaviors arise via natural selection through their effects on the survivorship or reproduction of relatives

61

Inclusive fitness

An individual's total genetic contribution to the next generation

Includes own direct fitness plus indirect fitness devalued by "r"

Inclusive fitness = DF + IF x r

62

Degree of relatedness or "r"

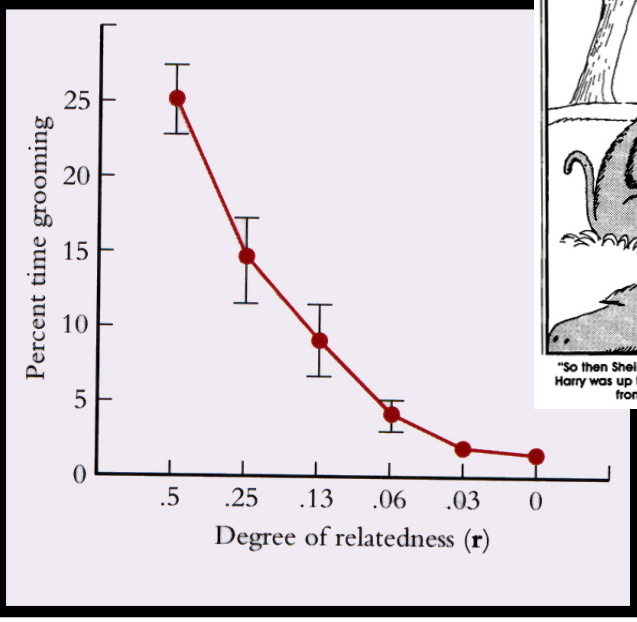
The average proportion of genes shared between two individuals

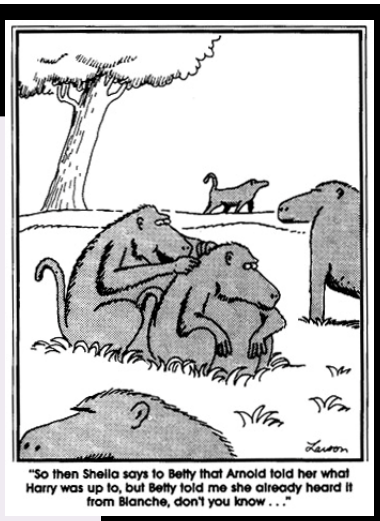
Relationship	"r"
full siblings	1/2
half siblings	1/4
parent-offspring	1/2
grandparent-grandchild	1/4
aunt or uncle-niece or nephew	1/4
first cousins	1/8

Two kinds of fitness: direct & indirect

63

Grooming





64

Hamilton's rule

$$C < B \times r$$

B = Benefit to recipient
r = degree of relatedness between actor & recipient
C = Cost to actor

65

Vervet monkey

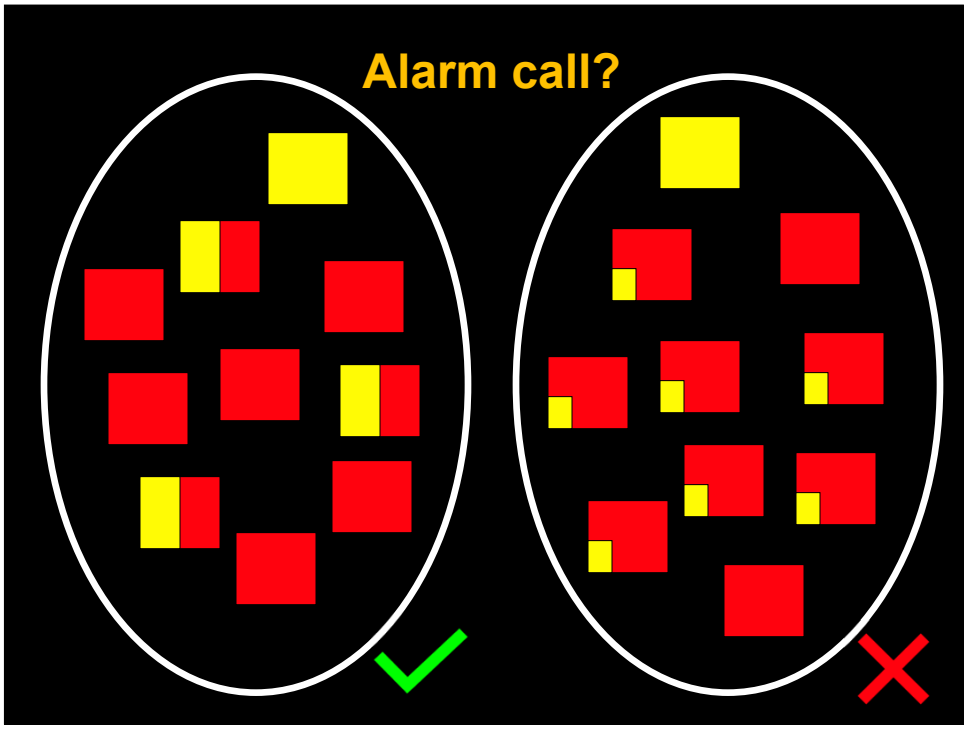
Predators & alarms

Snakes

Eagles

Leopards

66



67

Big question

Can altruism occur between non-kin?

68

Reciprocal altruism

consortship

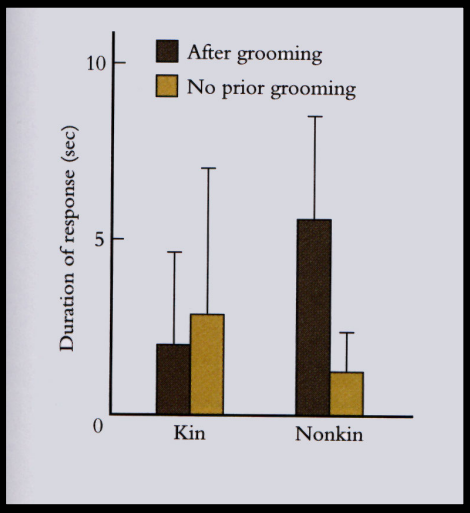
fighting males

69

Reciprocal altruism

- Certain conditions need to be met
  - Frequent interactions
  - Individual recognition
  - Way of punishing cheaters
  - Long term benefits outweigh costs
- Exchanges can be in different "currencies"

70



Reciprocity in different currencies among vervet monkeys

71

Culture in non-human primates

- First observed in japanese macaques
- A female started washing sweet potatoes – younger individuals picked up that behavior

Imo

72

Culture in non-human primates

- Tool use (mainly for extractive foraging) observed in many species:
  - capuchins, macaques, baboons (in the wild and captivity)
  - guenons, mangabeys, patas (in captivity)
  - orangutans, chimpanzees, gorillas (in the wild and captivity)

73

Culture in great apes

- Orangutans and chimpanzees show regional variation in tool use!

Tool types	Gombe	Mahale	Kibale	Tai	Bossou
Leaf sponge	×		×	×	×
Termite fish	×	×			
Ant dip	×			×	×
Honey dip	×			×	
Nut hammer				×	×
Ant fish		×			
Bee probe				×	
Marrow pick				×	
Pestle pound					×
Gum gouge					×
Algae scoop					×
Hook stick					×
No. of feeding-tool types	4	2	1	6	7

74

Some interesting facts…

- Gorillas use branches as crutches or planks to cross bodies of water
- Chimpanzees use poles to reach high shelves or to escape zoo enclosures
- Nut-cracking in chimpanzees has an archaeological record
- Chimpanzees use spears to hunt galagos, orangutans use spears to fish!

75

More interesting facts…

A captive chimpanzee collected stones to throw at zoo visitors later – evidence of planning and premeditation!

76

More interesting facts…

A captive capuchin used a rock it uses to crack nuts to shatter the glass of its enclosure

77

78