Social Relations

• Basic Terminology
  
  - Behavioral Ecology – the relationships between organisms and environment that are mediated by behavior
  
  - Sociobiology – the study of social relations (dominance relationships, reproductive interactions, cooperative behaviors, all can lead to increased fitness)
  
  - Fitness – the number of off-spring, or genes, contributed by an individual to future generations, which can be substantially influenced by social relations within a population
  
  - Female – produce larger, energetically costly gametes
  
  - Males – smaller less costly gametes
    
    • Created a situation where males actively court, while females are highly selective
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- Hermaphrodites – combine male and female function in the same individual

- Charnov, Smith and Bull (1976) – three conditions that should favor hermaphrodisim
  
  • Low mobility
    
    – Limits male to male competition
    – Depends upon structures designed for competition

  • Low overlap of resources by males and females (plants, pollen is produced well before seeds mature)

  • Sharing costs for male and female functions (flowers aid both male and female functions of the plant)
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- Two major concepts of social relations

  - Mate choice by sex and/or competition for mates among individuals of the same sex can result in selection for particular traits in individuals, a process called *sexual selection*.

- Sexual Selection – the result of differences in reproductive rates among individuals as a result of differences in their mating success – two forms:

  - Intrasexual Selection – individuals of one sex compete among themselves for mates (larger size, teeth, horns [antlers])

  - Intersexual Selection – members of one sex consistently choose mates (of the other sex) on the basis of a particular trait
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- Mate Choice and Sexual Selection in Guppies

» Native to streams and rivers of Trinidad and Tobago, and South American mainland

» Clear streams to murky lowland rivers

» Live in areas

  Headwaters above waterfalls- absent of predators, with killifish (*Rivulus*) – eats mostly juveniles – low predation

  Lowland rivers - with pike cichlid (*Crenicichla*) – east mostly adults, highly visual predator – high predation
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Endler (1980) – performed an elegant experiment, placing guppies in man-made ponds of similar dimensions, similar characteristics with different predator pressures.

Experimental conditions:

- **High predation**: Pike cichlid plus guppies
- **Low predation**: *Rivulus* plus guppies
- **No predation**: Guppies only

Results:

- **High predation**: Decreased color in male guppies
- **Low predation**: Increased color in male guppies
- **No predation**: Increased color in male guppies

Decreased color in male guppies supports the hypothesis that visual predators feed disproportionately on colorful males.

Increased color in low and nonpredatory environments supports the hypothesis that colorful males have a mating advantage.
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Endler field tested his experiment
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Compared to the other populations, male guppies in high predation environments showed reduced number of spots.

After 15 generations the number of spots increased on male guppies transferred from a high predation to a low predation site.
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» **Mate Choice by Female Guppies**

Houde (1997) found that female choose a male based upon the following characteristics all of which enhanced the fitness of the male:

- Brightness
- Number of red and blue spots
- Total pigmented area
- Carotenoid (orange) area

» **Kodric-Brown (1993)** found that male competitive interactions also played a role in mating, she designed an experiment whereby she allowed females to see males and then come in contact with them to mate.
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- **Mate Choice Among Scorpionflies** – Thornhill (1981) studied these organisms that:

  » Feed on dead arthropods in the forest understory, this food source is in short supply and leads to a great deal of competition (males will fight over them and even steal from spider webs to gain food)
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Thornhill set up several experiments to study the elaborate mating behavior exhibited by these organisms.

In one he set up aquaria with 12 flies and added 6 dead crickets (2 lg, 2 med, and 2 small) – he allowed competition by the males to take place then added females to observe their preferences, he found

What did females gain by this?

rate of egg laying was higher

A higher percentage of male scorpion flies offering medium and large crickets mated compared to males with small crickets, salivary masses, or no offerings.
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» He then asked, what factors determine successful competition by males? – He set up an experiment to see if males that where unsuccessful in competition would take of advantage of a cricket if given the chance.

Thornhill added 6 dead crickets and 12 male scorpion flies to each aquarium.

Six males gained possession of the 6 dead crickets, while the other 6 males secreted salivary masses.

Six males guarding crickets removed.

Six remaining males abandoned their salivary masses and moved to crickets.
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Lastly, Thornhill looked at how males compete for arthropods, and how does this relate to mating success?

While the smallest males offered mainly salivary masses or nothing…

…the largest males claimed most of the dead crickets for nuptial offerings.

A higher percentage of large male scorpion flies mated compared to medium and small males.
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- Nonrandom Mating Among Wild Radishes – experimental work performed by Marshal and Fulsom (early 1990’s) – they found that wild radishes are:
  
  » Self-incompatable

  » Fertilized by insects carrying pollen on average from seven (7) different plants

They questioned, whether fertilization was a random process – they performed random pollinations and examined three parameters

» Number of seeds sired in mixed populations

» Position of seeds sired

» Weight of seeds sired
Evidence for nonrandom mating by pollen donors comes from variation among donors in:

- percentage of seeds sired,
- positions of seeds sired in pods,
- and the average weights of seeds sired.
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They found that field observations yielded similar results.

Pollen donor C1 pollinated a much higher percentage of seeds than either A1 or B1, indicating nonrandom mating in this field situation.
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The results of this field experiment demonstrated interference competition

Reduced pollen germination when pollen from two donors was mixed suggested inhibition of germination process.
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- The evolution of sociality is generally accompanied by cooperative feeding, defense of the social group, and restricted reproductive opportunities

Terminology

Sociality – group living and cooperation

Eusociality – highly complex, stratified societies (ex. ants and termites) – three major characteristics

1. individuals of more than one generation live together

2. cooperative care of young

3. division of individuals into sterile, or nonreproductive and reproductive castes
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- Cooperative Breeders – those that help in the process of producing offspring even though they are not their young, can do this in several ways
  - Defending territory or young
  - Preparing and maintaining a nest or den
  - Feeding young

The question arises, why do this?

Two potential reasons:

1. Helpers will benefit by aiding their own fitness by improving rates and survival of their relatives, referred to as *inclusive fitness*, often called *kin selection*

2. Helpers gain experience in raising young, and recruiting helpers when the time comes – helpers may inherit breeding territory when original breeders die

Various examples in nature
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- Green Woodhoopoes – live most commonly in open woodlands with tree cavities for nesting and roosting
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- Lignon & Lignon (1978 – 91) banded 386 birds, from their studies they learned:
  
  - The parentage of 93% of the birds in their study area
  
  - Birds lived in flocks of 2 – 16 with the average between 4 – 6
  
  - Males (which are 20% larger than females) defend territories
  
  - Learned that a major cause of death is predation, and that deep cavities provided greater protection, deep cavities are at a premium in these environments
  
  - After birth young remain close to where they were born, their *natal territory* exhibiting *philopatry*
    
    » 18 bred in the territory in which they were born
    » 14 bred in adjacent territories
    » 6 bred in a territory two or three away from their birth site

The question is why?

Further study revealed:
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- 91% of females and 89% of males left no descendents

- Reproductive success varied dependent upon 2 sources:

  » Rain during the dry season

![Graph showing the relationship between dry season rainfall (mm) and young produced per flock. Higher rainfall during the dry season tends to reduce reproduction by green woodhoopoe flocks.]
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» Quality of breeding territory

Reproduction was consistently higher on high quality territories.
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By helping two things were gained:

Helpers on average, passed on 50% of their genes by protecting siblings, this is the same as if they were their own offspring

Helpers had an increased chance of inheriting their parents territory which is a high quality territory

- African Lions – Packer and Pusey have revealed much about the complicated societies in which lions live in the Serengeti
  - Related females live in family groups called prides
    » Usually 3 – 6 adults, with as many as 18 and as few as 1
    » Their offspring live within these prides along with coalitions of males that are either related or unrelated
  - Cooperation with Pride
    » Females nurse each others cubs
    » Hunt cooperatively
    » Cooperatively defend their territory, especially protect the young from aggressive males (usually occurs when males are displace by invading males)
    » Males cooperate in defending the pride from invading males and predation of young by hyenas
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- What do females have to gain by this?
  
  » Increases their inclusive fitness

- What do males gain? Not as easy to explain since not all members of a coalition are not necessarily related

![Graph showing the proportion of young sired by male rank and coalition size.](image)

- Males in coalitions of two or three are often unrelated, ...
- ...while larger coalitions are rarely made up of unrelated individuals.

- First and second ranked males sire most cubs, ...
- ...while third and fourth ranked males rarely sire cubs.