Desert Patterns

Plants
- Growth and reproduction
- Water loss prevention
- Defenses

Animals
- Growth and reproduction
- Water loss prevention
- Defenses

Abiotic Features

Introduction

A major emphasis in ecology is the discovery and study of patterns. If every single organism were entirely unique in every way, it would be impossible to define any ecological principles or make any predictions regarding ecological interactions. Every single situation would be new. The purpose of ecology is to determine the causes of the interactions observed, not describe each and every one as a unique entity.

Individual organisms collectively make up complex communities, and even more complex ecosystems when abiotic features are included in the mix. Studying individual behavior yields only a portion of the story. A more complete understanding of the interactions among and between organisms and their environment can be accomplished through the search for patterns and sequences in nature. Once basic patterns in a population are discovered, predictions can be made about similar populations and ultimately even about more complex communities. This leads us to the goal of ecology, which is to understand the distribution and abundance of organisms.

When you are observing nature and running experiments, look for patterns and sequences of events. These patterns or sequences can be on short or long time scales. For example, rainfall is best observed as an annual pattern, whereas the life cycle of many insects can be a matter of only hours or days. All organisms go through a life cycle that follows its own pattern and sequence, but all living organisms have a life cycle, so some similarities can be identified. Also look for similarities and differences of physical structures and behaviors. Nutrients and minerals in the soil or water also go through cycles. As students notice these patterns they will generate more questions than they (and you) will know what to do with!

General patterns

Abiotic patterns to track and graph over time (these can be recorded daily, weekly, monthly or annually):

- Rainfall
- Air
- Ground temperature
- Water temperature
- Humidity
- Wind speed
- Day length

Biotic patterns to track and graph over time (these can be recorded daily, weekly, monthly or annually):

- Flowering of different plant species
- What plant and animal species are observed in the habitat (don't forget to check leaf litter, the soil, and pond)

- Growth rates of plants
- Abundance of organisms
- Observable birth and death rates

Do you see any trends or **correlations** between some abiotic and biotic factors?

As **herbivory** is decreased, plants will increase in height, width and **biomass**, number of flowers, fruits and seeds. The same is expected when nutrients, water and/or light are increased (to a point - too much is detrimental). When the soil is improved, plant density decreased, or **pollinator** density increased, the same effects are expected to occur.

If the number or variety of seed dispersers is increased, expect to see a wider distribution of plant species.

As nutrients are increased, growth rates and number of offspring will increase. **Competition** for resources will decrease, temporarily, until the number of animals increases and competition occurs again.

Patterns Found In the Lower Sonoran Desert

Plants— Growth and reproduction

- Plants tend to bloom in the spring after fall/winter rains and late summer after monsoon rains.

- Some plants bloom for a very limited time to take advantage of their pollinators.

- Some desert plants have a very short life cycle, growing quickly, producing seeds and then dying. Others grow very slowly, taking many years to reach reproductive maturity. (See

  resource allocation.)

- Many desert wildflower seeds will not germinate until enough water (rain) has washed away a chemical on the seed surface that prevents germination.

- Many species of desert plants have seeds that will survive years in the ground until conditions are favorable for growth.

Plants— Water loss prevention

- Those plants that resist drought by losing leaves grow new leaves after enough rain has fallen. (e.g. ocotillo)

- Tiny leaves reduce water loss to **transpiration** (water evaporating through leaves) because less surface area is exposed to the sun and wind.

- Many desert plants have a waxy surface or **cuticle** on the leaves to prevent water loss. Another structure that prevents water loss is hair (trichomes) on the leaves.

- Most desert plants have many roots near the surface of the ground to soak up rainwater before it **evaporates**. Some desert plants have a very long taproot to reach deep groundwater (e.g., mesquite).

- Light leaf color reflects the sun's rays, reducing heat and evaporation.

- Some desert plants move their leaves throughout the day so sunlight hits leaf edges, thus reducing the amount of heat absorbed by the leaves (e.g., jojoba).

- Many plant leaves wilt in the heat of the day but regain their form in the evening. This is another way to reduce water loss. Wilting helps close the**stomata**, the openings in the leaves that allow water, carbon dioxide and oxygen to move in/out of the plant. In these plants, **photosynthesis** actually takes place at night because the process requires the stomata to be open. Light energy is collected during the day and stored until used at night.

- Some plants release chemicals into the soil that inhibit other plant seeds from germinating nearby and competing for water and other resources. This is called allelopathy. Plants using it will usually be alone. Creosote is an example.

- Many desert plants have stems that are green for photosynthesis. Those that do will usually have either no leaves (e.g. cacti) or very small leaves (e.g. palo verde).

Plants– Defenses

- Many plants have developed defenses against **herbivores**, such as spines, thick outer layer, bad taste or even chemicals that are toxic when ingested.

- Plants also have temporal defenses against herbivory. Plants that grow very quickly, mature, reproduce and die are less likely to be discovered and eaten by an herbivore, be it insect, mammal, bird or reptile.

Animals– Growth and reproduction

- Seed eating (granivorous) ants will typically have colonies near seed producing plants such as grasses.

- Butterflies, moths and bees are most commonly seen when flowers are in bloom.

- Most native bees are solitary; they do not live socially in hives like the common honeybee. Why this is so is still unclear. It may be due to the effect of natural selection in the desert. The common honeybee, *Apis mellifera*, was imported to the United States centuries ago from Germany.

- Some solitary native bees sleep at night with their legs wrapped around twigs of plants.

- Digger bees dig tubular holes in the ground for egg laying.

- Butterflies and moths tend to lay clusters of shiny little eggs on the undersides of leaves (and sometimes other green surfaces). Species that use specific plants will lay eggs on those plants only.

- Male hummingbirds claim territories and fight off other males. They will allow females into their territories to feed. Two hummingbirds at a feeder will be either two females or a male and a female.

- Aquatic insects are more common in the warmer months. They will become dormant or less active in cooler months.

Animals— Water loss prevention

- Mammals are more susceptible to the heat than other animals and so tend to be less active during the hottest part of the day. Many mammals are dusk-dawn active (crepuscular).

- Lizards and other reptiles need heat to become active and to digest food. They therefore tend to be active during the day. They do seek refuge from the heat when it gets too hot even for them.

- Most desert insects and some mammals do not need free water to drink. Water needs are supplied completely by ingested foods.

Animals— Defenses

- Some animals defend themselves temporally by being active when their predators are inactive.

- Some animals (usually insects) defend themselves by being distasteful and/or being toxic.

- Mimicry is another defense used by animals. Mimicry can either accomplish camouflage or make the animal look like another species that is distasteful or toxic.

Abiotic features

- Sonoran desert soils tend to be alkaline (basic).

- Desert soils are usually a mixture of clay and sand, allowing water to quickly soak in and be lost to shallow rooted plants.

- Less shaded ground gains heat rapidly but also loses it more rapidly at night, leading to great temperature fluctuations.

- High surface temperatures create rising hot air currents, leading to plant drying. Plants that live close to the ground lose less water to this ground wind.