## Classification Categories to Study Biodiversity

### *Endemic Species*

***Dipterocarpus***

***Garcinia***

**Black ruby barb**

***Loris***

### Indigenous Species

***Snake head***

**Kitul**

### Migratory Species

**Indian fly catcher**

**Indian pitta**

### Invasive alien species

**Giant African snail**

**Water Hyacinth**

***Lantana***

***Panicum***

### Relict Species

***Ichthyophis***

***Lingula***

### Exotic Species

***Tilapia***

**Rubber**

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### Extinct Species (EX)

**Dodo**

**Wooly Mammoth**

***Crudia zeylanica***

### Extinct in the wild (EW)

**Giant tortoise of Seychelles**

### Critically Endangered (CR)

**Marbeled rock frog**

**Maha madu**

### Endangered Species (EN)

**Wesak Orchid**

**Elephant**

### Vulnerable (VU)

**Butter Cup**

**Dusky-striped jungle squirrel**

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UNIT 08

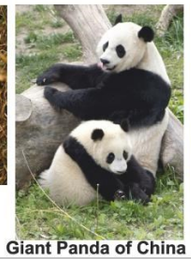
## *Unit 08 Environmental Biology* 5

**8.3. 1: Explores biodiversity and threats due to human actions**

Biology ENGLISH MEDIUM

### Flagship Species

**Bengal Tiger**



**Giant Panda of China**

**Blue Magpie**

SAMPATH LANKADHEERA

B.Sc. (Hons), M.Sc.

**2017 AL (revisited)**
**(b) Invasive species**

1. Invasive alien species are alien (exotic) plants and/or animals
2. whose introduction and spread outside their natural geographic range
3. threaten native biodiversity.
4. Alien invasive species compete against or prey on native species,
5. which can lead to their extinction.
6. they may lack natural predators in the new environment.
7. This is a great opportunity for them to reproduces successfully
8. and spread without limits to take over the environment.
9. They can transport disease, out-compete native species,
10. alter food chains, decrease biodiversity,
11. and even change ecosystems properties
12. by altering soil composition or creating habitats that encourage wildfires.
13. Eg. Lantana (E)/ Gandapana (S)/Nayunni (T)-(*Lantana camara*)
14. Guinea grass (E)/ Gini- thana (S)/ Ginipullu (T) (*Panicum maximum*)

**2013 AL (revisited)**
**(c) Briefly describe in-situ and ex-situ conservation.**

1. The principal goal of conservation activity is to ensure the long term survival as many species as possible.
2. Species that are in danger of extinction have to be specially protected and
3. steps should be taken to ensure their continued reproduction and survival.
4. Conservation can be done in two ways
5. In - situ conservation
6. Ex - situ conservation
7. In - situ conservation, Conservation of any component of biodiversity / species / genes I their natural habitat,
8. reproduction is facilitated in the natural habitat
9. large enough population and
10. adequate I appropriate habitat space have to be ensured.
11. Methods of in - situ conservation
12. Sanctuaries /National parks.
13. Species reintroductions (into the natural habitat)
14. Ex - situ conservation
15. Conservation of species
16. outside their natural habitats.
17. Conditions similar to the natural habitats are provided / specially created situations are provided,
18. reproduction and survival are ensured.
19. Methods of ex - situ conservation
20. Botanical gardens.
21. Zoological gardens/Turtle hatcheries.
22. Field genes banks/Seed banks /Germplasm centers /Genetic resource centers.
23. Captive breeding/Artificial breeding.

**8.3.0 : Explore biodiversity as a component of the environment**

**8.3. 1: Explores biodiversity and threats due to human actions**

**Learning outcomes:**

- defines biodiversity, ecosystem diversity, species diversity and genetic diversity
- describes the values of biodiversity under the given themes
- states the main five ways that biodiversity is lost illustrating examples in Sri Lanka
- explains extinction as a natural process, but the rate has been greatly increased by human activity
- defines threatened species according to the Red Data Book
- defines the biodiversity hotspots
- expresses the meanings of the given terminologies by giving Sri Lankan examples as appropriate appreciates the vast biological diversity of Sri Lanka and recognizes the importance of taking necessary actions to protect it.

## Biodiversity

**Definitions**

Biodiversity includes all forms of "life" on earth. Biodiversity is the variability among living organisms from all sources including terrestrial, marine, and other aquatic ecosystems and their ecological interactions with the environment. Biodiversity is explained under three levels. They are genetic diversity, species diversity and ecosystem diversity.

**a. Genetic diversity**

The basic component of biological diversity is the genetic variation that exists both within and among species. This genetic variation is the basis for evolution.

**b. Species diversity**

This is simply the variation that can be recognized among different species. It includes the number of species (species richness) and their abundance.

**c. Ecosystem diversity is the variety of habitats, living communities and ecological processes in the living world.**

Ecosystem diversity is the largest scale of biodiversity, and within each ecosystem, there is a great deal of both species and genetic diversity incorporated.



22. Releasing of Sulphur dioxide ($SO_2$) and nitrous oxide ($N_2O$) gasses react with water and make the rain water acidic resulting acid rains.
23. Acid rains caused by air pollution contributes to the death of trees killing many buds, leaves and the seedlings and causing damage to the plant roots.
24. Introduction of invasive alien species
25. Invasive alien species are alien (exotic) plants and/or animals whose introduction and spread outside their natural geographic range threaten native biodiversity.
26. they may lack natural predators in the new environment.
27. This is a great opportunity for them to reproduces successfully and spread without limits to take over the environment.
28. They can transport disease, out-compete native species, alter food chains, decrease biodiversity, and even change ecosystems properties by altering soil composition or creating habitats that encourage wildfires.
29. Eg. Lantana (E)/Guinea grass (E) (*Panicum maximum*) Climate change:
30. Climate change is predicted to be the greatest long-term threat to biodiversity.
31. Increasing temperatures and temperature extremes, increasingly severe droughts, rising sea levels, possible decrease in rainfall, regional flooding and reduced water availability change ecosystems.
32. Many species will not be able to adapt themselves fast enough to keep up with the coming changes driving them to extinction or being endangered.
33. Evidence suggests that the warming of the past century already has resulted in marked ecological changes, such as changes in growing seasons of crop species, distribution ranges, and patterns of seasonal breeding of animals.

**(c) Briefly describe the measures taken to conserve bio-diversity at the national and global level.**

34. A principal goal of conservation is to ensure the long term survival of as many species as possible.
35. Species that are in danger of extinction have to be specially protected and steps should be taken to ensure their continued reproduction and survival.
36. Conservation can be done in two ways. In-situ conservation:
37. The species is protected and its reproduction facilitated in its natural habitat.
38. Basically a large enough population and adequate, appropriate, habitat space has to be ensured.
39. Eg. National parks such as Yala and Minneriya national parks, Forest reserves such as Kanneliya, Piduruthalagala
40. Ex-situ conservation:
41. The species is taken out of its natural habitats, and looked after in places where its survival and reproduction are ensured.
42. Zoological gardens and Botanical gardens of a country play a key role in ex-situ conservation.

36. Select the response that indicates a relict species and a species endemic to Sri Lanka respectively,
(1) *Acanthus ilicifolius* and *Dipterocarpus zeylanicus*
(2) *Panicum maximum* and *Garcinia quaesita* (3) *Ichthyophis sp.* and *Salacia reticulata*
(4) *Crudia zeylanica* and *Puntius nigrofasciatus*
(5) *Lingula sp.* and *Loris tardigradus* 2021/36

**Essay Model**

1. (a) Explain what is meant by biodiversity.
(b) Describe causes of loss of biodiversity.
(c) Briefly describe the measures taken to conserve biodiversity at the national and global level.

**Answer**

**(a) Explain what is meant by biodiversity.**

1. Biodiversity is the variability among living organisms from all sources including terrestrial, marine, and other aquatic ecosystems and their ecological interactions with the environment.
2. Biodiversity is explained under three levels.
3. Genetic diversity
4. The basic component of biological diversity is the genetic variation that exists both within and among species.
5. Species diversity
6. This is simply the variation that can be recognized among different species. It includes the number of species (species richness) and their abundance.
7. Ecosystem diversity is the variety of habitats, living communities and ecological processes in the living world.

**(b) describe causes of loss of biodiversity.**

8. Habitat loss/fragmentation:
9. Humans supplant natural ecosystems to grow food, harvest materials, and build our settlements alter or eliminate the conditions needed for plants and animals to survive.
10. This result in the displacement or destruction of biodiversity.
11. Eg: Deforestation, filling of wetlands Mass scale destruction of Mangrove.
12. When habitats are divided into fragments due to establishment of man built structures such as roads,
13. the animals and plant species are forced to occupy smaller area in a crowded manner which is harder for biodiversity to sustain as in previous habitat conditions.
14. Overexploitation:
15. Harvesting or exploiting biodiversity products in a manner and a rate which it cannot recover within the periods of exploitation leads to danger of biodiversity being completely lost.
16. Eg. Over collection of indigenous medicinal plants/Export of sea cucumber for medicinal purposes/Ebony (E) over exploitation for timber/Intense commercial fishing has led to over fishing threatening decline of food fish like Tuna and Cod
17. Pollution:
18. Pollution simply means addition of unwanted materials to air, water, soil.
19. Due to extensive use of agrochemicals that wash away with rain water into the water bodies make the water rich in nutrients (eutrophication) resulting in algal blooms.
20. Algal blooms create oxygen depleted zone in aquatic ecosystems and greatly reduce the populations of fish and other aquatic species.
21. Uses of synthetic fertilizers has resulted pollution of rivers in many down stream areas affecting the water quality and making it unsuitable for human use



Ecosystem diversity on a global scale would be the variation in ecosystems in large regions (biomes) such as deserts, forests, grasslands, wetlands and oceans whereas in smaller localized regions it can be explained by means of different ecosystems.

**The importance and values of biodiversity**

The individual components of biodiversity—genes, species, and ecosystems provide the human society with a wide array of goods and services. Genes, species, and ecosystems of direct, indirect, or potential use to humanity are often referred to as "biological resources". Genes are used by plant breeders to develop new crop varieties. Many species are used as various foods, medicines, fibers, fuels and industrial products. This include food resources like grains, vegetables, fruits which are obtained from plant resources and meat, fish, egg, milk and milk products from animal resources. The biodiversity products can be harvested and consumed directly without passing through a formal market (non commercial goods). Eg: Fruits, fish, edible roots, leaves, nuts, flowers, meat, animal product like milk and honey, timber, fire wood, fiber, wool, wax, resin, rubber, silk and decorative items, and traditional medicines, etc. Some products can be harvested and available through a formal market (commercial goods). Many industries such as food, textile, leather, silk, paper pulp are based on the direct use of biological resources. The ecosystems provide many services to us, such as air and water purification, erosion prevention and flood control.

Therefore the value of biodiversity is explained through its "goods" and "services" provided to humanity and sustenance of the environment.

- **Environmental service value:** This is the most important services provided by biodiversity in maintaining critical environmental functions.
  Eg. Carbon dioxide fixation through photosynthesis, maintaining of essential nutrition cycles, maintaining water cycle and recharging of ground water, soil formation and protection from erosion, regulating climate by recycling moisture into the atmosphere, water purification, pollination, etc.

- **Recreational value:** There is a great aesthetic value provided by biodiversity. Natural landscapes at undisturbed places are a delight to watch and also provide opportunities for recreational activities and hobbies such as bird watching, photography etc. Biodiversity provides inspiration in artistic activities like poetry, painting, dance etc. It promotes ecotourism, helps to generate revenue by designing of zoological, botanical gardens, national parks etc.

- **Ethical value:** This is the right of all living beings to live on this planet, humans have no right to decide which species should exist since we are just a small part of the greater creation of nature.

- **Educational/Scientific value:** knowledge about biodiversity helps in new scientific discoveries and technological innovations to find solutions to the problems we face today.
  Eg. Learning of other animals like nematodes, rats and primates has helped in understanding human body and development of medicines, knowledge about how animals react before a natural disaster is helpful in disaster management, Interacting with biodiversity is proven to be helpful in developing creativity, relieving stress and development of personality.

- **Social/Cultural/Religious values:** Biodiversity can be important to different societies and communities due to unique reasons Eg. Some wetland sites are sacred to Aborigines of Australia, twenty eight species of trees are sacred for Buddhists, Bulls are considered to be an important part of Hindu culture.

**Figure 8.27 : Recreational value of Biodiversity**

**Loss of Biodiversity**

Animal and plant species die off all the time. It's how the biological world rolls. However, things have changed dramatically in recent decades. According to some scientists, Earth is currently in the midst of its sixth mass extinction. The last major extinction occurred some 65 million years ago, when a large asteroid slammed off the coast of Mexico, killing off the dinosaurs and most everything else.



36. Which of the following indicates in correct order, the animals included in the least concerned (CR), near threatened (EN) and data deficient (VU) categories of the IUCN red data book?
(1) Marbled rock frog, Wesak orchid, Duskey striped jungle squirrel
*(2) Kithul, Puntius nigrofaciatus, Ichthyophis*
*(3) Loris tardigradus, Dipterocarpus zeylanicus, Elephant*
*(4) Maha madu (S) Ratchatha madupunai (T), Loris tardigradus*
(5) *Wesak orchids, Marbeled rock frog, Butter cup* 2014/36/Revisited

37. Which of the following pairs of organisms are most similar when biodiversity aspects are considered?
(l) *Puntius nigrofasciatus* and Tilapia (S/E) Japan meen (T)
(2) Giant panda and Lingula
(3) Indian pitta and snakehead
(4) Giant African land snail and Water Hyasinth
(5) Blue magpie and Rubber 2015 /37

35. This question is based on the following species.
A Water hyacinth B - Puntius nigrofasciatus C - Garcinia quaesita
D - Maha Madu (S) Ratchaha madupunai (T) E - Tilapia (E/S) Japan meen (T)
F - Elephas maximus
Which of the following statements regarding the above species is correct?
(1) Two of the above species are invasive,
(2) Two of the above species are endemic to Sri Lanka.
(3) Two of the above species are critically endangered.
(4) One of the above species is extinct in the wild
(5) None of the above species is included in the vulnerable category. 2016/35/Revisited

35. Which of the following three belong to the same group when endemism or indigenousness or exoticness or migration is considered?
(1) Black ruby barb, snakehead, Wesak orchid
(2) Rubber, Kithul (S) Thippilipanai (T), Dipterocarpus zeylanicus
(3) Indian fly catcher, Indian pitta (4) Slender Loris , *Garcinia quaesita*, Snake head
(5) Tilapia, rubber, pitta 2019 old/35 revisited

37. Which of the following is not an environmental service value of biodiversity?
(1) Regulating climate (2) Recharging ground water (3) Water purification
(4) Helping disaster management (5) Prevention of soil erosion 2019/37

35. Select the response with three threatened organisms.
(1) Bengal tiger, dodo, Sri Lankan elephant
(2) Black ruby barb, giant tortoise, woolly mammoth
(3) Tilapia, water hyacinth, blue magpie
(4) Giant African land snail, giant panda, Indian fly catcher
(5) Maha madu, Wesak orchid, dusky-striped jungle squirrel 2020/35

35. TWO invasive alien organisms in Sri Lanka are
(1) Giant African land snail and Citronella grass. (2) Tilapia and Tussock grass,
(3) Guinea grass and Cogon grass. (4) Gini Andara and Themeda.
(5) Lantana and Water Hyacinth. 2023/35

15. The information on the endemicity, abundance and feeding habit of five animal species named as A. B, C, D and E are as follows
A: Endemic, found in large numbers, the numbers have reduced in the recent past, omnivorous diet.
B: Not endemic, found in large numbers, carnivorous, specialized dietary habit.
C: Endemic, found in small numbers, numbers have reduced in the recent oust. herbivorous, specialized dietary habit.
D: Not endemic, found in small numbers, herbivorous, non-specialized dietary habit.
E : Endemic, found in small numbers, omnivorous diet.
Which of the above species is most likely *to* he endangered in near future?
(1) A (2) B (3) C (4) D (5) E (2006/10)

16. Sri Lankan elephants are considered to be
(1) critically endangered organisms. (2) endangered organisms. (3) vulnerable organisms.
(4) conservation dependent organisms. (5) threatened organisms (2008/7)

17. Which one of the following statements is true regarding an endemic species?
(1) It is a species that has not changed over several million of years.
(2) It is a species that will not be subjected to future evolutionary changes.
(3) It is a species confined to a certain region of the world.
(4) It is a species that has a very high threat of extinction.
(5) Its removal will result in the collapse of the ecosystem. (2009/9)

18. The plant species *Alphonsea hotensis*. Which is an extremely rare species. Was not found in any wild environment in a survey carried out recently. Which one of the following statements is most likely to be correct regarding this species?
(1) It is an extinct species now. (2) It can included in the critically endangered category
(3) If it is indigenous, it can be included in the extinct in the wild category.
(4) If few plants of this species are present in a cultivation, it can be included in the extinct in the wild category.
(5) Given information is not adequate. (2010/8)

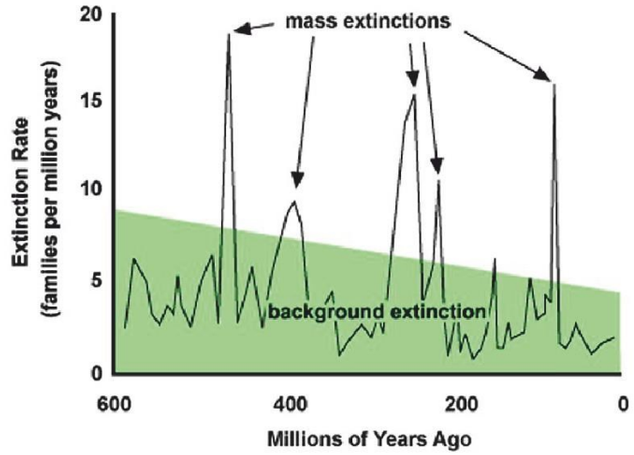
19. Which one of the following animals is most likely to be a keystone species.
(1) Marbled rock frog (2) Elephant (3) Tautara (4) Water Hyasinth (5) Planktons

20. Some categories of threatened organisms given in the IUCN red data book with examples are given below. Which one of the following IUCN category – example combinations is correct?
(1) Extinct - Tuatra (2) Critically endangered- Marbled rock frog
(3) Endangered-jungle squirrel (4) Vulnerable - Asian elephant
(5) Near threatened – Black ruby barb,

21. Select the group/ groups which contains an organism that differs from the other when endemicity, indignity, migratory or flagshipness is considered.
(A) *Dipterocarpus zeylanicus, Garcinia quaesita* (B) Indian flycatcher, Indian pitta,
(C) Loris tardigradus, Kitul (D) Blue magpie, Black ruby barb
(E) Bengal tiger, Giant panda 2012 /49/Revisited

32. Which one of the following animals has the very high risk of becoming extinct in wild?
(1) Leatherback turtle (2) Elephant (3) Giant tortoise (4) Lingula (5) Blue magpie
2013/32/Revisited






Today, scientists say the extinction rate is as much as 1,000 times faster than what should be natural rate would be. This is solely because of the very high and negative impact of humans on biodiversity due to high population and development. Virtually all of Earth's ecosystems have been dramatically transformed through human actions, for example, many mangrove and coral reef areas have been lost. Within groups of conifers, cycads, amphibians, birds, and mammals up to 50% of species are threatened with extinction, according to the IUCN Red List. Within many species groups, such as amphibians, African mammals, and birds in agricultural lands, the majority of species have faced a decline in the size of their population, in their geographical spread, or both.

**Threats to Biodiversity**

**Habitat loss/fragmentation:** Humans supplant natural ecosystems to grow food, harvest materials, and build our settlements. These actions alter or eliminate the conditions needed for plants and animals to survive. When natural habitats are converted into other human uses such as agriculture or built up area they are no longer able to support the species present in the original habitat. This result in the displacement or destruction of biodiversity. Eg: Deforestation, filling of wetlands Mass scale destruction of Mangrove in lagoons such as Negombo and Puttalam due to establishment of prawn culture destructed the biodiversity of mangroves in these areas.

*Figure 8.28 : Habitat loss*

When habitats are divided into fragments due to establishment of man built structures such as roads, the animals and plant species are forced to occupy smaller area in a crowded manner which is harder for biodiversity to sustain as in previous habitat conditions.

**Overexploitation:** Harvesting or exploiting biodiversity products in a manner and a rate which it cannot recover within the periods of exploitation leads to danger of biodiversity being completely lost. Eg. Over collection of indigenous medicinal plants from forests in Sri Lanka for export such as Kotalahimbutu (S)/ - (*Salacia reticulata*). Export of sea cucumber for medicinal purposes from Sri Lankan shores. Ebony (E)/Kaluwara (S), Karun-kaali (T)- (*Diospyrus ebanum*) is threatened due to over exploitation during the colonial period. Ebony has a very slow growth rate and take many years to grow. Intense commercial fishing has led to over fishing threatening decline of food fish like Tuna and Cod in world's oceans.

**Pollution:** Pollution simply means addition of unwanted materials to air, water, soil. Due to extensive use of agrochemicals that wash away with rain water into the water bodies make the water rich in nutrients (eutrophication) resulting in algal blooms. Algal blooms create oxygen depleted zone in aquatic ecosystems and greatly reduce the populations of fish and other aquatic species. Uses of synthetic fertilizers for tea in montane areas also has resulted pollution of rivers in many down stream areas affecting the water quality and making it unsuitable for human use Releasing of Sulphur dioxide ($SO_2$) and nitrous oxide ($N_2O$) gasses react with water and make the rain water acidic resulting acid rains.



8. Which one of the following IUCN categories includes the organisms that are most likely to become extinct first?
   (1) Low risk category (2) Vulnerable category (3) Rare category
   (4) Conservation dependent category (5) Data deficient category (2003/11)

9. Some categories of species considered in the study of biodiversity are as follows
   A - Relict species; B - Keystone species; C - Endemic species; D - Flagship species
   Which one of the following sequences of organisms gives the correct examples for the categories in A, B, C and D?
   (1) Lingula, Bengal tiger, *Dipterocarpus* sp., Phytoplankton
   (2) Giant panda, Phytoplankton, *Dipterocarpus* sp., Lingula
   (3) *Dipterocarpus* sp., Phytoplankton, Lamp shell, Blue magpie
   (4) Lingula, Phytoplankton, *Dipterocarpus* sp., Giant panda
   (5) Bengal tiger, Lingula, *Dipterocarpus* sp., Phytoplankton (2004/6 Revisited)

10. Which one of the following statements is correct?
    (1) There are no critically endangered species in Sri Lanka.
    (2) All critically endangered species kept in zoological gardens and botanical gardens are found in natural habitats
    (3) A species included in the endangered category may be included in the vulnerable category in future.
    (4) All critically endangered species are endemic to a small geographic area.
    (5) Endangered species in Sri Lanka are mainly conserved by *ex-situ* conservation methods. (2004/8)

11. In the context of biodiversity endemic species are
    (1) Species found growing naturally in only one country.
    (2) Species that have disappeared from all but one area due to climatic changes.
    (3) Species that are essential to the functioning of the ecosystem where they occur.
    (4) Species that serve as symbols of environmental awareness or national culture.
    (5) Species that are predominantly conserved in National parks. (2005/6)

12. Which of the following is not considered an ex-situ conservation method?
    (1) Establishment of gene banks. (2) Establishment of national parks
    (3) Establishment of national botanical gardens.
    (4) Establishment of turtle hatcheries (5) Establishment of elephant orphanages. (2005/7)

13. Which of the following statements in incorrect regarding the evolutionary process?
    (1) Natural extinction of species is a part of the evolutionary process.
    (2) The last major extinction in the history of evolution of biodiversity is elimination is elimination of dinosaurs
    (3) The rate of evolution of species is generally higher than the rate of extinction of species.
    (4) Rate of extinction of species decreases with increase in human population.
    (5) Extinction of species favours the origin of new species. (2005/9)

14. Which one of the following statements is incorrect?
    (1) Blue magpie of Sri Lanka is a flagship species in Sri Lanka
    (2) All invasive alien species are exotic
    (3) Many of the major environmental problems today are global in nature.
    (4) Establishment of sanctuaries is an *in-situ* conservation method.
    (5) There are no relict species in Sri Lanka because it is an island. (2006/9 Revisited)

## MCQ

1. Which of the following statement/statements regarding biodiversity is/are false?
(A) Increase in human population size is a root cause for the loss of biodiversity on earth.
(B) Ex-situ conservation practices have helped to conserve some endangered species of Sri Lanka.
(C) If conservation strategies are properly implemented, animals and plants can be protected from the threat or extinction.
(D) Human use of living resources always results in an increase in the rate of extinction of these resources.
(E) Evolution of certain biological processes has resulted in the expansion of biodiversity in the past. (2001/52)

2. Which of the following could be considered as relict organisms?
(A) Dinosaurs (B) Mammoth (C) Lingula (D) *Ichthyophis* (E) Sri Lankan elephants (2001/54)

3. Which of the following biota have lived on earth for the longest time, with the least amount of change?
(1) chimpanzees (2) crows (3) grasses (4) whales (5) Lingula (2002/8)

4. Flagship species are
(1) Species confined to a certain country or area.
(2) Species included in ICUN red data book.
(3) Species depicted in national flags of countries.
(4) Species which are symbolic of ecosystem in need for conservation
(5) Species which are protected by law.(2002/10)

5. What statement/s is true about extinction of species?
(A) It is a natural process
(B) According to present findings, the main process of extinction that occurred on earth is the extinction of dinosaurs.
(C) Rate of extinction of species has increased during the last century.
(D) Extinction is essential to make way for new species.
(E) Rate of extinction of species is generally greater than rate of speciation. (2002/60)

6. Which one of the following statements regarding biodiversity is correct?
(1) The three major divisions of' biodiversity are species diversity, genetic diversity and habitat diversity
(2) Species diversity is the diversity among the organisms within a species.
(3) Because of the increasing concern on biodiversity, all species that live on earth are most likely to be identified within the next 10 years.
(4) The most number of animal species Identified so far belong to the phylum Mollusca.
(5) Genetic diversity contributes to the development of insecticide resistant varieties among insect pests. (2003/7)

7. Which one of the following is an in-situ method of conservation?
(1) Establishment of sanctuaries (2) Establishment of turtle hatcheries
(3) Establishment of elephant orphanages
(4) Establishment of seed banks. (5) Establishment of botanical gardens. (2003/10)



Acid rains caused by air pollution contributes to the death of trees killing many buds, leaves and the seedlings and causing damage to the plant roots.

**Introduction of invasive alien species:** Invasive alien species are alien (exotic) plants and/or animals whose introduction and spread outside their natural geographic range threaten native biodiversity. Alien invasive species compete against or prey on native species, which can lead to their extinction. Once introduced , for a considerable period of time, they may lack natural predators in the new environment. This is a great opportunity for them to reproduces successfully and spread without limits to take over the environment. They can transport disease, out-compete native species, alter food chains, decrease biodiversity, and even change ecosystems properties by altering soil composition or creating habitats that encourage wildfires. Eg. Alien invasive species such as, Lantana (E)/ Gandapana (S)/Nayunni (T)-(*Lantana camara*) does not al low germination and seedling growth of many other plants as it produces toxins which are added to soil through leaf litter. Extensive spread of Guinea grass (E)/ Gini- thana (S)/ Ginipullu (T) (*Panicum maximum*) in especially in the dry pathana areas facilitates fire due to its dry biomass during drought seasons.

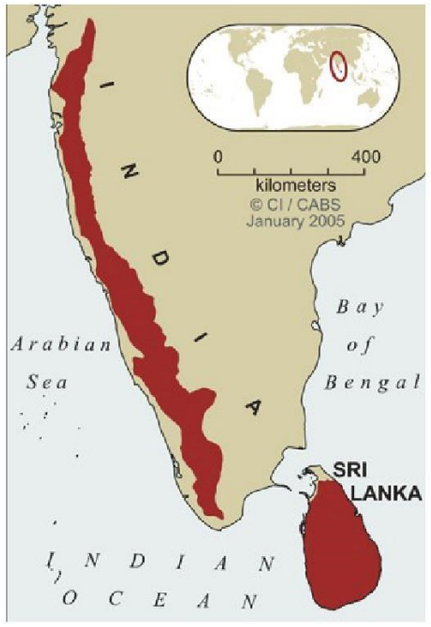
*Lantana* (E)/ Gandapana (S)

*Panicum maximum*

**Climate change:** Climate change is predicted to be the greatest long-term threat to biodiversity. Increasing temperatures and temperature extremes, increasingly severe droughts, rising sea levels, possible decrease in rainfall, regional flooding and reduced water availability change ecosystems. Many species will not be able to adapt themselves fast enough to keep up with the coming changes driving them to extinction or being endangered. Evidence suggests that the warming of the past century already has resulted in marked ecological changes, such as changes in growing seasons of crop species, distribution ranges, and patterns of seasonal breeding of animals.

**Biodiversity hot spots**

The areas with a high concentration of endemic species facing exceptional levels of threats have been described by Myers in 1988 as biodiversity hotspots. As a whole Sri Lanka has a high degree of endemism. Sri Lanka (wet zone of Sri Lanka) together with Western Ghats of India is considered as one of the Biodiversity hot spot in South Asian region.




**Extinction of species**

- Existing species have to make room for new species either by changing themselves or by becoming extinct. Therefore natural extinction has to be recognized as part of the evolutionary process.
- The rate of evolution has been generally higher than that of extinction. Therefore, there has been an increase in Biodiversity over time.
- Extinction is the elimination of the last member of a species from the earth.
- With the growth of human population and civilization, mankind has greatly increased the rate of extinction.
- The earth today is dominated by humans and no ecosystems on earth's surface is free from human influence.
- In general it is estimated that about 5-10% of the species may face extinction within the next 30 years.



(iii) Briefly explain what a keystone species is.

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**AL 2020**

(iv) Write the common name of a plant in Sri Lanka which is facing a very high risk of extinction in the Wild.

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(a) State the group Of organisms that contributes most to reduce the C02 content in the atmosphere.

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**AL 2022**

1. State **five** important environmental services provided by biodiversity

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**AL 2023**

1. State **four** types of values of biodiversity

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**AL 2024**

1. What is meant by ethical value of biodiversity?

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**AL 2016**

(iv What is a keystone species?

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(v) Explain the concept of flagship species.

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**AL 2017**

(ii) (a) What is an extinct species?

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(b) Give an example for an extinct bird.

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(iii) What are the major objectives of Biodiversity Convention?

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**AL 2018**

(a) What is in-situ conservation?

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(b) State two in-situ conservations (revisited)

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**AL 2019 Old**

(ii) What is extinction of species?

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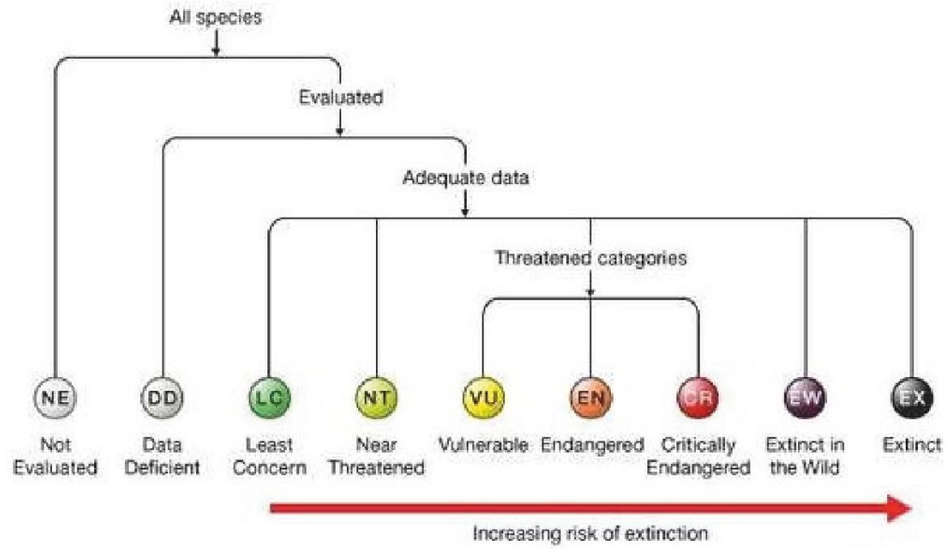
Not only a species but also family or genus or a sub species (taxon) can become extinct if there had been a continuous pressure for its survival. The Red Data book published by the International Union for Conservation of Nature (IUCN) provides a list of threatened species and define extinct and threatened species as follows.

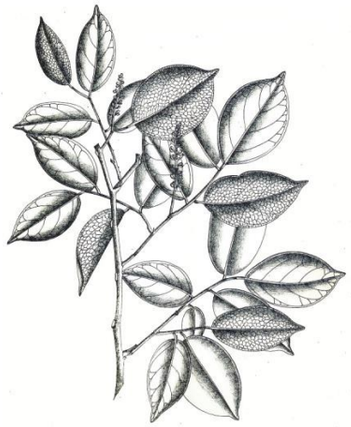



**EXTINCT (EX)**

- A taxon is Extinct when there is no reasonable doubt that the last individual has died. Eg. Dodo (Lived in Mauritius), Wooly Mammoth (Lived in North America), Legume (*Crudia zeylanica*)

**Dodo**

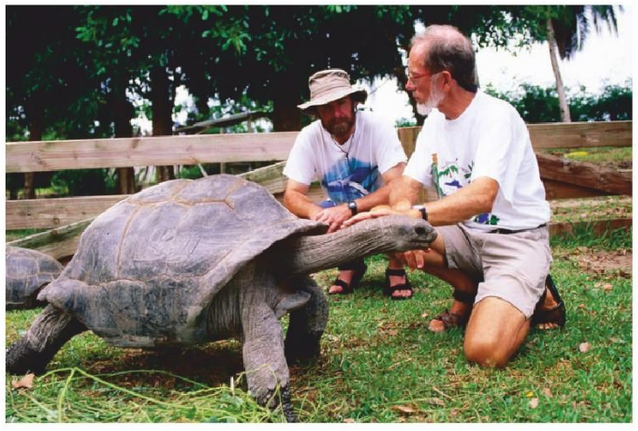
**Wooly Mammoth**



**Legume (*Crudia zeylanica*)**

**Extinct in the wild (EW):**

- A taxon is extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalized population (populations) well outside its natural habitat.
  Eg: Giant tortoise of Seychelles



**Different categories of threatened organisms:**

A species is said to be 'threatened' when it is about to leave the world. Threatened organisms are described under three categories. Critically endangered, endangered and vulnerable. The red data book has indicated other categories such as nearly threatened, least concern etc, but these are not considered as a ' threatened species.



(b) Keystone species

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(c) Flagship species

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04. Name an animal that can be considered as a flagship species of Sri Lanka.

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05. What is the most practical way of conserving biodiversity of a particular country?

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06. What is meant by ***ex-situ*** and ***in-situ*** conservation?

Ex-situ conservation

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In-situ conservation

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07. State **two** major methods of ***ex-situ*** conservation.

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08. State two major methods of ***in-situ*** conservation.

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## Structured Essay

01. Draw a tree to show classification of following IUCN categories.
Extinct Species (EX), Extinct in the wild (EW), Critically Endangered (CR), Endangered Species (EN), Vulnerable (VU) Near threatened (NT), Least concern (LC), Conservation Dependent (CD), Data Deficient (DD), Not evaluated (NE)

02. Select the category of organisms in Table A from Table B

| Table A |
|---|
| *Crudia zeylanica,* Dodo, Wooly Mammoth |
| Puntius nigrofasciatus (E: Black ruby barb, S: Bulathhapaya, T: Veddiyan) Loris tardigradus (E: Slender loris, S:Unahapuluwa, T:Thevangu) |
| The Bengal tiger of India, the giant panda of China, Blue magpie of Sri Lanka- (S: Lanka kehibella, T: Neelavudalperumkuyil) |
| Lula(S)/ Snake head (E)/ Viral (T), Kitul(S)/ Thippilipanai (T) |
| Etha / Aliya (S)/ Yanai (T), Elephant (E), Wesak Orhid (S/E/T) |
| Planktons of a pond |
| Giant tortoise of Seychelles |
| Tilapia (S/E), Japan meen (T), Rubber (S/T), Rupper (T) |
| Punchi Leena (S)/ Dusky-striped, jungle squirrel (E) and Buttercup (E) |
| The Tuatara of New Zealand, Ichthyophis and Lingula |
| Marbled rock frog (E)/Dumbaragalparadiyamadiya (S) and Maha madu (S)/ Ratchatha madupunai (T) |
| Kalutara Golubella (S)/Giant African land snail €, Japan jabara (S)/ Water Hyacinth (E)/ Kulavazhai (T) |
| Dipterocarpus zeylanicus(S: Hora, T: Ennai), Garcinia quaesita (S: Goraka, T: Gorakappuli) |
| Suduredi hora(S)/ Indian fl y catcher(E) /Inthianeepidipan (T), Avichchiya (S)/Indian pitta- (E)/ Aarumanikuruvi (T) |
| Lantana(E)/ Gandapana (S) / Nayunni (T)-(Lantana camara) |

| Table B |
|---|
| **Extinct Species (EX)** |
| **Extinct in the wild (EW)** |
| **Critically Endangered (CR)** |
| **Endangered Species (EN)** |
| **Vulnerable (VU)** |
| Endemic species: |
| Indigenous species: |
| Exotic (alien) species: |
| Migratory Species: |
| Relict species: |
| Flagship species: |
| Keystone species: |
| Invasive alien species- |

03. What are known as (a) endemic species, (b) keystone species and (c) flagship species?
(a) Endemic species

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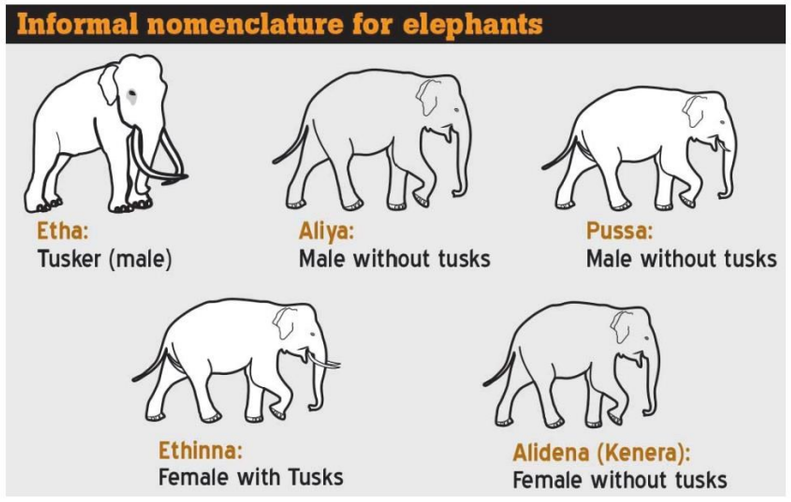
**CRITICALLY ENDANGERED (CR)**

- A taxon is critically endangered when the best available evidence indicates that it is facing an extremely high risk of extinction in the wild. Marbled rock frog (E)/Dumbara galpara diya madiya (S) and Maha madu (S)/ Ratchatha madupunai (T)- can be listed as one example to represent animals and plants critically endangered in Sri Lanka.

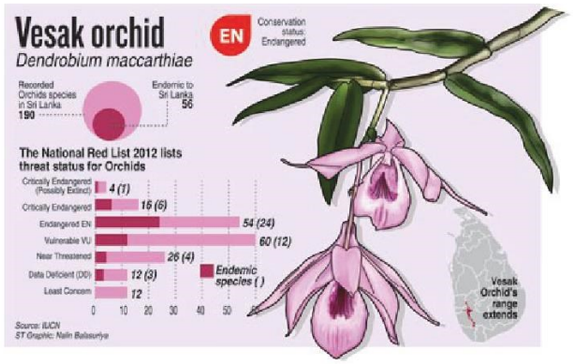
**Dumbara galpara diya madiya**

**ENDANGERED (EN)**

- A taxon is endangered when the best available evidence indicates that it is facing a very high risk of extinction in the wild.
Eg: Etha / Aliya (S)/ Yanai (T), Elephant (E)




**Eg: Wesak Orhid (S/E/T)**




**VULNERABLE (VU)**

- A taxon is vulnerable when the best available evidence indicates that it is facing a high risk of extinction in the wild.
  Eg: Punchi Leena (S)/Dusky-striped, jungle squirrel (E) and Buttercup (E)- are among the vulnerable species found in Sri Lanka.

**Punchi Leena**

**Buttercup**

**Endemic species:**

- An endemic species is a species that is confined to a particular area or country, and not found growing naturally anywhere else in the world.
- Two examples for plant species endemic to Sri Lanka are:
  *Dipterocarpus zeylanicus* (S: Hora, T: Ennai)
  *Garcinia quaesita* (S: Goraka, T: Gorakappuli)



Japan jabara (S)/ Water Hyacinth (E)/ Kulavazhai (T) was introduced to the country in nearly 110 years ago as an ornamental plant not knowing that it will become a serious invader afterwards.

**Conservation**

- A principal goal of conservation is to ensure the long term survival of as many species as possible.
- Species that are in danger of extinction have to be specially protected and steps should be taken to ensure their continued reproduction and survival.
- Conservation can be done in two ways.

**In-situ conservation:**

- The species is protected and its reproduction facilitated in its natural habitat.
- Basically a large enough population and adequate, appropriate, habitat space has to be ensured.
  Eg. National parks such as Yala and Minneriya national parks, Forest reserves such as Kanneliya, Piduruthalagala

**Ex-situ conservation:**

- The species is taken out of its natural habitats, and looked after in places where its survival and reproduction are ensured.
- Zoological gardens and Botanical gardens of a country play a key role in ex-situ conservation.

Kiwi

**Keystone species:**

- These are species that play a very important role in the stability and functioning of a system.
- If that species is removed the system tends to collapse.
  Eg. Planktons of a pond

**Invasive alien species- :**

- Invasive alien species are alien (exotic) plants and/or animals whose introduction and spread outside their natural geographic range threaten native biodiversity.
- Invasive alien species take the advantage of 'human disturbances' in the environment to establish and spread themselves.
- Their capability to tolerate wide range of environment conditions and high reproductive output help them to easily and successfully expand their populations.
- Although only a small percentage of alien species become invasive they damage biodiversity (ecosystem, species and genetic levels) in everywhere they invade and alter the services and ecosystem values of the introduced environment.
- Therefore invasive alien species are considered as a major cause for depletion of biodiversity and environment degradation.
- The following examples represent invasive alien animal and plant species in Sri Lanka.
  Kalutara Golubella (S)/ Giant African land snail (E) was introduced to Sri Lanka as a contamination of soil brought with some other plants. The soil contained eggs of the snail.




*Dipterocarpus zeylanicus* *Garcinia quaesita*

- Examples of two animal species endemic to Sri Lanka are;
  *Puntius nigrofasciatus* (E: Black ruby barb, S: Bulathhapaya, T: Veddiyan)
  *Loris tardigradus* (E: Slender loris, S:Unahapuluwa, T:Thevangu)

*Puntius nigrofasciatus*

*Loris tardigradus*

**Indigenous species:**

- A plant or animal species that occurs in its historically known natural range and that forms part of the natural biological diversity of a particular geographic area.
- Examples from Sri Lankan indigenous species are:
  Lula (S)/ Snake head (E)/ Viral (T)
  Kitul (S)/ Thippilipanai (T)

Lula (S)/ Snake head (E)/ Viral (T)

Kitul (S)/ Thippilipanai (T)

**Exotic (alien) species:**

- A species that has been introduced from another geographic region to an area outside its natural range due to human activities.
- The introduction of species can be intentional or accidental.
- The following examples represent examples for intentional and direct introductions. Accidental introductions are indirect introductions often considered as 'contaminations' of direct introductions.
  Tilapia (S/E), Japan meen (T) for inland fishery industry.
  Rubber (S/T), Rupper (T) for plantation industry.

**Migratory Species:**

- Migration refers to the act of moving from one place to another in a manner that is seasonally determined and predictable.
- Migration takes place so that organisms can avoid unfavorable environmental conditions that limit breeding.
  Suduredi hora(S)/ Indian fly catcher(E) /Inthianeepidipan (T)
  Avichchiya (S)/Indian pitta- (E)/ Aarumanikuruvi (T)

Indian flycatcher

Indian Pitta



**Relict species:**

- The remnants of a once widespread species, which are now found in very restricted or isolated areas, due to fact that areas in which these species are found is lost in many parts of the world.
- The Tuatara is an example which lives only on a few small islands of New Zealand.
  *Ichthyophis*/ Kahahiridanda (S) a primitive ancient legless amphibians with a worm like body with 2 yellow strips on body/internal fertilization and oviparous)
  *Lingula* / Lamp shell (E) Lampuch chippi (T) found in Tambalagamuwa bay in Trincomalee is an example for a relict species in Sri Lanka. Lamp muscles evolved during Archeozoic era about 450 million years ago.

***Ichthyophis***

***Lingula***

**Flagship species:**

- Flagship species is a species chosen as a symbol or icon to represent an ecosystem in need for conservation. These species are chosen for their vulnerability, attractiveness or distinctiveness in order to bring about support and acknowledgement from the public at large. Thus, the concept of a flagship species is that the publicity given to few key species, will help the conservation of entire ecosystem and all species contained therein.
- The Bengal tiger of India, the giant panda of China, Blue magpie of Sri Lanka - (S: Lanka kehibella, T: Neelavudalperumkuyil) are examples.

Bengal tiger

Giant panda

Blue magpie