## Introduction

## Sex Ratio

- Must be careful in examining sex ratios:
- Males more obvious plumage often
- In breeding season, males more obvious behaviorally
- Sexes may migrate separately


## Terms

- Ratios commonly expressed:
- Males:females to make 100 total (50:50)
- Males / 100 females
- Percent of total which are male (or female)
- Less commonly as females/male


## Terms

- Ernst Mayr (1939) suggested a classification based on age:
- A. Primary sex ratio $=$ at conception
- B. Secondary sex ratio $=$ at birth
- C. Tertiary sex ratio $=$ at later specified age

Mammalian and Avian Patterns
A. Basic tendency:

- Mammals - Sex ratio shifts toward more females in older age classes
- Birds - Opposite: shifts toward males predominating in older are groups

Mammalian and Avian Patterns

- B. Why? What are reasons? Two types of expanations:
- 1. Internal: Sex-linked lethal factor
- 2. Environmentally induced mortality related to behavior and life history of sexes


## Examples: Humans

- Why do women live longer than men?
■ Holden, C. 1987. Science 238:158-160
- Women outlive men by a margin of 4 to 10 years throughout the industrialized world.
- Now that females are no longer being felled by childbirth, it has become clear that they enjoy an advantage in survival rates.
$■$ James V. Neal (Univ. Washington): "We really are the weaker sex, biologically less fit than females at every step of the way."


## By Age

- At conception: 115 males to 100 females
- At birth: 105 to 100
- Male excess in spontaneous abortions, miscarriages, and stillbirths prior to birth and higher neonatal and infant mortality
- At 30: sex ratio is equal
- By 65: 84\% females \& 70\% males still alive


## Male to female death ratio

- 3.9 to 1 for homicide in Alameda County, Calif.
- Also higher for lung cancer, suicide, pulmonary disease, accidents, cirhosis and heart disease (2 to1)


## Y chromosome

- Maleness seems to carry intrinsic risk.
- Study of Amish families with and without long arm of $Y$ chromosome
- In families with: women died in mid-70's and men 5 or 6 years earlier
- In families without: women died at ave. age of 77 while 14 men died at 82


## Hormones

- Males and females have equivalent cholesterol levels until puberty.
- Males suffer an exponential rise in heart disease in their 40's, but female rise does not start till 50's after menopause.
- Animal and human studies show that estrogen protects against heart disease by lowering levels of low-density lipoproteins (LDLs, "bad" cholesterol) and keeping high-density lipoproteins (HDLs, "good" cholesterol) up.


## Hormones

- Androgen, lowers HDL and raises LDL.
- Hormones also affect the immune system.
- Animal and human studies show that females have greater immune responses than males:
- This is associated with higher female antibody responses and tumor resistance,
- but also higher female rates of autoimmune diseases (arthritis, lupus).


## Examples in Birds

- Sex ratio in young close to 50:50
- In adults it increases towards males
- Usual rationale for higher mortality in females is stresses and hazards of nesting


## Examples in Birds

## - Pheasants in Wisconsin

- Wagner (1957) found:
- late summer mortality higher in hens when nesting pushed later by poor spring
- Grouse in northern Wisconsin
- Dorney and Kabot (1960) saw
- year to year sex ratio changes affected by spring weather (poor nesting weather killed the females)
- Relating female losses to stress factors
- Stress is somewhat intangible and difficult to measure
Can look at physiological condition


## Physiological Condition

- Peterson - Oldsquaws


## Physiological Condition

- Most birds at peak physiological condition just prior to breeding season.
- After laying first egg females condition begins to decline.
- Extent of decline depends on severity of breeding season,
■ i.e. number of clutches, number of eggs.


## Gallinaceous

- Large clutch or renesting leads to decline in condition
- In chickens, layers at end of season are skin and bones, breasts are hatchet shaped
- Deplete protein reserves
- Moult follows placing more stress on them


## Energy

## - Energy stored as

- glycogen,
- lipids,
- protein.
- During laying and incubation these stores are depleted.
■ Gallinaceous birds, hens start out with relatively little fat


## Canada Geese

- Hanson and Raveling saw
- No food during egg laying and most of incubation
- Need large fat reserves for eggs and own energy requirements
- Every day that spring is late, bird burns up enough energy to lay one egg
■ So ave. clutch size declines one egg


## Predation

- Females nesting on ground or low in vegetation and undertaking all of the incubation (typically) may suffer more predation than males.
■ Keith (1961) studying waterfowl during nesting found:
- 2\% loss of drakes

■ 8\% loss of hens (mostly due to predation while nesting)

## Intraspecific competition

- Perhaps females lose out in competition for food.
- S. Dakota, after a hard winter 75\% of phesants found dead were females though they only made up 57\% of population
- On Protection Island sex ratio changed from 50:50 after introduction to 60:40 at high pheasant densities


## Examples from

 Mammats- Higher mortality rates in males may be due to greater activity:
- a. Larger home ranges
- b. Reproductive behavior - ungulates rut in late fall and go into winter in poor condition
- c. Physiology - testosterone in bulls inhibits fat deposition

Richardson's Ground Squirrels

- See table in class notes p. 54
- Juveniles 50:50 sex ratio
- 11 months 30:70
- juvenile males hibernate 1 mo. later and emerge 2 wks. early - periods of no food and high predation
■ 12 months 11:89
- Males driven out by females and dominant males - to die in poor habitat


## Ungulates

Imbalance toward females accentuated when food shortages occur on overutilized range.

■ Elk - Cowan 1950, Flook 1970

- Reindeer - Klein 1968


## Sex Ratios in Fish

- Vary considerably but close to 50:50 in most. - Nickolsky 1963
- In freshwater fishes most studies show more males in young of the year while very strong preponderance of females in older fish.


## Significance of Sex

 Ratio- Dependent on mating system
- Component of efficient herd management in mammals


## Snowshoe Hare

- No change in sex ratios apparent


## Sex Ratios in Fish

- Males produce many more sperm than females eggs
- If too biased, fertilization declines
- Trout on spawning grounds


## Patterns in Mammals

- Younger females produce more male offspring
- First offspring at any age is more likely to be male

Natality Patterns

- 1. Youngest reproductive age classes have lower birth rate than adults
- 2. In less favorable environmental conditions, reproductive rates decline most in younger age classes.
- 3. In fish, reproductive success is extremely variable.

