1. Discuss the unique flora and fauna of Australia. What are the geographical factors that impart this uniqueness?

Approach:

Question is straight forward in its approach students are expected to discuss the unique geographical features of Australia and how it impacts the distribution of flora and fauna of the country cum continent.

Introduction:

Australia's geographic isolation has meant that much of its flora and fauna is very different from species in other parts of the world. Most are found nowhere else. However, some closely related species are found on the continents which once made up the ancient southern supercontinent Gondwana. Covered in rainforest and ferns 300 million years ago, Gondwana included South America, Africa, India and Antarctica. Most of Australia's flora and fauna have their origins in Gondwana, which broke up about 140 million years ago.
Australia separated from Antarctica 50 million years ago. As it drifted away from the southern polar region, its climate became warmer and drier and new species of plants and animals evolved and came to dominate the landscape.

Body:

Flora

- Australia has a huge diversity of plants (27 700 plant species according to the last studies), due to the fact that the country is huge and the climate is different from one region to another. From the rainforests of the North Queensland to the dry vegetation of the Red Centre, from the temperate plains of the NSW to the forests of Tasmania, diversity seems to have no limit.
- Even in the most arid parts of the country, sudden rainfalls can turn a desperate landscape into a field of wildflowers. Among Australia's thousands of plant species, some are more emblematic than others. One of the best known Australian tree is the Eucalyptus. More than 2 500 species of Eucalyptus are represented in Australia! On warm days, eucalyptus forests are sometimes shrouded in a smog-like haze.
- The Blue Mountains, 70kms west of Sydney, take their name from this haze. Australia also has around 1 000 species of acacia, that they call "wattles.
- Located in North Queensland, this forest is the oldest tropical rainforest on earth, dating back 135 million years! Since 2015, most of the forest is listed as a UNESCO world natural site. The Kakadu National Park and its wetlands (also called billabongs) are another must-do for nature lovers. The Kakadu is not only Australia's largest National Park, it is also a UNESCO world natural and heritage site.

The fauna of Australia consists of a huge variety of animals. Did you know that more than 80% of mammals, nearly 90% of reptiles and more than 90% of amphibians that inhabit the continent are endemic to Australia? Mammals:

- Marsupials: They are certainly the most famous Australian animals! A distinctive characteristic is that most of the young are carried in a pouch. That is of course the case of kangaroos. There are in fact many species of kangaroos: Eastern grey kangaroos, Red kangaroos, Western grey kangaroos, Tree kangaroos... You might also see wallabies, which are smaller than kangaroos, and wallaroos, which are even smaller! Another emblematic species of marsupials is koalas.
- Monotremes: They are probably the most exotic animals of Australia, a transitory group between mammals and reptils! You have certainly heard about the platypus, this crazy mammal with a duck beak. They are the only mammal that lay eggs instead of giving birth! The platipus is the animal emblem of the state of New South Wales.
- Placentals: As stated before, there are only a few native placental mammals in Australia. Dingoes are one of them. For many Australians, the dingo is a cultural icon. They play a prominent role in the Aboriginal culture. Dingoes are the largest terrestrial predator in Australia. They play an important role as an apex predator. However, they are seen as a pest by farmers, due to attacks on animals.
- Reptils and Batracians:Australia is home to 140 species of snakes. Uniquely, Australia has more venomous than non-venomous species of snakes! The most dangerous are the inland taipan, the tiger snake and the common death adder. Fortunately, the snakes are shy animals that flee contact with humans. Casualties are therefore really rare. Crocodiles: Saltwater crocodiles can be find along the Northern coast of Australia. They are the largest of all living reptiles. Males can reach sizes up to 6.30m! The saltwater crocodiles are carnivorous predators, that are dangerous for humans. Signs have been displayed to inform people that crocodiles live around, but do no hesitate to ask locals for more details. Freshwater crocodiles are much smaller (2-3 meters) and are not known as man-eaters. However, they might bite if you disturb them.
- Fish and marine animals: About 25% of the world's species of fish can be found in the Australian waters. The Great Barrier Reef is listed as a UNESCO world natural site since 1981. Australia is home to 1700 species of corals, and is therefore a paradise for divers and snorkelers! Those that want to watch whales will also find happiness in Australia. Humback whales are the most common species.
- Birds: There are over 800 species of birds in Australia. Half of them are endemic. The best spots to watch them are the Broome Bird Observatory and the Kakadu National Park. Some species are really unusual. The emus, the second-largest living bird by height, are able to run as fast as horses... but cannot fly!

Unique Geographical Features of Australia

Australia is a relatively low-lying island with low relief. It is the flattest of all the continents. The various highland ranges are pronounced, but are not high in elevation. The Great Dividing Range is a mountain chain extending

from Melbourne in the south to Cape York in the north. This low-lying range of highlands averages about four thousand feet and reaches an elevation of just over seven thousand feet at its highest peaks in the south. The largest river in Australia is the Darling-Murray River system that starts in the highland of the Great Dividing Range and flows inward through New South Wales, Queensland, Victoria, and South Australia.

The great interior of the country is home to the massive outback. Extending west from the Great Dividing Range, the outback encompasses most of the interior. This region receives less rainfall than along the coast and its terrain consists of deserts and semiarid plateaus with rough grasses and scrublands. The outback is sparsely populated, but is home to a number of aboriginal groups. Many of the school-age children in the outback have traditionally received their school lessons through television or radio broadcasts because of their isolation. Mining and some agricultural activities can be found in the outback. Alice Springs is located in the center of the continent and has been given the designation of the middle of nowhere, or the center of everything.

The deserts of Australia's interior make up a large portion of the continent. Western Australia has three large deserts: the Gibson Desert, Great Victoria Desert, and Great Sandy Desert. The Simpson Desert is located in the border region between the Northern Territory, Queensland, and South Australia. These deserts are not all sand; course grasses and various species of spinifex, a short plant that grows in sandy soil, also grow in the deserts. The Great Artesian Basin on the western edge of the Great Dividing Range receives very little rainfall. It would be classified as a desert but for its underground water resources, which support extensive farming operations. Large livestock businesses exist in Australia's interior with massive herds of cattle and sheep. The grassy plateaus and scrublands provide grazing for domesticated livestock and even wild camels. The Great Barrier Reef, the largest barrier reef in the world, extends for 1,600 miles off the northeastern coast of Australia. It is home to a host of sea creatures and fish that draw millions of tourists each year.

Conclusion:

Australia is both the flattest continent and, except for Antarctica, the driest. Seen from the air, its vast plains, sometimes the colour of dried blood, more often tawny like a lion's skin, may seem to be one huge desert. One can fly the roughly 2,000 miles (3,200 km) to Sydney from Darwin in the north or to Sydney from Perth in the west without seeing a town or anything but the most scattered and minute signs of human habitation for vast stretches. A good deal of the central depression and western plateau is indeed desert. Yet appearances can be deceptive. The red and black soil plains of Queensland and New South Wales have long supported the world's greatest wool industry, and some of the most arid and forbidding areas of Australia conceal great mineral wealth.

2. What is an air mass? With the help of suitable examples, illustrate the impact of air mass on weather conditions.

Approach

The candidate needs to explain what is an air mass in the first part of the answer and then elaborate upon the impact of air mass on weather conditions, with the help of proper examples for substantiation.

Introduction

An air mass is a large volume of air in the atmosphere that is mostly uniform in temperature and moisture. Air masses can extend thousands of kilometres across the surface of the Earth, and can reach from ground level to the stratosphere into the atmosphere.

Body

- Air masses form over large surfaces with uniform temperatures and humidity, called source regions. When winds move air masses, they carry their weather conditions from the source region to a new region. When the air mass reaches a new region, it might clash with another air mass that has a different temperature and humidity. This can create a severe storm.
- The warm air masses form over the equator or desert areas where the solar radiation is maximum. In clear, almost cloudless days, the heat is reflected back to the atmosphere. The air becomes light and spreads.
- Cold air masses form near the poles where solar radiation is at a minimum. On cloudless days, the snow cover near the Poles, reflect sunlight away, preventing the earth to warm up. When this persists for a long period of time, cold air masses form over a large area.

Impact of Air mass on weather conditions –

In a particular area, the occurrence of particular air masses helps to ascertain the climate of that region. This in turn decides the type of flora and fauna as well as the type of crops that can be grown. For instance –

- Precipitation: E.g. the maritime-tropical air over Atlantic Ocean, Caribbean Sea is a major reason for precipitation east of Rocky Mountains. It is also the cause of persistent humidity in the summer season.
- Temperature: Maritime polar air affects the coastal temperature in subtropical and arctic regions.
- Cyclones and anti-cyclones: Stormy cyclones form near the air-mass fronts. The mixing of air masses will result in rising air feeding the cyclone formations in the subtropical cyclone. Similarly, the warm maritime tropical air mass will provide the energy for tropical cyclones.

- Drought: they are the result of hot, dry air mass. This can destroy natural vegetation and kill trees. These regions have the increase risk of devastating wildfires. E.g. California wild fires.
- At the boundaries between air masses, the clash of masses of air with different characteristics can lead to dynamic weather like hail, tornadoes, high winds or ice storms. E.g. tropical cyclones formed in East China Sea.
- Air masses can control the weather for a relatively long time period: from a period of days, to months. Most weather occurs along the periphery of these air masses at boundaries called fronts.

Conclusion

Air masses spread across massive region, extending up to hundreds of kilometres and they exercise a considerable influence on the climatic conditions of the region over which they lodge and carry with them distinctive climatic features of their source region. This demonstrates their importance and the need to understand the phenomenon in a more holistic way.

3. Discuss the formation of ocean currents and their impact on coastal climate.

Approach

Candidates are expected to write about ocean currents and then discuss how there formation impact the coastal climate.

Introduction

The term "current" describes the motion of the ocean. Ocean currents are driven by wind, water density differences, and tides. Oceanic currents describe the movement of water from one location to another.

Body

Formation of ocean currents due to:

- Salinity: Waters of low salinity have lower density enabling them to flow on the surface of waters of high salinity while waters of high salinity flow at the bottom.
- Landmass: A land mass obstructs the direction of flow of ocean current and divides the ocean current to flow in a different direction.
- Influence of insolation: Heating by solar energy causes the water to expand. That is why, near the equator the ocean water is about 8 cm higher in level than in the middle latitudes. This causes a very slight gradient and water tends to flow down the slope. The flow is normally from east to west.
- Influence of gravity: Gravity tends to pull the water down to pile and create gradient variation.
- Influence of Coriolis force: The Coriolis force intervenes and causes the water to move to the right in the northern hemisphere and to the left in the southern hemisphere. These large accumulations of water and the flow around them are called Gyres. These produce large circular currents in all the ocean basins. One such circular current is the Sargasso Sea.
- Planetary winds: The planetary winds are permanent winds Trade winds, Westerlies and Polar Easterlies that blow from one pressure belt to the other. The oceanic circulation pattern roughly corresponds to the earth's atmospheric circulation pattern. There is a change in the direction of ocean currents with a change in direction of the monsoon winds in the Indian Ocean.

Currents affect the Earth's climate by driving warm water from the Equator and cold water from the poles around the Earth. It has various impact on the coastal climate:

- Desert formation: Cold ocean currents have a direct effect on desert formation in west coast regions of the tropical and subtropical continents. There is fog and most of the areas are arid due to desiccating effect (loss of moisture).
- Rains: Warm ocean currents bring rain to coastal areas and even interiors. Example: Summer Rainfall in British Type climate. Warm currents flow

parallel to the east coasts of the continents in tropical and subtropical latitudes. This results in warm and rainy climates. These areas lie in the western margins of the subtropical anti-cyclones.

- Moderating effect: They are responsible for moderate temperatures at coasts. North Atlantic Drift brings warmness to England. Canary cold current brings cooling effect to Spain, Portugal etc.
- Drizzle: Mixing of cold and warm ocean currents create foggy weather where precipitation occurs in the form of drizzle [Newfoundland].
- Climate: Results in Warm and rainy climates in tropical and subtropical latitudes [Florida, Natal etc.], Cold and dry climates on the western margins in the sub-tropics due to desiccating effect, Foggy weather and drizzle in the mixing zones, Moderate clime along the western costs in the sub-tropics.
- Tropical cyclones: They pile up warm waters in tropics and this warm water is the major force behind tropical cyclones.
- Navigation: Currents are referred to by their "drift". Usually, the currents are strongest near the surface and may attain speeds over five knots (1 knot = ~1.8 km). [At depths, currents are generally slow with speeds less than 0.5 knots]. Ships usually follow routes which are aided by ocean currents and winds. Example: If a ship wants to travel from Mexico to Philippines, it can use the route along the North Equatorial Drift which flows from east to west.
- Fishing: Mixing of cold and warm ocean currents bear richest fishing grounds in the world. Example: Grand Banks around Newfoundland, Canada and North-Eastern Coast of Japan. The mixing of warm and cold currents help to replenish the oxygen and favor the growth of planktons, the primary food for fish population. The best fishing grounds of the world exist mainly in these mixing zones.

Conclusion

Ocean currents and mixing by winds and waves can transport and redistribute heat to deeper ocean layers. Ocean currents acts to neutralise the temperature difference between different areas in the oceans just like the winds do on land. Currents are also important in marine ecosystems because they redistribute water, heat, nutrients, and oxygen about the ocean.

4. How does geomorphology of a region shape the economy? Illustrate.

Approach- Question is straight forward. Candidate is expected to define geomorphology and explain how it shapes economy of a particular region with the help of suitable examples.

Introduction

Geomorphology is the study of landforms, their processes, form and sediments at the surface of the Earth (and sometimes on other planets). Study includes looking at landscapes to work out how the earth surface processes, such as air, water and ice, can mould the landscape. The different climatic environments produce different suites of landforms. The landforms of deserts, such as sand dunes and ergs, are a world apart from the glacial and periglacial features found in polar and sub-polar regions.

Body

How geomorphology shapes economy of the region?

- Minerals: Areas with mineral deposits attract industries. Mining and industrial activities generate employment. So, skilled and semi–skilled workers move to these areas and make them densely populated. Katanga Zambia copper belt in Africa is one such good example.
- Landforms: People prefer living on flat plains and gentle slopes. This is because such areas are favourable for the production of crops and to build roads and industries. The mountainous and hilly areas hinder the development of transport network and hence initially do not favour agricultural and industrial development. So, these areas tend to be less populated. The Ganga plains are among the most densely populated areas of the world while the mountains zones in the Himalayas are scarcely populated.
- Soils: Fertile soils are important for agricultural and allied activities. Therefore, areas which have fertile loamy soils have more people living on them as these can support intensive agriculture.
- Availability of water: It is the most important factor for life. So, people prefer to live in areas where fresh water is easily available. Water is used for drinking, bathing and cooking – and also for cattle, crops, industries and navigation. It is because of this that river valleys are among the most densely populated areas of the world.
- Geomorphological factors influence industrial activities. Industrialisation: Industrial belts provide job opportunities and attract large numbers of people. These include not just factory workers but also transport operators, shopkeepers, bank employees, doctors, teachers and other service providers. The Kobe-Osaka region of Japan is thickly populated because of the presence of a number of industries.

- Urbanisation: Cities offer better employment opportunities, educational and medical facilities, better means of transport and communication. Good civic amenities and the attraction of city life draw people to the cities. It leads to rural to urban migration and cities grow in size. Mega cities of the world continue to attract large number of migrants every year.
- Transport and communication-Demand for transport is influenced by the size of population. The larger the population size, the greater is the demand for transport. Routes depend on: location of cities, towns, villages, industrial centres and raw materials, pattern of trade between them, nature of the landscape between them, type of climate, and funds available for overcoming obstacles along the length of the route.

Conclusion

Geomorphological factors play central role in determining the sort of economic activities that will play out in the region. These factors determine the location of particular industry, raw material for production and place of marketing. Economy revolves around these factors and shape economy in the long run.

5. How are coral reefs formed? Discuss. What are the most potent threats to coral reefs?

Approach

Discuss necessitates a debate where reasoning is backed up with evidence to make a case for and against an argument and finally arriving at a conclusion. So discuss the formation of coral reefs and then mention the most potent threats to them.

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.

Body

How are the coral reefs formed:

- Coral reefs begin to form when free-swimming coral larvae attach to submerged rocks or other hard surfaces along the edges of islands or continents. As the corals grow and expand, reefs take on one of three major characteristic structures — fringing, barrier or atoll.
- Classic coral reef formation change through time. They begin with a brand new tropical island (produced by an oceanic hot spot or at a plate boundary) and gradually change through thousands of years from a fringing reef, to a barrier reef, to an atoll, and finally to an extinct reef as a seamount or guyot.
- A fringing reef forms along the shoreline of most new tropical islands. This is because the reef building coral animal is one of the few marine organisms that can survive in the warm, nutrient-poor surface tropical waters.
- A barrier reef forms as the oceanic island begins to sink into Earth's crust due to the absence of volcanic island building forces, the added weight of the coral reef, and erosion at the surface of the island.
- An Atoll forms when the oceanic island sinks below the surface of the ocean but the coral reef continues to grow upward.

The most potent threats to coral reefs

- Coral reefs face numerous threats. Weather-related damage to reefs occurs frequently. Large and powerful waves from hurricanes and cyclones can break apart or flatten large coral heads, scattering their fragments.
- Reefs also are threatened by tidal emersions. Long periods of exceptionally low tides leave shallow water coral heads exposed, damaging reefs.

- The amount of damage depends on the time of day and the weather conditions. Corals exposed during daylight hours are subjected to the most ultraviolet radiation, which can overheat and dry out the coral's tissues.
- Corals may become so physiologically stressed that they begin to expel their symbiotic zooxanthelle.
- Increased sea surface temperatures, decreased sea level and increased salinity from altered rainfall can all result from weather patterns such as El Niño. Together these conditions can have devastating effects on a coral's physiology.
- In addition to weather, corals are vulnerable to predation. Fish, marine worms, barnacles, crabs, snails and sea stars all prey on the soft inner tissues of coral polyps. In extreme cases, entire reefs can be devastated if predator populations become too high.

Conclusion

Coral reefs may recover from periodic traumas caused by weather or other natural occurrences. If, however, corals are subjected to numerous and sustained stresses including those imposed by people, the strain may be too much for them to endure, and they will perish. Although corals can survive a bleaching event, they will eventually die if they are under repeated stress. Outbreaks of coral disease typically follow bleaching events since stressed corals are more susceptible to infection.