Biology 11A Lecture Notes – Test 5

Chapter 36 – Population Growth and Regulation

A. Introduction
    a. Ecology – study of the interaction among living things and their environment.
    b. Abiotic (nonliving) and biotic (living) components
    c. Populations → Communities → Ecosystems → Biosphere
B. Population dynamics
    a. Population growth = births – deaths. If migration is included, add immigrants – emigrants.
    b. Exponential growth gives rise to a J curve (Fig. 36.4A)
    c. A typical growth curve will look an S curve. (Fig. 36.4B)
        i. *Limiting factors* keep population at *carrying capacity* (maximum population that an ecosystem can support) (Fig. 36.4C)
        ii. Factors
            1. Limited resources (Fig. 36.5A)
            2. Natural events – e.g. weather (Fig. 36.5B)
            3. Human activity – pollution, habitat destruction
            4. Predation – predator and prey cycles. Some go through boom-and-bust cycles (Fig. 36.6)
            5. Parasites
    d. Population distribution (Fig. 36.2)
        i. Clumped – organisms work together, resources are not evenly distributed
        ii. Uniform – territorial, scarce resources
        iii. Random – no social groups, good resources
    e. Survivorship curves (Fig. 36.3)
        i. Early loss
        ii. Constant loss
        iii. Late loss
C. Human population growth
    a. Current population is about 7 billion. Humans have been in exponential growth for about 400 years. Just starting to slow but should still double in about 50 years. (Fig. 36.9A)
    b. Developing countries have increasing (S. Amer., Asia, Africa) vs. developed countries have zero growth (US, Europe) (Tab. 36.9)
        i. Balance of births-deaths. E.g. Mexico transitions to lower birth and death rates. This is demographic transition. (Fig. 36.9B)
        ii. Age structure (Fig. 36.9C)
            1. Rapid growth shows triangular shape while zero growth is rectangular.
    c. Ecological Footprint
        i. The amount of land necessary to sustain current standard of living.
        ii. Some countries use more resources than others (Fig. 36.11B)
    d. Carrying capacity gets pushed up by technology (agriculture, medicine, etc.). Some estimates at 12 billion.

Chapter 37 – Communities and Ecosystems

A. Communities
    a. Community – all organisms in a particular environment.
    b. Symbiosis

i. Mutualism + +
ii. Commensalism + =
iii. Parasitism + -

c. Competition
i. Competitive exclusion – only one species can occupy a niche. Gause 1934 showed P. aurelia outcompetes P. caudatum.
ii. Resource partitioning – new niches are created to allow more species

d. Predator-Prey Dynamics
i. Defenses (Fig. 37.5)
1. Chemical – use poisons, toxins. Organism may have a warning color.
2. Camouflage – blend into the environment
3. Mimicry – copy the appearance of another organism.
ii. Coevolution – reciprocal adaptations. Passion Flower develops toxin. Helioconius evolves resistance. Passion Flower develops fake egg sacs. (Fig. 37.7)

B. Ecosystems

a. Energy flow
i. Energy flow and chemical cycling (Fig. 37.14)
ii. Trophic structure: producers → consumers → decomposers (Fig. 37.18)
1. Food chains describe who eats who (Fig. 37.8)
2. Food webs are more realistic than food chains (Fig. 37.9)
iii. Energy pyramids: only 10% energy transferred to next trophic level. (Fig. 37.16)
1. Why eating lower off the food chain is better for environment (Fig. 37.17)
2. Energy required for transportation and processing should also be considered.

b. Chemical cycles
i. Abiotic (nonliving) and biotic (living) transfers
ii. Carbon: CO_2 fixed from atmosphere. Fossil fuels are a reservoir. Humans remove fossil fuels and burn them, creating too much CO_2 (Fig. 37.19)
iii. Phosphorus: only phosphate used. Over-mining and fertilization introduces too much causing overgrowth. (Fig. 37.20)
iv. Nitrogen: N_2 unsuable. Fixed to NO_3, NH_4 which plants/bacteria use. Humans over-fertilize introducing too much NH_4. (Fig. 37.21)
v. Clearcutting can eutrify lakes (introduce too many nutrients) (Fig. 37.22)

Chapter 35 – Behavior

A. Basic behavior – influence by genes and environment.

a. Innate behavior – controlled by genes, not environment
i. Genetic basis – populations of male voles
1. Prairie voles are monogamous
2. Mountain voles are promiscuous
3. Gene for vasopressin receptors higher in prairie voles. Mice transgenic for VR become monogamous.
ii. Fixed action patterns – programmed sequence of events. E.g. graylag goose (Fig. 35.2A)

b. Learned behaviors – controlled by genes and environment
i. Experiment to show environmental control
1. Some Norway rats are good parents – retrieve young and aggressive to strangers

2. Some Norway rats are bad parents - do not retrieve and are less aggressive
3. Pups raised by other mother behave more like parents later. (Fig. 35.3B)

ii. Types
1. Habituation – loss of response to stimulus after repeated exposure.
2. Imprinting – learned behavior that becomes permanent. Limited to sensitive period. E.g. gooselings, songs of sparrows (Fig. 35.5A)
3. Spatial learning – use landmarks for orientation (Fig. 35.7C)
4. Cognitive mapping – create mental maps (Fig. 35.8)
5. Association – learning by conditioning. (Fig. 35.9)
6. Social learning – imitation (Fig. 35.10)
7. Problem-solving – a form of cognition. (Fig. 35.11)

B. Social behaviors
a. Foraging
i. Generalists eat a wide variety (e.g. sea gulls)
ii. Specialists only eat certain foods (e.g. koalas)
iii. Animals create a search images to find favorite food
1. Optimal forage theory states that you should pursue food that gives highest caloric content per energy spent catching it. (Fig. 35.12)
b. Communication
i. Uses, all senses: touch, sound, chemical, visual, smell.
ii. E.g. bee waggle dance helps communicate location of flower sources (Fig. 35.13B)
c. Mating behaviors
i. Mating systems – related to reproductive success
1. Monogamous - one mate with pair-bonding
2. Polygamous - more than one mate with some pair-bonding
3. Promiscuous - many mates with no pair-bonding
ii. Leads to mating rituals (Fig. 35.14B)
d. Territoriality – in limited resources, this helps parcel out space (Fig. 35.18)
e. Agonistic behavior – resolving conflicts without fighting. Use postures, threats, sounds instead
f. Dominance hierarchies – pecking order to establish social rank
g. Altruism (Fig. 35.22)
i. Kin selection – help your families genes
ii. E.g. prairie dog guards, moles

Chapter 34 and 38 – Ecosystems and Conservation

A. Ecosystems
a. Factors
i. Abiotic – solar, water, temperature, wind
ii. Biotic – natural selection
b. Climates (Fig. 34.5)
i. Rotation of earth causes variation in sun and wind (Fig. 34.5AB)
ii. Wind patterns give uneven heating resulting in rainy and dry areas (Fig. 34.5CD)
iii. Ocean currents affect local climates (Fig. 34.5EF)
c. Aquatic biomes
i. Oceans are largest – coral reefs are most biodiverse (near surface) (Fig. 34.6A)
ii. Freshwater includes streams, lakes, ponds, rivers. (34.7A)
iii. Estuary – fresh and salt water. (Fig. 34.6D)

iv. Wetlands are between aquatic and land. (Fig. 34.7B)

d. Terrestrial biomes
    i. Tropical Forest – hot and wet. Most biodiverse. Stratified.(Fig. 34.9)
    ii. Deserts – hot and dry. (Fig. 34.11)
    iii. Chaparrel – moderate temperature all year. Rain in winters only (Fig. 34.12)
    iv. Grasslands – seasonal. Prairie is an example (Fig. 34.13)
    v. Tundra – cold and dry. Permafrost. Summer blooms (Fig. 34.16)

B. Conservation
    a. *Biodiversity*- variety of life forms on Earth
        i. 1.5 million described species. 5-15 million total.
        ii. *Biodiversity hotspots* (20% of species in 1% of land area) (Fig. 38.11)
            1. Coral reefs (Fig. 38.2B)
            2. Rainforests (warmer, wetter regions)
        iii. Value
            1. Medicine – e.g. rosy periwinkle for cancer (Fig. 38.1)
            2. Direct consumption – agriculture, wood etc.
            3. Regulation of environment – waste disposal, climate control.
    b. Causes of loss/extinction
        i. Habitat destruction – number 1 cause – 73% of all extinctions
            1. Global warming – alters biosphere (Fig. 38.5.6, 7) Greenhouse effect due to human release of gases.
        ii. Invasive species – new location allows overexpansion of an organism.
        iii. Overexploitation – taking too much. E.g. overfishing.
        iv. Pollution – release of toxins. Biological magnification of a pollutant up the food chain can be serious (Fig. 38.4)
    c. Management
        i. Concepts
            1. Landscape ecology – entire habitat must be preserved. Fragmentation of a population can be a problem.
            2. Edge effect – edge of preserved area bordering unpreserved. Can have positive or negative effect
            3. Corridor – vital strip that connects fragmented populations. Yellowstone to Yukon Project is an attempt to connect populations (Fig. 38.13A)
        ii. Restoration – return degraded ecosystems back to natural state
            1. E.g. Everglades in Florida. Need to be flooded to maintain life. Stop residential development but allow certain flood crops like sugarcane and rice. Flood using water from Lake Okeechobee. (Fig. 38.14)
        iii. Sustainable development – balance growth and preservation.