**Essay 1) Climate change has been identified as the most significant threat to the future health of the Great Barrier Reef. The effects of climate change can be both direct and indirect. Based on current rates of carbon dioxide emissions, not only are global sea temperatures projected to increase but the average pH of the oceans is also expected to significantly decrease.**

**A) What is the primary source of the increasing levels of carbon dioxide in the atmosphere?**

**B) How does carbon dioxide lead to increasing ocean temperatures and decreasing ocean pH (i.e. what is the science behind increasing carbon dioxide levels, climate change and ocean acidification?).**

**C) At times in the past, the Earth has been warmer and the seas have been more acidic. Why do the current trends in climatic warming and ocean acidification present a special challenge to the creatures of the Great Barrier Reef?**

The primary source of the rise in carbon dioxide emissions is humans and human activities such as the burning of fossil fuels and deforestation. Despite having occurred in the past, the immediate concern with the increase in ocean temperatures and decrease in ocean pH to the great barrier reef is that this change is much more rapid then it has ever been.

In recent years, humans have had a greater impact on climate change than at any other time in the history of our species. The increase in demand of fossil fuels such as oil, coal, and natural gas has caused a rapid surge in the emission of CO2 into the atmosphere of our planet. In addition, the deforestation of some of the world’s largest forests has disrupted the balance of carbon dioxide by eliminating the largest consumers of this gas.

The decrease in ocean pH that has occurred in the past century has been detrimental to the great barrier reef. This process occurs when carbon dioxide levels increase in the ocean. The majority of the carbon dioxide that enters the atmosphere when fossil fuels are burned by human’s dissolves into the ocean. As a result, the ocean acidifies quickly which leads to coral not being able to take in the calcium carbonate that they need to maintain their exo-skeletons. (Tarrant) Similarly, as more carbon dioxide is released through the burning of fossil fuels, the ozone in the atmosphere becomes thinner allowing more ultraviolet rays from the sun. These UV rays heat the surface of the ocean which causes a disturbance in the circulation of ocean currents. (Riebeek) Because the ocean surface is hotter, the currents in the ocean that are responsible for maintaining temperatures in a variety of maritime ecosystems are disrupted greatly. In addition, warmer ocean temperatures have led to algal blooms that threaten reef systems around the world. Without drastic changes, these issues are going to continue to get worse and we risk permanently damaging our oceans.

Although the oceans have been warmer and much more acidic in the history of the earth, current trends have been such a concern for the great barrier reef because these changes are happening in such a short period of time. As a species, human populations have grown at an unsustainable rate in modern times. This growth means an increase in the burning of fossil fuels and deforestation for agriculture. As a result, plants and animals have not been able to keep up with this rapid change and have not had time to adapt. This is extremely evident in the great barrier reef because ocean acidification, coral bleaching, and other factors have greatly disrupted this ecosystem and have caused extinction or a decline in almost all species that live there. The damage humans have done to our planet is past the point of repair. We must focus now on preserving the species we have left and ensuring our planet is livable for future generations.

Citations

Riebeek, H. (2016). *The Ocean’s Carbon Balance*. [online] Earthobservatory.nasa.gov. [Accessed 4 Jul. 2018].

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**Essay 2) Both New Zealand and Australia have native animal species that are significantly different from other parts of the world.**

**A) Which group of vertebrates came to dominate New Zealand and which group of vertebrates came to dominate Australia?**

**B) What were the factors that led to the success of these different vertebrates in these two locations?**

**C) Today what are the greatest threats to these groups of vertebrates?**

Australia and New Zealand are unique in that they have distinct species of invertebrates that came to dominate these regions. Because of a variety of geological factors, marsupials and monotremes now dominate Australia and unique species of birds dominate New Zealand.

New Zealand has a very dynamic landscape which has contributed to the diversity of flora and fauna found there. The most logical explanation for why New Zealand had extremely unique species of birds that dominated the region is the Oligocene drowning that occurred around thirty million years ago. (Tarrant) This drowning led to most of New Zealand’s landmass being submerged for a long period of a time which wiped out almost all terrestrial species. Once water levels fell, the only vertebrates that could inhabit this area were species of birds that eventually evolved to fill the ecological niches that mammals used to fill. Because they had no natural predators, these birds experienced vast success here and continued to evolve into unique species such as the giant moa and haast eagle. The bird species in New Zealand continued to be successful until the first humans inhabited the region and introduced different mammals like rats. Human destruction of the environment has contributed to the extinction and near extinction of species such as the Takahe. In addition, the introduction of new mammal predators like cats, stoats, and weasels has led to the extinction of many other species.

In the same way that birds dominate New Zealand, marsupials and monotremes have come to dominate Australia. Due to Australia’s drying and cooling periods and its geographic isolation, many invertebrates were wiped out and the ones that survived adapted specific traits to thrive in these conditions. For example, marsupials give birth to undeveloped young that grow in the mother’s pouch for the first few months of their lives. (Ling) Marsupials can travel easily with their newborn offspring to locate food and water which contributes greatly to the success of these species. In addition, another type of mammals known as monotremes evolved and adapted to thrive in the ecosystems of Australia. Monotremes are unique in that they are the only mammals to lay eggs which contributes to their success in harsh climates. Furthermore, species such as echidnas adapted swimming abilities to survive during floods as well as burrowing abilities to dig underground quickly to survive during fires. The greatest threat to these species is habitat destruction and the increase in vehicles. Because of habitat loss and roadkill, species like brush tail opossums, short beaked echidnas, and the platypus are experiencing a decline in population.

Australia and New Zealand have some of the most unique and diverse species of vertebrates anywhere in the world. However, the recent impact of humans on the environment has caused a rapid loss of native species in these two regions and without an increase in conservation efforts, we risk losing most if not all the species.

Citations

Tarrant, M.A. (2015). Sustaining human societies and the natural environment: eBook. Austin, TX: Sentia Publishing.

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**Essay 3) How do natural biotic (i.e. living) systems support humans and human society? How would you describe to a friend or family member the ‘value’ of a New Zealand rainforest (e.g. Deep Cove), a coral reef or an oasis in the Australian outback?**

Natural biotic systems support humans and human society in a variety of ways such as providing medicinal uses, producing food, and boosting the global economy through tourism. As a result, living systems including coral reefs are crucial in supporting human life on earth.

Coral reef systems and the Great Barrier Reef in general contain a plethora of natural medicines. It is thought that reef systems could potentially contain the cures for societies most pressing ailments such as asthma, arthritis, and even cancer. (Levins) However, the average person does not understand how crucial reefs are in providing medicines and do not value them as important. Nearly thirty treatments made from marine organisms are being developed and tested on humans to treat different forms of cancer. In addition, it is thought that we are three hundred times more likely to find new medicines in the oceans and coral reefs than on land. (Levins) If this does not become common knowledge, we run the risk of destroying our most useful assets in finding a cure for the deadliest diseases.

Reef systems around the world are extremely important in producing food for a great deal of the planet’s population. It is thought that approximately one hundred million people around the world rely on reefs for subsistence living alone. (Tarrant) This does not include the huge numbers of commercial fishing boats that harvest fish in these waters to export overseas and sell domestically. Despite the negative impacts that fishing has on reef systems, this practice is crucial in producing food for people globally. By creating “green” zones and not allowing fishing in some regions, the Australian government is able to draw a fine line between using the great barrier reef as a food source but also managing the populations of its species. However, recent legislation has disrupted this balance and much of the reef is dying at an unsustainable rate. If this issue is not addressed, we risk losing not only a world heritage site but also a food source that people rely on all over the world.

One of the greatest economic benefits of reef systems and the great barrier reef Is the tourism industry. The great barrier reef is said to generate over sixty thousand jobs and contributes nearly six billion dollars to the Australian economy. In addition, this magnificent reef attracts one and a half million tourists every year. (Tarrant) This industry is crucial to the infrastructure of many towns and cities throughout Queensland. However, the combination of new coal mines being constructed and a variety of other factors is beginning to threaten this industry. Action must be taken to preserve this natural wonder.

Coral reef systems are crucial in supporting human life on earth. The rapid decline of reef systems around the world is detrimental to the global economy and signifies the loss of many potential medicines. If this issue does not gain widespread attention, humans will risk losing one of the most valuable natural assets on our planet.

Citations

Levins, N. (2018). *Coral Reefs and Medicine / The Nature Conservancy.* [online] Nature.org. [Accessed 2 Jul. 2018].

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