SAVANNAH
CREATING HOPE THROUGH HUMAN-WILDLIFE SOLUTIONS

Stage 5 & 6: Geography GE5-1, GE5-2, GE5-3, GE5-5, GE5-7, P3, H5, H11

IT TAKES A COMMUNITY...
WE ARE ALL IN THIS TOGETHER.

LION PRIDE LANDS photo by Nick Stevens

Students will develop a deeper understanding of the Kenyan Savannah and some of the issues facing the environment and animals.

They will use their Geographical skills and apply them to solve a range of questions surrounding the Savannah. Students will be evaluating and explaining environmental management strategies as well as applying mathematical ideas and techniques to analyse geographical data.

TARONGA ZOO SYDNEY

For the Wild

OUTLINE

GIRAFFES by Rick Stevens

AT SCHOOL

The activities in this resource have been created to compliment a self-guided tour of the Savannah exhibit.

The questions align with the Stage 5 and 6 Geography syllabus and explore a range of issues facing the Kenyan Savannah, such as animal population decline, biodiversity and infrastructure.

Students will also work through problems that involve building on an understanding of Kenyan Ecology and absolute location and climate.

AT THE ZOO

Explore Taronga's Savannah Exhibit and immerse yourself in the lives of the Indigenous Kenyan people.

Discover how they live, use the land and interact with the wildlife around them. Find out how your everyday actions can help support the families and wildlife of Kenya.

Taronga Conservation Society Australia would like to thank NSW Department of Education Geography Advisors for their contribution to this resource.

TARONGA ZOO SYDNEY

For the Wild

POPULATION DECLINE

At school – before the zoo

Calculating percentage change is an important skill for Geographers measuring the relative impact of different events.

If whole values were the only measure used to describe change, people may fail to take into account the initial value and over or underestimate the extent of the change. Percentage change allows for comparisons to be made between events.

One method for calculating percentage change is to use the following formula:

$$\left(\frac{\text{new value}}{\text{old value}} - 1\right) \times 100 = \text{percentage change}$$

This can be remembered by the mnemonic "**No one remembers percentage change**"

Example

Over the past 30 years, Giraffe populations have declined by 36%. There are only 96,000 remaining today.

What was the population of Giraffe 30 years ago?

In this equation, we know the new value (96,000) and the percentage (-0.36) but we still don't know the old value.

$$-0.36 = (96{,}000 \div \text{old value}) - 1$$
$$+1 \qquad\qquad +1$$

$$0.64 = 96{,}000 \div \text{old value}$$
$$\times \text{old value} \qquad \times \text{old value}$$

$$\text{old value} \times 0.64 = 96{,}000$$
$$\div 0.64 \qquad \div 0.64$$

$$\text{old value} = 96{,}000 \div 0.64$$

$$\text{old value} = 150{,}000$$

Answer: 30 years ago there were 150,000 giraffes.

Questions

1. Lions declined 42% in the past 20 years. There are estimated to be only 29,000 remaining. **What was the population of lions 20 year ago?**

2. It was estimated that in 1970, there were 15,000 Grevy's zebras. Today there are approximately 3000. **Calculate the percentage decline in 50 years since 1970.**

3. Today there are 300,000 chimpanzees however the Jane Goodall Foundation predicts that current trends will lead to an 80% decline over the next 30 years. **According to this prediction, how many chimpanzees will there be in 2050?**

GIRAFFES by Rick Stevens

ABSOLUTE LOCATION *and* CLIMATE

At school – before the zoo

Absolute Location refers to the position of a place on the Earth.

Absolute location is measured in degreed of latitude and longitude. Latitude is one of the greatest factors affecting climate because of the amount of insolation (energy from the sun's radiation received) at different locations.

Ntashawua attends Ngutuk Engiron Primary School in the Westgate Conservancy in Kenya. Ngutuk Engiron Primary School is located at approximately 0°40'N 37°20'E. Use this information to answer the following questions.

Questions

1. Absolute location:
   a. What significant line of latitude is Ngutuk Engiron Primary School located near?
   b. What do you expect the climate to be like in a location at this latitude?
   c. Locate Ngutuk Engiron Primary School on Figure A (see attachment for larger image)
2. Climate:
   a. Use the key to describe the spatial pattern of rainfall in Kenya (for example, what areas receive the most rain (North, East, South or West)? Where is there less rain?
   b. Use Figure A to estimate where Ngutuk Engiron Primary School is located in Figure B.
   c. What is the annual average rainfall at Ngutuk Engiron Primary School?
   d. Taronga Zoo, Sydney receives approximately 1200mm rainfall annually while Taronga Western Plains Zoo in Dubbo receives 600mm. Compare the amount of rainfall at Ngutuk Engiron Primary School and Taronga's zoo sites.

TIP: There are 60 minutes in every degree.
15' = one quarter of a degree
20' = one third of a degree
30' = half a degree
40' = two thirds of a degree
45' = three quarters of a degree

Figure A: Map of Kenya

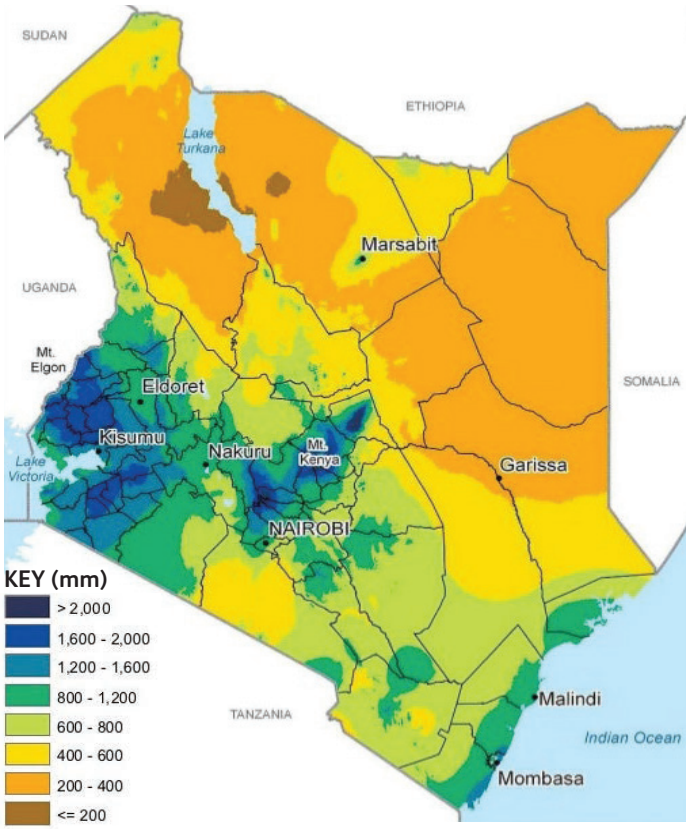


Figure B: Choropleth map showing average annual rainfall in Kenya

BIODIVERSITY *and* INFRASTRUCTURE

At school – before the zoo

The Lamu Port-South Sudan-Ethiopia Transport (LAPSSET) is a major infrastructure project that will include building linear developments such as roads, railways, and pipelines, as well as airports in eastern Africa.

These planned developments may have economic benefits for some communities and businesses. However there are risks for wildlife and pastoralists.

Some of these services will be built in ecologically sensitive areas.

ZEBRAS by Rick Stevens

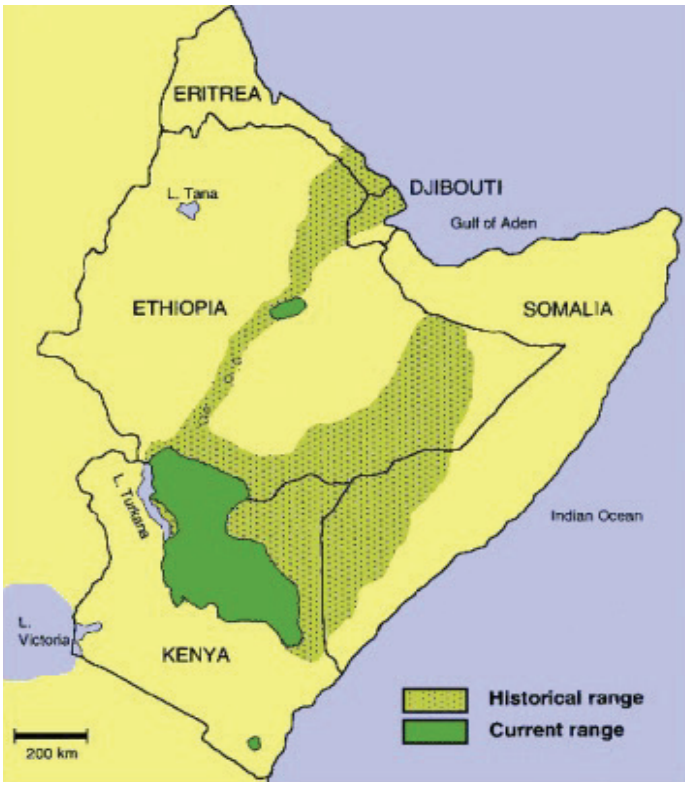


Figure C: Map of the range of Grevy's Zebra

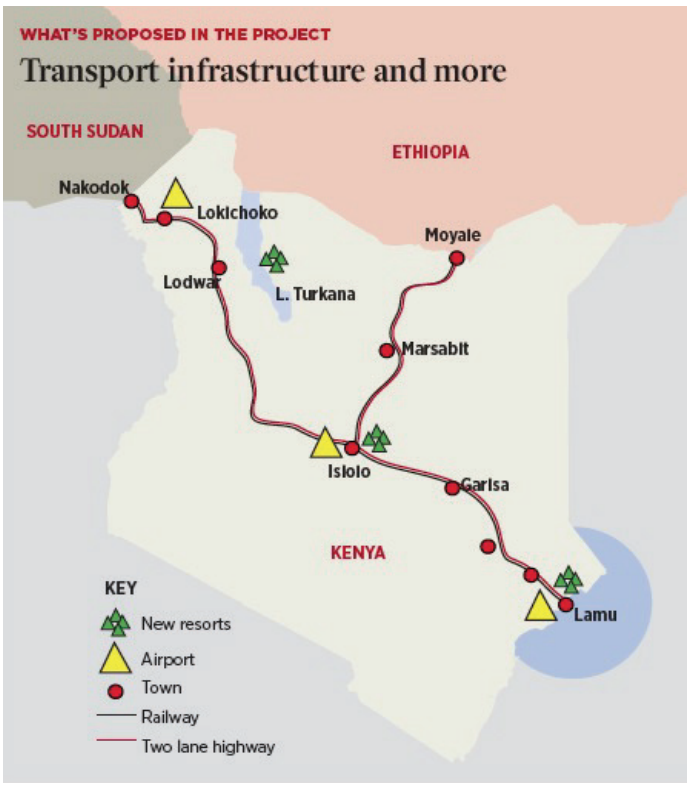


Figure D: Map of the proposed LAPSSET development

Questions

1. Linear infrastructure means projects built in a 'line'. These projects can cut through the environment.

   Refer to Figures C and D and use the PMI chart to brainstorm the potential environmental, social and economic impacts of linear infrastructure developments such as LAPSSET in eastern Africa.

	Positive	Minus	Interesting
Environmental			
Social			
Economic			

2. Figure E shows a modification to the LAPSSET Project to reduce the negative impacts on the environment, such as habitat fragmentation.

   a. **Define the term 'habitat fragmentation'**

   b. **Hypothesise how the design of the rail bridge shown in Figure C may reduce the potential impact of habitat fragmentation**

Figure E: Photograph of rail bridge

SAVANNAH ECOLOGY

At school – before the zoo

East African savannah can be described as being in a "Fire Climax" state.

This means that fire controls what plants live in the ecosystem.

There are two types of common plants in a Fire Climax state;

- the plants that encourage fires, and
- the ones that can endure fire.

All plants in this ecosystem are xerophytic (adapted to drought) and pyrophytic (adapted to fire). The fires produce a fine ash providing nutrients for the new growth of grass and prevent the ecosystem from becoming a rainforest.

The plants that encourage fires are grasses.

A huge variety of grasses grow in Eastern Africa, and all of them have the same traits that encourage and protect them from fire during the dry season. Grasses encourage fire by having easily drying, vertically standing stalks, providing abundant fuel for the fires and making it easy for them to burn.

Grasses are protected from fire in three ways:

1. First, when grasses dry, they remove much of their nutrients to the roots, so when a fire does burn the plant, very little important material is lost.
2. Second, grasses have large supplies of extra nutrients stored underground, so that they can easily re-grow lost leaves after burning.
3. Finally, all plants have what is called an apicalmeristem, a part of the plant which controls upward growth.

In most plants, the apical-meristem is located at the top of the highest branch. If you have ever tried a gardener's trick and cut the top branch off of a plant, you will have noticed that it stops growing vertically and instead get wider and thicker.

In grasses, this apical-meristem is located below the green growing part of the plant, and hidden below the ground. Thus, grasses are pushed up from the ground and not growing up from their tops.

When a fire burns grass or an animal eats grass, they are not damaging the important apical-meristem, only eating the leaves.

MASAI MARA NATIONAL RESERVE, KENYA by David Clode via Unsplash

The second type of savannah plants are those that can endure fire. These plants are trees, and some herbs.

The majority of trees in African Savannahs are Acacias, Commiphoras, or Terminalias. All of these trees have the same characteristics that protect them from fire; an insulating layer of bark.

Most savannah trees are susceptible to fire when they are young, but as they grow larger, they become resistant to fire, and thus reach what is called a "size escape" from fire. Once trees have become large enough, only frequent and hot fires can kill them.

Across the Kenyan savannah there are two general groups of animals;

- **those that migrate, and**
- **those that are resident in one place all year.**

These resident animals tend to congregate in special places which scientists call "hotspots". At these places, many species gather together and graze the grass intensively, so that the grass forms a "grazing lawn" of highly productive, short vegetation (similar to the short grass plains during the rainy season).

Hotspots tend to occur at the boundaries of carnivore ranges, where carnivores are less likely to go so that they don't meet their neighbours.

Oddly enough, hotspot grass is much more productive than nearby ungrazed grass. Scientists are interested to see if the grazers themselves create the hotspots by fertilizing the area with their dung as they feed.

During the rainy season, birds, insects, and both large and small mammals thrive in the savannah, but the rainy season only lasts 6 to 8 months. During the dry season, surface water from the rain is quickly absorbed into the ground because the soil is extremely porous.

Competition for water during the dry season is intense. Consequently, most birds and many of the large mammals migrate during the dry season in search of water. Because drought conditions are sometimes localized, the migration may be just to another area within the savannah. When drought conditions persist for a long time and over a wide area, the animals may migrate to another biome until the rainy season begins again.

Questions

1. **Define the following terms: apicalmeristem, pyrophitic, size escape, xerophytic.**
2. **Describe why "hotspot" lawns are more productive than other savannah regions.**
3. **Explain why "hotspot" lawns are found on the edge of carnivore ranges.**

WILDEBEEST, KENYA by Bibhash via Unsplash

Trees

Deciduous: Trees usually lose their leaves during drought to reduce evapotranspiration.

Leaves: Leaves are small, waxy and often thorn-like; this reduces evapotranspiration; sunken stomata further reduce moisture loss. Thorn-like leaves protect against predators.

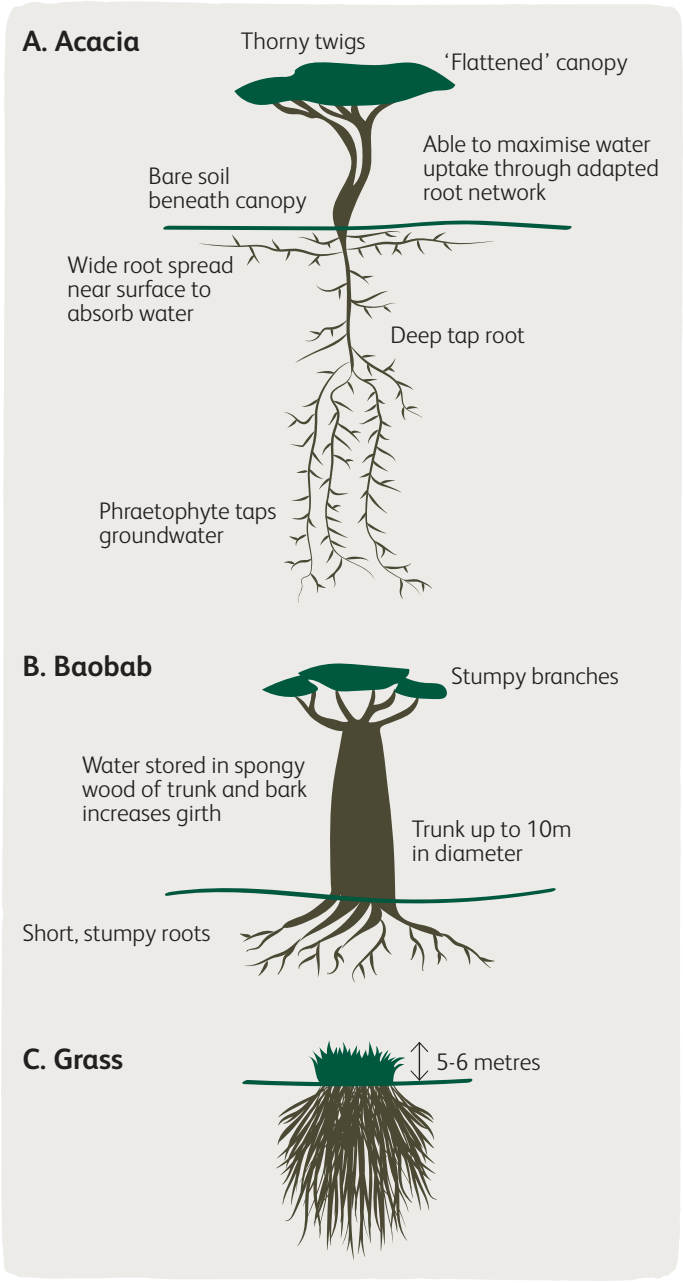
Bark: Thick and/or resinous bark protects the vascular system from heat and/or fire.

Roots: Trees such as acacia have deep, wide root networks to 'tap' the water table and catch water from an increased area.

Spacing: Trees are widely spaced to reduce competition for scarce water resources.

Water storage: Semi-succulent trees, like baobab, store water in their trunk.

Dormancy: Most trees become dormant for the duration of the drought; during this period, leaves are shed.



Grasses

Grasses have a variety of adaptations which allow them to grow successfully under drought/fire conditions:

- They lie dormant until the seasonal rains, then grow vigorously in large tufts or tussocks, often attaining heights of 3-5m, which means that in some localities they dwarf the more stunted trees around them.
- As the dry season advances, the grasses turn a pale straw colour (from their 'normal' yellow colour) and die back, to remain once again in their dormant state until the next rains.
- Most are perennial (live for several years) and their seeds are so drought resistant that they are able to lie dormant for many years. This capability is now increasingly important in many savannah areas where rainfall is becoming less reliable.
- Store food (starch) and moisture in their root systems.
- Pyrophytic (fire adapted), as growth occurs from the base of the stem (which is at, or close to, ground level); this means both that when the grasses are damaged in fire, they are able immediately to start to regrow and the bulk of the biomass is stored below ground. This growth adaptation also affords them protection from permanent damage by their predators, provided that they are not overgrazed; as it is being nibbled away, grass is able to continue to grow from its stem base. This is in contrast to trees, which grow from their outer tips; thus, while they may have some adaptations to survive fire, they can be seriously damaged by the actions of browsers who dine on the tips of the branches and leaves.
- Following prolonged drought, grasses have the ability to absorb water much more quickly after first rainfall; they do not need water droplets to reach the finer pore spaces before they can absorb moisture and this therefore means that they are able to transpire fully as soon as rain falls.

Questions

1. **Identify all the xerophytic and pyrophitic features of savannah plants in a table like this:**

Xerophytic	Pyrophitic

2. **If the grasses shown (C) are approximately 5-6m, how deep do the roots penetrate?**
3. **Draw your own diagram showing savannah grasses and label the apical-meristem, nutrient stores in roots and pyrophitic features.**

THE COMPLEXITIES of GRAZING AND DESERTIFICATION

Watch this TED talk!

ted.com/talks/allan_savory_how_to_fight_desertification_and_reverse_climate_change/transcript?language=en

Overgrazing and ploughing over of grasslands lead to erosion of the soil during droughts. The loose soil left behind is picked up by strong winds, causing dust storms for miles and the loss of fertility in the earth.

Desertification is the end result of the available rainfall becoming increasingly less effective. It is occurring to varying degrees in vast regions of the world where atmospheric humidity is erratic due to rainfall that is seasonal in nature.

The vast grasslands, savannahs and man-made deserts that constitute the greatest areas of the world's land experience seasonal rainfall and thus dry or dormant periods in every year – high or low rainfall. In such seasonal environments perennial grass plants, and their dead litter, provide most of the soil cover and more so as rainfall gets lower and insufficient for a full canopy tree cover. Such grass plants co-evolved with their living soils and the vast herding herbivore populations that sustain pack-hunting predators. Most perennial grasses have growing points close to ground level, out of harm's way because they co-existed with billions of grazing herbivores.

Grass plants grow profusely during the growing season, but as the atmosphere dries off most of the plant above ground dies. This dead plant mass, dying within a short few months every year, needs to decay biologically and rapidly for growth to continue uninterrupted in the following season. However, in the absence of adequate grazing herbivores the dead material that stands upright shifts from rapid biological decay to gradual breakdown through oxidation and weathering. This gradual breakdown leads to the dead material filtering and inhibiting light from reaching growth points and thus provoking the death of many grass plants. What follows varies with the amount of rainfall. If the precipitation level is high enough, grassland shifts to shrubs and trees, or else where lower, it shifts to bare generally algae-covered soil and desert bushes.

HERD OF ELAND, KENYA by Sutirta Budiman via Unsplash

As grass/plant spacing opens and bare soil increases, the available rainfall becomes less effective – leading to desertification.

Rain that soaks into the soil largely evaporates out of the soil surface in subsequent days. Or, if large falls of rain occur, most of the rainwater flows off – causing flooding. This is why both droughts and floods have increased in frequency and severity even where no change in rainfall has yet occurred. This process happens more rapidly where rainfall is lowest.

In such environments, before humans killed off most wild herbivores, rainfall effectiveness and health of grasslands was maintained by masses (billions) of large herding animals with bunching behaviour as protection from pack-hunting predators. Bunching, even where no migration occurs, ensures movement off of dung and urine fouled ground, so constant movement led to trampling, grazing, dunging and urinating thus maintaining overall soil cover and grassland health.

Following the killing of most herbivores and their replacement by relatively few domesticated livestock, humans would soon have learned that the grasslands began dying if not burned using fire.

While fire does remove the moribund material and thus keep adult grass plants alive prolonging the grassland, it also exposes soil and leads to wider plant spacing and thus desertification over time.

Questions

1. **Compare the impact of livestock today to the impact of hooved animals prior to intensive agriculture in relation to soil quality.**

2. **Write an I.D.E.A. paragraph analysing the relationship between livestock and desertification.**

   IDENTIFY the significance of desertification

   DEFINE desertification

   EXPLAIN the causes of desertification

   ANALYSE the positive and negative impacts of livestock on desertification and ecosystem functioning

DOMESTICATED BOS INDICUS CATTLE by Juliana Amorim via Unsplash