X.   MAIN TOPIC

X.x   <u>Subtopic</u>
- *Significant Ideas:*

X.x.x   Knowledge & Understandings
- Applications & Skills

3.   TOPIC 3: Biodiversity & Conservation *(13 hours)*

3.1.   <u>An Introduction to Biodiversity</u>
- *Biodiversity can be identified in a variety of forms, including species diversity, habitat diversity, and genetic diversity.*
- *The ability to both understand and quantify biodiversity is important to conservation efforts.*

3.1.1.   **Biodiversity** is a broad concept encompassing the total diversity of living systems, which includes the **diversity of species**, **habitat diversity** and **genetic diversity**.

3.1.2.   **Species diversity** in communities is a product of two variables: the number of species (**richness**) and their relative proportions (**evenness**).

3.1.3.   Communities can be described and compared through the use of **diversity indices**. When comparing communities that are similar, **low diversity could be indicative of pollution or eutrophication or recent colonization of a site**. The number of species present in an area is often indicated of general patterns of biodiversity.

3.1.4.   **Habitat diversity** refers to the range of different habitats in an ecosystem or **biome**.

3.1.5.   **Genetic diversity** refers to the range of genetic material present in a population of a species.

3.1.6.   Quantification of biodiversity is **important to conservation efforts** so that the areas of high biodiversity may be identified, explored, and appropriate conservation put in place where possible.

3.1.7.   The ability to **assess changes to biodiversity** in a given community over time is important in assessing the impact of human activity in the community.
- ***Distinguish*** between biodiversity, diversity of species, habitat diversity, and genetic diversity.
- ***Comment*** on the relative values of biodiversity data.
- ***Discuss*** the usefulness of providing numerical values of species diversity to understanding the nature of communities and the conservation of biodiversity.

3.2.   <u>Origins of Biodiversity</u>
- *Evolution is a gradual change in the genetic character of populations over many generations, achieved largely through the mechanism of natural selection.*
- *Environmental change gives new challenges to species, which drives the evolution of diversity.*
- *There have been major mass extinction events in the geological past.*

3.2.1.   Biodiversity arises from **evolutionary processes**.

3.2.2.   **Biological variation** arises randomly and can either be beneficial to, damaging to, or have no impact on, the survival of the individual.

3.2.3.   **Natural selection** occurs through the following mechanism.
1) Within a population of one species, there is genetic diversity, which is called **variation**.
2) Due to natural variation, some individuals will be **fitter** than others.
3) Fitter individuals have an advantage and will **reproduce more successfully** than individuals who are less fit.
4) The offspring of fitter individuals may **inherit** the genes that give that advantage.

3.2.4.   This **natural selection** will contribute to the **evolution of biodiversity** over time.

3.2.5.   **Environmental change** gives new challenges to species: those that are suited will survive, and those that are not suited will not survive.

3.2.6.   **Speciation** is the formation of new species when populations of a species become **isolated** and evolve differently from other populations.

3.2.7. **Isolation** of populations can be caused by environmental changes forming barriers such as *mountain formation, changes in rivers, sea level change, climatic change,* or *plate movements*. The surface of the Earth is divided into crustal, **tectonic plates** that have moved throughout **geological time**. This has led to the creation of both land bridges and physical barriers with evolutionary consequences.

3.2.8. The **distribution of continents** has also caused climatic variations and variation in food supply, both contributing to evolution.

3.2.9. **Mass extinctions** of the past have been caused by various factors, such as *tectonic plate movements, supervolcano eruption, climatic changes* (including drought and ice ages), and *meteorite impact* – all of which resulted in new directions in evolution and therefore increased biodiversity.

- *Explain* how plate activity has influenced evolution and biodiversity.
- *Discuss* the causes of mass extinctions.

3.3. Threats to Biodiversity

- *While global biodiversity is difficult to quantify, it is decreasing rapidly due to human activity. Classification of species conservation status can provide a useful tool in the conservation of biodiversity.*

3.3.1. Estimates of the total number of species on Earth vary considerably. They are based on **mathematical models**, which are influenced by **classification issues** and a **lack of finance for scientific research**, resulting in many habitats and groups being **significantly under-recorded**.

3.3.2. The current rates of species loss are far greater now than in the recent past, due to increased human influence. The human activities that cause species extinctions include **habitat destruction**, introduction of **invasive species**, **pollution**, **over harvesting**, and **hunting**.

3.3.3. The IUCN publishes data in the "**Red List of Threatened Species**" in several categories. Factors used to determine the conservation status of a species include: *population size, degree of specialization, distribution, reproductive potential and behavior, geographic range and degree of fragmentation, quality of habitat, trophic level,* and the *probability of extinction*.

3.3.4. **Tropical biomes contain some of the most globally bio-diverse areas** and their unsustainable exploitation results in massive losses in biodiversity and their ability to perform globally important ecological services.

3.3.5. **Most tropical biomes occur in LEDCs** and therefore there is **conflict** between exploitation, sustainable development and conservation.

- *Discuss* the case histories of three different species: one that has become extinct due to human activity, another that is critically endangered, and a third species whose conservation status has been improved by intervention.
- *Describe* the threats to biodiversity from human activity in a given natural area of biological significance or conservation area.
- *Evaluate* the impact of human activity on the biodiversity of tropical biomes.
- *Discuss* the conflict between exploitation, sustainable development, and conservation in tropical biomes.

3.4. Conservation of Biodiversity

- *The impact of losing biodiversity drives conservation efforts.*
- *The variety of arguments given for the conservation of biodiversity will depend on EVSs.*
- *There are various approaches to the conservation of biodiversity, each with associated strengths and weaknesses.*

3.4.1. **Arguments** about **species and habitat preservation** can be based on *aesthetic, ecological, economic, ethical,* and *social* justifications.

3.4.2. **International**, **governmental**, and **non-governmental organizations (NGOs)** are involved in conserving and restoring ecosystems and biodiversity, with varying levels of effectiveness due to their use of *media, speed of response, diplomatic constraints, financial resources,* and *political influence*.

3.4.3. Recent **international conventions** on biodiversity work to create collaboration between nations for biodiversity conservation.

3.4.4. **Conservation approaches** include **habitat** conservation, **species-based** conservation, and a **mixed** approach.

3.4.5. **Criteria** for consideration when **designing protected areas** include *size*, *shape*, *edge effects*, *corridors*, and *proximity to potential human influences*.

3.4.6. Alternative approaches to the development of protected areas are **species-based conservation strategies** including: *CITES*, *captive breeding* and reintroduction programs, and *zoos*, selection of *"charismatic" species* to help protect others in an area (**flagship species**), selection of **keystone species** to protect the integrity of the food web.

3.4.7. Community support, adequate funding and proper research influence the **success of conservation efforts**.

3.4.8. The **location of a conservation area** in a country is a significant factor in the success of the conservation effort. Surrounding land use for the conservation area and distance from urban centers are important factors for consideration in conservation area design.

- *Explain* the criteria used to design and manage protected areas.
- *Discuss* the success of a given protected area.
- *Evaluate* different approaches to protecting biodiversity.