20.4-CONSERVATION

Suatainable resource:

- A sustainable resource as one which is produced as rapidly as it is removed from the environment so that it does not run out.

Note: Some resources can be conserved and managed sustainably, limited to forests and fish stocks

Explain how forests can be conserved using:

Education:

- **Public Awareness:**
- Educational programs and campaigns can inform the public about the importance of forests in maintaining ecosystem health, supporting biodiversity, and mitigating climate change. Educated individuals are more likely to support conservation efforts and make sustainable choices in their daily lives.
- **Community Involvement:**
- Educating local communities living near forests about the benefits of sustainable forest management and the consequences of illegal logging or deforestation can lead to more responsible forest use.

Protected Areas:

- **National Parks and Reserves:**
- Establishing protected areas, such as national parks, wildlife reserves, and conservation areas, is a critical conservation strategy. These areas provide a sanctuary for wildlife and plants, and they restrict human activities that could harm forests. They also serve as valuable research and educational resources.
- **Forest Management Plans:**
- Some protected areas allow for sustainable resource extraction while maintaining the long-term health of the forest. Carefully managed timber harvesting can be compatible with conservation goals when carried out in accordance with responsible forest management practices.

Quotas:

- **Sustainable Harvesting:**
- Establishing quotas for timber and non-timber forest products, based on scientific assessments of sustainable yield, helps regulate the extraction of resources. Quotas ensure that only a certain amount of wood or other forest products is harvested, leaving the forest with sufficient time to regenerate.

Replanting:

- **Reforestation:**
- Replanting or reforesting areas where trees have been cut down can help restore forest cover. This practice not only conserves forests but also mitigates carbon dioxide emissions, contributes to carbon sequestration, and provides habitat for wildlife.
- **Afforestation:**
- Planting trees in areas that were previously not forested, such as degraded lands or urban areas, can help expand forested areas and enhance ecosystem services.

Explain how fish stocks can be conserved using:

Education:

- **Public Awareness:**
- Educational campaigns can inform the public about the importance of sustainable fishing practices and the consequences of overfishing. Educated individuals are more likely to support conservation efforts and make informed choices in their fishing activities.

Closed seasons

- **Temporal Closures:**
- Closed seasons or specific times of the year when fishing for particular species is prohibited can help protect vulnerable fish populations during their breeding seasons. This allows fish to reproduce and replenish their numbers.

Protected areas:

- **Marine Reserves:**
- Establishing marine protected areas (MPAs) or marine reserves can provide a safe haven for fish populations. These areas restrict or ban fishing activities to allow fish to grow and reproduce without disturbance. MPAs can also help maintain genetic diversity.

Controlled net types and mesh size:

- **Selective Fishing Gear:**
- Encouraging the use of selective fishing gear, such as size-appropriate mesh nets and escape devices for non-target species, reduces bycatch and minimizes the capture of undersized fish. This allows juvenile fish to grow and contribute to future populations.

Quotas :

- **Total Allowable Catch (TAC):**
- Setting TACs for different fish species and fisheries helps regulate the overall amount of fish that can be legally caught. These quotas are based on scientific assessments of sustainable yield, ensuring that fishing activities remain within sustainable limits.

Monitoring:

- **Fishery Surveillance:**
- Implementing monitoring programs and patrols to enforce fishing regulations and ensure compliance with quotas and size limits.
- **Scientific Data Collection:**
- Regular scientific assessments and data collection are crucial to determine the health of fish stocks and make informed management decisions. This includes data on population size, growth rates, and reproduction

Explain why organisms become endangered or extinct, including:

- **Climate change :**
  Climate change, largely driven by human activities such as the burning of fossil fuels, results in shifts in temperature and precipitation patterns. These changes can disrupt ecosystems, affecting species' distribution and ability to adapt. Some species may be unable to migrate or adapt quickly enough to survive in a changing climate. Habitat destruction, Hunting, Overharvesting, Pollution and Introduced species

- **Habitat Destruction:**
  The destruction of natural habitats, primarily due to activities like deforestation, urbanization, and agriculture, can displace species and reduce their access to essential resources, such as food, water, and shelter. Habitat fragmentation can also limit the movement of species.

- **Hunting and Overharvesting:**
  Overexploitation through hunting, fishing, and the collection of animals and plants for trade can lead to population declines and even extinction. This often occurs when species are targeted for their fur, meat, tusks, or other valuable parts.

- **Pollution:**
  Pollution, including air and water pollution, can have severe effects on organisms. For example, chemical pollutants can contaminate ecosystems, harming aquatic life and impacting terrestrial organisms. Chemicals like pesticides and heavy metals can disrupt ecosystems and harm species within them.

- **Introduced Species (Invasive Species):**
  Invasive species, often introduced unintentionally or intentionally by humans, can disrupt ecosystems by outcompeting native species for resources, spreading diseases, and causing habitat changes. Invasives can push native species to the brink of extinction.

- **Natural Processes:**
  Extinction can also result from natural processes, including geological events (e.g., volcanic eruptions and asteroid impacts), climatic shifts (e.g., ice ages), and disease outbreaks. While these factors have driven extinctions in the past, their role is typically minor compared to the pressures induced by human activities.

Describe how endangered species can be conserved, limited to:

Monitoring and protecting species and habitats:

- **Habitat Protection:**

One of the most effective ways to conserve endangered species is to protect their natural habitats. This can be achieved through the establishment of protected areas, wildlife reserves, and conservation easements.

- **Law Enforcement:**

Enforcing regulations and laws that prohibit hunting, poaching, and habitat destruction is essential. The presence of park rangers and conservation officers helps deter illegal activities and protect wildlife.

- **Research and Monitoring:**

Regular monitoring of endangered species is crucial to assess population trends and the effectiveness of conservation efforts. This data informs management decisions and allows for adaptive conservation strategies.

- **Habitat Restoration:**

In some cases, degraded habitats can be restored through reforestation, wetland restoration, or other conservation practices, which can improve the living conditions for endangered species.

Education

- **Public Awareness:**

Education and outreach programs help raise public awareness about the importance of conservation and the specific threats facing endangered species. Informed individuals are more likely to support conservation initiatives and make sustainable choices.

- **Stakeholder Engagement:**

Engaging with local communities, indigenous peoples, and stakeholders is critical. Collaborative efforts can lead to more effective conservation strategies and reduce conflicts between conservation goals and human interests.

Captive breeding programmes

- **Genetic Diversity:**

Captive breeding programs are established to maintain and increase the genetic diversity of endangered species. This is vital for the long-term survival of small, isolated populations.

- **Reintroduction:**

Captive-bred individuals can be reintroduced into their natural habitats when conditions are suitable. This process can bolster wild populations.

Breeding and Care:

Specialized facilities care for and breed endangered species in captivity, ensuring their health and reproductive success.

Seed banks:

- **Plant Conservation:**

Seed banks, also known as gene banks or seed vaults, store seeds from a wide variety of plant species, including endangered ones. This serves as a backup in case of habitat loss, disease, or other threats to plant populations.

- **Crop Diversity:**

Seed banks can also store agricultural crop seeds, preserving genetic diversity that may be valuable for food security and agriculture in the face of changing environmental conditions.

Describe the reasons for conservation programmes, limited to:

(a) Maintaining or increasing biodiversity:

- **Preserving Species Diversity:**

Conservation programs help maintain and increase the diversity of species in an ecosystem. Biodiversity is vital as it contributes to ecological stability, resilience, and the health of ecosystems. It also provides resources and benefits for human societies, such as food, medicine, and ecological services.

(b) Reducing extinction:

- **Preventing Species Loss:**

Extinction is a natural process, but the rate of species extinction has accelerated due to human activities. Conservation programs work to reduce the risk of extinction by protecting endangered and threatened species, both in their natural habitats and through ex-situ conservation (in captivity).

(c) Protecting vulnerable ecosystems:

- **Conserving Unique Habitats:**

Many ecosystems, such as rainf-orests, wetlands, and coral reefs, are particularly vulnerable to degradation and habitat loss. Conservation efforts are crucial in safeguarding these ecosystems, as they often house a disproportionately high number of species and provide vital ecological services.

(d) Maintaining Ecosystem Functions, Nutrient Cycling, and Resource Provision:

- **Nutrient Cycling:**

Ecosystems play a crucial role in nutrient cycling. They recycle and redistribute nutrients, such as carbon, nitrogen, and phosphorus, which are essential for the growth of plants and the sustenance of all life forms. Conserving ecosystems helps maintain this vital process.

- **Resource Provision:**

Ecosystems provide a wide range of resources, including food, medicine, fuel, and genetic materials. Conservation programs ensure the sustainable use of these resources, preventing overexploitation and maintaining the health of ecosystems.

- **Genetic Diversity:**

Ecosystems house a wealth of genetic diversity. This genetic diversity can be valuable for breeding programs, crop improvement, and medical research. Conservation programs aim to safeguard this genetic wealth for future use.

Describe the use of artificial insemination (AI) and in vitro fertilisation (IVF) in captive breeding programmes:

Artificial insemination (AI) and in vitro fertilization (IVF) are valuable techniques used in captive breeding programs to manage and conserve endangered or threatened species. These methods can help overcome reproductive challenges and boost the success of breeding efforts.

Here's an explanation of how AI and IVF are used in captive breeding programs:

1. Artificial Insemination (AI):

Artificial insemination involves the collection of reproductive materials from animals and the controlled transfer of sperm into the female's reproductive tract. In the context of captive breeding programs, AI is used to:

- **Overcome Reproductive Barriers:** Some animals in captivity may face difficulties in mating naturally due to behavioral or physical issues. AI can enable successful reproduction without the need for physical contact between individuals.
- **Genetic Diversity:** AI allows for the selection of specific males and females to optimize genetic diversity within captive populations, reducing the risks of inbreeding.
- **Disease Control:** AI can minimize the risk of disease transmission that may occur through natural mating, particularly when animals are susceptible to certain diseases.
- **Sperm Preservation:** AI often involves the collection, evaluation, and cryopreservation of sperm samples. This preservation allows for the long-term storage of genetic material and can be useful for future breeding efforts.

2. In Vitro Fertilization (IVF):

In vitro fertilization is a process where eggs are fertilized by sperm outside the body, typically in a laboratory setting. In captive breeding programs, IVF is used for various purposes:

- **Assisting Reproduction:** IVF can be employed when natural reproduction is challenging, especially for species with low reproductive rates or fertility issues. It enables the creation of embryos outside the female's body.
- **Embryo Storage:** IVF often involves the development of embryos that can be stored cryogenically for later use. This helps maintain genetic diversity and allows for timed reproduction to coincide with favorable environmental conditions or resources.
- **Genetic Management: L**ike AI, IVF allows for controlled breeding and genetic management to reduce the risk of inbreeding and maximize genetic diversity.
- **Rescue and Recovery:** For critically endangered species with very small populations, IVF can be a last-resort option to recover and propagate the species when natural reproduction has become almost impossible.

Explain the risks to a species if its population size decreases, reducing genetic variation (knowledge of genetic drift is not required)

A species that experiences a decrease in its population size faces several significant risks due to the reduction of genetic variation. Genetic variation refers to the diversity of genetic traits and alleles within a population. When the genetic variation within a species decreases, the following risks become more pronounced:

Increased Vulnerability to Diseases:

A decrease in genetic variation means that a population is more likely to be genetically homogenous, with many individuals sharing similar genetic traits. If a disease or pathogen arises that can exploit a specific genetic vulnerability, it can spread more easily within the population, potentially causing devastating epidemics.

Reduced Adaptability to Environmental Changes:

Genetic diversity allows a species to adapt to changing environmental conditions over time. With reduced genetic variation, the species may be less capable of adapting to new challenges, such as alterations in climate, food availability, or habitat conditions.

Inbreeding Depression:

In small populations with limited genetic diversity, there is an increased likelihood of close relatives breeding with one another (inbreeding). Inbreeding can lead to the expression of harmful recessive alleles, resulting in offspring with reduced fitness, lower survival rates, and increased susceptibility to genetic disorders.

Loss of Unique Traits:

As genetic diversity decreases, unique and potentially valuable traits within the population may be lost. This can affect the species' capacity to utilize specific ecological niches, find innovative ways to acquire resources, or adapt to changing conditions.

Reduced Reproductive Success:

A decline in genetic diversity can result in a decrease in reproductive success, including fertility and mating success. This can further hinder the population's ability to recover.

Altered Population Structure:

As genetic diversity decreases, the population may become less structured, with fewer variations in physical traits and behaviors. This homogenization can limit the population's ability to exploit various ecological niches and resources.

Greater Susceptibility to Environmental Catastrophes:

Reduced genetic variation can make a population more susceptible to catastrophic events, such as natural disasters, that threaten its survival. With limited genetic diversity, the species may lack individuals with unique traits that could help it adapt to post-disaster conditions.

Higher Risk of Extinction:

Ultimately, a population with severely reduced genetic diversity is at a significantly higher risk of extinction. The combination of genetic vulnerabilities, inbreeding depression, and a reduced capacity for adaptation can make it extremely difficult for the population to recover or persist over the long term.