Temperate Grasslands Biome

- Describe the structure and function of temperate grassland ecosystems
- Illustrates the impact of human activity using a temperate grassland case study- i.e. the North American Prairies

INTRODUCTION

Grasslands are one of the Earth's major biomes (bioclimatic zone), i.e. regional groupings of plant and animal communities that inhabit a large geographical area whose climate largely determines its vegetation type. Grasslands are found on every continent except Antarctica and have local names. Fig.1 shows temperate grasslands based on their distinctive climatic characteristics. Grasslands are largely devoid of trees, although in many areas conditions are wet enough for some trees to survive.

Fig. 1 Distribution of grasslands biomes

The prime factors in influencing the distribution of grasslands are climatic; grasslands can survive areas of low rainfall, or where heat and high rates of evaporation reduce the effectiveness of the rainfall, which would be unsuitable for trees. Grasses are well adapted with a rapid life cycle, and a dense root network to areas with unpredictable rainfall patterns. Locally impoverished soils may lead to grasslands, in areas, which are wet, enough for forests. In many other areas grasslands are found as a result of human factors, for example the trees have been destroyed by fire and are therefore a plagio-climax vegetation (anthropogenic) not a natural climatic climax. Grasslands provide an enormous range of goods and services, in particular food. Cereal crops are all varieties of grass, and grasslands are the main feeding/grazing grounds for meat-producing animals which humans hunt or reap.

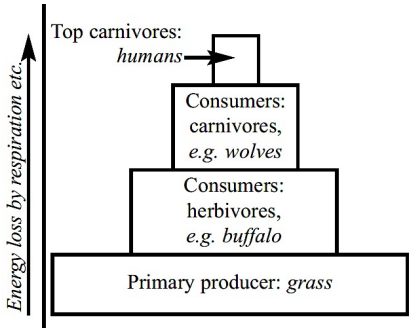
Fig. 2 The temperate grasslands biome

Approximate latitude	40° - 55° N and S
Climate • *temperature* • *precipitation* • *climate type*	 -15° - 20°C Average 5 months growing season. Limiting factor: low winter temperatures. Adaptation rapid life cycle. 250 - 600mm: *Spring (late) summer maximum.* *Winter precipitation as snow.* Temperate continental
Soils	Long grass prairie: *chernozems (black earth)* Short grass prairie: *chestnut soils* Leaching after spring - *snow melt* Capillary action - *accumulation of calcium*
Native species	Bison, buffalo
Land use	Traditional herding and hunting, *e.g. in Mongolian Steppes.* No longer in N. America. Intensive arable farming for cereals/soya beans and ranching.
Plant adaptations	Nearly all grass - *wind chill from strong winds and physiological drought limits trees*
Main issues	Loss of biodiversity - *introduced species* Under threat from agriculture, especially in Americas. Issues of hi-tech farming, eutrophication etc. Extreme fragmentation - *few natural areas left, especially in USA.* Excessive farming of marginal lands - *massive soil erosion issues in Steppes and Prairies (dust bowls).*

TEMPERATE GRASSLAND STRUCTURE

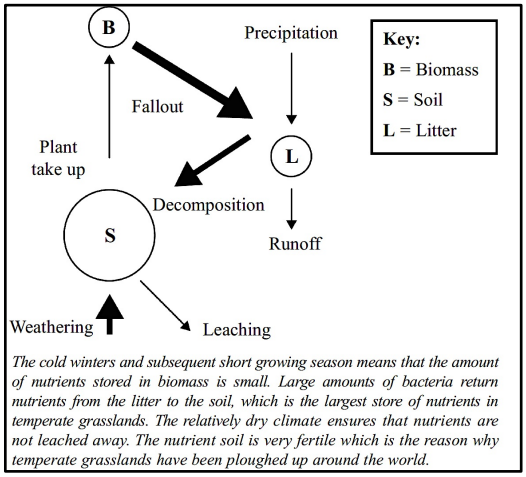
Ecosystem structure describes the ways in which its biotic (living) and abiotic (non-living) factors are arranged and interact. A sensible way to show structure is by showing a trophic level diagram Fig. 3:

Fig. 3 Trophic levels



TEMPERATE GRASSLAND FUNCTION

Ecosystem functioning refers to how energy flows through it and how nutrients are cycled within it. Models and diagrams help in understanding these functions, e.g. energy flows can be shown in trophic pyramids or food chains and nutrient cycling by Gersmehl diagrams:



The cold winters and subsequent short growing season means that the amount of nutrients stored in biomass is small. Large amounts of bacteria return nutrients from the litter to the soil, which is the largest store of nutrients in temperate grasslands. The relatively dry climate ensures that nutrients are not leached away. The nutrient soil is very fertile which is the reason why temperate grasslands have been ploughed up around the world.

NPP (net primary productivity) g/m²/yr	Biomass (kg/m²)	Rates of biomass: NPP	World NPP %
600 (0.6 kk/m²/yr)	1.6	2.7	5.4

- Net primary productivity is the new growth available (generated by the producers) to feed other levels of the food chain. NPP = GPP – R (where GPP = gross primary productivity and R = respiration).
- Biomass is the term used to describe the energy stored as a dry weight. This energy is transferred through the ecosystem giving rise to a food chain. Each organism in the chain feeds on and gains energy from an organism preceding it (e.g. lions from wildebeests), and itself provides energy for a predator.
- Each link is termed a trophic level. There are normally no more than four trophic levels because energy is lost via respiration, decay and excretion – hence the pyramid shape of Fig.3, as a result of the decreasing width of each trophic level.

The key to the ecosystem are the primary producers – green plants capable of producing their own food by photosynthesis, i.e. autotrophs. Grass (**gramineae**) is a highly successful plant with 9000 species, which can grow in a wide variety of environments. Also, unlike most plants grass thrives on being eaten (grazed), burned and trampled because it has multiple growing points (or meristems). Thus a high number of consumers (heterotrophs) can be supported. These are animals, which obtain their food by eating plants or other animals. With higher primary productivity tropical grasslands support more large mammals than temperate ones:

- herbivores eat plants
- carnivores eat other animals
- omnivores eat plants and animals
- detrivores feed on dead plant and animal matter

Nutrient cycling is the process by which bacteria and fungi feed off dead organic matter (detritus) and release the nutrients essential to plant growth such as carbon, hydrogen and potassium. These nutrients are available for plant uptake.

THE FUTURE FOR TEMPERATE GRASSLANDS

The long-term survival of the world's temperate grasslands is vital if they are to remain agriculturally viable and supply grain to a growing population. The use of soil conservation methods is likely to assume increased importance if climate change occurs. It is predicted that the Prairies, Pampas and Steppes would become drier as temperature rose, perhaps leading to severe drought and a fall in grain crop yields.