HABITATS

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HABITAT

A habitat is the environment in which a community, species, population or organism usually lives. Habitats can be described in terms of their **geographic locations** (e.g. tropical environments exist at the *equator*) or the **type of ecosystem** (e.g. *grassland* habitats are found at diverse locations, including America and Africa).

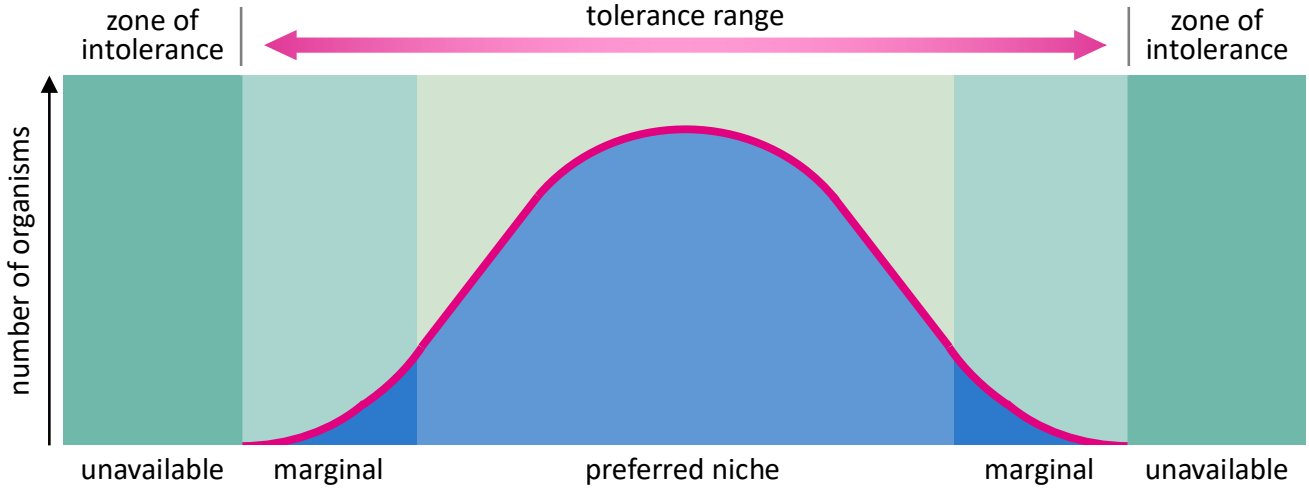
LIMITING FACTORS

In ecology, a limiting factor is a component of an ecosystem which limits the distribution or numbers of a population. **Abiotic variables** (non-living) can function as limiting factors to influence species distribution. Examples of abiotic conditions include light intensity, temperature, soil pH (or mineral content), humidity (or rainfall), wind speed (or tidal action), salinity, turbidity and atmospheric gas concentrations (CO_2 or O_2).

All populations have optimal survival conditions within critical minimal and maximal thresholds. As species are exposed to the extremes of a specific limiting factor, the survival rate begins to drop (**law of tolerance**).

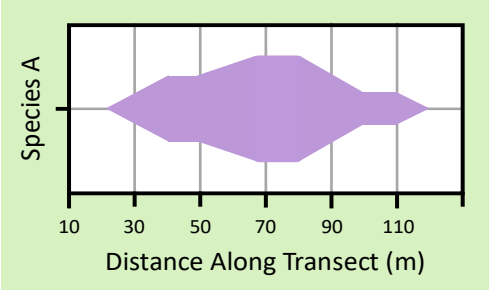
The distribution of a species in response to a limiting factor is shown as a bell-shaped curve with 3 regions:

- **Optimal zone** – Central portion which has conditions that favour reproductive success and survivability
- **Zones of stress** – Regions flanking the optimal zone, where organisms can survive with reduced success
- **Zones of intolerance** – The extremes beyond the curve where the members of a species cannot survive



TRANSECTS

Transects can be used to assess species distribution in correlation with any abiotic factor that varies across a measurable distance. Transects are a straight line along an abiotic gradient from which population data can be recorded (using quadrats) to determine a pattern. A **kite graph** can be used to represent changes in species distribution in a clear and effective fashion. The relative width of each kite represents the abundance of an organism at any point.



CORAL REEFS

Coral reefs are an example of a marine ecosystem whereby distribution is determined by abiotic conditions. Reef-building coral exist in a symbiotic relationship with the photosynthetic algae (**zooxanthellae**) and this relationship can only occur under certain parameters (a change in conditions may lead to coral bleaching).

- **Water depth** – Coral can only survive at shallow depths (sufficient light must penetrate for the algae)
- **Salinity** – Coral are marine organisms that exist in saline waters (freshwater runoffs can limit growth)
- **Water clarity** – Water must be clear enough for light to penetrate (water pollution can reduce growth)
- **pH** – Low pH conditions reduce the availability of carbonate ions the coral needs to build exoskeletons
- **Temperature** – Polyps show a range of tolerance of 20 – 28^{o}C (algae expelled at higher temperatures)

BIOMES

A biome is a geographical area that has a **particular climate** and maintains a **specific community** of animals and plants. As all ecosystems within a biome have similar abiotic conditions, all species in these ecosystems are exposed to similar selection pressures. This means similar characteristics provide a survival advantage and become more common in the population. The communities in the different ecosystems may not share common ancestry, but have independently developed the common characteristics by convergent evolution.

ADAPTATIONS

Organisms possess a variety of adaptations to help them survive in specific biomes or under certain abiotic conditions. Environments with unique variables include dunes, mangrove swamps, deserts and rainforests.

Coastal Sand Dunes:

Sand dunes are characterised by low levels of loosely-packed sediment with reduced nutrient levels and minimal water availability. Marram grasses have horizontal underground stems (**rhizomes**) to maximise root penetration and stabilise the plant. The root systems are both deep and extensive to improve anchorage and access to deeper reservoirs of underground water. The leaves are curled and stomata sunk in pits to reduce their exposure to external air.

Mangrove Swamps:

Swamps are characterised by waterlogged soils with low oxygen availability and high levels of salinity. Mangroves may have parts of their roots above ground (aerial root system) to take in oxygen for cell respiration. Mangroves are **halophytes** (salt tolerant) and can sequester salts within the cell wall or vacuoles to minimise osmotic disruptions. Some mangroves may concentrate salts in particular leaves, which are then shedded from the plant (abscission).

Hot Deserts:

Deserts are characterised by low levels of rainfall (dry and arid) and extreme temperatures (hot during day and cold at night). Plants adapted to desert conditions are called **xerophytes** and are typically low-growing with reduced leaves to minimise transpiration. Most plants (such as the *Saguara cactus*) have thick, waxy cuticles to reduce water loss by evaporation. Animals (such as the *kangaroo rat*) have kidneys with longer loops of Henle – this improves water retention and produces more concentrated urine. Animals will also typically spend daylight hours in underground burrows or shaded areas to avoid the higher temperatures.

Tropical Rainforests:

Rainforests are characterised by dense vegetation (restricts light availability) and high levels of biodiversity. Plants must compete for access to sunlight (*epiphytes* grow on tree branches while *lianas* will use trunks as a climbing scaffold). Emergent trees (such as the *Kapok tree*) grow above the canopy and are supported by wide buttress roots. Animals (such as *spectacled owls*) may be nocturnal or rely on other senses to thrive in low light conditions. Other animals (like *spider monkeys*) have a smaller stature and possess limb structures suited for climbing and brachiation. Animals are often camouflaged or use biological mimicry to hunt food.

Desert Adaptations

Cactus

Kangaroo Rat

Rainforest Adaptations

Kapok Tree

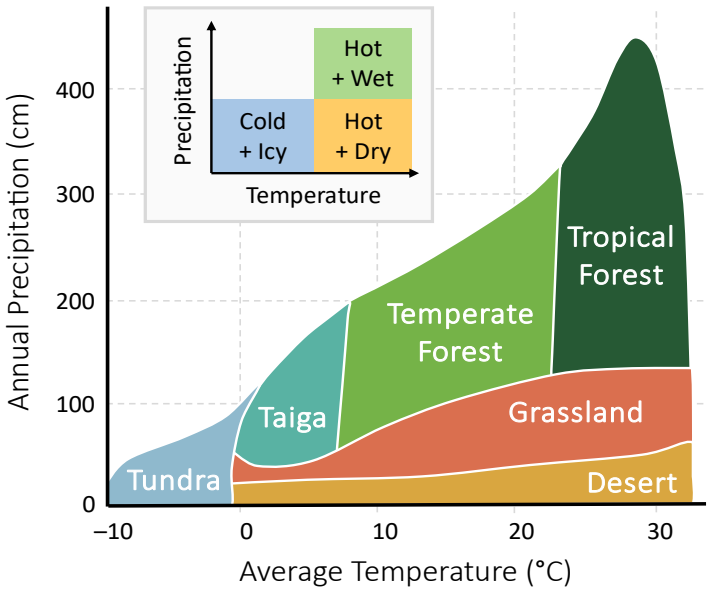
Spider Monkey

BIOME DISTRIBUTION

The main factors affecting the distribution of biomes are **temperature** and **rainfall** (precipitation). Each of these factors will vary according to latitude and longitude, as well as altitude and proximity to the ocean. The distribution of biomes relative to these two factors can be visually displayed via a climograph. When constructing the graph, average temperature is on the horizontal axis and annual rainfall is on the vertical axis. Graphs may look different depending on whether temperatures are shown as increasing or decreasing.

Whittaker's Climograph:

The most widely recognised climograph of biome distribution was developed by Robert Whittaker in 1975. According to this graph, deserts typically have high average temperatures but low rainfall (i.e. hot and dry). Rainforests typically have both high temperatures and high precipitation (warm and wet). Taigas typically have low temperatures and reasonably low precipitation (cold and icy). Temperate forests and grasslands tend to have more moderate conditions with some variation (e.g. prairies and savannahs are both grasslands but their specific climates are slightly different).

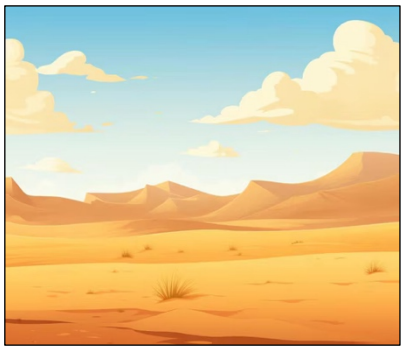


TYPES OF BIOMES

Types of biomes include desert, grassland, tropical and temperate forest, taiga (boreal forest) and tundra. These biomes will each demonstrate specific characteristics that are common to all of their ecosystems.

Desert

Deserts experience extreme temperatures – hot days (50°C) and cold nights (0 °C). Deserts have very low precipitation and minimal rainfall (< 30cm year). Productivity is extremely low due to the general lack of available water. Consequently, desert only support a small number of species that are well adapted to the dry conditions.



Grassland

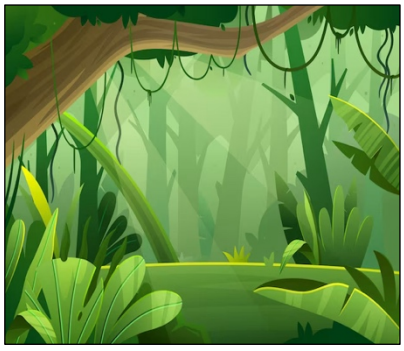
Grasslands tend to have more moderate temperatures and rainfall (500 - 1000 mm yearly). Rainfall tends to coincide with wet and dry seasons (droughts are common). Productivity is relatively low – grasses are dominant as there is not enough consistent rainfall to support tree growth. Animals are grazers (some predators).

Temperate Forest

Temperate forests demonstrate moderate temperatures and precipitation levels. Seasonal trends exist, but without any temperature extremes. Trees are deciduous, so productivity is high during certain seasons. Soil is very fertile due to leaf fall each autumn and overall biodiversity is quite high. The yearly rainfall is 750 - 1500 mm.

Tropical Forest

Tropical rainforests have very high levels of annual rainfall (2000 – 10 000 mm) and the temperatures are consistently warm (between 20 – 25°C). Trees are not deciduous so the soil is nutrient poor (no litter) and the vegetation is organised into layers. Productivity is very high as is overall biodiversity.



Boreal Forest (Taiga)

Boreal forests (taigas) are cold and icy (0 – 15°C) with a small amount of precipitation (but high snow fall). The dominant trees are conifers (evergreen) and productivity is low. Taigas tend to support small numbers of well-adapted species that may be migratory (the summer period is short in duration).

Tundra

Tundras are extremely cold (<0°C) and have very little rain (water is typically frozen). The productivity is minimum due to insufficient water and light and few species inhabit these areas (the ones that do tend to be migratory or hibernate during the darker winter periods). Average rainfall is <250 mm.