BEST 'O' LEVEL BIOLOGY REVISION NOTES®

BIODIVERSITY compiled by G. Taruvinga

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TOPIC 8 BIODIVERSITY
Form 3: The Five Kingdoms

KEY CONCEPT	OBJECTIVES Learners should be able to:	CONTENT (ATTITUDES, SKILLS AND KNOWLEDGE)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES

8.9.1 Biodiversity	• state the five kingdoms of living organisms
	
	• state characteristic features of the five kingdoms
		• Five kingdoms
		  - Prokaryotae/Monera
		  - Protoctista/Protista
		  - Fungi
		  - Plantae
		  - Animalia
		• Diagnostic features
			• Classifying organisms into five kingdoms
			
			• Discussing characteristic features of each kingdom
				• ICT tools
				• Braille software/Jaws
				• Samples of organisms
				• Print media

THE FIVE KINGDOMS CLASSIFICATION SYSTEM

All living things can be grouped into five categories. This is called the five kingdom proposal and was introduced by **Robert Whittaker** in 1968 as a way to categorise all organisms.

Living organisms are divided into five kingdoms:

- Prokaryotae/Monera
- Protoctista/Protista
- Fungi
- Plantae
- Animalia

KINGDOM PROKARYOTAE

Diagnostic features of Prokaryotae

- Unicellular and Microscopic.
- Non-membrane bound (no nuclear membrane, no ER, no mitochondria).
- Cell wall made of **murein**.
- Examples: Bacteria or Cyanobacteria (photosynthesising bacteria).

Economic importance of Prokaryotae

1) Production of antibiotics
2) Biological control of pests: Replace pesticides
3) Degrade or break down herbicides.
4) Bioremediation: breakdown or neutralise toxic wastes.
5) Production of biogas.
6) Decompose sewage waste or organic matter.
7) Produce food by fermentation e.g. diary product cheese, yoghurt, sour milk
8) Used in the manufacture of drugs e.g. insulin
9) They help in the digestive system of ruminants
10) Causes diseases e. g cholera, gonorrhea and tetanus.
11) They help in the fixation of nitrogen in the nitrogen cycle

KINGDOM PROTOCTISTA

Diagnostic features of Kingdom Protoctista

- Mainly small eukaryotic organisms.
- Many live in aquatic environments.

- This is usually the kingdom where organisms which aren't animals, plants or fungi go.
- Examples: Algae, slime moulds and the malaria causing Plasmodium.

Economic importance of Kingdom Protoctista

1) Cause diseases in humans e.g. malaria and bilharzia
2) Cause diseases in plants e.g. late potato blight and soft rot in seedlings.
3) Source of food e.g. kelps are edible.
4) Source of commercial products e.g. antiseptics and algar.
5) Source of minerals e.g. kelps are rich in sodium, potassium and iodine.
6) Primary producers of aquatic ecosystems.

KINGDOM FUNGI

Diagnostic features of Kingdom Fungi

- Eukaryotic
- Multicellular
- Cell wall made of **chitin**.
- The members of this kingdom don't possess photosynthetic pigments and are therefore **heterotrophic**.
- Examples: Mushroom, Mould, Puffball

Economic importance of Fungi

1) They are used as a source of food e.g. mushroom.
2) Yeast is used in the bread making industry.
3) Since yeast respires anaerobically, it is used to produce alcohol and wine.
4) It is used to make antibiotics like penicillin.
5) It is used in the decomposition of o compost.
6) It is used to flavour cheese.
7) Some cause diseases like athlete's foot, thrush.

KINGDOM PLANTAE

Diagnostic features of Kingdom Plantae

- Eukaryotic
- Multicellular
- Cell wall made of **cellulose**.
- Members of the plantae group contain photosynthetic pigment and gain their energy through it and are therefore **autotrophic**.

Economic importance of Kingdom Plantae

Can be positive (beneficial) or negative (harmful):

Beneficial roles of plants
- **Producers** of food for consumers by the process of photosynthesis.
- **Drinks:** natural fruit juices
- **Producers** of oxygen used by animals during respiration.

- Absorb CO_2 from air thereby reducing the greenhouse effect/global warming.
- **Timber** used for construction and furniture, e.g. pine trees.
- **Paper** for print or written communication.
- **Medicinal use** e.g. herbs
- **Cosmetics** e.g. Aloe vera and lavender oil.
- **Tourism:** Eco-tourism generates forex and jobs.
- **Clothing fibres** e.g. cotton.
- **Decoration** of businesses and parks e.g. flowers/ornamental plants.
- Plants are habitats for many animals.
- **Transpiration** release water vapour for the water cycle.
- **Firewood and charcoal:** fuels for cooking and heating.
- **Fossil fuels e.g.** oil, coal and natural gas were derived from ancient plant reserves.
- **Nitrogen fixation:** Legumes host bacteria that fix nitrogen.
- **Prevent soil erosion** as plant roots bind soil particles together.

Harmful roles of plants
- **Invasive plants** outcompete and drive out native plants.
- **Weeds** compete with crops and reduce yields.
- Many plants produce **pollen**, which can cause **allergies**.
- Some plants produce **toxins** that cause allergic skin rashes e.g. poison ivy.
- Some plants contain **harmful chemicals** e.g.tobacco tar is carcinogenic/ causes lung cancer.

KINGDOM ANIMALIA

Diagnostic features of Kingdom Animalia

- Eukaryotic
- Multicellular
- Heterotrophic
- The members of this kingdom can be split into two groups, vertebrates and invertebrates.

The vertebrate subsection of the Animalia kingdom can be split again into five different sections:

- Fish
- Amphibians
- Reptiles
- Birds
- Mammals

Economic importance of Kingdom Animalia

1) **Tourism:** Tourists visits to game parks boost the economy and create jobs.
2) **Food** e.g. Meat and milk from cows and goats, honey from bees, eggs from poultry etc.
3) **Wax** from bee hives is used to make candles, shoe polish, floor polish and cosmetics.
4) **Hunting** provides food and income from selling game meat.
5) **Leather:** Hides of mammals are used to make leather products e.g. shoes, belts and bags.
6) **Fishing** provides food and jobs.
7) **Seed dispersal** e.g. fruit bats.

8) **Pollinating agents:** Animals such as insects (bees) and birds are pollinating agents in plants and crops.
9) **Fabrics:** Silk worms produce silk used to make silk fabrics.
10) **Lac** secreted by lac insects is used to make bangles, varnishes and sealing wax.
11) **Biological control** of pests e.g. beetles such as lady birds are used to control aphids, *Gambusia* fish control mosquitoes by feeding on mosquito larvae.
12) Sponge skeletons are used for **bathing sponges**.
13) Cattle, horses, donkeys and camels are used as **draught power** in agriculture.

Table summarizing the diagnostic features of the five kingdoms

Kingdom	Number of Cells	Type of Cells	How they gain their energy?	Do they move?	Examples
Prokaryotae	Unicellular	Prokaryotic	Some Heterotrophic, Some Autotrophic	Some	Bacteria, Cyanobacteria
Protoctista	Mainly Unicellular	Eukaryotic	Some Heterotrophic, Some Autotrophic	Some	Amoeba
Fungi	Multicellular	Eukaryotic	Heterotrophic	Mainly not	Mushroom, Mold, Puffball
Plantae	Multicellular	Eukaryotic	Autotrophic	No	Trees, Flowering Plants
Animalia	Multicellular	Eukaryotic	Heterotrophic	Yes	Bird, Human, Cow

BEST 'O' LEVEL BIOLOGY REVISION NOTES ®

THREATS TO BIODIVERSITY & CONSERVATION MEASURES

Compiled by G. Taruvinga

BIODIVERSITY
Form 4: THREATS AND CONSERVATION MEASURES

KEY CONCEPT	OBJECTIVES Learners should be able to:	CONTENT (ATTITUDES, SKILLS AND KNOWLEDGE)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES

8.19.1 Threats and Conservation measures	• explain threats to biodiversity
	
	• describe conservation measures
		• Threats to biodiversity
		  - Deforestation
		  - Invasive species
		  - Habitat destruction
		  - Climate change
		  - Pollution
		• Measures
		  - Afforestation
		  - Uses of alternative sources of energy
		  - Preservation of endangered species and agents
			• discussing threats to biodiversity
			
			• Discussing conservation measures
			• Participating in tree planting activities
				• ICT tools
				• Braille software/Jaws

Threats to Biodiversity

Climate change
Deforestation
Extinction
Habitat loss
Invasive species
Pollution
Human **P**opulation
Over-exploitation

Mnemonic: CDE HIPPO (Comrade Hippo)

Threats to biodiversity can be remembered using the mnemonic **Cde Hippo**. **D**eforestation, **C**limate change, **E**xtinction, **H**abitat Loss, **I**nvasive Species, **P**ollution, Human **P**opulation, and **O**ver-exploitation.

1) Climate change

Global warming

- **Global warming** is the gradual increase in the average temperatures of the earth's atmosphere caused by the **greenhouse effect**.
- The **greenhouse effect** is the trapping of radiant heat from the sun in the atmosphere caused by **greenhouse gases** especially **carbon dioxide, methane** and **water vapour**
- Without the greenhouse effect, the mean temperature on Earth would be -18°C and there would be very little or no life. So the greenhouse effect itself is a good thing
- However, the problem is that the increased release of the greenhouse gases, **carbon dioxide** and **methane**, is causing an increase in the greenhouse effect called the **enhanced greenhouse effect**. This is leading to global warming
- The carbon dioxide (CO_2) comes mainly from the burning of fossil fuels and methane (CH_4) comes from the digestive systems of cattle and from decomposing urban waste dumps.

Human activities which increase greenhouse gases in the atmosphere

Human activities are increasing the amount of some greenhouse gases in the atmosphere. For example:

- burning fossil fuels in industry, vehicles and power stations releases carbon dioxide
- deforestation releases carbon dioxide when trees are burnt and reduces the absorption of carbon dioxide through photosynthesis
- farming cattle and growing rice in paddy fields releases methane

Global warming and climate change

One impact of global warming is climate change, which is a long-term abnormal change in weather patterns.

Examples of climate change include:

- patterns of rainfall changing
- changes to weather extremes

The effects of global warming, and the climate change that it causes, include:

- more frequent floods and droughts
- glaciers and polar ice melting
- sea levels rising
- loss of habitats
- temperature and water stress for humans and wildlife
- changes in the distribution of species
- changes in the ability of some regions to produce food

We are already experiencing some of these effects.

Reducing the effects of global warming

The rate of global warming can be reduced by reducing the rate at which greenhouse gases are being released. For example:

- using energy resources more efficiently, e.g. more cars with a higher fuel efficiency
- using renewable sources of energy (e.g. solar power) instead of fossil fuels
- reducing waste by recycling (e.g. plastic bottles)
- reducing deforestation (e.g. reducing the conversion of rainforest to farmland)
- reforestation/afforestation: regenerating forests (planting trees)
- car pooling or using public transportation: teaming up to use one vehicle for a journey instead of many vehicles. This means less fuel is burnt into carbon dioxide.

2) Deforestation
- **Deforestation** is the rapid destruction of woodland by humans.
- The major reasons for deforestation are:
  1. Obtaining hardwood (e.g. teak) for furniture.
  2. Obtaining softwood for paper and other wood products.
  3. Clearing areas for cattle farming.
  4. Clearing areas for agriculture.
  5. Clearing areas for urbanisation, including road building.
  Effects of deforestation include:

- Reduced soil fertility.
- Soil erosion as soil is left bare and exposed to wind and rain.
- Gully formation.
- Landslides
- Siltation of rivers.
- No roots to bind soil particles together leading to soil erosion.
- Habitat loss.
- Destruction/loss of useful plant and animal species.

3) Extinction
- Extinction is the dying out of a species leaving no living representatives.

Causes of extinction

1. Extinction is due to overharvesting (the removal of organisms from the environment at a faster rate than the organisms can reproduce).
2. Destruction of habitats.
3. Widespread deforestation can lead to extinction of plant species.
4. Uncontrolled fishing can lead to extinction of fish.
5. Poaching can also lead to extinction of animals

4) Habitat Loss
- As more land is taken up for human activities, animal habitats are destroyed and animals have less space to live in.
- Causes of habitat loss include pollution, industrial activities, agriculture, mining, deforestation for firewood and timber.

5) Invasive Species

- Invasive species (also called introduced species, alien species, or exotic species), is any non-native species that harms the ecosystem it colonizes.
- Invasive species are those that have been moved intentionally or unintentionally by humans into a new geographic location where they are not naturally found.
- An invasive species can either be a plant or an animal.
- Native species are the indigenous species that are threatened by invasive species.

How invasive species spread

1. Intentionally or unintentionally introduced by humans into an ecosystem.
2. Carried unknowingly together with goods around the world.
3. Insects can get into wooden goods and transported to other ecosystems.
4. Some may attach to boats or ships and carried to new places
5. Some ornamental plants can escape into the wild and become invasive.
6. And some invasive species are intentionally or accidentally released pets.

Invasive species cause harm to native species in the following ways:

1. They do not have natural predators or controls in the new area in which they are introduced. Therefore they grow, reproduce and spread aggressively.
2. Therefore they outcompete native species for food and space etc.
3. They prey on native species, prevent them from reproducing or kill their young.
4. They destroy food sources of native species.
5. They change the soil chemistry of an ecosystem making it unsuitable for native plants.

6. They displace native species leading to their decline or extinction.
7. They may hydridize with native species to produce more harmful hybrids.

An example of an invasive species in Zimbabwe is the water hyacinth

- **The water hyacinth** is an **invasive plant species** which was introduced to Zimbabwe from the Amazon Basin of Brazil as an ornamental plant for ponds.
- The water hyacinth has colonised **Lake Chivero** and rivers such as **Manyame**.
- Moving easily with water currents, winds or other accidental means, such as fishing nets and boats, the plant has invaded rivers, canals, ponds, lakes, dams and many freshwater bodies in Zimbabwe.
- It grows by forming thick mats above the water.
- Some of the problems arising from the growth of water hyacinth in thick mats are:

1. reducing infiltration of sunlight into water. Therefore submerged aquatic plants die and decay due to lack of photosynthesis.
2. reducing water quality from decomposing plants
3. outcompeting and eliminating native aquatic plants
4. altering the habitats of aquatic organisms
5. changing the temperature, pH and oxygen levels of water
6. blocking irrigation channels and rivers
7. restricting livestock access to water
8. restricting recreational use of waterways
9. reducing aesthetic values of waterways
10. preventing local people from fishing thereby reducing their source of food and income.
11. creating a microhabitat in which vectors of human diseases and poisonous snakes breed.

Summary on invasive species:

- Invasive species spread rapidly and outcompete or prey on native species.
- Invasive species can eliminate native species therefore reducing species diversity.
- They may spread rapidly because this new location is free of predators, parasites and competitors that would normally limit their population in their natural environment.

6)   Pollution
- Pollution is contaminating the natural environment with harmful substances from human activities.
- A substance which contaminates the environment is called a **pollutant** e.g. pesticides and heavy metals such as mercury.
- Increasing human population has led to an increase in pollution. Some of this is due to:

- more fossil fuels being burnt for heat and power
- more food being grown
- land taken over for industry and housing
- mining activities.

❖ **Four things that are being greatly polluted by human activities are:**
  ▪ **The land**
  ▪ **Air (the atmosphere)**
  ▪ **Water**
  ▪ **Food chains**

Land pollution

- The rubbish we throw out that is not recycled goes into a land fill. These are huge holes in the ground into which our rubbish is dumped. Some things like batteries cannot be put into landfill sites because of the toxic chemicals they contain. They must be recycled.
- Other land pollution comes when some people dump rubbish in public or other private places, often to avoid paying for it to be disposed of. This is called **fly tipping** and is illegal.
- Land pollution changes the chemistry of the soil and kills soil organisms by either poisoning them or destroying their habitats.

Air pollution

- Combustion of fossil fuels and other fuels releases carbon dioxide. This contributes to the greenhouse effect and leads to global warming and climate change. (The threats to biodiversity due to global warming and climate have been dealt with previously)
- Combustion of fossil fuels also releases sulfur dioxide and nitrogen oxides which can cause acid rain.
- Acid rain changes the acidity of the soil and hence destroys soil habitats and microorganisms.
- Acid rain also changes the acidity of aquatic ecosystems thereby destroying aquatic organisms and their habitats.
- Air pollution can also be caused by tiny particulates from smoke which can cause smog.
- The level of pollution in air or water can be indicated by the species living there. This is known as pollution indicator species. The pollution indicator species are sensitive to high levels of pollutants and they die.
- Lichens are air pollution indicator species as they will only grow in areas which are free of air pollutants such as those produced by traffic and industries.
- If they are found in an area growing on barks of trees, it shows that the surrounding air is clean.

Water pollution

- Nitrate and phosphate fertilisers are very soluble in water and are easily washed off fields by the rain and then into rivers and reservoirs.
- High concentrations of nitrates, phosphates and sewage in water then leads to **eutrophication**.
- Pesticides used by farmers to kill weeds or insects may be washed or blown into streams and rivers.
- Stonefly larvae and freshwater shrimps are water pollution indicator species. If these animals are found in a river, it shows that the river is clean. However, some animals are adapted for surviving in polluted conditions, for example blood worms and sludge worms. Presence of these species indicates there is a high level of water pollution
- Pollution is also indicated by acidic pH or lack of oxygen in water.

Eutrophication

- Eutrophication is excessive nutrients in a body of water e.g. river, usually caused by runoff of nutrients (animal waste, fertilizers, sewage) from the land, which causes a dense growth of plant life; the decomposition of the plants depletes the supply of oxygen, leading to the death of aquatic animal life.
- The process of eutrophication can be outlined as follows:

  1. increased nitrates in the water increase the growth of algae and plants

2. the algae form a bloom over the water surface, preventing sunlight reaching other water plants
3. these plants die because they are unable to carry out photosynthesis without light
4. microorganisms such as bacteria increase in number as they decompose the dead plants, using and reducing the oxygen content in the water during respiration as they do so
5. the low oxygen levels can cause aquatic insects and fish to suffocate, and eventually the lake may be left completely lifeless

Pollution of food chains

Bioaccumulation

A chemical which contaminates the environment is called a **pollutant**. Examples of these are:

- pesticides - used by farmers to prevent pests eating their crops
- heavy metals - used in industry

− These types of pollutants affect organisms by a process called bioaccumulation.
− *Bioaccumulation* is the process of chemicals becoming increasingly concentrated in animal tissues as they move up the food chain.
− Here is one way pollutants can enter a food chain.

1. The pollutant is washed into rivers and lakes.
2. It enters the food chain by adhering to or being absorbed by producers.
3. When the producer is eaten, the pollutant it contains is passed onto the next trophic level as it is persistent. It remains in the body tissues of the organism because it is not easily broken down.
4. The pollutant continues to accumulate, increasing in concentration, as it moves up the food chain.
5. By the time it reaches the top carnivore, the pollutant will have accumulated to such an extent that it becomes toxic, causing reduced fertility or even death.

− Tertiary consumers which eat high on the food chain (including humans!) are at risk of bioaccumulation poisoning.

DDT
− DDT is a chemical pesticide which was used by farmers to control insect pests eating their crops. It can be used to demonstrate bioaccumulation as shown in this diagram.
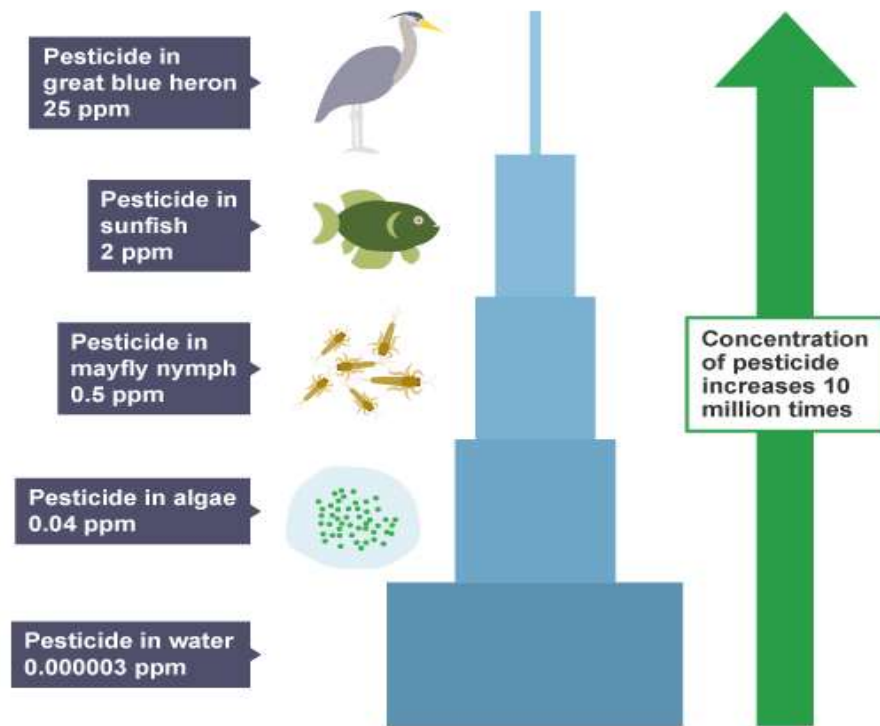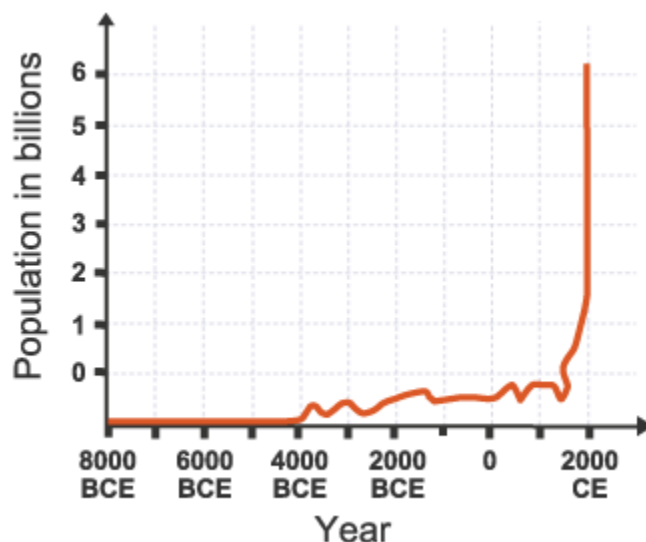
DIAGRAM: Bioaccumulation. The concentration of DDT is shown in the diagram in parts per million (ppm)

- The high concentrations of DDT in birds of prey weakened their egg shells, their young died and populations decreased

7) Human Population
- The graph of human population shows that there has been an **exponential increase** in the human population since 1800 AD.

- Some reasons why the human population is increasing exponentially are:

1. better health care so people are living longer.
2. new medicines are being developed so people don't die of previously fatal diseases.
3. farmers are able to produce more food using new breeds and equipment.
4. some religions do not permit the use of contraception.

– As the human population increases, the volume of waste and pollution that is produced also increases. The pollution harms the ecosystem and kills the organisms that live within it.
– The larger the human population gets, the more land we require. More houses must be built, more resources found, more food must be grown and more waste is produced. This often means less space and fewer resources for other animals and plants.
– Often biodiversity is significantly reduced when land is cleared for human uses, such as building, quarrying, farming and waste disposal.
– There is reduction in biodiversity when an area of rainforest is cut down to grow crops.

8) Over-exploitation

– Over-exploitation is the removal of organisms from the environment at a faster rate than the organisms can reproduce.
– Over-exploitation is always done for human gain
– Over-fishing and over-harvesting are examples of overexploitation.
– The population might be able to recover if exploitation is stopped soon enough. If this does not happen then the organisms will become extinct.
– Over-fishing and over-harvesting also has knock-on effects on other organism in a food chain. The organisms which eat the overharvested organisms will decrease in numbers due to lack of food.
– Fish have been vulnerable to overfishing due to:
   1. the demand of protein diet due to the growing human population.
   2. technological developments like refrigeration, sonar, large nylon nets and onboard processing of fish in large boats.

CONSERVATION MEASURES

❖ Conservation is the preservation of ecosystems and the organisms within them.
❖ The following are conservation measures which help maintain biodiversity :

   1. preservation of endangered species by introducing breeding programs.
   2. protection and development of new endangered habitats, often by making National Parks.
   3. Afforestation: The conversion of bare or cultivated land into forest.
   4. Reforestation: The replanting (restoration) of a forest that had been reduced by fire or cutting.
   5. Use of alternative energy sources which are environmental friendly e.g. solar energy and hydro-electric power.
   6. replanting hedgerows because there is higher biodiversity in them than the fields they surround
   7. reducing deforestation and the release of greenhouse gases
   8. recycling rather than dumping waste in landfill sites.
   9. making and enforcing laws to prohibit poaching, overfishing, pollution, cutting down of trees, etc.
   10. creating laws and systems to prevent introduction of invasive species into other areas.
   11. destroy invasive species, e.g. pulling hyacinth weeds out of water using boats.