1. What are coral reefs and how do they get formed? Discuss the global distribution of coral reefs.

Introduction

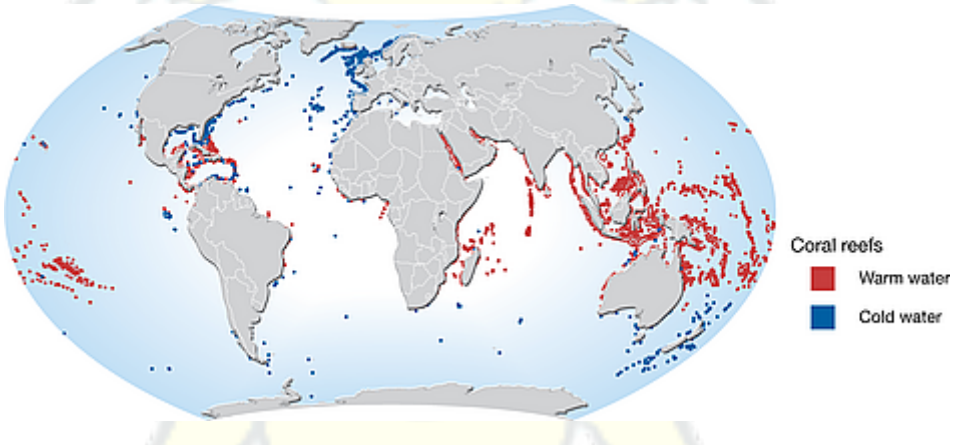
Coral reefs are the most diverse of all marine ecosystems. Coral reefs cover less than 1 percent of the ocean floor — all the reefs combined would equal an area of about 285,000 square km. About 25 percent of all known marine species rely on coral reefs for food, shelter and breeding. They are also referred to as "the rainforests of the sea" for their biodiversity.

Body

- Coral reefs are large underwater structures composed of the skeletons of colonial marine invertebrates called coral. The coral species that build reefs are known as hermatypic, or "hard," corals because they extract calcium carbonate from seawater to create a hard, durable exoskeleton that protects their soft, sac-like bodies. Other species of corals that are not involved in reef building are known as “soft” corals. These types of corals are flexible organisms often resembling plants and trees and include species such as sea fans and sea whips.
- Each individual coral is referred to as a polyp. Coral polyps live on the calcium carbonate exoskeletons of their ancestors, adding their own exoskeleton to the existing coral structure. As the centuries pass, the coral reef gradually grows, one tiny exoskeleton at a time, until they become massive features of the marine environment.
- Most corals, however, depend on algae called zooxanthellae to provide energy via photosynthesis. The corals have a symbiotic, or mutually beneficial, relationship with the zooxanthellae. These algae live inside the coral polyp's body where they photosynthesize to produce energy for themselves and the polyps.
- The polyps, in turn, provide a home and carbon dioxide for the algae. Additionally, the zooxanthellae provide the coral with their lively colors — most coral polyp bodies are clear and colorless without zooxanthellae.
- Deep-sea corals live in much deeper or colder oceanic waters and lack zooxanthellae. Unlike their shallow water relatives, which rely heavily on photosynthesis to produce food, deep sea corals take in plankton and organic matter for much of their energy needs.
- Coral reefs are typically divided into four categories, according to CORAL:
- Fringing reefs are the most commonly seen reef and grow near coastlines.
- Barrier reefs differ from fringing reefs in that they are separated from the coastlines by deeper, wider lagoons.
- Patch reefs typically grow between fringing and barrier reefs on the island platform or continental shelf.

- Corals are colonial, the size of a colony can be large. Reefs, which are usually made up of many colonies, are much bigger still. Reefs form when corals grow in shallow water close to the shore of continents or smaller islands. It takes a long time to grow a big coral colony or a coral reef, because each coral grows slowly. The fastest corals expand at more than 6 inches (15 cm) per year, but most grow less than an inch per year. Reefs themselves grow even more slowly.

- Reef-building corals are restricted in their geographic distribution by their physiology. For instance, reef-building corals cannot tolerate water temperatures below 18° Celsius (C). But there is a presence of cold water corals.
- Many grow optimally in water temperatures between 23° and 29° C, but some can tolerate temperatures as high as 40° C for short periods. Most also require very saline (salty) water ranging from 32 to 42 parts per thousand, which must also be clear so that a maximum amount of light penetrates it.
- Corals are found all over the world's oceans, from the Aleutian Islands off the coast of Alaska to the warm tropical waters of the Caribbean Sea. The biggest coral reefs are found in the clear, shallow waters of the tropics and subtropics. The largest of these coral reef systems, the Great Barrier Reef in Australia, is more than 2,400 kilometers.



Conclusion

Hundreds of millions of people rely on coral reefs for essential nutrition, livelihoods, protection from life-threatening storms and crucial economic opportunity. At the same time, about half the world's shallow water coral reefs are already gone, and without urgent action to address climate change, pollution, overfishing and destructive coastal development, these life-sustaining natural wonders could all but disappear.

2. If you were to visit the Antarctica, which major ice bodies would you encounter in your journey towards the south? What are the most potent threats to these ice bodies? Examine.

Introduction

Antarctica is earth's southernmost continent. The Antarctic ice sheet is the largest single mass of ice on Earth. Most of Antarctica is a polar desert, with annual precipitation of 200 mm along the coast and far less inland; there has been no rain there for almost 2 million years, yet 80% of the world freshwater reserves are stored there.

Body

Major ice bodies towards the south

- Brunt Ice Shelf
- Larsen ice shelf
- Ronne Ice Shelf
- Ross Ice Shelf

Most potent threats to these ice bodies

- **Anthropogenic causes** – The industrial revolution, carbon dioxide and other greenhouse gas emissions have raised temperatures, even higher in the poles, and as a result, glaciers are rapidly melting, calving off into the sea and retreating on land.
- **Fishing** – Fishing for krill could be particularly significant as these are at the bottom of many Antarctic food chains.
- **Tourism** – With the accompanying pollutants that accompany ships and aircraft, the possibility of oil spills and the effects of lots of people and infrastructure on wildlife and the wider environment.
- **Pollution** – CFC's and other ozone depletion materials are responsible for the ozone hole that has appeared over Antarctica for over 30 years, chemicals produced thousands of miles away are found in Antarctic ice and in the bodies of wildlife.
- **Methane** – Melting permafrost releases methane: a greenhouse gas more potent than carbon dioxide in terms of warming potential.
- **Oil spills and gas extraction** – An extractive oil and gas industry poses new danger to already vulnerable animal populations.

Conclusion

Melting sea ice is also likely to have global consequences by unlocking new shipping routes and exposing more fossil fuel reserves. But it is clear that although Arctic and Antarctic sea ice only covers a small fraction of the Earth's surface, there may well be serious climate-related impacts

3. Why are mangrove forests ecologically valuable? Examine the geographical factors that lead to the concentration of mangroves in certain parts of the world.

Introduction

Mangroves are salt-tolerant vegetation that grows in intertidal regions of rivers and estuaries. They are trees and shrub species that grow at the interface between land and sea in tropical and subtropical regions of the world, where the plants exist in conditions of salinity, tidal water flow and muddy soil.

Body

Ecological valuable of mangrove forests

- **Biodiversity** – Home to an incredible array of species, mangroves are biodiversity hotspots. They provide nesting and breeding habitat for fish and shellfish, migratory birds, and sea turtles. An estimated 80% of the global fish catch relies on mangrove forests either directly or indirectly.
- **Livelihoods** – fishers and farmers depend on these natural environments to provide healthy fisheries from which to fish, and healthy land on which to farm.
- **Water quality** – Mangroves are essential to maintaining water quality. With their dense network of roots and surrounding vegetation, they filter and trap sediments, heavy metals, and other pollutants. This ability to retain sediments flowing from upstream prevents contamination of downstream waterways and protects sensitive habitat like coral reefs and sea grass beds below.
- **Coastal defence** – Mangroves are the first line of defence for coastal communities. They stabilize shorelines by slowing erosion and provide communities from increased storm surge, flooding, and hurricanes. In 2003, it was estimated that a quarter of the world's population lived within 100 kilometres of the coast and at 100 meters of sea level. Robust mangrove forests are natural protection for communities vulnerable both to sea level rise and the more intense and frequent weather events caused by climate change
- **Carbon storage** – Mangroves "sequester carbon at a rate two to four times greater than mature tropical forests and store three to five times more carbon per equivalent area than tropical forests" like the Amazon rainforest. This means that conserving and restoring mangroves is essential to fighting climate change, the warming of the global climate fuelled by increased carbon emissions, that is already having disastrous effects on communities worldwide.
- **Materials** – In addition to consuming fish and shellfish from the mangroves, communities have historically used mangrove wood and other extracts for both building and medicinal purposes. Their potential as a source for novel

biological materials, such as antibacterial compounds and pest-resistance genes, remains largely undiscovered.
- **Sustainable development** – Intact and healthy mangrove forests have an potential for sustainable revenue-generating initiatives including ecotourism, sport fishing, and other recreational activities.

Geographical factors that lead to the concentration of mangroves in certain parts of the world

Mangroves are found in 105 nations globally. Although distributed across 105 nations, the top 10 mangrove holding nations contain approximately 52% of the global mangrove stock with Indonesia alone containing between 26% and 29% of the entire global mangrove stock.

- Maximum concentration of mangroves is found between 5-degree north to 5-degree south of equator. Asia has the largest amount around 43 percent of world's mangrove followed by Africa, North America, Oceania and South America
    - Papua province of Indonesia archipelago
    - Tarut island, Saudi Arabia
    - Sundarbans mangroves, India
- Mangroves of the World have been divided into two groups: Eastern group i.e. East Africa, India, Southeast Asia, Australia and the Western Pacific and Western group comprises of West Africa, South and North America and the Caribbean Countries.
- The most extensive area of mangroves is found in Asia, followed by Africa and South America.
- Four countries (Indonesia, Brazil, Nigeria and Australia) account for about 41 percent of all mangroves.
- The Sundarbans region is the world's largest area of mangrove forest, spanning approximately one million hectares (2.47 million acres) in India and Bangladesh.

Conclusion

According to a report by IPCC 2018, mangroves are threaten by impacts of global warming. But seeing the benefit provided by these mangroves, it is highly necessary that we should conserve them with holistic and integrated approach. Mangrove for future by IUCN and government of India is a step in right direction. It will also fulfil sustainable development goal 14 i.e. conservation of lives depended on oceans.

4. What are cold deserts? Discuss their global distribution. How are they different from hot deserts? Explain.

Introduction

Cold desert are arid ecosystems which receive rainfall less than 25cm in a year. They are located in the interior of the continent and at high latitude, characterized by the temperate climatic condition – hot summer and chilled winter.

Body

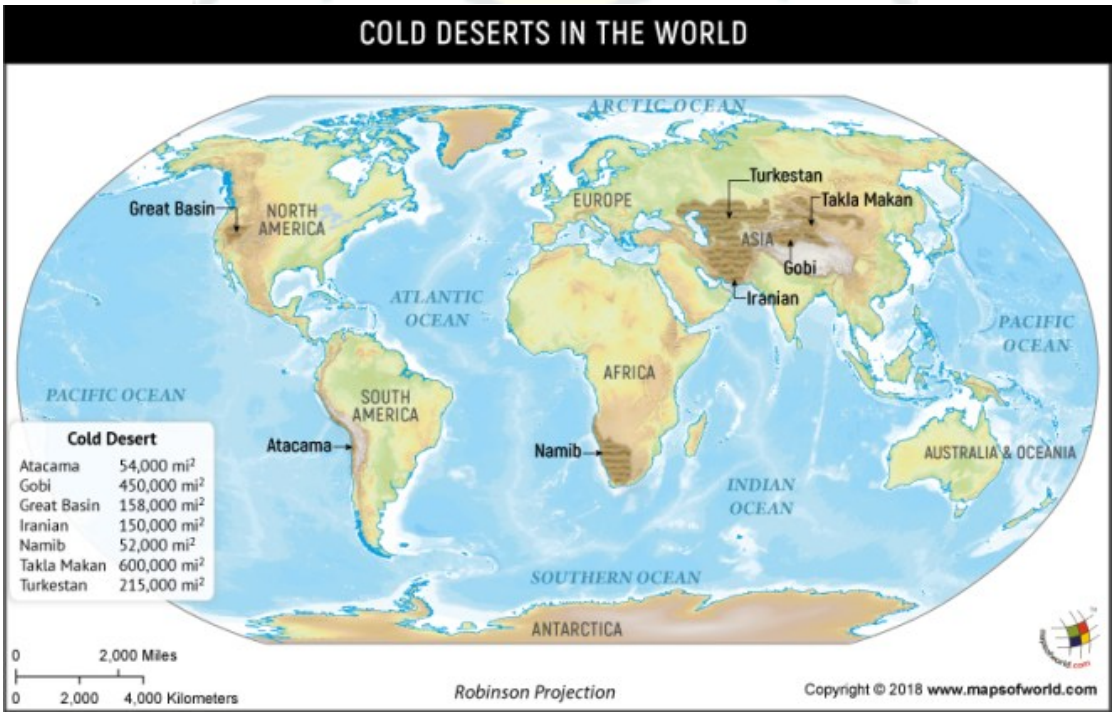
Global distribution:

- Cold deserts occur in temperate regions at higher latitudes.
- These deserts are often situated on plateaux and are a part of continental interiors.
- They are present in almost every continent but confined to temperate regions.

Distribution of cold deserts is depicted in the map. Some of them are

- North America – Great basin
- South America – Atacama Desert, Patagonian desert
- Eurasia – Iranian desert ¸Gobi desert, Turkestan
- Africa – Namib desert

In India, we can see the presence of cold desert like conditions in the region of Ladakh.



Courtesy : mapsofworld.com

Difference between hot and cold deserts:

The main aspect that differentiate the cold desert from a hot desert are:

- The hot deserts are mainly formed in tropical and subtropical regions whereas the cold deserts are found in temperate regions.
- Hot deserts are formed due to reasons like the offshore wind patterns, aridity due to cold current, sand property and heat whereas cold deserts are formed mainly due to continentality and rain-shadow effects.
- The cold deserts have an extremely chilling winters which is totally absent in hot deserts.

Apart from this, some of the differences include:

Hot Desert	Cold Desert
It has a sandy soil.	It has sand, ice or snow covered land.
It is red or orange in colour.	It generally appears gray.
Precipitation levels are generally lower than cold deserts.	They tend to have higher precipitation levels than hot deserts.
Evaporation is higher than precipitation in hot deserts.	Precipitation is higher than evaporation in cold deserts.
Commonly found animals include fennec foxes, dung beetles, bactrian camels, sidewinder snakes, Mexican coyotes etc.	Commonly found animals include foxes, jackrabbits, kangaroo rats, pocket mice, badger etc.
Vegetation is very rare and mostly includes ground-hugging shrubs and short woody trees.	Vegetation is scattered with needle like leaves.

Conclusion

The worrying trend is the increase of desertification and expansion of both the types of deserts. Natural causes for desert formation have been from times immemorial, it is the anthropogenic causes which are cause of concern. The plan of action to combat desertification needs to be in line with the UN convention to combat desertification (UNCCD).

5. What is badland topography? How are they formed? Discuss their distribution in India.

Introduction

Badlands are some of the best examples of naturally occurring, erosion-shaped terrains on earth. They are simply clay soils in dry areas that have been eroded to a significant degree, so as to form their iconic shapes and topography.

Body

- Badlands are erosional landforms of highly dissected morphology that are pervasive on soft bedrock in a variety of climate conditions. Although these systems share common geomorphological features, badlands may show diverse erosive activity, age and dynamic behaviour, which complicates the analysis of the reasons for badland formation.
- Badlands develop in arid to semiarid areas where the bedrock is poorly cemented and rainfall generally occurs as cloudbursts. The dry, granular surface material and light vegetation is swept from the slopes during showers, leaving the gullies bare.
- Badland are areas cut and eroded by many deep, tortuous gullies with intervening saw-toothed divides. The gullies extend from main rivers back to tablelands about 150 m (500 feet) and higher.
- The gully bottoms increase in gradient from almost flat near the main rivers to nearly vertical at the edges of the tablelands. Because the rocks are not uniform in character, differences in erosion result in stair-step profiles.
- The joining and separating of the gullies cause many isolated irregular spires, small flat-topped buttes, or mesas, and produce a landscape of jagged, fluted, and seemingly inaccessible hills.
- Badlands have also been formed artificially by mining operations and by poor agricultural practices that remove topsoil from the land.

The Distribution of Badlands in India:

- According to one estimate, most of the badlands in India, which are presently sculptured by rills, gullies and ravines, were once covered by thick deciduous forest.
- The factors and processes of deforestation throughout the country were industrialisation, railway building, extension of settlement and agricultural activities.
- In Uttar Pradesh, the problem of ravine erosion and formation of badlands has been noticed along the Yamuna. Chambal, Gomati and their tributaries flowing through the districts of Etawah. Mathura, Jalaun, Jhansi, Hamirpur, Banda, Agra and Mirzapur.
- In Madhya Pradesh, badlands are seen along Chambal, Sindh and their tributaries critically affecting districts like Shivpur. Morena. Bhind, Gwalior, Ujjain and Mandsor.
- In Rajasthan, the problem of gully erosion is most acute along the Chambal and its tributaries like Banas, Kalisindh, Parbati, Mej and Morel. Districts like

Kota, Bundi, Sawai. Madhopur, Tonk, Jhaleswar. Jaipur and Bharatpur districts are most affected.

- Bihar also has significant areas under ravenous lands in Hazaribagh, Ranchi. Singhbhum district of Chotanagpur plateau.
- In West Bengal, gully eroded and shallow ravinous badlands occur in the fringe areas of Chotanagpur plateau and adjoining Rarh upland. The Chotanagpur plateau consist four erosion surfaces and interconnecting scarps that have been marked by three intermittent uplifts from early Tertiary to Pleistocene.

Conclusion

In light of the fact that the country is losing about 8,000 hectares of land to ravines every year, it becomes necessary to develop capability to fight deforestation and other factors affecting badland formation and help safeguard the integrity of land in India.