
GS Foundation Program 2024 | D11 | Benchmark Assignment #107

Subjective Questions:

Q.1) The winter rains in North India are largely related to Jet streams and Western disturbances. Bring out the relationship. (15 marks, 250 words)

Q.2) Write a short note on: (10 marks, 150 words)

- a) Keystone species
- b) Indicator species
- c) Invasive species

Objective Questions:

Q.1) Consider the following statements in reference to keystone species:

1. Extinction of a keystone species results in the degradation of whole ecosystem.
2. Top predators like tiger are considered keystone species.
3. Herbivores cannot be keystone species.

Which of the statements given above is/are correct?

- a) 1 and 2 only
- b) 1 and 3 only
- c) 2 and 3 only
- d) 1, 2 and 3

Q.2) “These are the large brown algae. They are the underwater forests that grow in relatively shallow waters close to the shore. They are also considered as keystone species and help reduce coastal erosion. They are recognized as one of the most productive and dynamic ecosystems on Earth.”

Which of the following is the most likely referred in the above passage?

- a) Mangrove
- b) Kelp
- c) Vallisneria
- d) Sargassum

Q.3) Vultures which used to be very common in Indian countryside some years ago are rarely seen nowadays. This is attributed to

- a) The destruction of their nesting sites by new invasive species.
- b) A drug used by cattle owners for treating their diseased cattle.
- c) Scarcity of food available to them.
- d) A widespread, persistent and fatal disease among them.

Q.4) With reference to the invasive species in India, consider the following:

1. An invasive alien species is a problematic species introduced outside its natural past or present distribution.
2. Water Hyacinth is an invasive species native to Amazon basin that populates ponds in India.
3. *Senna spectabilis* has become a major threat to the Shola grasslands ecosystem in the Nilgiris.
4. Cartagena Protocol on Biosafety focuses to address the issue of invasive species.

Which of the statements given above is/are correct?

- a) 1 and 2 only
- b) 2, 3 and 4 only
- c) 1 and 3 only
- d) 1, 2, 3 and 4

Q.5) With respect to invasive alien species, which of the following statements is incorrect?

- a) A non-native species becomes invasive when it threatens local biodiversity.
- b) They can lead to both increase and decrease in species richness in the host region.
- c) In India Myna is an invasive alien species.
- d) Nearly 50% of species in Indian flora are invasive alien species.

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Subjective Questions:

Q.1) The winter rains in North India are largely related to Jet streams and Western disturbances. Bring out the relationship.

Approach:

1. Write about Jet streams and Western disturbance in introduction.
2. Explain the relation between Jet streams and Western disturbances and winter rains
3. conclude

Jet streams are high-altitude, fast-flowing air currents that meander across the globe in the upper troposphere. In the Northern Hemisphere, the polar jet stream and the subtropical jet stream are two key components that influence weather patterns. During winter, the polar jet stream often shifts southwards and intersects with the subtropical jet stream over North India.

Western disturbances, also known as extratropical cyclones, are weather systems that originate in the Mediterranean region and move eastwards. These disturbances are associated with low-pressure systems in the mid-latitude regions. As they approach North India, they interact with the southward-shifting polar jet stream.



The interaction between the polar jet stream and western disturbances leads to the following relationship:

1. **Moisture Advection:** The southward shift of the polar jet stream allows it to transport cold air from the higher latitudes towards North India. Simultaneously, the western disturbances draw in moisture from the Mediterranean Sea and the Arabian Sea. The convergence of cold air and moisture-laden air results in the formation of clouds and precipitation.

2. **Triggering Mechanism:** Western disturbances act as a triggering mechanism for rainfall in North India. As these weather systems encounter the southward-displaced polar jet stream, they intensify and induce atmospheric instability. This instability, combined with the presence of moisture, leads to the development of precipitation, including rain and snowfall in the higher altitudes.
3. **Variation in Rainfall Patterns:** The intensity and distribution of winter rainfall in North India can vary based on the interaction between the polar jet stream and western disturbances. The movement and strength of the disturbances, as well as the positioning of the jet stream, determine the amount and spatial distribution of precipitation.
4. **Orographic Effect:** The interaction between the polar jet stream and western disturbances contributes to the orographic effect in North India. As the air masses are lifted over the Himalayan mountain range, they are forced to ascend, leading to cooling and condensation. This process enhances precipitation, particularly in the foothills and northern slopes of the mountains, resulting in higher winter rainfall.
5. **Rain Shadow Effect:** The positioning of the jet stream and the path of western disturbances can also create rain shadow areas. As the air masses descend on the leeward side of the mountains, they become drier and inhibit rainfall. This effect is observed in regions like the Northwestern Plains of India, where the Aravalli Range and the Western Ghats act as barriers to the moisture-laden air from reaching further inland.
6. **Seasonal Variability:** The occurrence and strength of western disturbances can vary from year to year, leading to interannual variability in winter rainfall patterns. Factors like the strength of the polar jet stream, the positioning of the subtropical jet stream, and large-scale climate oscillations (e.g., El Niño and La Niña) can influence the frequency and intensity of western disturbances, consequently impacting winter rainfall in North India.

The winter rainfall influenced by jet streams and western disturbances is crucial for agriculture, as it supports the growth of rabi crops and contributes to water resources through groundwater replenishment and reservoir filling. Understanding and monitoring these atmospheric dynamics are essential for effective water resource management, agricultural planning, and overall climate resilience in North India.

Q.2) Write a short note on:

- a) Keystone species
- b) Indicator species
- c) Invasive species

a) Keystone Species:

Keystone species are vital components of ecosystems, exerting a disproportionately large influence on their structure and function. Despite their relatively low abundance or biomass, their ecological role is crucial. Removing a keystone species can lead to cascading effects

throughout the ecosystem, impacting other species and altering the ecosystem's balance. For example, the gray wolf is a keystone species in Yellowstone National Park. Their presence helps control populations of herbivores such as elk, which in turn affects vegetation growth and provides habitat for various other species.

b) Indicator Species:

Indicator species serve as valuable indicators of the overall health and condition of an ecosystem. They possess certain characteristics that make them sensitive to environmental changes or specific conditions. By monitoring the presence, abundance, or behavior of indicator species, scientists and conservationists can gain insights into the state of an ecosystem. For instance, the presence of certain butterfly species can indicate the quality of a meadow, while the decline of amphibian populations can indicate environmental pollution. Indicator species provide early warning signs of ecosystem disturbances, helping guide conservation efforts and inform management decisions.

c) Invasive Species:

Invasive species are non-native organisms that are introduced to an ecosystem, often causing harm to native species and their habitats. These species have a competitive advantage, allowing them to rapidly spread and outcompete native species for resources such as food, habitat, or sunlight. The impacts of invasive species can be far-reaching, disrupting ecological processes, reducing biodiversity, and altering ecosystem dynamics. One notable example is the red lionfish, which has invaded Caribbean coral reefs. Their predatory behavior and lack of natural predators have resulted in a significant decline in native fish populations, threatening the overall health and diversity of the reef ecosystem. Efforts to prevent the introduction and spread of invasive species are crucial to preserving the integrity of ecosystems and protecting native biodiversity.

Objective Questions:

Q.1) Consider the following statements in reference to keystone species:

1. Extinction of a keystone species results in the degradation of whole ecosystem.
2. Top predators like tiger are considered keystone species.
3. Herbivores cannot be keystone species.

Which of the statements given above is/are correct?

- a) 1 and 2 only
- b) 1 and 3 only
- c) 2 and 3 only
- d) 1, 2 and 3

Ans) a

Exp) Option a is correct

Statement 1 is correct: Keystone species are those which have a disproportionately large impact on a particular ecosystem relative to its population. If a keystone species is lost, it will result in the degradation of whole ecosystem. For example, certain plant species (ebony tree,

Indian-laurel) exclusively depends upon bats for its pollination. If the bat population is reduced, then regeneration of particular plants becomes more difficult.

Statement 2 is correct: All top predators (Tiger, Lion, and Crocodile) are considered as keystone species because they regulate all other animals' population indirectly.

Statement 3 is incorrect: Herbivores can also be keystone species, ex- Elephants. Their consumption of plants helps control the physical and biological aspects of an ecosystem.

Q.2) “These are the large brown algae. They are the underwater forests that grow in relatively shallow waters close to the shore. They are also considered as keystone species and help reduce coastal erosion. They are recognized as one of the most productive and dynamic ecosystems on Earth.”

Which of the following is the most likely referred in the above passage?

- a) Mangrove
- b) Kelp
- c) Vallisneria
- d) Sargassum

Ans) b

Exp) Option b is correct.

Kelp forests are extensive underwater habitats that range along 25% of the world's coastlines. They grow best in cold, nutrient-rich water, where they attain some of the highest rates of primary production of any natural ecosystem.

Statement a is incorrect. Mangroves are the forests that grow in sheltered low-lying coasts, estuaries, mudflats, tidal creek backwaters, marshes and lagoons of the tropical and subtropical regions. They are salt-tolerant or halophytes and are adapted to harsh ecological conditions. E.g., Sonneratia and Avicenna.

Statement b is correct. Kelp forests are large brown algae seaweeds. They grow in “underwater forests” in shallow oceans and nutrient-rich waters. Generally speaking, kelps live farther from the tropics than coral reefs. However, a few species have been known to occur exclusively in tropical deep waters. They are considered as keystone species. They help reduce coastal erosion and acts as a breakwater during large storms. They are an important source of potash and iodine. Many kelps produce algin, a complex carbohydrate useful in industries such as tire manufacturing, ice-cream industry.

Statement c is incorrect. Vallisneria is commonly called the eel grass or tape grass. It is the most commonly found aquatic weed plant. It was introduced as an ornamental aquarium plant in India. The genus is widely distributed in tropical and subtropical regions of Asia, Africa, Europe, and North America. In Malayalam, it is known as thalayattippullu, vazhakala and mudipayal. It was recently in news as it is posing a threat to paddy cultivation in the state of Tamil Nadu.

Statement d is incorrect. Recently, the Surge in nitrogen has turned sargassum into the world's largest harmful algal bloom. Sargassum is a genus of large brown seaweed (a type of algae) that floats in island-like masses and never attaches to the seafloor. The Sargasso Sea, lying within the Norwegian current circuit, is full of large quantities of Sargassum seaweed and is an important geographical feature.

Q.3) Vultures which used to be very common in Indian countryside some years ago are rarely seen nowadays. This is attributed to

- a) The destruction of their nesting sites by new invasive species.
- b) A drug used by cattle owners for treating their diseased cattle.
- c) Scarcity of food available to them.
- d) A widespread, persistent and fatal disease among them.

Ans) b

Exp) Option b is correct

Vultures are on the verge of extinction in India because a banned drug being used illegally to treat suffering cattle. Diclofenac, an anti-inflammatory drug used by farmers to ease pain in cattle, is deadly to vultures. The endangered birds eat the remains of the drugged animals and suffer kidney failure and visceral gout, which is usually fatal.

Q.4) With reference to the invasive species in India, consider the following:

1. An invasive alien species is a problematic species introduced outside its natural past or present distribution.
2. Water Hyacinth is an invasive species native to Amazon basin that populates ponds in India.
3. Senna spectabilis has become a major threat to the Shola grasslands ecosystem in the Nilgiris.
4. Cartagena Protocol on Biosafety focuses to address the issue of invasive species.

Which of the statements given above is/are correct?

- a) 1 and 2 only
- b) 2, 3 and 4 only
- c) 1 and 3 only
- d) 1, 2, 3 and 4

Ans) d

Exp) Option d is correct.

Statement 1 is correct. An **alien species** is a species introduced outside its natural past or present distribution; if this species becomes problematic, it is termed an **invasive alien species**. They are the most common **threat to amphibians, reptiles and mammals** on The IUCN Red List; they may lead to changes in the structure and composition of ecosystems detrimentally affecting ecosystem services, human economy and wellbeing. **UNSDG no.15** addresses the issues of invasive alien species.

Statement 2 is correct. **Lady Hastings**, wife of the first British Governor-General who **brought Water Hyacinth (native to South America) to India** towards the end of the 18th century. **This plant is native to Brazil's Amazon basin.** It is also referred to as the **terror of Bengal** given its effect on the local ecology and lives of the people. It has an effect on irrigation, hydroelectric generation and navigation. It also leads to a drastic reduction in fish production, aquatic crops and an increase in diseases caused by mosquitoes.

Statement 3 is correct. *Senna spectabilis* is a deciduous tree **native to tropical areas of America**. The thick foliage of the tree arrests the growth of other indigenous tree and grass species. Thus, it causes food shortage for the wildlife population and also adversely affect the germination and growth of the native species. The **Kerala Government is planning to arrest the rampant growth** of invasive plants, especially *Senna spectabilis*, in the forest areas of the **Nilgiri Biosphere Reserve (NBR)**, including the **Wayanad Wildlife Sanctuary**.

Statement 4 is correct. The **Cartagena Protocol on Biosafety to the Convention on Biological Diversity (CBD)** is an international agreement which aims to ensure the safe handling, transport and use of living modified organisms (LMOs). It recognizes that there is an **urgent need to address the impact of invasive species**. It states that “Each Contracting Party shall, as far as possible and as appropriate, prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species”.

Q.5) With respect to invasive alien species, which of the following statements is incorrect?

- a) A non-native species becomes invasive when it threatens local biodiversity.
- b) They can lead to both increase and decrease in species richness in the host region.
- c) In India Myna is an invasive alien species.
- d) Nearly 50% of species in Indian flora are invasive alien species.

Ans) d

Exp) Option d is correct.

Option a is correct. **Alien species** are those which occur **outside their natural range**. When they **threaten native plants and animals** or other aspects of biodiversity, they are called **invasive species**.

Option b is correct. An **invasion** can lead to an **increase in species richness**, as invasive species are **added to the existing species pool**. On the other hand, it also **leads to extinction of native species** resulting in **decrease of species richness**.

Option c is correct. Some of the **invasive fauna** found in **India** are: crazy ant, giant African snail, **myna**, gold fish, donkey, house gecko, etc.

Option d is incorrect. About 40% of species in Indian flora are alien, of which 25% are invasive.