1 Population Biology – an Introduction

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2 Populations

- Population biology
  - the study of populations of animals and plants,
  - a population being a group of interbreeding organisms in a specific region —for example, the members of a fish species on a reef

3 Populations

- Population
  - a given population is usually isolated to some degree from others of its species, whether geographically or in terms of behavioral or anatomical differences, but its boundaries may be vague
  - for example, the fish in a lake may also interbreed with the fish of interconnecting waterways.
  - a population is a useful, if occasionally artificial, unit for study

4 Populations

- Population density = individuals/unit area
- sometimes only reproductively active individuals counted

5 Patterns of population dispersal

- clumped – like humans (something makes an area favorable: soil, weather, rainfall, salinity)

6 Patterns of population dispersal

- uniform – very evenly spaced (creosote bushes in the desert are very, very evenly spaced)
  - they effectively remove limited water from surrounding area
  - animals use the shade and protection of the bush to forage for seeds
  - only successful seeds are in areas where a plant has died

7 Patterns of population dispersal

- random spacing – no pattern
- wolf spiders in forests
- ferns in the forest

8 Population Size Changes

- Factors that change a population
  - emigration – loss of individuals from a population
  - immigration – new individuals move in and live permanently
  - birth
  - death

9 Types of population growth

- Calculation of population growth

- per capita – per head (how many do you produce, how about your neighbor, etc.)
- birth rate = number of births/total population in a specific time period
  - example – 100 births/400 rats in one month

10 Types of population growth

- Calculation of population growth
  - must also factor in deaths so you need a death rate = deaths/total population in a specific time period
    - example – 40 deaths/400 rats in one month

11 Types of population growth

- net reproduction rate per individual rate or r:
- subtract death rate from birth rate
- r = br – dr (this is NOT births – deaths)
  - our example - 0.25 – 0.10 = 0.15 / month = r

12 Types of population growth

- G – population growth per unit time
- r - net reproduction rate per individual per unit time
- N – number of individuals in a population
- G = rN
  - our example: G = (0.15) x 400 = 60 new individuals/month
  - After one month the population is G PLUS THE ORIGINAL POPULATION G+N
  - This is the NEW N after one month!!!
  - Compute G + N for all of my homework problems!

13 Types of population growth

- Zero population growth – number of births is balances by the number of deaths for a given interval of time
- G = 0
- births = deaths

14 Graphing Population Growth

- Exponential Growth – follows a J –shaped curve (book examples are much steeper and indicate faster growth rates) – all are exponential!
- as you can see in the graph below exponential rates increase on the y axis much faster than on the x axis (exponentially more!)

15 Graphing Population Growth

- logistical growth – s shaped curve
- j shaped at first
- slows then levels off as carrying capacity is reached

16 Graphing Population Growth

- A – exponential growth region
- B – population that has exceeded the carrying capacity of the environment
- C – population that is dying out possibly due to over population (B)
- D – stable population in equilibrium with the environment

- E – carrying capacity of the environment

17 Population Growth

- doubling time – period of time needed to double the population – troubling for humans
  - 1650 AD – 200 years
  - 1960 – 30 years
  - 1975 – 15 years
  - 1987 – 12 years
  - 2012 - 61 years (finally an improvement!)

18 Population Growth

- Doubling time

- An example of a test-like question…

  In 1932, the mule deer population in Montana was 200,000 and after 20 years of careful wildlife management the population had grown to 394,000. This represents the:

  - a. polyploidy b. logistical growth
    c. doubling time d. exponential growth

19 Population Growth

- Biotic potential – maximum reproductive rate
- rarely do conditions permit biotic potential
  - shelter
  - food supply
  - water
  - minerals
  - energy
  - all of the above and more are collectively limiting factors to population growth

20 Population Growth

- the carrying capacity (E) is the maximum number of individuals that a particular environment can support
- sometimes a population can increase beyond the carrying capacity with precipitous declines shortly thereafter (C)

21 Density dependent vs. independent population controls

- density dependent – these factors increase or become more prominent when the population density increases
  - disease
  - predation
  - stress
  - pollution
  - parasites
  - pathogens

22 Density dependent vs. independent population controls

- density independent – these factors have their actions without regard for population density

- weather – lightning, temperature, snowfall, drought
- natural disasters and other catastrophic events
- seasonal cycles
- total space

23 Survivorship Curves

- There are three stages in each curve:
  - Dependency (Pre-reproductive)
  - Reproductive
  - Post-Reproductive

24 Survivorship Curves

- The three types of curves are:
  - Type I - Most die in post-reproductive stage, i.e. at end of physiological life span (humans, large mammals under favorable conditions like zoos, annual plants)

25 Survivorship Curves

- The three types of curves are:
  - Type II - Death rate is constant over lifespan, e.g. birds, rodents, perennial plants

26 Survivorship Curves

- The three types of curves are:
  - Type III - Most die early in life - fish, invertebrates (such as starfish or oysters), perennial plants