Ch 4- Population Ecology

0) Ecology – The economics of nature

A) Recall that economics is the study of how resources are distributed.

I) The Study of ecology

A) Organization – In order to communicate and understand the effects of interactions ecologist use levels of organization

1) Individual - the smallest level of organization, it takes an individual to participate in the processes of life (eating, waste, reproduction, procreation)

2) Populations – Groups of individuals within a given area.

a) Evolution takes place within populations

b) All populations on earth make up a species

Species – generally a species is defined as individuals who can reproduce and form fertile offspring, but this definition falls short when discussing certain species (ie. bacteria). In this age we use a genetic definition. That is, "individuals with virtually identical DNA"

3) Communities – all populations in a given location

a) Community ecology – how populations interact

4) Ecosystems – everything (biotic and abiotic) in a given area.

a) Ecosystem ecology – how species use and share nonliving resources.

5) The Biosphere – Basically, the world.

B) Habitat – The environment where an individual lives.

1) the habitat must provide for all needs of an individual

2) Some species can change habitats

3) Humans beat habitat needs, we move our resources around.

II) Population descriptions

A) Because species survive in a population (group) it is logical to describe the characteristics of the whole population

B) Size – sheer (total) number

C) Density – how many in

1) All species have upper and lower limits to the needs of population density.

a) If species cannot find a mate, they cannot reproduce

b) If there are too many individuals, they will exhaust food and shelter supplies (starvation etc…)

(11-8) D) Distribution – Different species will tend to arrange themselves differently within their environment

1) Random – Resources are plentiful, no particular interaction between individuals

a) Common for plants because where ever seeds land is the main organizer

2) Uniform – (evenly distributed) occurs when individuals are territorial

3) Clumped – occurs when individuals need a particular resource

a) ex: in a desert the only trees live near oases

b) Also occurs for protection. Recall: herring.

c) Humans live clumped near waterways

E) Age Structure ratios

1) Ecologists use a uniform graph to discuss populations.

2) Age structure refers to the number of individuals who are:

a) pre-reproduction

b) reproductive age
c) post-reproductive age

3) Sex ratio refers to # men vs. # women
4) See p 108 for example
5) conclusions
a) Many individuals past reproductive age means population will decrease
b) Many young means population will explode
c) Sex ratios tend to indicate something in behavior
i) Lions mate one male to many females.
ii) certain human cultures kill female babies

F) Population Density - # individuals per unit land
1) This is a more useful number than (total) population
2) Eq'n: (Total Pop) / (Total Area)
3) Different species prefer different pop. densities.

G) Sampling – method used for estimating a population size
1) Extrapolation – a direct count that is assumed to represent the whole
a) Choose a representative area
b) Count the number of individuals of each species
c) Multiply the numbers to account for total size
- That is, if you measured 1/5 of the area, multiply your numbers by 5
2) Indirect observation – Using evidence to prove a species is present (and how many)
a) Important for solitary/shy species
3) Mark and recapture.
a) Used for large populations that are hard to count
b) Steps:
i) capture a group & count
- mark them (paint etc…)
ii) release them back into the wild.
iii) capture a new group, count, estimate total population

$$\frac{\#\ caught(1st)}{total\ \#} = \frac{\#\ marked}{\#\ caught(2nd)}$$

III) Population Growth (why do some populations explode?)
A) Basic equation
1) Growth Rate = (# added - # lost) / (total population)
a) # added = births + immigrants
b) # lost = deaths + emigrants
c) These are annual numbers
d) Seasonal migration doesn't count

B) Strategies
1) Different species grow different
a) Type I – few individuals die as children. Most die old.
-humans, whales
b) Type II – Death is basically constant through life
- birds, rodents
c) Type III – many kids that mostly die. Those who survive will likely grow very old.

- fish, frogs, spiders

d) The graphs of these are Survivorship Curves (p111)

C) Types of population growth

1) Exponential Growth –When resources are virtually unlimited population will increase at their maximum biotic potential.

a) biotic potential – The maximum offspring an individual can produce.

i) Humans *can* have about 12 kids per couple (sheesh)

ii) Type III species have very high biotic potentials

b) resources are almost never unlimited

i) Maybe after an ice age, or a forest fire.

ii) Bacteria sitting on your pizza overnight.

c) here's how it works:

i) Population * max growth rate = new pop

ii) new pop * max growth rate = newer pop

iii) repeat

d) see graph p 114

2) Logistic Growth

a) MUCH more common

b) looks exponential until limiting factors start killing/ preventing

i) Limiting factors – anything that limits pop growth

ii) Carrying Capacity – the max number of individuals that a h
support.

- when a population exceeds carrying capacity individuals die (starvation, disease, etc)

iii) see: graphs p 115

3) Cyclical change- many species undergo regular changes in population

a) consider mosquitoes, they live mostly in summer

Exponential Growth:
Bacteria undergo binary fission every 45 minutes so max rate = x 2 / 45min
A) 1 bacteria lands on food @ 12:00pm
B) 12:45 → 2 bac.
C) 1:30 → 4 bac.
D) 2:15 → 8 bac
…12:00 am
→65,536 bac.