GLY 102 – Global Environmental Science part 2
Handout for Lecture 3

EVOLUTION
Jean-Baptiste Lamarck (French: late 1700s-early 1800s): predominant theory of "evolution" prior to Darwin:

- •During their lifetimes, individual organisms **acquire** structures or skills useful in dealing with environment
- •These acquired structures are passed on to their descendants
- •Over time, the accumulation of acquired structures changes one type of organism to another
- •Flaw with Lamarckian Evolution: characters acquired **during the lifetime** of an organism are **not passed on to descendants!**

During early-mid 1800s, two natural historians independently developed an alternative, and superior model: **Natural Selection**.
Two individuals were **Alfred Russell Wallace** and **Charles Darwin**:

- •Both British
- •Both trained in England, but traveled to far countries (Darwin to South America and Galápagos,Wallace to Amazon River basin and Malaysia)
- •Independently made same basic observations and conclusions
- •Mutual friends decided to present papers of both (in 1858) on their behalf, so both could get credit

The following year (1859) Darwin published *On the Origin of Species by Means of Natural Selection*: an instant "best-seller" and source of decades of controversy.

Their basic observations:

I. Organisms in all populations possess heritable **variations** - size, color, agility, speed, digestion…

II. Some variations are more favorable then others.

III. More young are born to every population than can POSSIBLY survive

IV. Those with favorable variations are more likely to survive and produce offspring with their favorable variation.

•Thus, IF some variation gives the individual a slight advantage (bigger, stronger, smaller, smarter, less tasty, whatever) at surviving; and IF that variation is inherited; THEN there is a somewhat better than average chance that organisms with that variation will survive to bear the next generation. Over the long expanse of geologic time, the accumulation of these variations will change the population from one form to another: the origin of species.

Thus Origin of the Species by Means of Natural Selection

•This process is analogous to **artificial selection** (i.e., domestication), and thus called **natural selection**.

•NOTE: Natural Selection is **NOT** "survival of the fittest", as implied by your textbook
•NOTE ALSO: Darwin did not use the word "evolution" very often; instead, preferred the phrase **"descent with modification"**.

Example of the British Pepper Moth
If you want more information on this go to the website -
http://www.uoguelph.ca/zoology/rush/unframed/92150www/coursework/mod1/m1-4.html

Read about the Galápagos finches (Figure 3.5) in your textbook.

•Darwin also pointed out a subset of Natural Selection: **Sexual Selection**, where the variation is "being more sexy" (and thus have better than average chance of breeding, and thus passing on "sexiness", compared to other members of the population): peacock tails, bird song, etc.
•Sexual Selection is actually often at odds with "Natural Selection" - prettier feature can also make it easier for a predator to find/catch

Adaptation
•term refers to when species acquire traits that allow them to survive in a specific environment.
– Acclimation - available to individual organisms during their lifetime - not hereditable
– Population level adaptation - brought about by the inheritance of specific genetic traits that allow a species to live in a particular environment

Natural Selection - Due to a variety of environmental pressures certain traits are favored
–Limited resources/space exert **selective pressure** on a population
•Physiological stress - moisture, temperature, pH, etc.
•Predation -
•Competition -
•Luck -

Another way to put Physiological Stress is **Tolerance Limits**
•the limits to the environmental conditions that a organism can endure.
–temperate –moisture –nutrient supply –soil and water chemistry –available space

•There are maximum and minimum tolerance levels for organisms
•Used to think that there was **one** critical limiting factor that determined the distribution of an organism –Saguaro cactus
•Found out that it is usually a combination of several different factors
•Juvenile forms almost always more sensitive than adult forms

Can also be used backwards - the presence or absence of certain species can be used to say something about the environment.
–lichen and eastern white pine are very sensitive to acid precipitation - their absence is indicative of acid rain & sulfuric acid (see Figure 3.2 in your textbook)

Evolution
•Gradualism - changes within species and the introduction of new species occurs gradually - slowly and steadily over huge period of time
•Punctuated Equilibrium - Species remain relatively unchanged thru most time until some relatively abrupt event causes change and new species develop in only a few thousand generations

Speciation •Given enough time generations of species may gradually evolve to become better suited to their environment (or much change because the environment changed)
•The decedents may change so much from their ancestors that they become a distinct species = speciation

This can result from •new opportunities •new risks •isolation (Darwin's finches)
–divergence - when a small population become isolated and its genetic characteristics become distinct from the original population

•read the section in the book on **Taxonomy –** "the naming of names"

Convergence •When different species develop functionally similar adaptations but come from different genetic stock

Lecture 4 –

Ecological Niche

•A description of the role played by a species in a biologic community, and
•The total set of environmental conditions/factors that determine a species distribution

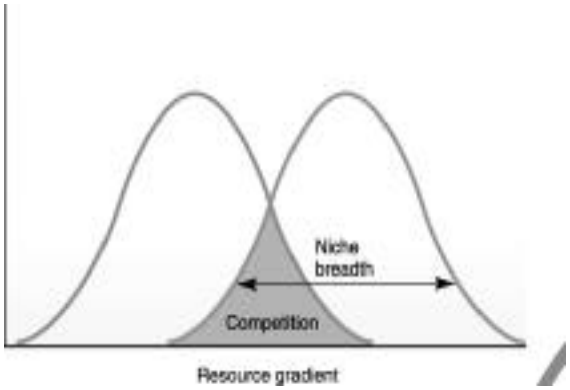
Generalist •A species that can adapt to a wide range of environments
–raccoons, rats, wolves, dandelions
–Can adept quickly to changes
•*Opportunistic* - appear quickly wherever an opening exists.
•*Pioneer species* - first to appear

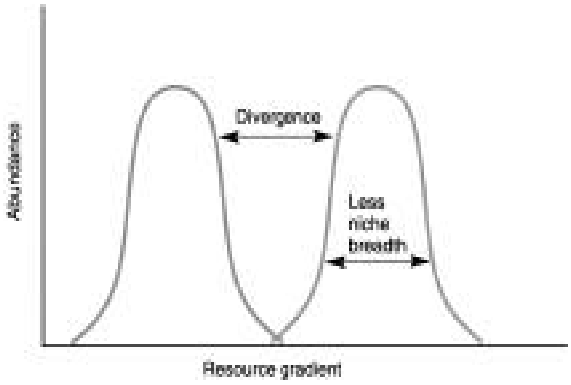
Specialist •A species specifically adapted to a very narrow niche or range of conditions
–pandas, koalas, wild roses
–Much less resilient to change, adept very slowly

Law of Competition

•no two species will occupy the same ecological niche and compete for exactly the same resources in the same habitat for very long.
–One group or the other will gain an advantage forcing the other group to move or change behavior or become extinct

– **resource partitioning -** adaptations geared to reduce competition in the same habitiat





<u>Species Interaction</u>

•Predation

–Predator - any organism that feeds directly on another living organism (Carnivores prey on other animals, Herbivores prey on plants, Omnivore prey on both

•Parasites and pathogens can also be considered predators

•**Competition**

–**Intraspecific competition**

competition within a species

–**Interspecific competition -**

competition between species

Can result in Coevolution where two species (predator and prey, birds and plants) evolve in response to changes in each other (prey gets faster, predator gets faster …)

•**Symbiosis** •the intimate living together of members of two or more species

•Unlike predation and competition, symbiosis *can* be beneficial to all involved parties (but not always).

•**Commensalism:** - "eating together at the same table" - in this association one member, usually the smaller, derives benefit from the association, whereas for the other member, the association is neither beneficial or harmful. The relationship can be that of sharing space, substrate, defense, shelter, transport or food.

•Most often these associations are facultative, that is the commensal will not die if it does not enter into the association. As apposed to an obligate one.

•Ex. Some species of barnacles are found only as commensals on the jaws of whales.

•The Remora fish (Echeniedea) is a long slender fish which has its dorsal fin modified as a sucker-like attachment organ. It attaches to the sides of larger fish and turtles using them as transport hosts but in addition, obtains food fragments dropped from the host.

•**Mutualism:** As the name would suggest this is an association in which both organisms derive mutual benefit.

•associations are seen in cleaning fish often seen around sharks feeding on parasites in the mouth and gills. The Egyptian plover performs a similar service by cleaning the mouth of crocodiles.

•Tick birds on rhinos and ox pecker birds on various antelopes also share a mutual relationship. In addition to removing ticks and other irritating insects, the ox peckers often signal the presence of predators to the antelopes.

•**Parasitism**

•" A parasite is an organism living in or on another living organism, obtaining from it part or all of its organic nutriment, usually to the detriment of its host.“

•Examples of parasitism include: tick-dog; tapeworm-human.

<u>Defensive Mechanisms</u> •Development of some mechanism by which to hide better or to defend oneself from attack. Toxins, smells, stingers or nettles, body armor

Mimicry •Evolving to look like something else

–looking like a more dangerous animal

–looking like something inedible

–looking safe - thereby preying on other organisms

Keystone Species •a species or group of species whose impact or involvement on its community/ecosystem is larger or more influential than expected from its mere abundance

•Absence of this/these species can reek havoc on an ecosystem