

**ESTIMATING THE NUMBER OF
ANIMALS IN WILDLIFE POPULATIONS
CHAPTER 5**

ABUNDANCE VERSUS DENSITY

POPULATION SIZE = ABUNDANCE

EXAMPLE

COUNT 450 DEER, ABUNDANCE = 450 DEER

POPULATION DENSITY INVOLVES AREA

$$D = N/A$$

EXAMPLE

COUNT 450 DEER IN 10 KM² OF HABITAT

$$D = 450/10 = 45 \text{ DEER /KM}^2$$

SEX AND AGE RATIOS

PROPORTION IN EACH SEX OR MALES PER 100 FEMALES

EXAMPLE

COUNT 40 MALES AND 60 FEMALES

$40/40+60 = 0.4 * 100 = 40\%$ MALES IN POPULATION

SO, 60% FEMALES

$40/60 * 100 = 67$ MALES PER 100 FEMALES

IMMATURES PER ADULT

EXAMPLE

COUNT 200 IMMATURES AND 100 ADULTS

$200/100 = 2.0$ IMMATURES PER ADULT

DEMOGRAPHIC RATES

BIRTHS PER INDIVIDUAL

BIRTH RATES

POTENTIAL VS. REALIZED

POTENTIAL=MAXIMUM NUMBER OF BIRTHS
POSSIBLE FOR THE SPECIES

REALIZED=ACTUAL NUMBER OF BIRTHS OR YOUNG
AT A GIVEN POINT IN THE CYCLE OR TIME

DEATH RATES

ANNUAL OR SEASONAL MORTALITY RATE
OR EXPRESSED AS SURVIVAL RATES

DISPERSAL, EMIGRATION, IMMIGRATION

**DISPERSAL=MOVEMENT OF ANIMALS FROM BIRTH RANGES
TO WHERE THEY REPRODUCE OR WOULD REPRODUCE
IF THEY SURVIVED**

EMIGRATION = PERMENANT MOVEMENT OUT OF A POPULATION

IMMIGRATION= PERMENANT MOVEMENT INTO A POPULATION

**MIGRATION = SEASONAL MOVEMENT FROM ONE RANGE TO
ANOTHER AND RETURN**

RATE OF POPULATION GROWTH

REALIZED: $N(T+1)/N(T) = \text{LAMBDA}$

2003 –COUNT 340 ELK IN POPULATION

2004 –COUNT 375 ELK IN POPULATION

$375/340 = 1.10$ POPULATION GROWTH RATE

$$\text{LAMBDA} = e^r$$

$r =$ INTRINSIC RATE OF GROWTH

$$\text{Ln} (\text{LAMBDA}) = r$$

$$\text{Ln} (1.10) = 0.095 = r$$

**REALIZED POPULATION GROWTH REFLECTS POPULATION
RESPONSES TO MANAGEMENT**

INTRINSIC

MAXIMUM PER CAPITA RATE OF GROWTH IS TERMED
INTRINSIC RATE OF GROWTH

IN THEORY, A POPULATION CAN SUPPORT A
SUSTAINABLE HARVEST AND REMAIN CONSTANT IN SIZE
WHEN PER CAPITA GROWTH EQUALS PER CAPITA
HARVEST

POPULATION CLOSURE

DEMOGRAPHIC=NO BIRTHS OR DEATHS

GEOGRAPHIC=NO MOVEMENTS INTO OR OUT OF THE POPULATION

OBSERVABILITY AND SAMPLING PROBLEMS

OBSERVABILITY = SEEING THE ANIMALS

HOW OBSERVABLE ARE THE ANIMALS?

SAMPLING

1. SURVEYING ALL THE AREA AT ONE TIME

$$C=BN$$

$$C = \text{COUNT}$$

$$N = \text{TRUE POPULATION SIZE}$$

$$B = \text{PROBABILITY OF SIGHTING AN ANIMAL}$$

ESTIMATING SIZE OF THE POPULATION= $N=C/B$

EXAMPLE

COUNT (C) = 350 ELK

OBSERVABILITY (B) = 0.5

$$N = C/B$$

$$N = 350/0.5$$

$$N = 700 \text{ ELK}$$

2. SURVEYING A PORTION OF THE AREA AT ONE TIME

$$C_s$$

$$N=C_s/A$$

WHERE A IS THE PROPORTION OF THE AREA SURVEYED
AND C_s IS THE COUNT OF ANIMALS ON THE SAMPLE AREA

COMBINING:

$$N=C_s/A*B$$

$$N = C_s / A * B$$

EXAMPLE

$$C_s = 350 \text{ ELK}$$

B = 0.5 OBSERVABILITY

A = 0.75 OR PROPORTION OF AREA

$$N = 350 / 0.75 * 0.50$$

$$N = 350 / 0.375$$

$$N = 933 \text{ ELK}$$

ABUNDANCE AND DENSITY

ALL INDIVIDUALS OBSERVED

CENSUS

THEN $B=1$ AND $A=1$ AND $N=C$

METHODS, DRIVE COUNTS, AERIAL SURVEYS, THERMAL SCANNERS

ALL INDIVIDUALS NOT OBSERVED

COUNTS

$B < 1$

DOUBLE SAMPLING

N = TOTAL POPULATION SIZE ON THE SURVEY AREA

N_1 = NUMBER OF RADIOMARKED ANIMALS KNOWN TO BE IN THE SURVEY AREA

N_2 = NUMBER OF MARKED AND UNMARKED ANIMALS COUNTED DURING THE SURVEY

M = THE NUMBER OF RADIOMARKED ANIMALS SEEN DURING THE SURVEY

$$B = M/N_1$$

RADIOMARKED 45 ANIMALS ON STUDY AREA DURING SURVEY, SAW 86 ANIMALS AND 10 WERE RADIOMARKED ANIMALS

$$10/45 = 0.222 = B$$

AND $N=N_2/B$

$$86/0.222 = N$$

$N = 387$ ANIMALS

ASSUMPTION: ALL THE ANIMALS ARE EQUALLY SIGHTABLE

ESTIMATES OF ABUNDANCE AND DENSITY

ALL INDIVIDUALS OBSERVED—COMPLETE COUNTS

TOTAL COUNTS

1. DRIVE COUNTS
2. TOTAL MAPPING OF BIRD TERRITORIES
MARK AND FOLLOW INDIVIDUALS
3. SPOT-MAPPING OR TERRITORIAL MAPPING METHOD
PLOTTING LOCATIONS OF INDIVIDUAL BIRDS
4. THERMAL SCANNERS
5. MULTISPECTRAL SCANNERS—NEW TECHNIQUE
6. POPULATION RECONSTRUCTION-FOLLOW
ALL INDIVIDUALS IN POPULATION UNTIL DIE
7. AERIAL PHOTOGRAPHY

INDICES USED TO ESTIMATE POPULATIONS

1. SPOTLIGHT COUNTS
2. ANIMALS CAUGHT ON TRAPLINES
3. COUNTS OF ANIMAL TRACKS
4. FECAL OR PELLETT COUNTS

MUST DETERMINE THE RELATIONSHIP BETWEEN
INDEX AND DENSITY