

### What is Ecology?

What is Ecology

- The study of our house and the individuals within

Abiotic - Atmosphere

Biotic - Primary producers, Secondary producers, Decomposers

Open systems - Earth can be affected by outside objects

Closed systems - Universe

Disciplines of Ecology

- Individual

-Population

-Community

-Ecosystem

-Landscape

- Biosphere

-Universe

### Biomes and State Factors

Climatograms - average temp season graph  
Temp/precipitation and highlighted growing season

Nine Terrestrial Biomes

1. Tundra

- coldest biome, permafrost and stunted  
-mountains, harsh wind, very short growing season

2. Boreal Forest (Taiga)

- Densely populated by coniferous trees  
- not below the Equator  
-Harsh winter, short growing

3. Temperate Rainforest

-mild temperature  
-lots of rain

-evergreen forest (Giants)

4. Temperate Seasonal Forest

- moderate temperature and precipitation  
- deciduous trees (oak, maple etc.)  
- low continentality

5. Woodland/ shrubland (chaparral)

-hot dry/mild wet  
-grasses and shrubs

### Biomes and State Factors (cont)

6. Temperate Grassland

- hot dry/very cold  
- grasses, flowers and shrubs

7. Tropical Rainforests

- Warm very humid  
- long growing

8. Tropical Seasonal Forest

- wet/dry seasons  
-deciduous trees

9. Subtropical desert

-hot temp, scarce rain  
-long growing season

### Five State Factors

1. Climate

2. Topography

3. Parent Material

4. Potential Biota

5. Time

Climate

-atmospheric conditions AVERAGED over years

-NOT weather

Topography

- layout of the land -elevation proximity to lakes

Parent Material

-underlying geology of a region  
- helps determine soil formation + nutrient availability

Potential Biota

- ecosystems hostages to evolution

Time

-Deep time - continental drift, meteor impacts

-Short term - Time since disturbance (succession)

### Hadley Cell

Hadley Cell (Tropical air mass)

1. Warm air rises, expands and cools

2. Releasing latent energy, warm air rises more

3. air moves poleward due to pressure gradient (subtropics)

### Hadley Cell (cont)

4. cool air sinks and heads back toward tropics with moisture

Rain Shadows

-effect Mountains and oceans have on temperature and precipitation

Elevation has significant effect on temperature

Continentality - climatic effect that results from a continental interior being insulated from oceanic influences

### Natural Regions of Alberta

1. Rocky Mountain

- coolest summers, shortest growing season

- Greatest elevational range

2. Foothills

- Mid elevation

-Bedrock ridges to hills

-lots of precipitation

- Forest-dominated

3. Boreal Forest

- Four months < -10 deg C

- 2 months of summer > 15C

- extensive coniferous and aspen trees

- wetlands and sand dunes

4. Canadian Shield

- exposed granite bedrock

-glacial deposits, small lakes, forests

5. Grassland

-rich topsoil

- flat-rolling prairie

-warmest and driest region

-trees along riverbanks, uncommon shallow saline lakes

6. Parkland

- a mix of grasses and trees

- Edmonton, Red Deer, Calgary



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### Adaptation

#### Adaptations

- Morphological, physiological or behavioural traits that provide a fit between the organism and the environment

#### Environment

- Biotic - biological components  
- Abiotic - physical components

#### Fit

1. Match - adaptations make sense given the conditions experienced by the organism

2. FITNESS - organisms with adaptations have higher success

#### Fitness

- Measure of the lifetime success  
- number of offspring  
- # of offspring surviving to adulthood  
- # of offspring having offspring  
- Survival is not as crucial as # of offspring

Evolution - Changes to the frequencies of alleles within a population

#### Natural Selection

- Selective agent is the biotic or abiotic environment

traits are favoured that enhance fitness

1. Variation in phenotype

2. Fitness is non-random in respect to phenotype

3. Phenotype is heritable

#### Forms

1. Stabilizing

- Avg phenotype has max fitness  
- removes extreme phenotypes  
- maintains average

2. Directional

- Operates when one extreme has higher fitness

- shifts average in the direction of extreme

3. Disruptive

- both extreme have higher fitness  
- removes average  
- two phenotypic groups

### Adaptation (cont)

#### Static adaptation

- unchangeable across environments and life stages

#### Ontogenetic adaptations

- adaptations specific to life stages

#### Plastic

- change as the environment

### Physiological Ecology

#### Range of Tolerance

Tolerance - degree of performance or fitness

Zone of intolerance - death is inevitable

Range of tolerance - full range individual can survive

Zone of physiological stress - barely survive

Range of growth - individual can survive and grow

Optimum range - individual can grow and reproduce

Enzymes - range temperature curve

#### INTERNAL BODY HEAT

$H_s = H_m + H_{cd} + H_{cv} + H_r + H_e$

$H_s$  - total heat

Metabolic heat - chemical reactions

Conduction - heat moves warm  $\rightarrow$  cold

Convection - movements air or water

Radiation - sun or radiated off of something (fire/rock)

Evaporative cooling - water

Ectotherms -  $H_s$  regulate by external temp

Endotherms -  $H_s$  regulated by internal process

Poikilotherms - Internal temp varies

Homeotherms - Internal temp remains constant

#### Coping with Extremes

1. Escape - migration, dormancy  
- Cytobiosis - complete loss of metabolism  
- Hibernation - reduced not shut down  
- Torpor - brief periods of reduced activity  
- Aestivation - adaptation for coping with extreme heat

2. Seasonally-appropriate phenotype

3. Compensate for the inability to thermo-regulate

### Physiological Ecology (cont)

- Make more enzymes, each enzyme is slow but do more work

- turn on appropriate gene under appropriate temperatures

4. Die - strong selection can lead to extinction or to adaptation

via evolution through natural selection

### The Niche

#### Niche

- The set of environmental factors that influence the growth survival and rep. of a species

- Niche axis - shows diversity

#### Fundamental Niche

- Abiotic and Food conditions in which a species might live, in the absence of interactions with other organisms

#### Realized Niche

- Abiotic and food conditions in which a species might live, given interactions with other organisms

### Allocation of Energy

#### Principle of the allocation of energy

- since energy resources are limited using energy for one thing reduces the energy available for another (e.g growth and rep)

#### Fast and Slow life histories

(R-selected) and (K-selected)

#### Life histories

1. Age of sexual Maturity

2. Fecundity

3. Partiy - breeding event

4. Parental investment

5. Longevity

#### Plants

- Competitors (top)- fare poorly in stress/disturbed

- Stress tolerant - unique adaptations

- Ruderals - quick to arrive and grow easily out-competed

### Behavioral Ecology I

Battle of the Sexes  
 Asexual reproduction - without the fusion of gametes  
 Autogamy - fusion of gametes - within the same individual (can swap gametes)  
 Allogamy - fusion of gametes - different individuals  
 Gynogenesis - sperm touches but not penetrates  
 hybridogenesis - Father's DNA excluded from next generation  
 Isogamy - Sperm and egg same size  
 Anisogamy - Sperm smaller than egg  
 Oogamy - Egg non-motile  
 Sexual Dimorphism - difference in size/appearance apart from genitalia  
 Anisogamous Species - sperm smaller than egg  
 Males - want to mate - Max. Fit.  
 Females - want to wait - Max. Fit.  
 Fit Max?? - males have more offspring  
 Male Phenotypes: compete with other males, attract females etc.  
 Female Phenotypes: drawing males in, choosing males  
 Consequences of Anisogamy  
 1. Female Choice  
 - Sexual selection, Direct/indirect benefits, Brain development  
 2. Battle of the males  
 -Direct battles, Sperm Comp, Interference, Infanticide  
 3. Sexual conflict between males and females  
 Tramatic insemination + infanticide  
 Features for grip  
 Genitalia changes  
 Cryptic Female choice - stores/ chemically kills sperm  
 Sexual Cannibalizm - female eats male  
 Battle of the female

### Behavioral Ecology I (cont)

1. Nonadaptive hypothesis- female aggression byproduct
2. Natural selection Hypothesis - compete for food and protection
3. Sexual selection - males are rare/good genes

### Mating Systems

Mating Systems  
 - Social sexual structure of a pop  
 Monogamy  
 - Exclusive  
 Serial - partner for that season but different yearly  
 Social - care of offspring together, not bio  
 Genetic - care for bio offspring  
 Polygamy  
 - multiple partners  
 Polygyny - Male +females  
 Polyandry - Female +males  
 Polygynandry -+males +females exclusive  
 Promiscuity  
 - no mate choice (seaannemines)  
 Sex with Benefits  
 - mate guarding  
 - female-enforced monogamy  
 - mate assistance  
 Direct benefits, Indirect benefits  
 Material benefits polyandry  
 - more resources  
 - Better protection  
 - infanticide resistance  
 - genetic benefits (better chance pregnancy)  
 Dispersion of resources and ability to defend  
 Uniform/Random/Clumped  
 Paternal Care  
 Altricial - born helpless  
 Precocial - born independent

### Population Ecology

Species  
 - a group of potentially interbreeding organisms capable of producing fertile offspring  
 Population  
 - Organisms ACTUALLY reproduce contained in the same geographic area  
 Population Characteristics  
 Geographic Range, Abundance, Density, Dispersion, Dispersal, Structure  
 1. Spatial distribution - Niche requirements, time, ability to get there  
 2. Abundance  
 -Census size (Nc) mark release capture  
 $M/N=R/C$   
 3. Density  
 # of individuals per unit area  
 4. Dispersion  
 5. Dispersal  
 -the movement of individuals

### Population growth

Type 1, Type 2, Type 3 - Percentage of survivors  $(\log(Ix*100))/(Max\ life\ span)$   
 $Ix$  = proportion of those born  $Nx/N0$   
 $bx$  = average number of female offspring an individual female has during  $x$   
 $Ixbx$  = replaced % of the starting population  
 $R0$  = Net reproductive rate sum of  $Ixbx$   
 snakes/snake/gen  
 $T$  = generation time sumof  $xIxbx/R0$   
 $r$  = per capita growth rate  $\ln R0/T$   
 snakes/snake/inst.time  
 BIDE  
 $N=B+I-D-E$   
 $N/T=BIDE/change\ T$   
 $r= b-d$   
 $dN/dt=rNt$   
 $Nt=N0e^{rt}$   
 $r=rmax((K-Nt)/K)$   
 $dN/dt = rmaxNt((K-N)/K)$



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### Intraspecific interactios

#### Intraspecific interactions

- Behaviours directed towards the recipient from an actor

Actor - doing the thing

Recipient - getting the thing

Cooperation - benefits both - forging, protection

Selfishness - benefits actor - self protection

Altruism - benefits recipient - kin selection  
greenbeard, reciprocal, costly signaling

Spite - no benefit

### Help

Help test



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