Sex Ratio

Introduction

- 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

- 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 age groups

- B. Why? What are reasons? Two types of explanations:
  - 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?
  - Women outlive men by a margin of 4 to 10 years throughout the industrialized world.

Weaker Sex?

- 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, cirrhosis and heart disease (2 to 1)

**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.

**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

- 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)
Stress
- 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.

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

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

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 pheasants 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 Mammals

- 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

Snowshoe Hare

- No change in sex ratios apparent

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.

Sex Ratios in Fish

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

Significance of Sex Ratio

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

Patterns in Mammals

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