# Biology Unit 1 Summary Notes 2018

Unit 1

Chapter 1 Biodiversity

## Definitions

#### Species A group of organisms that share a common gene pool and can interbreed to produce fertile offspring under natural conditions

Endemic A species that is **native** to a particular geographical region and is **not introduced**

Population A group of individuals belonging to the same species living in a particular area at the same time

Community The sum of different species inhabiting a particular habitat at one time

Niche Refers to the **role of the organism** and the resources it uses in the ecosystem

Ecological Niche How the organism fulfils its **role and the habitat**

Fundamental Niches Potential Habitat

Ecosystem A **self-sustaining unit** consisting of **interactions** between the

**community** and the **environment**

Biotic **Living factors** in an ecosystem

Abiotic **Non-living factors** in an ecosystem

Environment Abiotic and biotic factors of an area

Biome The **main category** of an **ecosystem** across a **large geographic area**

Biodiversity Biodiversity is a measure of all the **genes, species and ecosystems**

within a region. Refers to the amount of **biotic variation.** Species level

is the basic level

Genetic Biodiversity Refers to the **range of different genes** in the group and the **size of the**

#### gene pool

Mutation The **permanent change to genetic information**

Gene Mutation A **localised change** and only **affects a small part** of the organism Chromosome Mutation A **large scale change** and **affects a large part** of the organism Variation Variation **within a species** means **differences** between species. It can

be **genotypic** or **phenotypic**

Genotypic **Mutations**

Phenotypic Also known as **epigenetics.** This means **physical changes due to**

#### environment

Species Concepts (3)

Biological Characterises a species by having the potential to **interbreed** and produce **fertile offspring** under natural circumstances

Morphological Characterises a species by its **form** or **morphology** (appearance). It is

applied to fossils.

Phylogenetic Identifies a species as being the **smallest group** who can trace their

#### origins to a single ancestor

Species richness The count of the **number of different species** in the area

Species evenness Describes the **relative abundance of each species** in the area. It’s a

percent

Ecosystem diversity The **range of ecosystems** in a large area/earth. It includes the variety of

ecosystems as well as the **range of communities and habitats** that

occur in those areas.

The edge effect The **overlapping area** between two ecosystems **support species from**

#### both areas plus its own.

Species evenness and richness

* Species evenness is a species relative abundance in proportion to other species in a region.
  + This shows how even a region is
  +  evenness =  diversity
* Species richness is the number of different species in a region
  + A measure of diversity
    - Because a diversity requires a high amount of species
* Pair these two measures to create a balanced measure
  + If there is a high richness and a low evenness the ecosystem isn’t very diverse

## Edge Effect

* Ecosystems are fluid with **species crossing boundaries**
* Interactions within an ecosystem are **dynamic and variable**
* The edge effect is where two ecosystems **overlap**. It can and does support species from each ecosystem plus its own unique species

## Spatial and Temporal Scales

### Spatial scale

#### Geographical Location

* + - Latitude
      * Closer to the equator the higher the biodiversity
        + due to increased sunlight and rainfall
    - Altitude
      *  altitude =  𝑂" =  biodiversity + species
    - Isolation
      * Isolation causes the gene pool to be limited
        +  risk of extinction due to  variation

#### Habitat

* + - Terrestrial or aquatic
      * Terrestrial = land based
      * Aquatic = water based

#### Climatic Region

* Temporal Scale
  + **Geological Time**
    - Pre or Post industrial
      * Affects climate
        + Pepper moths (evolution)
      * Land clearing > habitat
    - Colonisation
      * Land clearing > habitat
      * Introduced species/ diseases

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## Australia’s Biodiversity Conservation Strategy 2010-2030

* Has 3 categories

### Engaging all Australians

* + **Mainstreaming biodiversity**  Expand biodiversity coverage in **school curricula**
  + **Increasing Indigenous engagement**  Extend opportunity for **employing indigenous**

people in **biodiversity** including through the **Indigenous protected areas program**

### Building ecosystem resilience in a changing climate

* + **Protecting biodiversity**  **Enhance** and **expand** the **national reserve system** and the national system of **Marine Protected Areas**
  + **Reducing threats to biodiversity**  develop tools to help guide and support priority setting for threat management at different scales

### Getting Measurable results

* + **Implement robust national monitoring, reporting and evaluation**  Progressively align and integrate reporting products across governments for effective biodiversity planning
  + **Delivering conservation initiatives effectively**  harmonise approaches to listing threatened species and ecological communities across jurisdictions

## Naturalists

* **Alfred Wallace –** The Wallace Line
  + An imaginary line that separates the continental bodies of Indonesia and Australia which separates endemic species

#### Joseph Banks

* + The banksia plant is named after him

#### Charles Darwin

* + Developed his own theory of evolution from his voyage

## Australia – a megadiverse country

* Australia is a megadiverse country due to its; **isolation**, the **selection pressures** (**El Nino** (fire) and **La Nina** (floods) and droughts) in different regions and **adaptive radiation** ((speciation) where one species becomes multiple new species)
* The criteria for a megadiverse country are:
  + Total **number of species** in a country – species richness
  + Number of **endemic species**

## Biodiversity Hotspots

* A biologically **diverse** and ecologically distinct region that is under the **greatest threat of destruction from humans**
  + Amount of endemism  **1500 endemic plant species**
    - Why?  No plants = no animals
  + Extent to which species are threatened  **70% of original habitat is lost due to human activity**
  + Examples of biodiversity; South-West WA, New Zealand, the Horn of Africa, Madagascar and the Indian ocean Islands

## World Heritage Sites

* A **natural or man-made site** recognised as being of an **outstanding international importance** and therefore deserving of **protection**. Sites are nominated and designated by the **World Heritage Convention.**

#### Have cultural, historical or scientific significance.

* **Internationally protected** due to the importance of the site for **current and future generations.**
* Examples in Australia  Freo prison, Uluru, Shark bay, Ningaloo reef and the Great Barrier Reef

# Chapter 2 Classification

## Definitions

Taxonomy **A branch of science concerned with the** classification of species**. Also known as taxa**

Eukaryotic Contains a **nucleus and membrane bound organelles**

Prokaryotic Contains **no nucleus or membrane bound organelles**

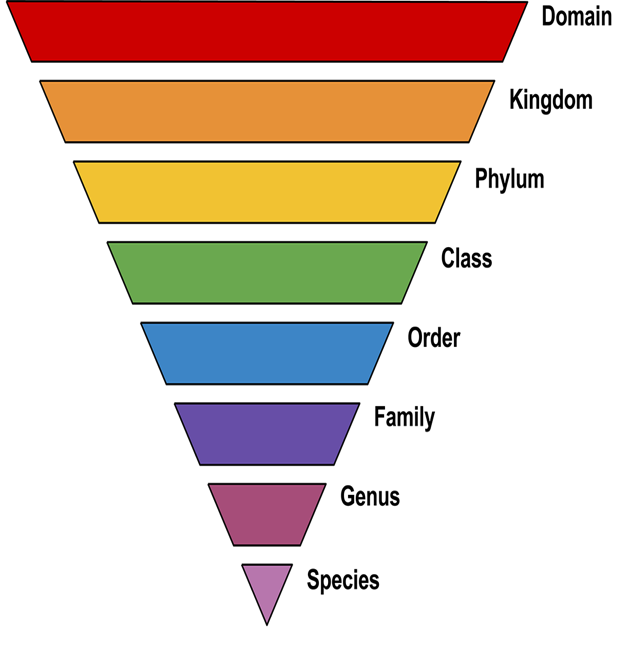
Bioinformatics Combines mathematical modelling, computer science and biology to

compare molecular sequences on a very large scale

## Classification

Least related

Most related.



**D**umb **K**ids **P**laying **C**atch

**O**n **F**reeways

**G**et **S**quashed

Least similar

(largest group size)

Most similar (smallest group

Eukarya

Archaea

Archaea

Bacteria

Bacteria

Domains

### Eukarya

Plantae

Fungi

Animalia

Protista

* + Eukaryotic organisms
    - Membrane bound organelles and nucleus
  + Larger cells than a prokaryotic cell
  + Protists, Plants, Fungi and Animalia

### Archaea

* + Prokaryotic organisms
    - No membrane bound organelles and nucleus

#### Peptidoglycan

* + Single celled
  + **Water environment** that contain **no oxygen** and **high salt** content
  + Contain protein, polysaccharides, lipids

#### Different cell walls to bacteria

* Bacteria
  + Prokaryotic organism
    - No nucleus or membrane bound organelles

#### No peptidoglycan

* + Single celled
  + Found **almost everywhere;** water, soil, atmosphere, in us

#### Different cell walls from archaea

Linnaean Binomial Nomenclature

* Invented by **Carolus Linnaeus**
* Consists of two parts:
  + Generic name (genus)
    - Always comes **first** and with a **Capital letter**
  + Specific name (species)
    - Always **follows** and with a **lower-case letter**
    - In Latin and descriptive
* **Both names are either *italicised* or underlined**
* Allows for easy communication

## Principles of Biological Classification

### Physical/structural features

* + Eukaryotic/prokaryotic
  + Body symmetry – radial (normal), bilateral (cut any way and still the same) or none
  + Vertebrae/invertebrae
  + Outer covering of the animal
  + Tail/no tail
  + Number of legs
  + Tissue layers
  + Organ structure
  + etc

### Method of Reproduction

* + The method of **reproduction** is an important feature also used to **distinguish groups from one another**
  + Reproduction can be;
    - **Sexual**  mixing gametes from two individuals where the fertilisation can occur

**internally** (humans) or **externally** (frogs)

* + - **Asexual**  one parent producing offspring identical to the parent (eg bacteria)
  + In mammals there are 3 types;
    - **Placental mammals**  give birth to live young after a gestation period (eg humans and elephants)
    - **Marsupials**  give birth to live young that develop in a pouch (eg kangaroos and koalas)
    - **Monotremes**  lay eggs (eg echidna and platypus)

### Molecular Sequence

* + Modern technologies are now used to **code DNA sequences** or **amino acid sequences of proteins**
  + DNA has 4 bases (A, T, C, G), the order codes for proteins and therefore physical features

#### DNA = proteins = physical features

* + Similarities and differences help scientists understand the relationships that exist between different organisms

#### Animals with similar molecular sequences are closely related

Classification Evolution

* Classification processes have changed and adapted due to technological advances, in particular

#### DNA sequencing

* Bioinformatics  the development of these specialised computer games has been very important in enabling scientists to further explore the relationships between organisms

## Why are organisms classified?

* It makes **communication easier and simpler** between scientists
  + Instead of describing a three part body with three pairs of legs, scientists just say ‘insect’
* Provides a **quick and accurate description** of a particular organism
  + ‘Mammal’ immediately provides how it feeds its young, body temperature regulation etc
* **Assists identifying** of an unknown organism

## Classification: the theory but why?

* **New technologies** mean we learn more about species meaning species are **reclassified**
* Always changes due to the discovery of new information

## Limits of Classification

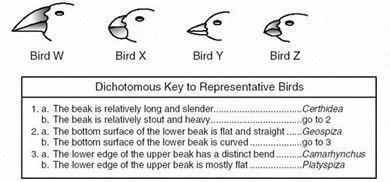
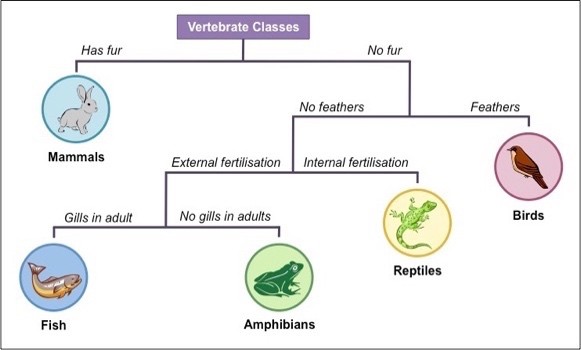
* It is an **artificial system**.
  + New species not yet discovered may challenge existing classification systems
* It is **subject to change** based on current and new information eg molecular sequencing

## Field guide

* A book containing **pictures and descriptions** of plants and animals in a particular area
* Limitations
  + Can only identify species to order level
  + Can be a slow process to identify a species if there are lots of organisms in the area

## Dichotomous Key

* A **classification key**, where each branch has **two options**
* It can be written as a list of steps or as a flow chart



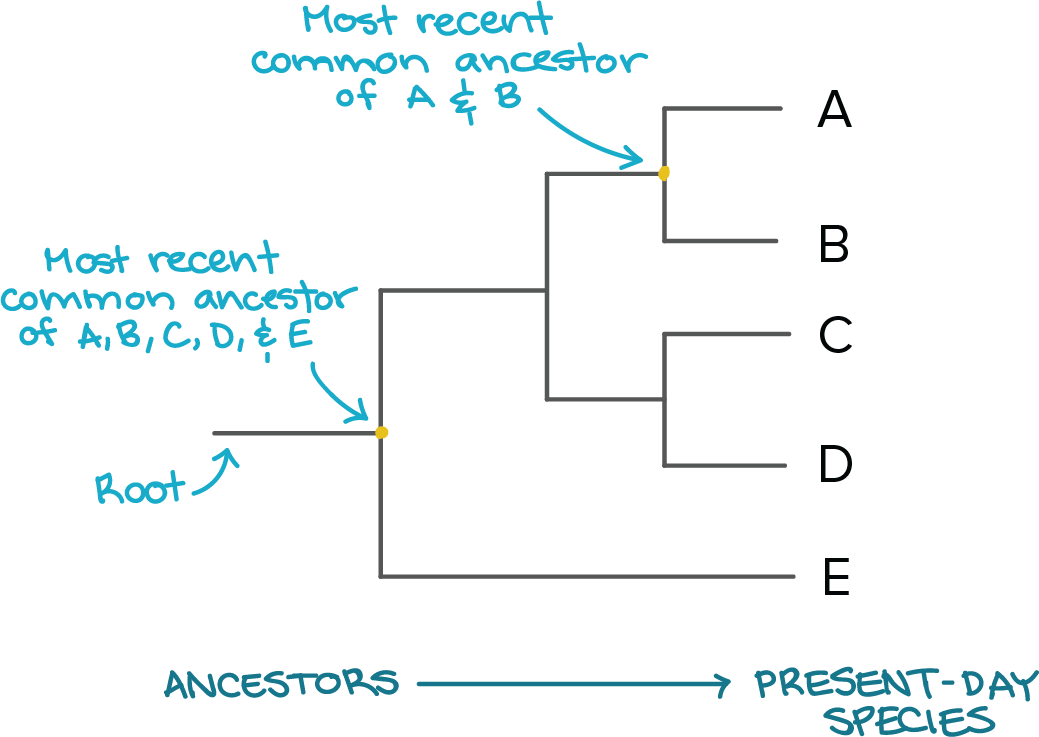
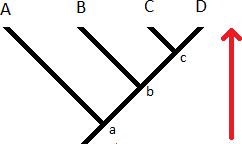
## Reflection of classification on evolutionary relationship

* All organisms on earth are related to one another meaning that at some point in time they shared a **common ancestor**
* Over generations populations change as organisms adapt to their environments.
  + Slow changes are referred to as **evolution** and can result in the formation of a new species
* Multiple species can develop from one common ancestor
* The more **recently** the **two species shared a common ancestor**, the more **closely related they are** and the more features they will have in common
* Can be displayed as a phylogenetic tree or a cladogram

## Cladograms and Phylogenetic Trees

* A **diagram showing relationships** between species
* Higher taxonomic levels (where species are least related) branch off from one another earlier (further back in time) than lower taxonomic levels (where species are most closely related)

Cladogram Phylogenetic Tree



## How to construct a cladogram/phylogenetic tree

1. Construct a character matrix

- A table of characteristics and which species has them

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Bryophytes | Pteridophytes | Gymnosperms | Angiosperms |
| Photosynthesis | + | + | + | + |
| Vascular tissue | - | + | + | + |
| Makes Seed | - | - | + | + |
| Seeds enclosed in  an ovary | - | - | - | + |

1. Put the species containing the most characteristics on the right and the least on the left (assuming there are no extinct species (which you stop the line earlier than present time)) Bryophytes Pteridophytes Gymnosperms Angiosperms
2. Lines
   1. For a cladogram draw a diagonal from the right down to the left, the draw diagonals from left to right to connect to this line
   2. For Phylogenetic tree start with a line at the bottom of the space. This line will the split, the left line will continue as a species (until it becomes extinct). The right continues and splits into 2 species. This continues with same pattern for all species
3. Characteristics
   1. After each split a new characteristic occurs
   2. After each split the right hand branch represents a new characteristic
4. Add time

# Chapter 3 Biodiverse Ecosystem

## Definitions

Limiting Factors An element of the **environment that restricts** the survival of an

organism to a region (a factor that means an organism can only

survive in a region if it is removed the organisms die or have to move on)

Biome A geographical area that can accommodate a number of different ecosystems

Ecosystem Interactions between the environment and its community

Habitat Is an area or environment within an ecosystem where an individual of a species lives, feeds and reproduces

Population A group of individuals belonging to the same species in the same place at the same time

Biosphere The sum of all ecosystems across the world

Nocturnal A species that is active at night

Diurnal A species that is active during the day

Coexist Refers to different **species living together** in a community **peacefully**

## Abiotic and Biotic Factors of an environment

|  |  |
| --- | --- |
| **Abiotic** | **Biotic** |
| * Wind * Rainfall * Nutrients * Soil and water pH * Soil and water salinity * Latitude * Altitude * Humidity * Light intensity * Day length * Gas concentration | * **Autotrophs** – producers/plants * **Heterotrophs** – consumers/animals * Herbivores * Omnivores * Carnivores * **Decomposers** – micro-organisms/bacteria * **Parasites** – feed off a host eg ticks * **Pathogens** – a disease causing micro- organism |

Limiting Factors

* An element of the **environment that restricts** the survival of an organism to a region
* For example: the **Malaysian pitcher plant** (carnivore)
  + Can only survive in a tolerance range of 1500 – 2600m above sea level, in humid environments with high levels of magnesium and iron in the soil

## Terrestrial Biomes

* Major variations between aquatic and terrestrial biomes include;

#### Climate

* + **Vegetation**
  + **Topography** (surface features eg mountains etc)

#### Soil type

* **Major biomes in Australia**
  + Savana grasslands
  + Desert
  + Mediterranean (chaparral)
  + Temperate forest
* Examples:

|  |  |  |
| --- | --- | --- |
| **Biome** | **Biotic Factors** | **Abiotic Factors** |
| **Taiga** | * Conifer Trees | * High oxygen levels |
| (A.K.A | * Moose + black bears | * Limited day light |
| coniferous forest or boreal  forest) | * Cross-bill * Wolverine + lynx | * Low temperatures * Infertile soil |
| **Temperate** | * American beech | * 25 to 50 N and S |
| **Forest** (A.K.A Deciduous | * Guelder rose * American bald eagle | * By the ocean * Very windy |
| forest) | * Eastern chipmunk | * 32 inches of rain |
| **Tundra** | * Artic moss * Artic willow * Artic fox * Polar bear | * 6-10 inches of rain * 50 to 75 N * Constant wind * Cold and dry |

## Aquatic Biomes

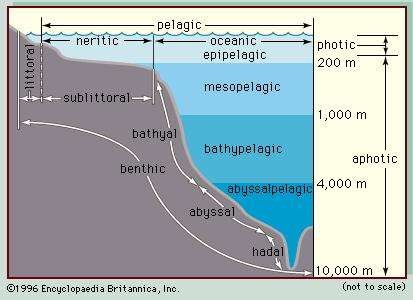
* Aquatic biomes form the **largest section** of the biosphere
* Water **covers 70%** of the earths surface
* There are **two main categories**;
  + **Fresh water** - <1% saline (lakes, rivers, ponds)
  + **Marine** - >3% saline (ocean, reef, rivers)
* **Estuaries** are where fresh and marine water meets, is considered **marine.**

Salinity = the concentration of sodium chloride/salt



## Water Layers

* **90%** of marine life is in the **photic zone**



* The photic zone accommodates

#### photosynthesising organisms

* As **depth increases** the water **temperature** and **available light decreases.** This limits the distribution of organisms
* The **aphotic zone** is where limited to no photosynthesis occurs
  + Photosynthesis from chemicals 

chemosynthesis 𝐻"𝑆

* + Organisms scavenge for food

## Eutrophication

* Refers to the increase of the concentration of nutrients – **nitrates and phosphates** in a **water body**

that promotes the growth of **algae blooms**.

 in nitrates and phosphates

 sun penet- ration

 plant deaths

oxygen levels

(due to 

photosynthesis)

Bacteria decompose plant matter

Oxygen levels

(consumption during cellular respiration)

Eventually reach a point where all species die

* Importance of nitrates and phosphates;
  + Nitrate is **contained in ALL proteins**
  + Phosphate is used to make **cell membranes and ATP (energy)**
* Water is really low in oxygen because it’s hard to dissolve in still water
  + Unbound oxygen
* Photosynthesis

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* Creates Oxygen
* Cellular Respiration

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* Uses oxygen

## Ecological Niches

* The **role of the organism** and the resources it uses in a particular ecosystem. Includes habitat, food sources and when they reproduce
* Example:

|  |  |
| --- | --- |
| Saddle Back Tamarin | Emperor Tamarin |
| * Diurnal * Arboreal (lives in trees) * Gestation period of 155 days * Generally have twins * Live in groups of 2-12 * Eat fruit and insects | * Diurnal * Arboreal * Feeds on fruits, insects, leafy plants, eggs and tree sap * Generally have twins * Gestation period of 140 days |

## Fundamental and Realised Niche

* **Fundamental Niche** (potential/ideal niche)

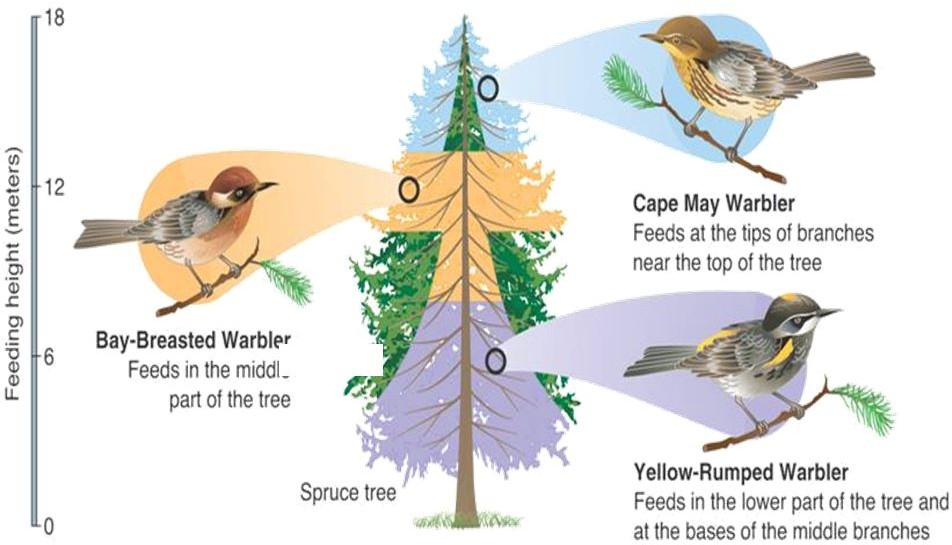
Fundament Niche

Realised

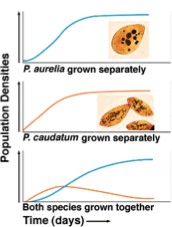
Nicheal

* + The **ideal** niches a species would occupy if there were no competitors, predators or parasites
* **Realised Niche** (actual niche)
  + The part of the fundamental niche that an organism **occupies** as a **result of limiting factors** present in its habitat
* When species have differences in their niches they can coexist
* Example: Kookaburras
  + Not distributed across its potential geographical range due to successful competitors occupying certain areas

## Resource Partitioning

* Organisms within an ecosystem cannot feed on the same food source at the same time
* Must differ in:
  + Food source the prefer
  + Use of space (eg top, bottom or middle of a tree)
  + Timing of activities (diurnal/nocturnal)
* This is **resource partitioning** and it **reduces competition**

#### It allows similar species to coexist

Competitive Exclusion Principle

* **Two similar species** that **compete for a resource cannot coexist** in the same community
* One will be able to obtain and use resources more effectively and in turn reproduce more quickly than the other. This is called **competitive advantage**

## Relationships and interactions between living things

|  |  |  |  |
| --- | --- | --- | --- |
| **Relationship** | **Definition** | **Type** | **Example** |
| **Competition** | An organism fights another organism for resources (food, shelter and nutrients) | **Intraspecific**: members of the **same species** competing for the same  resources | **Parrots** competing for suitable **hollows** in old trees for **nesting** |
| **Interspecific:** members of **different species** competing for the same  resources | **Paramecium – P. caudatum and P. Aurelia** competing for **nutrients** |
| **Collaboration** | Organisms that work with others to obtain resources | **Intraspecific**: members of the **same species** collaborate to obtain resources | A pod of **dolphins** swimming to **herd a school of fish** |
| **Interspecific**: This is  **mutualism** so **do not speak about** | N/A |
| **Predator- prey** | When an organism - the predator - kills and eats another organism - the prey | **Animal on animal** | Foxes on rabbits |
| **Animal on plant** | Horses on grass |
| **Plant on animal** | Pitcher plant on insects |
| **Symbiosis** | Describes the relationship between two species that live together where at least one benefits | **Parasitism**: **one species** (host) **is harmed** at the **benefit of the parasite** | Mistletoe plant obtains water and nutrients at the expense of the eucalypt  tree |
| **Mutualism**: A relationship where **both species benefit** | Sea anemones protect clown fish from predators and in return clownfish chase away butterfly fish which feeds on the sea  anemones tentacles |
| **Commensalism: one species benefits** and the **other is unharmed** | Remora fish attaches to sharks with a sucker, this gives them protection and they catch food scraps, this is to no benefit or  detriment to the shark |

Keystone Species

* A species in relatively **low abundance** that has a large influence over lower trophic levels to allow the **coexistence** of species in a particular area
* Keystone species **increase the biodiversity** by preventing lower trophic levels from monopolizing food, resources and space

#### Example: The purple sea star

* + PSS is a natural **predator to mussels** in the intertidal zones of the Pacific Ocean
  + When PSS are removed the **population of mussels increase significantly**
    - **Displace other sessile** (immobile) **organisms** such as barnacles and limits

#### decreases the biodiversity

* + When PSS are returned the mussels are preyed upon and the barnacles and limpets could reoccupy the space
  + The purple sea star allows the **coexistence** of other species
* Other examples; sea otter, grizzly bear and grey wolf, cassowary and mistletoe

# Chapter 4

Energy and Matter in Ecosystems

## Definitions

Biomass The total amount of matter of living material **in an ecosystem as a weight or energy (joules)**

Trophic levels A representation of a **feeding level** in the food chain of an ecosystem.

Trophic levels **have producers**

Consumer order The representation of the **feeding levels** in the food chain of an

ecosystem. The consumer order **does not contain producers**

Food chain One way energy transfer diagram

Trophic efficiency The percentage of energy at one trophic level that ends up at the next trophic level = **10%**

Decomposers **Decompose** (break down) **complex molecules** of the **organic material** in or on which they live and **recycle the materials back into the soil**

Pyramid of Numbers Shows the **number of organisms** at each trophic level per unit of area

Pyramid of Biomass Shows the **amount of matter** at each trophic level per unit of area (g/𝑚")

Pyramid of Energy Shows the **amount of energy** input into each trophic level per unit of area (𝐾𝐽/𝑚"). Never inverted

Source The **place of origin** of a material

Sink A **reservoir** of a material Non-biodegradable Can’t be broken down ppm Parts per million

## Energy Sources of Life

* Energy is essential for a system to work
* Energy **cannot be recycles** like matter and therefore it must be **supplied continuously**
* The **sun provides** most of the earths energy in the form of **radiant energy**

## Producers and Productivity - Photosynthesis

* Producers (plants) **transform sunlight into chemical energy** in a biochemical process called

#### photosynthesis

* Plant cells have specialised cell organelles called **chloroplasts** that **contain the pigment chlorophyll**. This pigment is able to absorb most of the chlorophyll in sunlight

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* Factors necessary for photosynthesis:

#### Sunlight

* + **Carbon dioxide**
  + **Water**
  + **Chlorophyll**
* Photosynthetic efficiency refers to how well a **producer coverts light into chemical energy**/carbohydrates
* This depends on the **availability of raw materials** (CO" + H"O), **sunlight** and the **temperature**

## Productivity Measures

* **GPP** – **Gross Primary Production/Productivity**  the total chemical energy produced by photosynthesis in an area (productivity is [\][ )

^\_`]

* **NPP** – **Net Primary Production/Productivity**  amount of chemical energy available to the

consumers **after producer respiration** – area or [\][

^\_`]

* **NPP = GPP – R** (respiration (plant))
* Respiration  **glucose + oxygen**  **ATP + water + carbon dioxide**

## Consumers and Energy

* **Consumers cannot carry out photosynthesis** and therefore cannot gain their energy directly from the sun
* Animals must gain their energy from the food they consume
* Consumers extract energy stored in chemical bonds by a process of cellular respiration

#### glucose + oxygen  ATP + water + carbon dioxide

* Energy is required for animals to carry out work
* ATP uses:
  + **Synthesis** of protein building materials; enzymes, glycogen, fats, hormones etc
  + **Growth and repair** – cell division for new tissues and repair of old and damaged tissues
  + **Reproduction** – energy is required for offspring to develop and grow
  + **Temperature maintenance** in warm blooded animals (birds and mammals). **Very big use of ATP**
  + **Mechanical work** – contraction of skeletal muscle, heart muscle, gut muscle etc
  + **Chemical work** – active transport, activities in the liver and kidneys, nerve impulses

## Food chains and Food webs

|  |  |  |
| --- | --- | --- |
| **Trophic Level** | **Organism** | **Source of chemical energy or ‘food’** |
| **First** | Producers | Make organic matter (food) from inorganic  substances using energy from sunlight |
| **Second** | 1st Order Consumers  (Herbivores) | Eat plants or other producers |
| **Third** | 2nd Order Consumers (Carnivores) | Eat herbivores |
| **Fourth** | 3rd Order Consumers  (top carnivores) | Eat predators |

* Only up to four trophic levels usually due to energy transfer and the 10% rule, anymore would be inefficient and unsustainable

### Food Chains

* + Shows the one way energy transfer as a diagram

#### Arrows show the direction of flow of chemical energy from the eaten to the eater

* + Like a flow chart
  + Example:
    - Grass  insect  quail  snake  eagle

### Food Webs

* + Shows the flow of chemical energy in an ecosystem
  + Producers are at the base of the food web diagram

#### Arrows show the direction of flow of chemical energy from the eaten to the eater

* + In a food web flow of chemical energy from the organic matter of dead organisms can be included

#### Contains decomposers

The 10% Rule

* Only **10% of the energy** at one trophic level is **passed onto the next level**
* The remaining 90% is the lost to the surroundings: **80% as heat** (from respiration) and **10% as waste (detritus)** (chemical energy)

## Different types of organisms

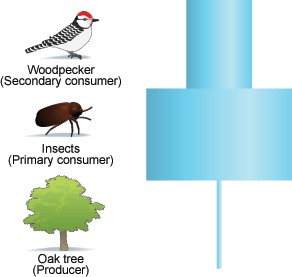
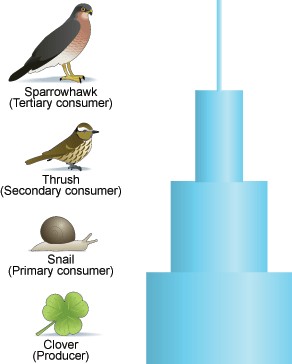
|  |  |  |
| --- | --- | --- |
| **Types of Organisms** | **Description** | **Examples** |
| **Autotrophs/ producers** | * 1st Trophic level * An organism capable of **making its own food** from inorganic (abiotic/nonliving) substances using: * Sunlight through **photosynthesis**   OR   * Chemicals (hydrogen sulfide) through   **chemosynthesis** | Plants, algae and bacteria |
| **Heterotroph/ consumer** | * An organism that **cannot synthesise** its own organic compounds/food. * Depends on other organisms for its nutrient/energy requirements |  |
| **Primary (1st order) consumer/ herbivore** | * 2nd Trophic Level * Feeds directly on producers | Wombats, many insects, kangaroo |
| **Secondary (2nd order) consumer/ omnivore/**  **carnivore** | * 3rd Trophic level * Feed on secondary consumers | Dingoes, kookaburra, fur seals, platypus |
| **Tertiary (3rd order) consumers** | * 4th trophic level * Feed on secondary consumers | Australian wedge tail eagle, sharks |
| **Omnivore** | * Feed on **both** plants and animals | Humans, foxes, |
| **Scavenger** | * Feed on dead organisms | Foxes, Quolls |
| **Detritivores** | * Feed on dead or decaying organic remains and wastes | Dung beetles, earthworms, yabbies |
| **Decomposers** | * Decompose (break down) complex molecules of the organic material in or on which they live and **recycle the nutrients back into the soil** | Fungi and some bacteria |

Pyramid of numbers

* The **number** of individuals at each trophic level in the food chain

#### Can be inverted

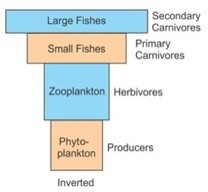
* + Because it **does not consider relative sizes** of the organism
    - Eg a tree can support a lot of smaller organisms meaning there will be less producers compared to the primary consumers



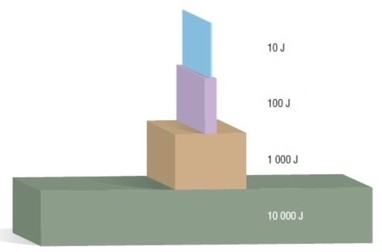
## Pyramid of Biomass

* + - * Shows the amount of **matter** at each trophic level per unit of area (g/m")
      * Biomass in each trophic level is almost always less than the level below, rarely is it not

### Inverted pyramid of biomass

* + Would occur in situation like that of phytoplankton and zooplankton
    - Due to the **short gestation period** of phytoplankton there is a very **high turn over** meaning there is a relatively constant number, instead of fluctuating, allowing **more life than phytoplankton to be supported**

## Pyramid of Energy

* A pyramid of energy shows the **amount of energy input** into each trophic level in a given area of an ecosystem over an extended period of, often one year
* Bar length denote chemical energy at each level

#### Can never be inverted

* + Can never be inverted as the total amount of energy decreases at each trophic
    - Only 10% of the energy at each trophic level is passed onto the next level, giving the pyramid shape

## Matter Recycling

* The difference between energy and matter:
  + Energy is provided continuously and constantly by the sun
  + Matter that exists on earth is **fixed** and must be **recycled**
    - Matter is recycled between the **biotic** components and **abiotic** components of the ecosystem
* Detritivores (eg worms) feed on detritus (waste) and scavengers feed on dead carcasses, recycling the organic matter back into the food chain
* Decomposers breakdown detritus which allows the nutrients to be recycled into the soil

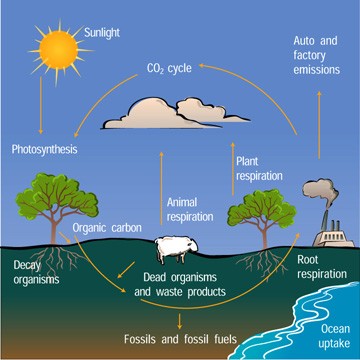
## Nutrient Cycles

* Involve two components:

1. A **biological component** that follows how the element cycles through the organisms
2. A **geochemical component** showing how the element cycles through soils, rocks, water and the atmosphere

* Given the interdependent manner in which these components are related, nutrient cycles are called **biogeochemical**

## The Carbon Cycle

* Importance to life
  + Carbon is essential
    - It is incorporated in **biomacromolecules (organic matter)** which make up living organisms (carbohydrates, proteins, fats) which are used for **energy in cellular respiration**
* Source: Atmospheric carbon dioxide
* Sink: Rocks such as coal and limestone, in the ocean as carbonates
* CO" maintenance
  + Maintained by the balance between photosynthesis (CO" withdrawal) and cellular respiration and combustion
  + In the last 200 years atmospheric CO" has risen because humans have disrupted the balance

## Nitrogen Cycle

* Importance to life
  1. DNA/Nucleic acids
  2. Amino acids which make proteins
* Atmospheric presence: 80% of the atmospheric is gaseous nitrogen (N")
* 5 stages:

1. **Nitrogen fixation:** nitrogen is removed from the atmosphere
2. **Nitrification:** Nitrifying bacteria convert ammonium into nitrite and nitrite into nitrate
3. **Uptake and consumption:** Plants absorb nitrate from the soil
4. **Ammonification:** wastes broken down by decomposers and converted to ammonium
5. **Denitrification:** denitrifying bacteria break down nitrates and nitrogen

#### Atmospheric Nitrogen

𝐍𝟐(𝐠)

Nitrogen fixing bacteria

#### Plants

Uptake

Denitrifying Bacteria

Consumption

#### Ammonium

Nitrifying bacteria

#### Nitrite

Nitrifying bacteria

#### Nitrate

**Animals**

Decomposers

#### Wastes

Biomagnification

* The **accumulation** of **non-biodegradable** matter in the tissues of one organism which is then passed along the food chain, becoming **more concentrated** at higher trophic levels
* Also known as bioaccumulation
* A variety of chemicals are known to accumulate:
  + DDT
  + CFC
  + Heavy metals (e.g. lead and mercury)
* Biomagnification occurs because higher trophic levels must eat more of the lower trophic levels in order to survive. They cannot get rid of the matter due to it being non-biodegradable

Effect on organisms on a food chain

* Chemical pollutants enter ecosystem
* Pollutants enter food chain through a producer
* If the chemical is **non-biodegradable** it will **accumulate** in the organism
* This chemical is then passed onto **higher trophic levels** and progressively accumulates

Reduction

* Banning known harmful substances such as DDT
* Producing biodegradable substances
* Trying to reduce pollution

Example

Algae and aquatics 0.05ppm

Plant eating fish 1.2ppm

Carnivorous fish 2ppm

Fish eating bird 76ppm

* **DDT** was introduced into Australia in 1942 to control mosquitos and was extensively used as an agricultural insecticide
* DDT enters lakes/oceans as run off and accumulates in producers (algae)
* It then concentrates progressively in subsequent trophic levels
* Higher trophic levels such as fish-eating birds (e.g. peregrine falcon) may ingest toxic levels because they eat large amounts of lower order consumers

# Chapter 5 Population Dynamics

## Definitions

**Population** The members of the **same species** in one place at one time. They are dynamic

**Carrying capacity** The **maximum population size** of a species that can be

supported in a **given environment**

**Population size/ abundance** The **number of individuals in a population Population density** The **number** of species/individuals in a **given area Population distribution** The **spatial distribution** of a population in an ecosystem **Pest** An **animal or plant species that causes serious damage**

**to a valued resource:** pest species can damage the

**environment, decrease biodiversity** and drive organisms to **extinction**

## Natural and Artificial Populations

* Natural population: A population that exists on their own **without any human intervention** in its

**natural ecosystems** e.g. bacteria

* Artificial population: A population that are **managed by humans and live in an artificial ecosystem** e.g. white rhino

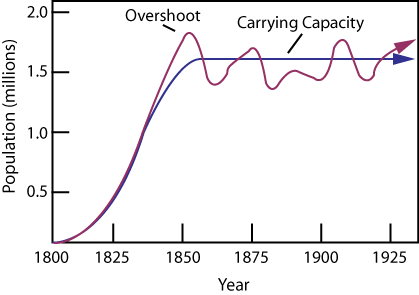
## Factors that affect population size

* **Physical size** of the **area**

#### Resource availability

* **Latitude** (distance from the equator)

## Phases of a population lifecycle

* Growth:
  + Available **resources exceed the number of individuals** able to exploit them
  + Reproduction is rapid and death rates are low, producing a **net increase in the population size**
* Stability:
  + Often **preceded by a ‘crash’** since the growing population outstrips its available resources
  + Stability is **usually the longest phase** of a populations’ life cycle
* Decline
  + Is the **decrease in the number** of individuals in a population

#### Eventually leads to population extinction

r-selected Species

* Fast growing and short-lived species who are the **first to occupy unused resources and living space in UNSTABLE environments**

Characteristics

* Short gestation periods
* Produce many offspring
* Short lived
* Lack of parental care of young
* Fast growth rate
* Small in size

### Examples

* Mice  Flies
* Bacteria  Fish
* Oysters  Weeds

### r-selection Strategy

* Occurs when opportunistic species quickly colonise an **unstable ecosystem** leading to a pattern of **rapid increase and rapid decrease (crash)** as they are eventually taken over by predators

## k-selected Species

* A slow growing, long lived species typically found in a **climax/steady-state community** (reached carrying capacity) where individuals successfully **compete for resources**

### Characteristics

* + Long gestation period  Extensive parental care of young
  + Few offspring  Sexually mature late in life
  + Long lived  Slow growth rate
  + Large in size

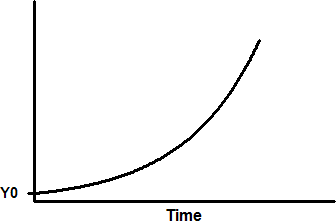
### Examples

* + Elephants  Penguins
  + Humans  Gorillas
  + Eucalypts  Sharks
  + Whales

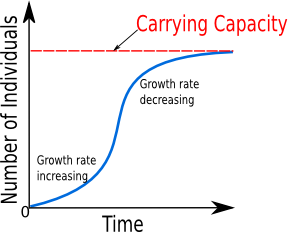
### k-selected Strategy

* K-selection in **stable environments** occurs when species live close to the **carrying capacity** of the environment. A sustainable population size is reached which can offer long term ecosystem **stability**. Organisms **successfully compete** for resources.

## Exponential Growth  J-curve

* Occurs when there is no limit to population size  results in exponential growth due to:
  + Resources are abundant
  + No predators
  + No disease
* 2 phases
  + **Lag phase:** initial slow increase in the size of the population
  + **Acceleration phase:** population size significantly increases with each generation

## Logistic curve  S-curve

* The effect of a limiting factor results in a carrying capacity of the environment being reached and a slowed growth rate
  + Competition for limited resources  predation
  + Disease/parasites
  + Overcrowding
* 3 phases
  + **Lag phase:** initial slow increase in the size of the population
  + **Acceleration phase:** population size significantly increases with each generation
  + **Deceleration phase:** population growth decreases as the environmental resistance (limiting factors) to growth increases
* Affected by **birth rate and death rate** as well as **immigration and emigration**
  + Food/water supply
  + Build up of toxic wastes (biomagnification)
  + Disease
  + Predation

## Measuring Population Growth

* Variables that affect population growth:
  + **Birth rate** (br) – number of births in a population
  + **Death rate** (dr) – number of deaths in a population
  + **Immigration rate** (ir) – net gain by movement of individuals into an area
  + **Emigration rate** (er) – net loss by movement of individuals out of an area

 +ve growth  br+ir > dr+er

* -ve growth  br+ir < dr+er
* 0 growth  br+ir = dr+er
* It’s a percent

### 𝒈𝒓𝒐𝒘𝒕𝒉 𝒓𝒂𝒕𝒆 = p(𝒃𝒓 + 𝒊𝒓) − (𝒅𝒓 + 𝒆𝒓)u ÷ 𝒐𝒓𝒊𝒈𝒊𝒏𝒂𝒍 𝒏𝒖𝒎𝒃𝒆𝒓 𝒐𝒇 𝒊𝒏𝒅𝒊𝒗𝒊𝒅𝒖𝒂𝒍𝒔

Open and Closed Ecosystems

* **Open ecosystem**  populations whose numbers are affected by immigration and emigration
  + E.g. swans immigrate to areas best for raising young

#### Growth rate depends on br, dr and migration rates

* **Closed ecosystem**  populations that are not subject to ir or er
  + E.g. Quokkas on Rottnest island

#### Growth rate depends only on br and dr

* + - Food supply, biomagnification, disease/parasites and predation affect population size

## Three Types of Distribution

#### Random

* + Spaced **irregularly**
  + The location of one organism doesn’t affect another
  + Common in plants

#### Uniform (continuous)

* + Organisms **spaced evenly**
  + The location of one individual determines the location of others
  + E.g. territory breeding or crops

#### Clumped (groups)

* + Organisms are **grouped together in clumps**
  + Usually caused by social behaviours or the availability of resources
  + e.g. school of fish or elephants around water holes
  + Also known as aggregated

## Quadrats

* Sampling method used to estimate distribution and abundance of stationary organisms or those who don’t move much
* A quadrat is a **square of defined area**

#### Randomly allocated and chosen

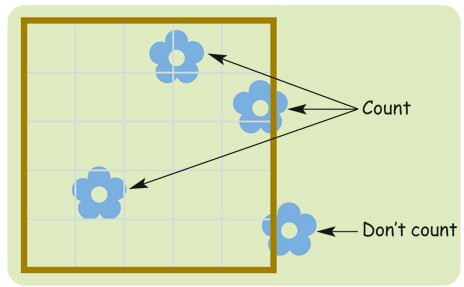
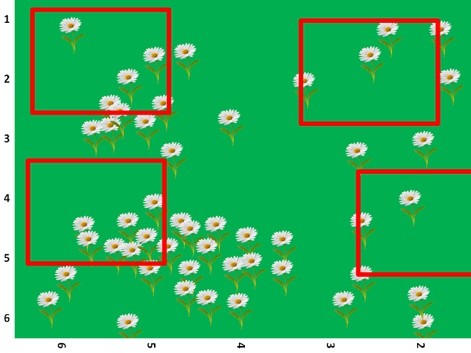
* The size of a quadrat is determined by the size of the organism
  + The larger the organism, the larger the quadrat
    - E.g. grass 10x10cm, trees 10x10m

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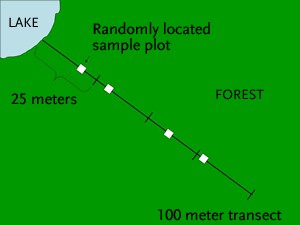
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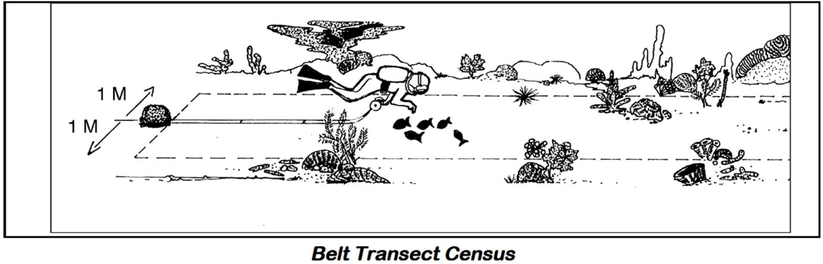
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## Transects

* A **line transect** is a line drawn through a community
  + Used to determine **distribution** of species (a cross section)
  + Used for species in **fixed positions** e.g. plants
  + Work best when abiotic factors differ along the length
    - i.e. soil types

####  environmental gradients

* + To improve the data quadrats may also be placed at intervals along the transect to record density at specific locations
* A **belt/strip transect** is a measured strip, where the number of species is recorded between two lines
  + Commonly used to estimate plant populations/immobile animal populations
  + Can also be used to estimate **large mobile animal populations**
    - E.g. aerial belt transects are used to

estimate kangaroo populations in open flat areas

## Capture-Mark-Recapture

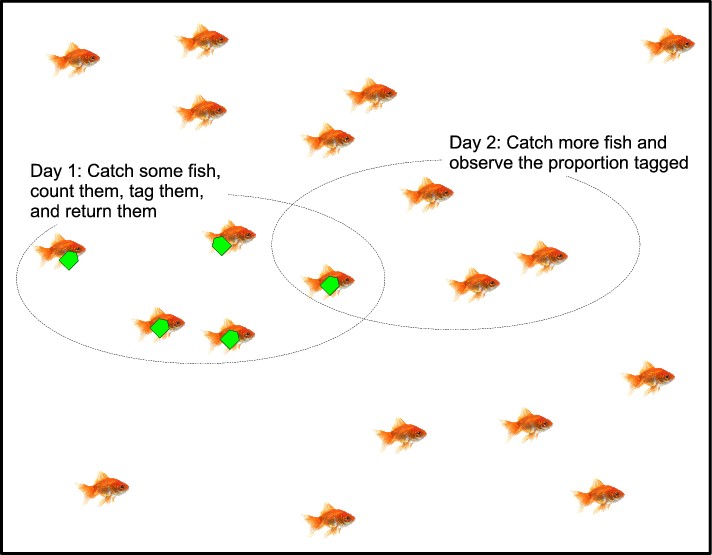
* The capture-mark-recapture method is commonly used to sample **mobile species**

1. **Capture**  randomly capture animals (nets, pitfall traps)
2. **Mark and Release**  each captured animal is marked (paint/bands/microchips) and returned to mix with the unmarked population
3. **Recapture**  Later a random sample is again taken and the number or marked and unmarked individuals are counted

* 𝑵 = 𝑴×𝒏

𝒎

* + 𝑁 total population to the nearest whole number
  + M  total marked (originally)
  + n  total captured (marked and unmarked)
  + m  number marked in recaptured



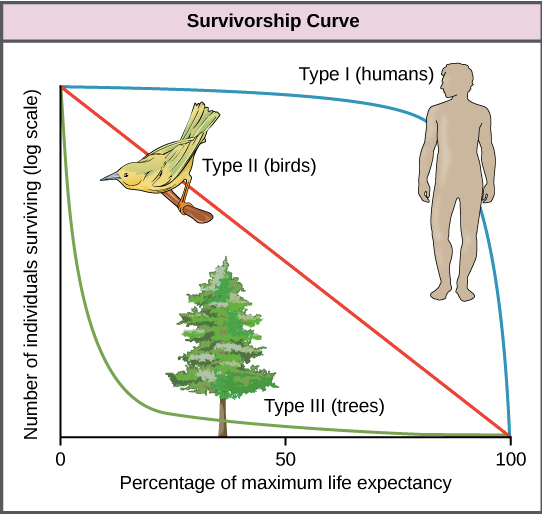
## Satellite sensing and remote tracking

* Telemetry is an automated communications process
  + By which measurements and other data are collected at remote or inaccessible points
    - Transmitted to receiving equipment for monitoring
      * From Greek roots
        + Tele means remote
        + Metron meaning measure
* GPS tracking is used to track the movements of migrating animals such as birds and caribou
  + Most efficient when tracking water animals such as whales, sharks, sea turtles and many sea birds
* Contribute to the improved management and conservation of species (endemic, endangered and pests)
  + As the data collected determines the movements of the animals and their destination
    - This information is used to determine the best management strategy to ensure the safe movement of the animals involved
* Example: In Victoria 2 penguins in Port Phillip Bay were fitted with a transmitter.
  + The information gathered showed they went on short 1-2 day trips to Phillip Island and long 10-50 day trips out into Port Phillip Island
  + It told conservation groups which areas to focus on protecting from human activity to increase penguin survival

## Population Regulation

* Factors in the environment, collectively referred to as **density-dependent factors**, act on a population
  + If a population rises above equilibrium or set point **homeostatic mechanism**. The increased ability of disease-causing organisms and parasites to spread also cause deaths and possible reduce breeding  decline in population
  + If the population falls below the set point, then there is less **environmental resistance** and the population begins to increase again. This kind of negative feedback is an example of homeostasis. This keeps the population constant
* **Density independent factors** are physical factors that affect **all individuals regardless of age or stage in growth**.
  + Examples include: physical factors such as acidity, rainfall, humidity, temperature, salinity and catastrophic events such as volcanic eruptions, tsunamis, fires, droughts, earthquakes and floods
* **Density dependent factors** are factors in the environment that keep the population relatively constant **affecting the greater density of the population**
  + Examples include: competition, disease, parasites, predation and food supply

## Survivorship Curves



|  |  |  |
| --- | --- | --- |
| **Classification** | **Description** | **Examples** |
| **Type 1**  (late loss) | Individuals that have a **high probability of surviving** through **early and middle life** but have rapid decline in the number of individuals surviving into late life | Humans Elephants |
| **Type 2**  (constant loss) | Shows a **constant mortality** rate for the species through its life. The individual’s **chance of dying is independent of their age** | Birds Lizards |
| **Type 3**  (early loss) | Depicts species where few individuals will live to adulthood and die as they get older because the **greatest mortality is experienced early in life** | Fish Frogs Plants |

* Pests in Australia:

## Chemical and Biological controls

* + Rabbits decrease vegetation and crops
  + Kangaroos decrease vegetation
  + Mice decrease grain crops
  + Cane toads cause loss of native species (mammals and reptiles)
* Chemical Control
  + The use of pesticides (chemicals) to control pest species
  + These can be quick and effective but can be environmentally damaging and costly
* Biological Control
  + The control of pests by interference with their ecological status by introducing a living organism into the environment

|  |  |
| --- | --- |
| **Agent** |  |
| **General Predators** | Organisms that consume a variety of pest species.  E.g. lady bugs target aphids, caterpillars, mites and small beetles |
| **Specialised predators** | Organisms that target one pest species  E.g. dragonflies target all life stages of mosquitoes |
| **Parasites** | E.g. wasps lay their eggs in the bodies of hosts leading to the  hosts deaths |
| **Microbial diseases** | Caused by bacteria and fungi and viruses that target species and  cause death |

* + Example:
    - South American Cane Toad was introduced to Queensland in 1935 to **control the cane sugar beetle**. Cane toads were not able to reach the beetle and rapidly spread into the wild. With **few natural predators and its ability to release a poisonous toxin** the introduction of the cane toad has been catastrophic to **native mammals and reptiles**

## Culling

* The thought of culling populations of a particular species that are pushing ecosystems beyond their carrying capacity can cause strong reactions in people
* Each year more than 2 million kangaroos are culled under strict regulations
* Koalas avoided being culled on kangaroo island, and after other techniques of sterilisation and translocation, their numbers are now reduced

## Reintroducing populations

* Translocation: the movement of an organism from one place with free release in another. There are 3 forms: introduction, reintroduction and restocking
* Useful in wildlife conservation to move species to pest free areas and to move species to an underpopulated area with plenty of resources
* Example: Galaxias are a native fresh water fish whose numbers have suffered since the introduction of the mosquito fish. Galaxias are being translocated to locations that are not infested with mosquito fish or to artificially created ponds

# Chapter 6 Changes in Ecosystems

## Definitions

**Succession** The **gradual** process by which ecosystems **change** and **develop** over

time. There are two types of succession: primary and secondary

**Nudation** The development of **bare sites**, with **no organisms** inhabiting the area. The bare site is the result of a major environmental disturbances such as a volcanic eruption

**Pioneer plants** Plants that **colonise bare sites**, beginning a chain of **succession**. They

have a wide tolerance and can survive in extreme conditions (r-selected

species). For example, **lichen and mosses**

**Primary succession** A series of community changes which occur on a new habitat which has

**never been colonised and has no soil** e.g. sand dunes, new rock surfaces

**Secondary succession** A series of community changes which occur on a new habitat which has **previously been colonised but is disturbed habitat** e.g. after a fire or flood

**Climax community** The **end-point** in succession, where the community has become **stable** (k-selected species). E.g. old growth forests and rainforests. Not all successions reach the climax community

**Deflected succession** Occurs when a community is **prevented** from reaching a **climax**

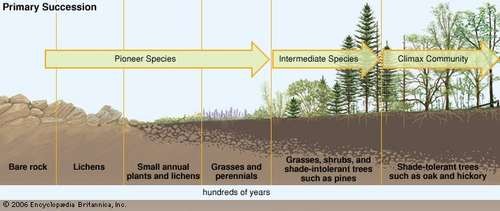
**community** because some form of interference by human activity e.g.

controlled burns

## Primary Succession

1. Disturbance such as volcanic eruptions, tsunamis, earthquakes or retreating glaciers results in the formation of bare rock with no organisms. This process is called **nudation**
2. **Prokaryotes** (cyanobacteria and algae) and microscopic **pioneer plants** (lichen and mosses) inhabit the bare area
3. **Acids secreted** by the lichens and the roots of mosses attack the rocky surface which results in

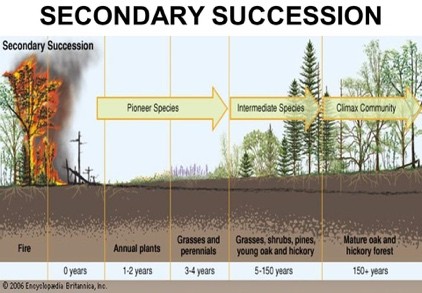
**weathering** (breakdown of rock) resulting in **soil**

1. The shallow soil makes it possible for more **mosses** to grow. As they die they add nutrients to the soil
2. As the soil develops **grasses** and **small herbaceous plants** start to grow. As they die more organic matter/nutrients are added to the soil and the **roots**

#### of plants further breakdown rocks

1. Deeper soil holds more water and this enables **small shrubs** to colonise these soils. This environment attracts many **r-selected species**
2. After many years **trees establish**, leasing to the development of a **climax community** which attracts **k-selected species**

## Secondary succession

1. Disturbances such as fires, floods, hurricanes and cleared land for farming results in the destruction of some plants and animals – **pioneer plants** and **soil remain present**
2. Grasses and herbaceous plants colonise the area first. **Seeds** are present in the soil or blown by wind/carried by animals. Revegetation occurs relatively fast as the soil is already present
3. **Succession continues**: shrubs  trees  climax community

## Contrasts between primary and secondary succession

|  |  |  |
| --- | --- | --- |
|  | **Primary Succession** | **Secondary Succession** |
| **Occurrence** | * On a site that has **never been colonised** before | * On a site that **has been colonised** but **destroyed** |
| **Soil** | * No soil * No seeds | * Soil present with seeds of   species that were present before |
| **First Life Forms** | * Microscopic Prokaryotes * Can’t be seen with the naked eye * Organisms with no nucleus    i.e. bacteria   * Microscopic pioneers   - Lichen and mosses | * Grasses and herbaceous plants that grow from seeds present in soil/windblown or animal borne seeds |
| **Stages of Development** | * Bacteria/algae  lichen/mosses  grasses  herbaceous plants    shrubs  trees | * Grasses  herbaceous plants    shrubs  trees |
| **Time** | * Very Long | * Relatively short |

Similarities in primary and secondary succession

* Both can reach climax community
* Both involve changes to the ecosystem over time
* Both will have r-selected species which will eventually give way to k-selected species

## Factors preventing climax community being reached

* Frequent natural disturbances: fire, floods and hurricanes
* Grazing by herbivores  grasslands
* Human activities: clearing for agriculture, building, pollution

## Volcanoes

* Volcanic eruptions result in **primary succession**
* During a volcanic eruption molten lava flows over the ground. It cools and solidifies into **bare rock**
* Lichen spores carried by wind settle in the rock and begin the process of succession, as the rock is broken down into soil

## Fire

* Climax community  fire  burns down climax community  bare ground with soil present 

grasses and herbaceous plants colonise  shrubs colonise  forest  climax community

#### Immediate effects of fire on biotic components

|  |  |
| --- | --- |
| **Positives** | **Negatives** |
| * **Germination**  seeds are released from many plant species  reproduction and regeneration * **Kills pathogens and insect pests** that preys on trees e.g. jarrah dieback * **Reduce leaf litter** | * **Decreased biodiversity** as it results in flora and fauna deaths * **Loss of vegetation/habitat** |

* **Immediate effects of fire on abiotic factors**

|  |  |
| --- | --- |
| **Positives** | **Negatives** |
| * **Ash creates nutrient rich soil** * **Increased light availability** due to loss of coverage * **Increased water absorption** due to reduced leaf litter | * **Increased erosion** * **Dry soil** if no rainfall * **Air pollution** * **Increased** 𝐂𝐎𝟐 **and greenhouse gases in atmosphere** |

* **Long term effects of fire on the ecosystem**
  + Promotes the **health** of the ecosystem by controlling **insect pests** and **pathogens** 

promotes the survival of native species

* + Results in **increased biodiversity**
  + Fire **open up spaces** and creates **nutrient rich soil** with a **seed bank** which promotes

#### secondary succession

* + Fire stimulates the **regrowth of many native plant species**
  + As most of the original seed bank is in the ground the forest will regenerate to much the same as before

## Climate Change

* Increase global temperature
* Melting ice caps
* Rising sea levels
* Extreme/changing weather patterns
* Coral bleaching due to rising sea temperatures
* Caused by a **rise in greenhouse gases** due to burning of fossil fuels, deforestation and farming

## Human Impacts  Negative

|  |  |  |
| --- | --- | --- |
| **Environmental issue** | **Human activities that cause the issue** | **Biological consequences** |
| **Habitat destruction/ fragmentation** | * Excessive clearing of bush land for pasture crops or urban sprawl | * Small isolated populations of animals and plants are created which lack genetic diversity and therefore   vulnerable to disease |
| **Overharvesting of natural**  **resources (over- exploitation)** | * Clearing too much vegetation * Overstocking * Overgrazing * Collecting too much plant material for burning (developing countries) * Over hunting of animals on land * Overfishing | * Habitat destruction * Erosion * Loss of soil nutrients * Increased dry land salinity * Reduction of native plants and animals to the point of extinction * Loss of biodiversity |
| **Introduction of invasive (feral animals)** | * Many animals have been allowed to escape into the wild or have been released deliberately * i.e. cats, foxes, rabbits, goats, camels, donkeys, horses and pigs | * Often feral animals ‘out compete’ native animals for food and sheltering spaces * May predate on native animals * May become so numerous they damage natural   ecosystems by overgrazing and eroding water courses |
| **Climate change/ greenhouse effect** | * Increased levels of carbon dioxide and methane in the atmosphere due to burning fossil fuels and to ruminant animals (farm animals i.e. cows and methane) | * Increase the worlds average temperature, climate disturbance, rising sea levels, loss of arable   (useable) land, loss of biodiversity |
| **Biomagnification** | * When certain pesticides and heavy metals etc., which bioaccumulate are use indiscriminately and in large quantities over a long period of time | * The tissue concentration of pesticides and heavy metals etc, increases up the food chain so that it is highest in the highest order consumers. This may affect of the higher order consumers leading to declining populations and   often at threat of extinction |

Strategies used to minimise human impact

### Genetic strategies

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| --- | --- | --- |
| **Strategy** | **Explanation** | **Example** |
| Seed Banks | * A laboratory in which plant seeds are first semidried and then kept in freezers or in liquid nitrogen | * The science directorate at Kings Park has a collection of over 2500 seeds taken from WA habitats, many of the seeds have been collected plants that are threatened |
| Captive Breeding programs | * Animals are removed from their natural habitats and bred (ex situ) to produce young in protected habitats (e.g. zoos). * When the species numbers and genetic diversity increase and a suitable environment becomes available, the organisms may be carefully reintroduced to their natural habitat | * At Perth Zoo, chudiches, numbats etc have all been bred successfully in captivity. Some have been returned to restored habitats |

Environmental Strategies

|  |  |  |
| --- | --- | --- |
| **Strategy** | **Explanation** | **Example** |
| Revegetation (reafforestation) | * When cleared areas of land which were previously woodland or forest have the same (or similar) native tree species replanted over the area | * Mine sites in the Darling Scarp which have been cleared, have vegetation replanted over them when the mineral has been removed |
| Control of introduced species | * Introduced species fall into two broad categories:   1. Cultivated crops and domesticated animals   2. Invasive pest species and other exotic species that are not apparently harmful * Conservation generally requires the limitation of this second category | * The cane toad * Attempts to prevent it from moving into WA appear to be failing * More support for those who are trying is needed |

Management Strategies

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| --- | --- | --- |
| **Strategy** | **Explanation** | **Example** |
| National parks | * Land set aside in Australia for recreation and conservation * Agriculture isn’t permitted * State government responsibility | * Covers 7% of Australia * Generally, wilderness areas which have rich biodiversity |
| Protected zones | * Places of special significance * Often a ‘no take’ policy is enforced   - Nothing can be used without government permission   * Areas where natural populations can flourish and provide a source of stock in some places for similar/neighbouring ecosystems | * Rottnest and Ningaloo there are sanctuary zones where all natural components are protected. People can ‘look, but not touch’ |
| Licenses | * Government issues special licenses to members of the public who wish to hunt or fish in particular areas, sometimes only at specific times. This enables authorities to monitor catches and protect populations of species involved | * Marron, Abalone, Rock lobster and several fresh water fish are protected in this way in WA |
| Open Seasons | * These are limited times during the year (which can be adjusted by the authorities at very short notice) in which some fish species (including shellfish) can be taken in certain areas | * Abalone could only be collected between 7am and 8am on Sundays from 2nd November to 7th December (2008) in an area between the Busselton jetty and Greenbugh River Mouth |