**1. Discuss the distribution of major mangrove concentrations in the world. What roles do mangroves play in maintaining the ecological balance? What are the threats to mangroves? Discuss.**

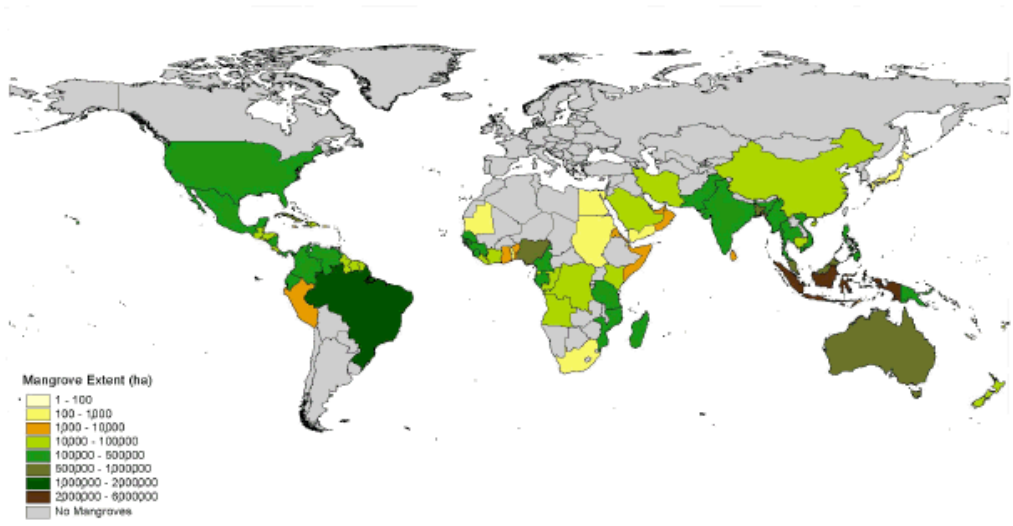
**Introduction:**

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:**

As of 2012, 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.

**Distribution of major mangrove concentrations:**




- 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.

**Role of mangroves in maintaining the ecological balance:**

- Basis of a complex marine food chain.
- Help in water quality improvements.
- Mangroves serve as breeding, feeding and nursery grounds for most of the commercial fishes and crustaceans on which thousands of people depend for their livelihood
- They are a natural coastal defence. The sturdy root systems of mangrove trees help form a natural barrier against violent storm surges and floods.
- River and land sediment is trapped by the roots, which protects coastline areas and slows erosion. This filtering process also prevents harmful sediment reaching coral reefs and sea grass meadows
- They are carbon sinks. Coastal forests help the fight against global warming by removing carbon dioxide from the atmosphere, most of which is stored within the plant. When mangrove tree roots, branches and leaves die they are usually covered by soil, which is then submerged under tidal water, slowing the breakdown of materials and boosting carbon storage.
- They are rich in biodiversity and harbour a number of faunal and floral species, both aquatic and terrestrial. Mangroves are regarded as the most productive ecosystems on account of the large amounts of organic and inorganic nutrients that are released by them.

**Threats to mangroves ecosystem:**

Climate change may reduce global mangrove area by 10-15%, but it is a long term, less significance threat to the current 1-2% annual loss from human activities.

**Natural threats:**

- Cyclones, typhoons and strong wave actions.
- Trampling and over grazing by wildlife and livestock close to mangrove regions.
- Damage by crabs, oysters and pests to the young seedlings of mangroves.

**Anthropological threats:**

- Agriculture: Many thousands of acres of mangrove forest have been destroyed to make way for rice paddies, rubber trees, palm oil plantations, and other forms of agriculture.

- Coastal Development: Coastal development takes many forms but as streams and wetlands are filled by roads and concrete, they can no longer process natural chemicals. Worse still, pollutants that accompany development can damage individual trees or whole tracts of mangroves.
- Shrimp Farming: By far the greatest threat to the world's mangrove forests is the rapidly expanding shrimp aquaculture industry. Hundreds of thousands of acres of lush wetlands have been cleared to make room for artificial ponds that are densely stocked with shrimp.
- Charcoal and Lumber Industries: Chopping down mangroves for charcoal and timber is an important cottage industry for many coastal communities. Mangrove wood is used for building material, fencing, and fuel. It also yields valuable, high-quality charcoal. In places where fishing has declined below subsistence levels, many people have turned to charcoal production for their livelihood, which furthers the cycle of habitat loss and fishery decline.

**Way forward:**

- Stronger Legal and regulatory approaches for protection must be enforced. Example: Maharashtra Govt ensured 'Reserved Forests' status to mangroves.
- Global initiatives like Mangroves for the Future (MFF) by IUCN, global assessment of mangrove status by Mangrove Atlas etc must be encouraged and participative.
- Heightened awareness by people all over the world and preservation methods and knowledge must be imparted effectively.

**Conclusion:**

As countries race to protect their forests, they must also protect the vital mangrove ecosystems along their coastlines. With continued data analysis, conservation, management and restoration, we can halt the loss of the world's remaining mangrove forests and begin to reverse it.

**2. What will happen if one day all the ice caps melt away? Analyse. What are the most potent threats to ice caps? Discuss.**

**Introduction**

The cryosphere is the part of the Earth system comprised of frozen water: ice sheets and glaciers, snow, permafrost and sea ice. As the climate warms, the inevitable response of the cryosphere is enhanced melting.

**Body**

**Effects of melting of ice caps:**

- **Loss of ice means more heat is absorbed**: Albedo is a measure of how well a surface reflects sunlight. Snow-covered sea ice has a high albedo and reflects 85% of sunlight. But the open water revealed as ice melts is darker and absorbs more – reflecting just 7%. The less sunlight the Earth's surface reflects the more heat the planet absorbs.
- **Thawing permafrost amplifies warming:** Rising Arctic temperatures are thawing once-frozen ground in the Arctic – known as "permafrost". Scientists are concerned that CO2 and methane released from the carbon-rich permafrost could cause additional warming by adding to greenhouse gases already in the atmosphere.
- **Melting Greenland ice sheet raises sea levels:** As land ice melts, it adds freshwater to the oceans causing sea levels to rise, and surface melt from Greenland is increasing, as the image below shows. Satellite data suggest over the last 20 years, the Greenland ice sheet has lost 140bn tonnes of ice per year.
- **Decreases the salinity:** Polar ice caps are made of fresh water, so adding more fresh water without adding more salt makes the ocean water less saline. This can cause problems for organisms that are well adapted to the very salty ocean waters.
- **Melting sea ice can influence winter weather:** As temperatures rise faster in the Arctic than at lower latitudes, this changes large-scale temperature and pressure gradients – which may have consequences for extreme weather in the northern hemisphere.
- **Ocean circulations could change**: Impact of Arctic and Greenland ice melt could be that the freshwater runoff into the ocean disrupts part of a major circulation system known as the Atlantic Meridional Overturning Circulation (AMOC). The AMOC carries warm surface water northward from the tropics, giving Western Europe its mild climate.
- **Changes to Wildlife**: In the Arctic, as sea ice melts, wildlife like walrus are losing their home and polar bears are spending more time on land, causing higher rates of conflict between people and bears.
- **Indigenous Peoples:** Tribals in the Northern Hemisphere are experiencing reduced hunting seasons because of increased early spring ice melts. Because they mostly live in the coastal regions near the arctic, they depend on sea ice as a means for transportation and hunting. As the ice melts, their means to support themselves decrease.
- **Transportation decreases**: Declining coverage of sea ice and snow, which will affect marine and ground transportation across the Arctic.

**Threats to ice caps:**

- **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 Antartic sea ice only covers a small fraction of the Earth's surface, there may well be serious climate-related impacts

**3. How is urbanisation affecting the water bodies in the cities? What are its implications? Examine.**

**Introduction**

The CAG report had referred to the 2015 Chennai floods as a man-made disaster. On a contradicting note, the same city of Chennai is now in the midst of water scarcity crisis.

**Body**

Urbanisation is taking place at a faster rate in India. Population residing in urban areas in India crossed 30% as per 2011 census, standing at **31.16%.**

According to the **Composite Water Management Index (CWMI)** report released by the NITI Aayog in 2018, 21 major cities (Delhi, Bengaluru, Chennai, Hyderabad and others) are racing to reach zero groundwater levels by 2020, affecting access for 100 million people.

**Urbanisation affecting Waterbodies:**

**Exploitation of Ground water:**

- We need to also realise that with the country's rapid urbanisation, demand cannot be met by groundwater reserves alone.
- For instance, according to the Delhi Jal Board estimates, groundwater meets just 10% of Delhi's drinking water needs. The rest is met by surface water sources, most of it transported from outside Delhi.

**Encroachment**

- In Bengaluru, 15 lakes have lost their ecological character in less than five years according to a High Court notice to the city's administrative body responsible for civic amenities and some infrastructural assets.

**Pollution**

- There is an increasing level of urban population which however is not having enough civic facilities such as adequate infrastructure for the disposal of waste. Therefore, lakes become the dumping grounds for disposing untreated local sewage and solid waste.

**Eutrophication:**

- Lakes are closed water bodies. Therefore, a large part of the substances that enter in the lakes become a permanent part of it. There is a rapid change in the in the lakes which leads to growth of unwanted weeds destroying ecology of the lakes.

**Unplanned Tourism Activities**

- There is unplanned tourism activities as there is no systematic planning and regulation. There is no adequate facility to dump garbage which leads to lakes becoming dumping grounds. Therefore, adequate arrangements for sustainable tourism must be made in cities like Udaipur which is filled with lakes, Dal Lake in Srinagar, etc.

**Implications:**

**Water Quality**

- Research within India revealed the scale of urbanisation impacts in Hyderabad, where the number of waterbodies has fallen dramatically. Lakes in Hyderabad were also found to have **fluoride concentrations** exceeding maximum permissible limits set by the Bureau of Indian Standards and World Health Organization.
- Fresh Water Watch measurements identified key links between the nutrient concentration and inputs of raw sewage, domestic waste and industrial effluents.

**Urban floods:**

- Improper and Inefficient Urbanisation is the primary cause for the floods in urban areas, especially in metros. For instance, failure of the drainage system is believed to be one of the primary causes behind the Chennai floods in December 2015 that led to the death of more than 400 people.

**Water Crisis**

- Cooum, Buckingham canal and Adayar are the three rivers that runs through the chennai city, all are dried up and dead due to industrial wastes and lack of civic measures.
- These coupled with Over exploitation of ground waters are turning cities into Dry and Dead cities in near future.

**Solution – Mitigation & Rehabilitation**

- Cities need to stop the destruction of local water bodies and local tree cover, treat its sewage properly, harvest rainwater, and stop straightening and concretizing the rivers and encroaching on their floodplain.
- **Mission Kakatiya Model:** Mission Kakatiya of Telangana involves the restoration of irrigation tanks and lakes/minor irrigation sources built by the Kakatiya dynasty.
- **Reclaiming of Kundalahalli Lake:** Kundalahalli lake in Bengaluru which had made way for a landfill has been reclaimed through corporate social responsibility funds in a Public-Private Partnership model.
- Mapping of the flood prone areas is a primary step involved in reducing the risk of the region. Historical records give the indication of the flood inundation areas and the period of occurrence and the extent of the coverage.
- Enacting the Flood Plain Zoning Bill in states
- The number of casualties is related to the population in the area at risk. Hence, in areas where people already have built their settlements, measures should be taken to relocate to better sites so as to reduce vulnerability.
- No major development should be permitted in the areas which are subjected to high flooding. Important facilities like hospitals, schools should be built in safe areas. In urban areas, water holding areas can be created like ponds, lakes or low-lying areas.
- Better coordination among the government agencies which undertake lake and wetlands restoration and protection programmes
- With the help of reforestation, protection of vegetation, clearing of debris from streams and other water holding areas, conservation of ponds and lakes etc. the amount of runoff can be decreased.

**Conclusion**

It is estimated that in just 30 years from now, by 2050, half of India will be living in cities. The Chennai crisis is not an alarm, but it is an explosion signalling to wake up

or else humanity would be facing the consequences of nature wreaking great havoc on humanity.

**4. Examine the factors behind the uniqueness of flora and fauna in Australia.**
**Introduction**

Australia is a land like no other, with about one million different native species. More than 80 per cent of the country's flowering plants, mammals, reptiles and frogs are unique to Australia, along with most of its freshwater fish and almost half of its birds.

**Body**

The distribution of both flora and fauna within a geographic range will depend on a number of related factors, including microclimate, predation pressure, competition, habitat structure and the distribution of resources including food, water and mates etc.
Evolutionary isolation and other geographical factors are responsible for unique flora and fauna of Australia.

**Evolutionary isolation**

- Australia has a unique flora and fauna because it was isolated from the rest of the world for very long periods.
- The Australian continent was surrounded by ocean for many millions of years, and so the plants and animals on that very large life-raft were able to evolve in distinctive ways.

**Geographical factors**

- Isolated Location: Tropic of Capricorn divides Australia into two almost equal parts. It has effects of tropical, subtropical as well as temperate climatic effects. It is surrounded by Ocean from all the sides.
- Tectonic stability: This has ensured any large scale destruction of flora and fauna.
- Unique Topography: Australia is divided into three major physical parts viz Eastern highlands, central low lands and western plateau.
- Diverse climatic features: Mostly desert or semi-arid in west and central parts of the country, south-east and south-west corners are temperate, whereas northern parts have tropical climate, varied between tropical rainforests, grasslands, part desert.
- Varying Rainfall: Due to unique topography and location, rainfall distribution varies throughout the Australian land. Eastern, north eastern and south western parts of the country comes in the way of rain bearing winds, thus receive heavy rainfall. Eastern high lands acts as a barrier to these winds, thus very large parts of western and central Australia have scanty or no rainfall at all.

**Conclusion**

- Due to such geographic uniqueness and evolutionary isolation, Australia became home to very unique flora and fauna, which includes largest number of marsupials and venomous snakes.

When animals and plants evolve in isolation they can become more vulnerable to novel predators or pathogens, this is one of the reasons Australia is so vigilant about quarantines and making sure they keep certain pathogens and invasive species out of the country.
Cane toads and rabbits are an example of invasive species gone amuck in Australia.
Aboriginals of Australia also played an important role in preservation and conservation of country's unique flora and fauna.

**5. Discuss the process of formation of coral reefs. What role does the Great Barrier Reef of Australia play in maintaining the coastal ecology? Explain.**

**Introduction:**

A coral reef is an underwater ecosystem characterized by reef-building corals. Reefs are formed of colonies of coral polyps held together by calcium carbonate. Most coral reefs are built from stony corals, whose polyps cluster in groups. Often called "rainforests of the sea", shallow coral reefs form some of Earth's most diverse ecosystems.

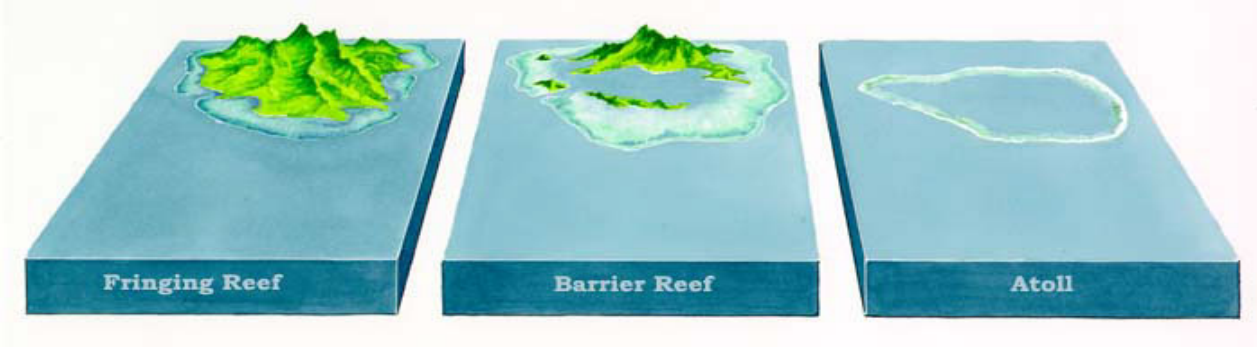
**Body:**

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 colours.

**The process of formation of coral reefs:**

Coral reefs are large underwater structures composed of the skeletons of colonial marine invertebrates called coral. 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.

Reefs form when corals grow in shallow water close to the shore of continents or smaller islands. As the corals grow and expand, reefs take on one of three major characteristic structures —fringing, barrier or atoll.




- 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.
- The rings of coral that makeup atolls create protected lagoons in the middle of the oceans, typically around islands that have sunk back down into the ocean.


The largest of these coral reef systems is the Great Barrier Reef in Australia. It plays an important role in maintaining the coastal ecology of the world in the following manner.

- It provides food, shelter and breeding area to at least 400 individual species of coral.
- It is the primary habitat for more than thousands of different species of fish, mollusks, sea snakes, sea turtles, whales, dolphins, birds and more. Their destruction can lead to the extinction of thousands of species of marine life.
- They reduce the damage in case of storms, hurricanes and tsunamis by absorbing wave energy and contribute to environmental protection through the reduction of coastal erosion.
- They protect ecosystems located between the reefs and coasts, such as seagrass and lagoon for example, and human settlements located by the sea.
- Reefs also protect the highly productive wetlands along the coast.

**Threat to Coral reefs:** Coral reefs are fragile because they are sensitive to water conditions. They are under threat from excess nutrients (nitrogen and phosphorus), rising temperatures, oceanic acidification, overfishing, sunscreen use, and harmful land-use practices, including runoff and seeps. Many of these threats can stress corals, leading to coral bleaching and possible death of these delicate ecosystems.

**Conclusion:**

Coral reefs deliver ecosystem services for tourism, fisheries and shoreline protection. They are also are a source of food and new medicines. The need of the hour is to protect coral reefs by reducing and eventually eliminating dumping materials and chemicals, reduce fishing and monitor the water quality of run-off directed toward the reef. Healthy reefs lead to healthy oceans, and healthy oceans are vital to all life on Earth.