Global marine life affected by constant rise of water temperature due to global w...

Environment, Nature

According to the United Nations Intergovernmental Panel on Climate Change (IPCC) and various climate-change models, the temperatures of the waters in tropical regions are to increase by 1. 8-4°C over the next century due to climate change (Bates et al. 58). This increase is in addition to the 1°C increase in temperature of global waters over the course of the twentieth century (Schmidt 294). Warmer waters can cause a destructive phenomenon called coral beaching where coral turns white and death is almost certain. Climate change also increases the rate at which coral reefs are being destroyed by other factors such as pollution and overfishing, which have plagued coral reefs for decades. Due to the damaging effects of global warming, the temperature of waters surrounding coral reefs are beginning to increase to rates that cause coral beaching at a massive scale. Marine ecosystems and the human population will feel a backlash if coral reefs were to disappear: marine organisms and fish will lose safe shelter, undiscovered organisms in coral reefs will be lost to science and medicine, economies (both local and state) will no longer be supported by tourism, and tropical coastline will erode with no protection. This could be a good place for thesis/topic statement before you get into the biology, etc

Coral reefs are built with calcium carbonate deposited by corals and calcareous algae. They provide shelter to about 25 percent of marine species and as such, are sometimes known as the “ rainforests of the sea” (Buddemeier, Kleypas, and Aronson Foreword). Found mainly in tropical waters, coral reefs have lived for many years due to stable temperatures in their habitat. But climate change has increased the temperatures of the waters and mass bleaching events, such as in 1998 where 16 percent of the

world’s coral reefs were destroyed, are occurring more frequently (Anthony et al. 173). Coral bleaching is one of the top threats facing reefs since it weakens coral causing them to be more receptive to disease and to lose the nutrients formed by the zooxanthellae alga.

Coral Bleaching:

While coral reefs provide shelter for many different organisms, their livelihood is based on a symbiotic relationship with zooxanthellae, a single-celled alga. Zooxanthellae are embedded in the coral tissue and supply the reefs with nutrients, such as carbon, created through photosynthesis (Schmidt 292-293). At the same time, the coral reefs provide shelter close enough to sunlight for the zooxanthellae to successfully create nutrients. As ocean temperature increases, zooxanthellae are unable to produce minerals and nutrients due to high temperatures and high light levels and are released by corals (Buddemeier, Kleypas, and Aronson 15). The white calcium carbonate skeleton is exposed since zooxanthellae alga is one on the main sources of color for coral reefs (Schmidt 293). Coral reefs then starve to death because they do not receive the carbon and other nutrients provided by zooxanthellae. There are two types of bleaching that are applicable to present-day events: Algal-stress bleaching and physiological bleaching. Algal-stress bleaching occurs when algae inside coral reefs are unable to create nutrients through photosynthesis due to high light and temperature levels. Physiological bleaching occurs when coral reefs are unable to hold algae and are instead using the energy to counteract the effects of long periods in high temperature waters (Buddemeier, Kleypas,

and Aronson 15). Bleaching causes coral to be more susceptible to diseases since they are weak with low minerals and nutrients.

There have been many mass coral bleach events in the history of the Earth, but the mass bleaching event in 1998 of coral reefs around the world stands out as the worst bleaching event in history (Anthony et al. 173). Over the course of a year, 16 percent of all coral reefs in tropical seas around the world were affected by coral bleaching. Parts of the Indian Ocean, Southeast Asia, and the western Pacific had a high mortality rate where 50-90 percent of affected reefs were destroyed (Wilkson 20). There are many effects where coral reefs disappear due to coral bleaching: Marine organisms and animals lose shelter, tourism money generated from coral reefs is lost, humans lose the ability exploit reefs for medicine and food, and tropical coasts are at risk of erosion.

Effects of Coral Bleaching:

Disappearing Shelter

As stated above, reefs provide a safe place for about 25 percent of marine life to take shelter from natural predators (Buddemeier, Kleypas, and Aronson Foreword). Due to climate change, reefs are losing the ability to hold marine organisms that produce limestone to build reefs, such as coral and calcareous algae and are instead using energy to catch fish or to remove sediment from coral (Schmidt 297). To put quite simply, without a safe place to live, many organisms will become endangered, which will ultimately lead to extinction. With the bottom of the food chain gone, one can only imagine what consequences will be felt throughout the whole ocean ecosystem. One

devastating effect of disappearing marine life on reefs is how the reefs become more venerable to diseases such as the black-band disease that occurs in the Caribbean ((Buddemeier, Kleypas, and Aronson 25). When shelter for marine organisms is destroyed, humans lose out on the ability to exploit resources such as fish and algae for food, medicine, and scientific advancement.

Economic Loss

Just as coral reefs protect marine life, the economies of many states are greatly supported by the tourism that is created from reefs. According to Eileen Clauseen, President of Pew Center on Global Climate Change, tourism and fishing of reefs provide $30 billion to local and state economies each year (Buddemeier, Kleypas, and Aronson Foreword). Also, The Great Barrier Reef pumps about $6 billion into the Australian economy each year through tourism alone (Access Economics 45). As coral reefs disappear from climate change and other sources, the standard of living will most likely fall in local societies around reefs. As the standard of living falls, exploitation of the reef will increase, leading to the destruction of more reefs. Chemical and blast fishing will become more common as the society struggles to survive (Buddemeier, Kleypas, and Aronson 30). A specific example is the loss of tourism felt after the 1998 bleaching event to the island of Palau in western Micronesia and the Maldives. In Palau, the mass bleaching event caused 50 percent of their reef to die off; and in the years to follow, tourism dropped by about 5-10 percent (Buddemeier, Kleypas, and Aronson 30). In the Maldives, tourism decreased and an estimated $0. 5-3 million of revenue was lost between 1998-1999 (Buddemeier, Kleypas, and Aronson 30). Without coral

reefs, many economies will be thrown into turmoil as they search for ways to make up lost revenue. Fishing in coral reefs is also very important to the livelihood of many people.

It is estimated that 25% of the fish caught each year come from reefs. This amount of fish caught also feeds about 1 billion people (Schmidt 294). Without coral reefs, overfishing in EEZ's and other areas will increase, leading to endangering marine animals. Established in 1997, the Reef Check Program surveyed thousands of coral reefs from 1997-1999 to monitor their health. The main way volunteers in the program determine a reef's health is by counting how many indicator organisms are on the reef under examination (Hodgson, and Liebeler 23). The more indicator organisms on a reef, the healthier it is. Lobsters, Large Groupers, Butterfly fish, and Giant Clams are among the selected indicator organisms of a healthy reef due to their sensitivity to changes in the reef and surrounding ocean (Hodgson, and Liebeler 23). Sadly, according to the 1997 survey, many of the indicator organisms were not present on reefs at all. While this is not a direct result of coral bleaching (since the 1998 mass bleaching event had not occurred yet) it can only be assumed that the amount of healthy reefs dropped severely due to bleaching caused by climate change. This assumption is supported through evidence collected after the mass bleaching event where affected coral reefs experienced a mortality rate of 50-90 percent (Anthony et al. 173). With disappearing reefs, the science community is not given the ability to study all marine organisms residing in coral reefs, and will lose the ability to discover new drugs found in marine organisms.

Scientific Loss

It has been estimated that reefs support 800 types of coral, 4, 000 fish species and an immense number of invertebrates (Schmidt 294). Some scientists estimate that hundreds of thousands of other species living in reefs are still uncounted for. Due to the fact that corals and other immovable marine organisms cannot escape predators, they must rely on chemicals produced naturally to divert enemies and diseases (Schmidt 294). Some examples of medicine produced by organisms housed in coral reefs are the antiviral drugs vidarabine and azidothymidine and the anticancer medicine cytaraine (Schmidt 294). Due to the large number of undiscovered marine organisms residing in coral reefs, there is no way to estimate how many life saving drugs can be created through chemical compounds produced by the uncounted marine organisms. While reefs could potentially advance medicine, coastal waters will lose the natural bodyguards against waves and other types of erosion. Very good – your organization is great and really helps the clarity of your presentation/argument

Coastal Erosion

As climate change causes the sea-level to rise and coral reefs to die out though coral bleaching and disease, erosion will have a greater affect on coastal areas. For example, if the

sea-level along the coast of Bonaire rose by 0. 5 meters it is estimated about 38% of coastal beaches will be lost, reducing the amount of tourism to Bonaire which will lead to a weaker economy (Bates et al. 112). The sediment from eroded coasts flow into the ocean and large amounts fall onto

reefs. Bleached reefs are affected the most from large amounts of sediments since they have to spend energy clearing the sediment from their system instead of catching food (Schmidt 297). The already weak reefs become weaker due to low nutrients in their system. The sediment also covers areas in reefs where coral larvae could possibly settle and grow (Schmidt 298). With no possibility of reproduction, coral reefs are destroyed at an increasing rate when other factors such as overfishing, pollution and disease are taken into consideration. Even though corals are disappearing at an alarming rate, studies done on different types of reefs show there is a good chance reefs will adapt to higher surface temperatures and will come back faster and stronger after a coral bleaching event.

Coral Adaptation:

Because reefs are found throughout the tropical and subtropical waters in the world, they experience coral bleaching and other stresses differently between the different reefs (Buddemeier, Kleypas, and Aronson 2). There are also differences between the types of corals. Corals with rapid growth rates and thin tissues are more reactive to coral bleaching, while corals with thick tissues and slow growth rates are known to recover from most coral bleaching events except the most deadly (Buddemeier, Kleypas, and Aronson 16). The ability for reefs to adapt to climate change and recover from coral bleaching depends on two key circumstances: First, the degree at which coral bleaching has affected the reef. And second, the amount of time it takes for reefs to return to their original state before coral bleaching.

For example, if a minor bleach event occurred over the course of two days and only caused a portion of the more vulnerable zooxanthellae to be expelled, corals could easily recover. The new space allows for hardier alga to move in and form another symbiotic relationship with the coral (Buddemeier, Kleypas, and Aronson 28). Secondly, if coral reefs are to recover from a coral bleaching event, they must do so quickly if they are to reach the level corals were at before being bleached. A recent study conducted in Dubai, United Arab Emirates showed that after a major bleaching event, reefs will return even after ten years, but the strength and diversity of the reefs will be decreased significantly (Bartholomew, Burt, and Usseglio 33). Although, another study done through the Great Barrier Reef Marine Park Authority have found evidence showing how major bleaching events can lead in increased thermal tolerance in reefs. Three coral genera (Acropora, Pocillopora, and Porites) were studied between 1998 and 2002 on whether or not reefs will return after a bleaching event with a higher heat capacity. The results showed all three coral genera experienced coral bleaching at a much lower level than what was estimated even though thermal stress in 2002 was almost double than what coral reefs experienced in 1998 (Anthony et al. 177). To help with stronger reefs, conservation efforts through many types of organizations are moving to educate the population about reefs, create marine sanctuaries for at risk reefs, and study the effect climate change is having of coral reefs.

Conservation of Reefs:

After the 1998 mass bleaching event, many people noticed the need for conservation efforts to help protect vulnerable reefs. The creation of Marine Protected Areas was offered as a way to reduce stresses such as land-pollution, over-fishing, and climate change. Also, there was a call to study how climate change is affecting coral reefs at a global scale (Wilkinson 20). Organizations such as the National Oceanic and Atmospheric Administration (NOAA) try to educate citizens about the sensitivity of coral reefs and when there should be as close to zero human contact with reefs during peak thermal stress (Schmidt 298). MPA's can successfully limit human contact which will cause bleaching events to be less severe since a large portion of coral degradation through human contact is lessened.

Conclusion:

If economies, medicine, costal lands and marine life are to advance, coral reefs need to be protected from climate change. Coral bleaching is affecting almost all coral reefs in tropical and sub-tropical waters. With the disappearance of zooxanthellae and other alga from increased water temperature, coral reefs lose nutrients produced by the alga and will degrade unless the bleaching event is shorten and the alga are given the chance to return. If the bleaching event drags on, marine life loses safe shelter and is at risk to be eaten by predators. Many marine organisms will become endangered since coral reefs hold about 25 percent of marine life (Buddemeier, Kleypas, and Aronson Foreword). With disappearing zooxanthellae, coral reefs lose the color that makes them so famous to

divers and tourists. Local economies dependant on reefs will be severely hampered if coral bleaching continues to cause reefs to turn white while degrading slowly. With disappearing reefs, the unknown marine organisms will remain undiscovered and the possible advancement in medicine will not occur. Since many drugs have been discovered through chemicals in alga and fish, the possibility of what lies underneath the coral is endless. Coral reefs also serve as a barrier against waves and other types of erosion. Without coral reefs, coastal waters will erode at a much faster rate, such as what is happening in the Island of Bonaire (Bates et al. 112). Even though coral reefs are degrading, there is hope through natural adaptation and conservation efforts by organizations. Minor bleaching events cause weaker alga to be expelled, letting stronger alga move in and continue the symbiotic relationship with the reef. While conservation efforts by agencies will help educate the public, create marine sanctuaries, and advance scientific research on the effect climate change is having on coral reefs. In the end, coral reefs are the most important ecosystem in the world because they truly are the “ rainforests of the sea.”

Excellent on threats; could use a clearer thesis statement and really needs quite a bit more on conservation efforts. Grade 90