

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

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

- Cyptobiosis - 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
 Trumatic insemination + infanticide
 Features for grip
 Genitalia changes
 Cryptic Female choice - stores/ chemically kills sperm
 Sexual Cannibalism - 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 (seaanneminiies)
 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 $(\log(Ix \cdot 100)) / (\text{Max life span})$
 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 sum of $xIxbx/R0$
 r = per capita growth rate $\ln R0/T$
 snakes/snake/inst.time
 $BIDE$
 $N=B+I-D-E$
 $N/T=BIDE/\text{change } T$
 $r=b-d$
 $dN/dt=rNt$
 $Nt=N0e^{rt}$
 $r=r_{max}((K-Nt)/K)$
 $dN/dt = r_{max}Nt((K-N)/K)$



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Intraspecific interactions

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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