What Does Biodiversity Loss Tell Us About Science and Technology?

IQP: What does the environmental crisis tell us about science and technology?

Advisor: Professor Roger Gottlieb

Submitted by: Louis Desy, Mia Holroyd, Megan Jordan, Nguyen Vo

5/4/2024

An Interactive Qualifying Project submitted to the faculty of WORCESTER POLYTECHNIC INSTITUTE in partial fulfillment of the requirements for the Degree of Bachelor of Science.

Table of Contents

Authorship

Section	Author
Abstract	Louis Desy
1. Introduction 1.1 Environmental Crisis 1.2 Technology 1.3 Biodiversity	Louis Desy
2. Why it's Important 2.1 Introduction 2.2 Relationship to the Food Web 2.3 Evolving Relationships 2.4 Agriculture and Monocultures 2.5 Perspective Shifts in Western Culture 2.6 Spirituality and the Environment 2.7 How do you define importance?	Megan Jordan
3 How we are Losing Biodiversity 3.1 Introduction 3.2 The Green Revolution in Punjab, India 3.3 How Did This Happen? 3.4.0 A General Description of the Causes 3.4.1 Politics 3.4.2 Economics 3.4.3 Culture 3.4.4 Science 3.5.0 Why Science Cannot be Trusted 3.5.1 Research 3.6 Conclusion	Mia Holroyd

4. Current and Future Solutions to Biodiversity Loss 4.1 Eco-friendly technology 4.1.1 Spatial Planning for Area Conservation in Response to Climate Change (SPARC) 4.1.2 AI for Good's Biodiversity Series 4.1.3 Infrared Imaging for Koala Conservation 4.1.4 Soundscape Analysis for Tropical Forests 4.2 Role of Biotechnology in Aiding Biodiversity 4.3 Current Acts to Protect Biodiversity 4.3.1 The Recovering America's Wildlife Act 4.3.2 The UN Convention on Biological Diversity 4.4 Future Approach to Protect Biodiversity 4.4.1 Nature-Based Solutions 4.4.2 Climate-resilient conservation 4.4.3 The Resilient Land Mapping Tool 4.4.4 Agroecological practice 4.4.5 Perspectives 4.4.6 Beliefs	Nguyen Vo Louis Desy
Synthesis of Findings and Final Remarks	Nguyen Vo

Abstract

The world is in the middle of an environmental crisis, one that is causing permanent damage to the communities we live in and to our bodies. We are seeing weather system damage like we've never seen before and the loss of biodiversity at an astounding rate. The one major cause for this is technology, or STEM. STEM, better known as science, technology, engineering and mathematics, has revolutionized our lives but has also produced many unneeded tools that go to waste. It has put out massive amounts of pollutants that have destroyed the world around us. The true extent of what technology has done will not be known for many years, but in the here and now one can see the massive effects that technology has on biodiversity. Biodiversity is known as the variation of life around us. Biodiversity is an important aspect of our lives, providing for us and helping us succeed in many cases. There are many things within technology that are actively destroying the environment, some of which are political systems, cultural systems, economic systems and science itself. As society moves forward, we've grown to rely on technology. Some being AI drones, and predictive systems. These act as stepping stones for fixing the loss of biodiversity. In addition to this, people must take a more pragmatic view of the world around us, not just anthropocentric and not just biocentric, but somewhere in the middle where we understand the needs of the environment but also the needs of ourselves. Next, society should adapt certain beliefs to help structure the change that must come, these being spirituality, minimalism and care ethics. By utilizing these beliefs, we can look at the damage that is caused and understand the steps that need

to be taken to repair this and prevent this from happening in the future. This paper acts as a call to action for us to hopefully change what we once thought was a destined end.

1. Introduction

The world has been experiencing a crisis, this crisis is known by many names, Climate Change, Global Warming, and the Environmental Crisis. The Environmental Crisis, as it will be referred to in the context of this paper, is the result of consistent pollution, deforestation, and adverse effects of technology. Resulting in compounding factors that put pressure on the environment, slowly breaking down the world. With this breakdown, extreme weather effects, loss in biodiversity, and adverse health effects follow. This paper will focus on one of the symptoms of the crisis, loss of biodiversity. Biodiversity, put simply, is the variety of organisms in the environment and how each of them connect. It shapes the world around society and how people in society live. This is through the various ways the environment contains important resources such as food, medicine, and culturally relevant icons. But, even with the significance that biodiversity has in society, it is falling apart. It is for humans to decide how and if society should step in to repair the losses that have been incurred. This may require a specific mind set with a need for more education. This paper will address that, it will explain what the environmental crisis and biodiversity is and why it is important. Technology is a major part of the ensuing crisis so what technology is will be explained. How we are losing biodiversity will be discussed, such as politics, culture, economics and science from the lens of technology. Finally, what should be done as society moves forward will be answered with current efforts to help the ever shrinking biodiversity. As a society, the understanding of biodiversity and its impact on us is an important lesson to learn. By getting this understanding humanity can move forward with never foreseen benefits.

1.1 Environmental Crisis

Over the past 50 plus years, researchers have been noticing a steady change in our environment. This change is not similar to a more natural change that could be seen in archaeological records or past environmental records. What is being seen today is a rapid warming of our environments, an increased acidification of the ocean, increased frequency of severe weathered patterns, shifting of climates, and a loss of biodiversity. These factors are compounding on one another to cause steady damage to human health and the abilities of human society. It is known as the environmental crisis. To understand the environmental crisis as a whole, it is important to understand each one of the parts of said crisis.

The rapid warming of our environments is visible in the changes of seasons. In New England, winter has seemed to almost disappear as snow has turned into slush and has become less frequent and less thick. The average temperature has been increasing 1 to 2 degrees fahrenheit over the past couple years. The increase in acidification is very visible as whole reefs are being completely bleached white due to the increased acid breaking down the reef life. Most commonly seen in the Great barrier reef with much of the coral life there dying over the past 20 years. The acidification is destroying sources of fish, causing decline in the fishing industry. This decline also damages the food sources of people who may rely on fish as their source of food for cultural or health reasons. The acidification is also seen to potentially reduce storm breaks, increasing damage done by storms. Severe weather patterns have become more visible as over the past decade, frequency of wildfires in California and more arid environments have been seeing wildfires at an astounding rate. But it is not just limited to wildfires, tornadoes and hurricanes have also increased in frequency and severity, some taking hundreds of lives and, at the bare minimum, ruining thousands of livelihoods. But once again they don't stop at just

natural disasters, everyday rainstorms are getting more frequent in some regions, droughts are becoming more frequent in some areas. Even wind storms are becoming more frequent and more dangerous. The shifting of climates is very visible as many areas have seen an increase in desert area, but we've also seen tree ranges shifting due to climate changes and animal habitats also changing. Some birds are not going as far for migration and some not even leaving for migration. There has even been environmental emigration, the migration of people or animals out of an area, as regions around the equator have been getting more severe environmental effects that are requiring people to leave their regions.

The final major part of the environmental crisis that will be talked about is the loss of biodiversity. The loss of biodiversity is something that is often forgotten about. Every year we've been losing one to two species of plants or animals. This may not seem like a lot, but the predicted Extinction rate is one every five years. The loss of biodiversity is affecting us in many ways, whether that be linked to agriculture or simply the change in the environment. The symptoms of the environmental crisis can be linked to many things, but the overarching cause of this disease is technology and how it is used today. As society has begun to rely on technology in the late 1800s with industrialization, our rate at which we put out pollutants has increased exponentially. Through various forms of research and simple observations, it is shown that pollutants have been causing disastrous effects on the world around us, not just stopping at the environment but targeting humans and their health as well. Technology itself is also a cause, not just its byproducts, by utilizing technology. Society has destroyed forests, ripped up the Earth, displaced people and animals and ruined the Earth's natural defense against alterations within the environment. Over the past 50 years , the understanding of this crisis has grown dramatically as we slowly put out more and more research and make more observations. It can be seen how truly

terrifying this crisis is. As a society, we've taken small steps to actually address the crisis, but these steps are minuscule when compared to the size of this crisis. The goal of this paper is to explain every part of the current crisis revolving around biodiversity, with this people will begin to take steps to change and improve the world around them. Our understanding of the environment and our relationship to it plays a massive role as we have a massive reliance on technology and idolize technology itself. Overall, technology has shifted society to target the environment in terrifying ways. Through this paper, the understanding of how technology has physically harmed the environment, put out byproducts that affect the environment, and has shifted our mentality that has also resulted in environmental damage will be shown.

1.2 Technology

Society utilizes tools and systems as its foundation, these tools are known as technology. Technology is defined as the application of science for practical application. With this definition a wide variety of concepts that are destroying the environment are forms of technology. Tools like phones, oil rigs, cars, and conveyor belts are all pieces of technology used with the idea that they have practical applications. Systems like industrial farming vs normal farming , healthcare, and mining/drilling are technological systems that are utilized. These technologies are the root for the ensuing environmental crisis thanks to human hubris. The goal of technology is always to further society with the development of tools such as AI, as human needs are fulfilled with technology, more small minor needs are found. How can I eat this messy food without getting my hands dirty, introducing the trongs. Tools like this have hyper specific uses that result in the

waste of material just to produce a waste product. Technology is advancing not just in the way of making better products but in the way of making too many useless and necessary products.

Technology isn't just a tool to better society, it is the very foundation that our modern society is built on. Ever since the first tool was made, humanity has approached the point of total reliance on the very tools we made. Our politics are based on our bettering technology and how we utilize it, questions like how to use this new missile, how should the internet be regulated, and how much money should we give to corporations to make sure they don't fail. Every political issue today revolves around technology itself or using technology to fix some perceived issue. Plus with the political system being completely funded by technology companies, our political system is a technological system. You can not do a single task without using technology. Our solutions for the current issues of the environment crisis rely on technology, the very cause of the problem. Our cultural systems today are also based around technology, with the sharing of information being completely through technological means. The ways to communicate now rely on TikTok, Facebook, Instagram, or some other social media app. This has connected humanity in many ways that has never been seen before, but it also caused culture to shift into digital formatting. Religions practice through technology/media, traditions/holidays are practiced digitally, and the cultural symbols that are used in society are ingrained in pieces of media. Technology is no longer an outlet of cultural exchange but it is our society's culture.

For the paper, technologies based around politics, economics, culture, and science will be discussed. When it comes to politics, it is hard to understand how it is a form of technology, but as it is derived from social science it is a form of social technology. With this in mind, politics has a few focuses that can be pointed to for negative effects on the environment. One such focus

is the global weakness, there is a split of focus when it comes to funding, this is a weakness that prevents the restoration of the environment while worsening the issue.

The second topic in politics is national competence, this is the idea of how resources are being spent. Many nations do not focus resources on bettering each other, thus focusing on themselves. The final political topic is the overarching governmental structure. This structure favors industrial buyers and the ultrawealthy, leading to bills that actively destroy the land instead of building it back up.

Next technology category is economics, in this category financial gain is everything. This results in the motto “the means justifies the ends,” economists real focus isn’t how the environment should be protected or how what is being done is destroying our environment. Instead the environment is a land filled with dollar signs, products to be sold.

The third category is culture, like politics, this is a social technology that may have a basis in the destruction of the balance of nature. This is through the “sports” that are key pieces in culture today, one such sport is hunting. Hunting is a massive problem when it comes to the loss of biodiversity. Culture also provides religion, which has influenced the minds of believers to feel as if they are the rulers of the world and thus can treat nature as they see fit.

The final category of technology to be discussed is science. Science is the big villain when it comes to technology, thanks to the dominating ego that it gives to its users. By simply wielding the blade of science, society believes it can control and use the world as it sees fit. As will be discussed later, technology as a double sided blade that could heal the world while providing for each and everyone of its inhabitants, but on the other side, what is being seen now, technology can eradicate the life on the planet while hoarding resources for though who can afford it in the made up system of finances.

1.3 Biodiversity

Biodiversity is the vast range of organisms in the world around us, including plants, animals, and bacteria. However, it extends beyond biotic life around us, going as far as including cultural and behavioral connections in the environment, the genetic variation in the life around us, the ecosystem, and the environmental evolution that is seen as stated by the United States Museum of Natural History. Take a meadow for example, biodiversity in this area will include carnivores, herbivores, and flora. One could see groups of insects that work to pollinate the area, spreading genetic information to various flowers. One could see rabbits and other small rodents feeding on grasses and flowers, keeping them from overgrowing. Birds would also be flying over, occasionally flying down to eat insects or seeds from the flowers. Small animals that are carnivorous like foxes could be seen roaming the area hunting and eating the rabbits and birds. The ecosystem seen here has many moving parts, with each piece relying on the next. In many cases there is what is known as a keystone species, a species that plays a major role in stabilizing the ecosystem. In this system a keystone species may be the bird, as this bird helps keep the bugs' population at a reasonable level and acts as a food source for the small carnivores. If they were to disappear the rabbits would be over hunted and pushed to extinction. We see ecosystems like this one all around us, in cities, forests, beaches, and in other locations across the world, they play a major role in the way we live, connect, and our specific cultural experience. This can be seen in oceanside towns that have specific traditions and practices with the ocean and the specific animals at their disposal.

The cultural aspect of biodiversity is also known as biocultural relationships. Biocultural refers to the dynamic relationship between person and place. In essence, this originates from communities and their spiritual, physical, and emotional connection to the environment, the use of certain plants and animals in ceremonies or in certain holidays as symbols, and the use of certain foods in traditional feasts. By utilizing the various animals and plants, the communities show a certain level of respect and appreciation of nature, in certain cultures that connection to nature is important and has evolved the very understanding of how one should interact with the environment, This helps us maintain an appreciation of nature. As biodiversity thrives, the cultural appreciation for the environment continues to grow, as new and current beliefs and practices change around the evolving environment. This connection to the environment via culture has even led to a very deep spiritual connection to the environment in some groups, helping to develop a rich connection to the environment. With a strong bond to the environment and the world around you, comes improved mental health and deep bonds. We may also see a form of cultural relationship between animals. Biologists have seen various practices in animal relationships that may be considered a cultural relationship, some may be forms of communication, learning from one another, mating rituals, and relationships with other species.

Every plant, animal, and human benefit from genetic variation, as threats come and go this simple biological tool protects the species from various threats that could very well make them go extinct. Looking between any two individuals in any given species one could see some variation. The simple variation in the physical attributes could be massive when talking about how it evolved.The variation in physicality means a lot in the wild, better weather protection, better muscle development for different tasks, or simply for better chances of finding a mate.. This variation is very important for how we can function and evolve as a species. Genetic

variation also alters the way evolution functions and how evolution will develop within the environment. Evolution is a major driving force of biodiversity. As biodiversity increases within the environment there's greater chance for animals to fit uniquely new niches, the way species interact with one another and how a species fits within the ecosystem.As an environment may change, evolution will kick in and help keep biodiversity alive with the help of adapting animals to the changes. Whether it be shifting of climate or slow forms of desertification, you may experience certain animals and plants evolving or adapting to live in their new environments. A prominent example of adaptation would be in the 1800s during the industrial revolution in Great Britain Due to the coal powered factories there was a lot of smog pushed into the air. In a particular area lived a white moth that was common, the smog in the air made it easy for prey to hunt them. Over time this moth species adapted to become darker and blend in with a smog reducing a prey's ability to hunt them in the smog. Epigenetics also plays a major role with adaptation, this being genes that don't activate until certain environmental factors place stress on the body resulting in these factors to activate. We can see this in humans, some groups of people who have ancestors that were part of severe famines now have a gene that can lead to building of weight when exposed to certain levels of carbohydrates and variation in diet. This is due to a certain form of insulin resistance so the body can store energy in sugars to be used later on out of fear of not getting enough food later. This gene that would have been dormant now affects the person, for what the body sees as the better, due to the change in certain environmental factors. Another example of this is in smokers, when comparing smokers to non-smokers, it is seen that a smoker has less DNA methylation in certain genes. Simply put methylation is adding a specific chemical group onto DNA. The gene most this occurs in is a tumor suppressing gene, meaning it gets activated more than in non-smokers. This is a genetic change that helps protect the body.

2 Why is Biodiversity Important

How is biodiversity important? Why does the environment need it and why would humans need it? Is this something that has quantifiable value? There are most likely as many ways to quantify importance as there are people. This depends on what an individual values. Who a person is shapes their priorities. Some find building a family to be the most important to them, others it is their economic ventures, others it can be entrepreneurial pursuits or creative endeavors. Biodiversity can be looked at from many perspectives, and therefore many different ways to value it. There is a value of biodiversity for the balance of nature, as it is one of the key factors that allows it to function. It can aid certain economic ventures and teach about better agricultural practices through observing how things prosper on their own. There are also intangible factors about biodiversity and the environment that have value, some psychological and others are more spiritual. Some of these things may be more obvious than others, but each factor has its importance that should be considered. Biodiversity has influence over much if not all of the world and the way it functions today, especially on the ecological level.

2.1 Relationship to the Food Web

The relationships of organisms can be best shown through food webs. Food webs (also known as food chains) indicate which organisms “eat” what. The lower levels are primary producers which are things like plants, followed by primary consumers that eat the plants, and then secondary consumers that eat the primary consumers as well as tertiary consumers that eat the primary and secondary consumers (etc.). There are also decomposers like fungi and the like

that eat the dead matter of everything on the web. The reason it is difficult to call organic relationships a chain is because it is not linear. Animals do not tend to just eat one thing and are not eaten by just one other species. As the natural structure of the ecosystem is more complex, the word web is more applicable, as it better describes the many different things that make up an organism's diet. If the relationships were as simple as being like a chain, then the ecosystem would be very unstable. As an example of a chain, starting with grass, which gets eaten by rabbits, which get eaten by foxes, both of which are eaten by wolves. If this is the entire ecosystem's relationship, while straight forward, it is unstable. What happens if a disease comes in and wipes out the rabbit population? In this example where these are the only organisms, the foxes would then be at risk because they do not have a food source. Then the wolves could lose both of its food options. This happens due to a lack of the complexity that is found in biodiversity. A biodiverse ecosystem has different species being able to "choose" from many different food options (although it is not so much about choosing, but about what an organism can get and has evolved to eat). The foxes would not just be eating rabbits, but also other rodents, birds, and other small creatures, and, as they are omnivores, also partake in some of what the primary producers offer, such as fruit and berries. Biodiversity allows ecosystems to function with stability. If a singular species is lost in a very biodiverse ecosystem, that ecosystem could potentially shift and reorder itself around what it has after a while. However, losing an entire prominent species will always have impacts. Especially if an entire niche is at risk. Different species play different "roles" in an ecosystem. By fulfilling these roles, the ecosystem remains at balance.

The main role or job of predator populations is to keep the prey populations in check. One of the largest threats to prey is to be killed by a predator, so therefore, if they were no longer

threatened in that way, their populations could grow. That by itself may not sound so terrible, but in actuality, an unchecked prey population can act almost like an invasive species, and outgrow their surroundings. Predators and prey have a relationship between their populations. If there is an increase in predator populations, this will lead to a decrease in prey populations. However, the now weakened prey populations will lead to a decrease in predator populations as there is less for them to eat. If the prey populations have higher population numbers, then the higher amounts of food will allow the predators to expand, until they over reach and end up decreasing in population again. Yellowstone National Park in the United States dealt with problems relating to this. As colonizers moved westward in the US, they brought many (bad) things, including a desire to conquer the natural world. This stemmed from a fear of what nature is capable of. In the current day in the US, things like wolves and similar tend to be at most problems that farmers face when protecting their livestock. In the past, they were large threats to one's life. This fear was accompanied by a desire to kill them for protection. Thus, as they expanded into the they proceed to be "untamed wilds", they had an expectation that they would need to kill whatever threats they found. In the conquest of the west, they also began to take what they thought was theirs. In this time, the land became "theirs" as well, and they moved to make it safer for themselves, which included removing certain threats. This led to a decline in wolf populations of the area, like in Yellowstone, as they wanted to make it safer for tourists. The last of the Yellowstone wolves were killed in the 1920s, despite it being made into a national park in 1872. With the wolves gone, the elk population greatly expanded and began to take over. Without the threat of being hunted by wolves, the elks could live with less concern. They could eat as much greenery as they handle, or stand at the watering holes and rivers for whatever amount of time they wished. And with each year there were more and more of them, because although they had

other predators, they were not enough to keep their populations down. This had the consequence of the surrounding being overgrazed, which not only caused greater damage to the plant life, but also the homes and hiding spots of smaller creatures that would rely on things like taller grasses and foliage to avoid their predators. The land around rivers was at high risk of eroding because the increasing number of elks were not being scared of as often. This was putting the ecosystem's functionality at risk. This behavior change is an effect of the loss of trophic cascades, which is how prey behaviors are impacted by predators. Wolves were eventually reintroduced in 1995, and have since been successfully integrated. The loss of an apex predator like wolves had huge impacts on Yellowstone National Park's stability. It upended the food web and caused many problems for most of the organisms. This can be true for the elks as well, because while they may have seemed to be having a great time, they would be faced with their own problems from the overgrazing. They would eventually have issues with food resources for their greater population numbers, as well as being more susceptible to the spread of diseases with their higher numbers and nothing to thin them out. The wolves fill an important role in their environment's structure. Without natural predators, a species can become like an invasive species, giving them free reign to their surroundings. However, if the prey population is dwindling, removing the predators will not just solve it, as it comes from the assumption that the predators are what is causing a reduction in their populations. Loss of the biodiversity that fills in the upper parts of the food web can allow for the rest of the food web to become unstable and, unless something enters to take their place, could lead to potential collapse.

The organisms that make up the bottom of the food web have a more immediate impact on an ecosystem's stability (because it is not about what they are eating, but rather what is eating them). Producers and primary consumers make up the base of what everything else eats, meaning

that if something were to happen to them on a large scale, everything could fall apart. Meaning that something that is a risk to large percentages of producers and primary consumers can be a risk to all. Plankton are a very important base of the marine food web. They are defined as organisms that are carried by currents. They fall into both the categories of producer and primary consumer (as the category of plankton is so broad). As microscopic plants, phytoplankton both intake CO_2 and produce oxygen, as well as perform photosynthesis. Zooplankton are larger and mostly eat phytoplankton. Zooplankton are an important part of the diets of larger species, including things from small fish to the blue whales. One of these zooplankton are pteropods, or sea butterflies. They are tiny snails that are typically less than a centimeter long. These snails are found in most of the ocean, from polar regions all the way to the tropics. They are key parts of many organisms' diets, including making up 60% of pink salmon diets, and are important to many others. This means things that are a risk to pteropods, also risk these organisms that eat them. The biggest risk to pteropods is currently ocean acidification. Ocean acidification is what happens when the ocean absorbs too much CO_2. The additional CO_2 that gets absorbed changes the quality of the water by lowering the pH levels, thereby making it more acidic. Higher acidity levels threaten many organisms' ability to calcify. Calcifying is a process that shelled animals use to build their hardened shells to protect their bodies, which also is what makes up the animal's bones. Because of the greater amounts of OC_2 in the atmosphere from the great amounts of carbon emissions that humanity has produced post industrial revolution, the pH level of the ocean has become low enough to be putting the pteropods (and other similar species) at risk. Their reduced ability to calcify is leading to them being found with thinner shells, which makes them more susceptible to diseases and injury. This puts their populations at risk. Not to mention the many other shelled creatures who are at risk of ocean acidification, which includes other

plankton, larger molluscs as well as other shellfish like decapods. However, even if it were just pteropods at risk, their decline would cause problems for the many creatures that eat them. Plankton like pteropods are load bearing supports of their ecosystems. Many species depend on consuming pteropods. They make up 60% of the diets of pink salmon, which is a common food source for many. Pteropods are currently key to the lives of many species, and many of those species are then eaten by larger things. Meaning that if they are lost before something else could take its place, many other species would be threatened. Because the other shellfish are also at risk, it would make replacing pteropods or other plankton difficult, as they too may be lost and be in need of replacements. Reductions in biodiversity, even of creatures that are incredibly small, can spell disaster for the rest. Losing major parts of the bottom of the food web, can result in nothing being able to properly eat, especially when so much of it is at risk for the same reason at the same time.

The lives of the organisms in an ecosystem are so involved with each other that losing too many of a species in a niche will greatly impact the rest. Under normal circumstances, so many species would not be at risk at once, but with things like extinction events and climate crisis, enough can be at risk or lost to cause catastrophic problems. Ecosystems will not have the time to rearrange to fill in these niches. To maintain the environment that exists today, there must be some regard and intention to protect for the many important species that allow it to function.

2.2 Evolving Relationships

Evolution is a species ability to adapt to its environment. This is a process that takes a long time (across many generations) and allows the species to persist even as its surroundings

change. Ecosystems have many different species adapting together and to each other. This means that species can evolve to work alongside and rely on another. Pollinators and flowering plants have this kind of relationship. The most common pollinators are bugs (bees, beetles, butterflies, etc.), but many ears also have bats and birds that are also pollinators. When they collect pollen from different flowers, they bring the pollen from one flower to the next. This causes cross pollination, which aids in the genetic diversity of the plants. While there are flowering plants that do not require the aid of pollinators to reproduce, most either do or are more productive with them. This includes 75% of agricultural food crops. So while the crops do not consume the pollinators (directly anyway), they are still reliant on them. There are other cases of this too, many tree drop seeds which then will get stashed away for winter by animals like squirrels and then forgotten, allowing them to grow. Many plants have evolved to have intentionally edible fruit so their seeds get picked up and spread by birds and other organisms. Bees tend to create more honey than they need because they evolved in situations where it was stolen. They now often create excess, thus allowing them to usually have what they need but producing a food source for others. Because of this, bees have a reciprocated relationship with beekeepers, who maintain their shelters and help them thrive, all while only taking their excess honey. These are examples of mutualism (where both parties benefit), which is a type of symbiosis. There is also commensalism, in which only one party benefits but the other is not harmed. Hermit crabs have this relationship with sea snails, where they take the snail's shells after they die to protect themselves. There are also remoras that hitch a ride on sharks to eat their leftovers, but do not do much hunting on their own. Parasitic relationships are harmful to one party, such as fleas on larger mammals, or barnacles growing on the bodies of sea creatures, which can be anything from crabs to whales. Organisms have more than just consumption based relationships. They

interact and have adapted alongside each other. This means that if a species were to be lost, then more than just the other organisms that eat it will have problems. The loss of bees and other pollinators (which are at risk due to habitat loss) will mean bad things for flowering plants, including many crops. The relationships within an ecosystem are complex and interconnected through how different species adapted over time. Perhaps there would be less trees without the critters that bury their seeds, or the remoras will have to start hunting or scavenging with less help without sharks. Losing parts of these relationships can cause issues and even spell disaster for the other party.

There can be artificial “solutions” to one side of these relationships crumbling, but it is hard to say how good they are. Yes, people could start using drones and other technology to pollinate their crops, but what does that do for the rest of the plants that do not have the support that agriculture does? There will be nothing to support the forests and other natural vegetation without anything to aid in cross pollination? Hermit crabs are already using littered plastic as shelter, but is that good for them? Especially after the generations that were spent on fitting into spiral shells, now stuck hiding in bottle caps and other trash. So while there are things that “could work”, would it really be right? Would that be a better world without those relationships and those species? The flowering plants and pollinators are important to each other, the snails are important to the hermit crabs, the sharks are important to the remoras, the squirrels are important to the trees. They have importance to each other, because they have come to need each other.

2.3 Agriculture and Monocultures

Agriculture is the basis of a functioning society, whether it be families or small groups growing and collecting their own food, or industrial farming working to feed thousands. Industrial agriculture farming tends to lean into being monocultures, or growing the same kind of crop exclusively. This allows for requiring less types of machinery because a farm that only ever grows wheat would not need something to harvest potatoes. This can also simplify processing as there would only need to have infrastructure to process one type of crop. The major downside of this, is the great increase in necessity for fertilizers and other resources. Growing the same exact kind of crop every season over and over again can increase risk of disease and pest problems and therefore would need more pesticides. It also decreases the quality of the soil as using the same kind of crop repeatedly leads to a reduction in the nutrients that the specific crop needs. This can be supplemented with chemical fertilizers, but only so much, and those cause their own problems both economically as well as environmentally. In the past, farmers used practices like crop rotation to maintain the quality of the soil. This is because some crops absorb nitrogen, while others release it. Crops like corn and wheat need to take in nitrogen, while legumes like beans deposit it back into the ground. Different plants thrive in different seasons, allowing for the farming to expand past just the wheat season, and instead also function beyond this and have multiple seasons of harvest. This kind of farming reintroduces nutrients to the soil without chemical fertilizers, and has worked for centuries. The current farming practices that use monocultures rely greatly on artificial components and chemical supports to continue functioning. This will eventually reach a tipping point where it will not be able to work anymore. When the pests start adapting to the chemical pesticides faster than people can make them and the crops do not have any of their own ways to protect themselves, they will struggle. Being the

exact same monoculture gives the pests many many chances to adapt, and they can and will. When the chemical fertilizers cannot keep up with the needs of the crops, they will be bound to produce less. And as this monoculture is grown repeatedly, the ground will lose more and more of the nitrogen that the crop needs. This will result in a need for even more fertilizer. With this kind of monoculture growing pattern, a farm will constantly need to use fertilizer. Incorporating the biodiversity that exists naturally in that environment can aid in agriculture production. Reductions in biodiversity result in higher amounts of artificial additives, especially when it involves crops that are not a part of the natural biodiversity of the area. A more biodiverse crop system like crop rotation will have a better chance of defending against pests, as it will not just be the same type and perhaps even exact same genetic lineage, thus giving the pests less chances to work with while they attempt to adapt to consume said crops. Incorporating a more biodiverse process could result in higher yields, less harsh chemical use, and allow for better coexistence with the surrounding environment.

2.4 Perspective Shifts in Western Culture

People do not tend to keep the same consistent values across too many generations, and things will inevitably change. These culture shifts could be caused by some discovery or new technology, or just the marching of time. One thing that has definitely been changed is our view of nature. Different cultures have different perspectives. Before colonization, the indigenous groups living in what is now the United States of America had their own different systems and way of treating and interacting with the natural world, and had been doing it for millenia. When European colonizers came across the sea, they also brought many different views and cultural

practices regarding nature to what the different societies already established had. So, as they tended to do, they went out of their way to shut down the different views and push for their own as they destroyed the cultures that already existed there. This included the idea that nature was something to concur and control. This is a theme of colonization, which comes from a group's desire to take and claim things as their own through violence, with the end goal of controlling everything. Part of the colonizers' desire to control nature came from their fear of it. Nature is capable of immensely “terrible” feats by human standards, storms that can wipe out hundreds if not thousands, diseases that can tear through populations, intense heat waves that leave everything to dry out, terrifying and brutal deaths by our fellow creatures. This can reasonably create fear. However, the idea of trying to conquer nature comes from the mindset of the world being something for humanity, rather than humanity being a part of nature. In the current day, it could be argued that a lot of nature has been concurred, enough so that laws have to be created to protect certain areas to maintain their natural attributes. The rest has been greatly tamed for human convenience. There is a deep separation between the people and nature. This level of conquering has its consequences. After decades of industrialization, there is a decrease in more natural approaches for many things. Humanity has gained the ability to do so much and so quickly. Sky scrapers, jet planes, advanced medicine: many unnatural things that have become relatively mundane. The man-made urban areas mainly have green spaces that are intentionally curated and trees selected for their convenient size and aesthetic. Suburban areas have manicured grass lawns with no variation and fences to keep things out. Even on the more rural side, there are many agricultural farms that have reshaped the land and intentionally try to keep wild animals away from large amounts of land (which is necessary to maintain their crops). This is a disconnect between humanity and nature, almost like people are somewhat trying to separate

themselves from the environment. However, there is still an attachment to the more natural world. It was at the start of the second industrial revolution (1870-1914) that Yellowstone was made into the world's first national park (1872). Even as American society was expanding beyond the natural world, there was clearly some need for it. Something compelled the people to make sure it was not lost, and this was before climate change was known to be a concern. People still found importance in nature being in its natural state. Now, this was not all sunshine and rainbows, as naming something a national park did not actually make it automatically protected. And in fact, there were initially moves to make Yellowstone National Park “safer” for tourists, including kicking out the indigenous people who had lived in the area for millenia, and as mentioned above, hunting the wolves until there were none left. The tourists that came in also had no problem just taking things and defacing the earth, showing either a clear lack of understanding of the point of natural nature, or a disrespect of it. So while there was interest in experiencing nature as cities were expanding, there was still a lack of individual desire and understanding to make sure that everything in the environment is kept for others to experience.

Today's standard values of nature are not unified. While it is not a popular opinion to say that the forests should burn or that an endangered animal should just go extinct, not everyone is rushing to hug every tree they find. It would be impossible to talk about attitudes around the environment in the current day with no mention of one of if not the biggest problem our species has faced in a while: climate change. The effects of years of industrialization are catching up to humanity. The pollution, resource waste, and thoughtless expansion are all showing their longer term effects. This is creating a more prominent movement of people fighting for the environment’s future. While there have always been people who have fought to protect nature, there is now a new intention behind it: self preservation. The impacts of climate change are not

just segregated to just the more natural areas. This will affect the entire human population eventually, if it is not on some level already. So for the people that are concerned for the longevity of the earth's ecosystems as they are now and how they have been, protecting nature is important. Impending "doom" can get a lot of people to consider what is important and worth protecting. The consequences for the decades and decades of people trying to separate humanity from nature and keep away from what is considered wild is catching up. The storms do not care if someone thinks they are an animal or not, they will continue on their paths regardless. Humanity is a part of nature and that nature will affect everything, no it must be respected.

2.5 Spirituality and the Environment

The more "developed" societies have created a great disconnect from nature. This can make it harder for people to value it, as they are not experiencing it in their day to day. Food and how it is sourced can show a lot about how a culture views nature. The industrial farming to grocery store pipeline shown prominently in the United States prevents people from seeing how the food is made and therefore separates them from it. Logically people know that milk and beef come from cows and the wheat gets turned into flour for bread but the "how" is often more up to imagination. Beyond food, the way that objects are made, like clothes and paper and furniture is not often seen. Non-synthetic clothes are made of natural fibers like cotton, which come from a plant and are then processed. Paper is also made from plant fibers, typically that of trees, and also processed until they are perfectly uniform and as unnatural as possible. Furniture can be made of anything from plastic to wood, and while wooden furniture shows more of the natural character of the resource, there is not typically a consideration for the tree it originated from.

However, there are still many societies with cultural and spiritual practices that include the more natural world.

Local food sourcing through one's own means can help bridge this gap. Inuit societies of the Canadian Arctic and Greenland are limited in their native food sources due to a lack of edible plants in polar regions. Inuit microbiologist at the University of Greenland Assistant Professor Aviaja Lyberth Hauptmann has said,

> "It's that consciousness that when we eat something, it comes from somewhere… our behavior has consequences. The Inuk word sila is not easily translated into English—it can mean weather, climate, spirit, wind, consciousness. What that points to is that it's all connected… We're not separate from nature; when our minds are well, when the sila inside of us is well, we can treat our environment well."

Seeing where the food comes from can help people better see how they are placed on the food web because it allows them to see exactly what their role is. This can create a deeper relationship with what is being eaten and therefore a deeper connection to the ecosystems that brought that food. It shows people how they are a part of the larger whole. This view is shared amongst other Indigenous cultures. Not only that humans are not separate from the rest, but are equal to them. That a human is not truly better or worse than any other organism. These views are tailored to the specifics of the areas that they were developed in, and develop practices based around the local biodiversity.

Different religions will have different views on nature, but many hold it to have significance. In Hinduism, nature is worth protecting because each part of it is a manifestation of sacred divinity. Along with this, they believe in the reincarnation cycle, where the souls of

people who die can be reborn into the body of an animal. This shows a clear connection between humans and the rest of the biodiversity, as all of it is in the same system of souls. Abrahamic religions view nature and all its parts as creations of god, and therefore should not be destroyed because they were put there on purpose. Destroying them would be disrespecting their god and taking away those creations goes against what was intended. The Gimi-speaking peoples in the Eastern Highlands Province of Papua New Guinea believe that they are there because nature is and nature is there because they are. They view it as forests being created by relationships between people and their ancestors and nature. Uganda has the Bakonzo people who believe that spirits inhabit the forests, rivers and springs, and that the spirit that controls nature and the lives of the people lives within the snowy peaks of mountains. Many New Age and Neopagan systems are based on the earth, and therefore have core belief systems based around biodiversity's importance. There is emphasis on giving back what one takes to the earth and maintaining one's part in the whole.

There are also more specific things that these belief systems desire to protect. Local communities that have sacred areas like forests or groves and the natural life that they hold, and therefore feel the need to protect and maintain them. India has protected sacred groves that house unharmed biodiversity. Catholic practices in central Italy are working to protect old growth forests as they view them as significant beyond just the present. Native Hawaiians protested a telescope being built on Mauna Kea due to its cultural significance as a sacred mountain that houses important deities and vast amounts of biodiversity. The sacred mountains in the Himalayas of Tibet are found to have greater overall species diversity than that of the surrounding mountains, showing clear care was put into protecting it.

Beyond biodiversity's function or uses, there can still be intrinsic value found. For millennia many human societies have been developing systems of belief that show care for the natural world. Humanity is clearly deeply connected to nature, and not just due to the science of being just as much a part of it. The many, many belief systems across the world carry variety in their interpretations of this connection, as well as what our role is. This could be as a shepherd to protect it, or just being another part of that larger whole. Regardless of the differences of the exact specifications, there is some deeper meaning that people can find in our place across the earth's many ecosystems. Within this meaning, people are able to find significant reasons to protect it. Across countless cultures and differing biomes and their vast varieties of biodiversity, there are people who find importance in it. This is not something that can be simply explained with facts or figures, but the impact and intention is there. The many different species that make up the ecosystems across the world are valued for more than their "uses". Their intrinsic value can lie deeper in culture and spirituality. For many, nature is as much a part of them as they as a human are.

2.6 How do you Define Importance?

Most arguments about protecting the environment or nature have either an outwardly said idea or subtle theme of it being for humanities benefit. Sometimes it can be phrased as obviously as "we will struggle or even die out without it", and other times it can be "we should protect it because of how beautiful it is". These are anthropocentric views, or a human first mindset. What about other perspectives? A more biocentric argument for biodiversity can be about how the environment works best together, but often, this argument still falls back to human needs, or that

we must protect biodiversity because nature's stability needs it and *we* need nature to survive. Through the years, environmental arguments have had human interests at the core of them. Initial arguments many years ago were more direct with this, like in the United Nations Stockholm Conference in 1972, which had an official title of "United Nations Conference on the Human Environment," instead of just environment. It went on to argue about the economic issues that could arise should certain parts of the environment not be conserved. It did not include all the organisms at risk, but instead focused on the ones that could be considered resources. Resources that were considered fair game to exploit. 15 years later, the Brundtland Report would push the importance of allowing for development, with a little twist of saying that it needs to allow for the next generation (of humans) to also be able to develop. As years continued, the cultural views on the environment shifted to better include nature and its need in the discussion, but it is still about how humanity benefits with it. The IPBES assessment from 2019 still pushes the importance of ecosystem services and nature's contributions to people. The environment itself has become a more significant part of these discussions as it is not just about human wants. However, it is still not entirely at the forefront. It is not unreasonable for human needs to be a major part of a discussion that humans are having, in fact it makes a lot of sense. It is difficult to completely remove oneself from the framing of a problem. Even sympathy is about how someone imagines they would feel if something happened to them. It might not even be possible to completely remove human needs from discussions, at least not anytime soon. Humans are a part of nature, after all, no matter how hard some try to separate us from it and pretend that we are not also animals. Including human needs as a part of a larger whole argument as to why the environment is worth protecting will ultimately hit a wider audience, between the people who care about it for its own sake and the people who care about it for themselves. So while the argument definitely

needs to include the environment's needs itself, including humanity is only natural. Ultimately, humanity is still not the majority of those affected in this issue, but instead the majority of what is causing it, and hopefully, what will be able to fix it.

3 How we are Losing Biodiversity

3.1 Introduction

Biodiversity, as discussed, is an important aspect of evolution, the food web, and our lives. Despite this, biodiversity is continuously being lost because of what society values. Society's values determine the way it is run. Because biodiversity is not something that is valued by many in our society, it is often overlooked when those in power decide how our society should run. Therefore, through culture, economics, politics, and science, those in power control society and leave out biodiversity. This section aims to explore these four topics and what causes them to contribute to biodiversity loss.

To further explain how each of these causes contribute to biodiversity loss, a real-life example will be explored, demonstrating just how easily society allows for biodiversity loss through the four causes.

3.2 The Green Revolution in Punjab, India

The Green Revolution was America's attempt to make agriculture in third-world countries more efficient and profitable by shifting to science-based methods. Although this revolution seems well intended, it resulted in the destruction of both nature and livelihoods, especially in Punjab, India, where our agricultural goals were pushed down the throats of unsuspecting civilians.

Up until 1889, the farmers of the Punjab respected nature and worked with it. This meant farming without pushing any limits or chemically manipulating the land. This was not the most productive method. However, it avoided any future problems that science posed and the people of Punjab were completely satisfied with their yields. The people needed more food after World War II, and India fell into a food crisis. India was confronted with two solutions: one indigenous and one exogenous. Some civilians took the indigenous approach, which was to continue working with nature, such as using natural pesticides and fertilizers, farming with seeds collected from the local ecosystem (not genetically modified), and using previous knowledge to understand the best places to farm at the right times. This approach encouraged each family to start growing their own food to survive the crisis. Others, a lot of whom were young scientists who studied in America, took the exogenous approach, which was the use of chemical pesticides, fertilizers, and industrial farming to dominate nature, taking advantage of everything it offered to Punjab. In 1966, Punjab suffered a drought, bringing them further into a crisis. Looking to America for help, India was denied any assistance from President Lyndon B. Johnson until they agreed to adopt the Green Revolution method. Faced with a crisis of starving civilians, Punjab had no choice but to agree to this agricultural method (Shiva).

The method that was used in Punjab was the use of new “miracle” wheat seeds. These seeds were genetically modified to grow more abundantly on less land area. There were a few direct impacts that this switch made on the lives of citizens. Firstly, many people were forced to give up their land to large organizations for industrial farming. This industrial farming was detrimental to the farmers, as it put many of them out of work and left them with no land left to live on. Not only this, but this switch made seeds profitable to those selling it, which meant that

farmers in India were now forced to buy seeds. This was economically taxing to the farmers, as they originally used seeds collected from nature which were completely free (Shiva).

Since the people were now only farming these “miracle” seeds, monocultures of wheat and rice were the only agricultural crops being grown. Monocultures of a crop refers to the farming of one species of crop (usually on an industrial scale). This lack of biodiversity heavily affected the people of Punjab. Firstly, it fueled epidemic diseases, such as Karnal Bunt. These diseases were not an issue when the agriculture being farmed matched the plants in the ecosystem since they all co-evolved together. However, when the switch was made to unnatural wheat monocultures that were not familiar with the ecosystem, they were much more susceptible to the dangerous diseases that arise in wheat. More diseased wheat led to the increasingly frequent replacement of the seeds, turning a renewable resource into a nonrenewable resource and causing the people of Punjab to spend more money (Shiva).

Secondly, these monocultures had not coevolved with the local pests in Punjab. Since the indigenous plants evolved with the ecosystem, they learned how to resist certain insects through natural selection. These monocultures were more attractive to the insects and could not fight them off. Therefore, the people of Punjab were forced to spend more money again, this time on insecticides to keep the wheat from being overrun by pests. This economic strain placed on Punjabi people increased the amount of suicides by Punjabi farmers. These pesticides were not only damaging to the economy of the low-income Punjab farmers, but also to the environment. The fertilizers and pesticides used during the Green Revolution dramatically lessened the fertility of soil in Punjab. Fertilizers also require a specific crop pattern that takes up more space, which leads to the destruction of forests to create more agricultural land. The chemicals left behind in

the soil increased the toxicity level and completely dried out areas that used to be ideal for farming.

In the end, despite the attempts made by the people, the pesticides did not even help, as the pests just evolved to withstand the effects of pesticides, leading to stronger, more persistent insects. The dried out soil led to the destruction of more trees in an attempt to find more land with the indigenous, fertile soil. With stronger insects and dried out land came the creation of stronger pesticides with higher concentrations and furthered the deforestation, which of course created more and more issues in the environment. It is a vicious cycle that society repeatedly falls victim to, which leads to the transfer of wealth from low-income farmers to international corporations.

3.3 How Did This Happen?

As previously mentioned, the four main causes of biodiversity loss are economics, politics, culture, and science. All of these can be related back to the Green Revolution example.

Firstly, economics played a major part in convincing the Punjab citizens that this revolution was needed. “In the second quarter of the century, from World War I to independence, Indian agriculture suffered a set-back as a consequence of complex factors including reduced exports due to worldwide recession, depression, and the near complete paralysis of shipping during World War II" (Shiva, 27). Because of these factors, the average income in Punjab during the time of the Green Revolution was poor. The 1965 Indian Prime Minister, Lal Bahadur Shastri, was having a difficult time allocating resources, as there were minimal resources to

allocate in the first place. After his death in 1966, major pressure was on India to do something to solve the economic crisis they were experiencing. Desperate for food, resources, and a better economy, India, especially Punjab, had serious motivation to join the revolution.

Politics, the second major cause of biodiversity loss, was also very connected to the economic issues India was facing at this time. The Green Revolution itself was a political movement driven by the United States in an attempt to "improve" the agricultural methods used in Third World countries. It was led by the Rockefeller Foundation and the Ford Foundation, both private American organizations focused on solving global political issues through funding and science-based methods. The economic and political influence of these organizations is still substantial to this day. The economic pressure mentioned previously, combined with the political pressure on India from these two foundations and Lyndon B. Johnson, forced India into complying with the Green Revolution. This political pressure manifested in the form of threats of cutting off any American assistance during India's food crisis.

Along with economics and politics, culture played a major role in contributing to the extreme biodiversity loss that was the Green Revolution in Punjab. In many cases, culture, as in the way that society behaves, contributes to biodiversity loss through our everyday lives, such as through hunting, fishing, driving, meat eating, and more to be discussed later. In this case, it wasn't necessarily the traditional Indian culture that contributed to the biodiversity loss in Punjab, but instead the American culture that was forced onto them once the Green Revolution had already been approved. As mentioned before, India's traditional agricultural methods relied heavily on their respect for nature and its limits. An example of this is one of India's latest court rulings that Mother Nature must receive the same rights as any other human being. In America, the culture during the time was much different. Through the Dust Bowl in 1930, it can be seen

that American culture doesn't respect nature and instead focuses on the domination of it. Sure, America has national parks and certain organizations that are dedicated to solving environmental issues, however, partly because of the structure of capitalism, many of the people that control the American government prioritize economics and profit over issues concerning nature. That is partly why hunting for sport is such a common practice in the United States. Not only this, but American culture normalizes the use of fertilizers, pesticides, and genetically modified plants, whereas India originally used natural processes to enhance their farming ability. It was only when India was forced to shift to this science-based, nature dominating culture that an immense amount of biodiversity was lost and new environmental issues arose.

Finally, the most important and leading cause of biodiversity loss that is very apparent in this instance is science. It was the trust that Americans had on science that supposedly caused us to force our scientific methods on Punjab. As mentioned before, Punjab's previous agricultural methods worked perfectly fine. Yet, we had (and still have) the strong belief that everything can be made better through scientifically "improving" pre-existing methods of anything. The American government knew India's method, which included working with nature to farm agriculture, yet, America's government truly believed that using pesticides, fertilizers, and genetically modified seeds to dominate nature was the better approach. This complete and total trust in science led the world into believing that India needed agricultural improvement when, in reality, their previous method had worked for them since agriculture was invented. It is our ambition and strive for improvement through science that constantly allows us to let disasters like the Green Revolution occur.

3.4.0 A General Description of the Causes

Up to this point, we have gone into detail regarding how each of these causes led to the Green Revolution example. Although a great measure of just how intense of an impact each of these causes can make when combined, the Green Revolution cannot show just how relevant these causes are to society's everyday life. Even individually on a much smaller scale, these factors cause us to lose a little biodiversity everyday without us ever noticing. Therefore, not only is it important to recognize the real-life examples that lead to biodiversity loss (like the Green Revolution), but it is also important to recognize what is happening everyday that we campaign against. This section aims to portray many of the other typical ways in which the four factors (politics, economics, culture, and science) covertly cause biodiversity loss.

3.4.1 Politics

Part III of the book, "Building Global Resilience in the Aftermath of Sustainable Development: Planet, People and Politics" by Richard Pagett analyzes a lot of the different ways in which the world's current political system contributes to the loss of biodiversity and the environmental crisis as a whole.

The first Pagett discusses is global weakness. The chapter states how biodiversity loss and the environmental crisis is a global issue and therefore should be dealt with globally. However, this is difficult to perform in the real world, as, "on the one hand, we need global institutions to hold poor national governance to account, yet on the other hand we need the national governments to fund the global institutions" (Pagett, 114). Therefore, to avoid the issue

of funding and in an attempt to avoid any sort of conflict with national governments, many global institutions that do currently exist do not see the wasting of our natural resources as a priority issue. Not to mention, to solve any sort of issue globally, agreement from every relevant country needs to be met, or else there is minimal to no chance of success. In addition to this, most national governments take a higher priority in their own country over any world issues, making the agreement between countries much more difficult, especially when certain countries (like the United States) have been taking advantage of environmental issues for years (like carbon emissions) and now expect other, less fortunate countries to not follow in the footsteps of the countries that successfully cheated the system. We need global agreement to solve an issue like biodiversity loss, yet it seems nearly impossible with our current global political system to achieve this. Pagett argues that our best approach to this would be to do our best to educate global leaders and try to stress the importance of preventative measures.

In addition to global weakness, Pagett discusses national competence. He argues that too many national governments focus their resources on defending themselves or attacking others rather than helping each other. A huge issue with the environmental crisis is that, to solve it, we must find renewable resources unlike fossil fuels that help keep every country sustainable. With this issue comes another consideration: not only do these resources need to be sustainable, but we need to find a way to make it affordable for all low income countries. As mentioned previously, global agreement is needed to solve biodiversity loss, therefore, if we find ways to make the world more sustainable, we need to also provide the resources to countries who can't necessarily afford not to use cheap, easy to access fossil fuels. This would mean changing national governments and political systems around the world. Less money would have to be allocated to military equipment and weapons. Instead of sending guns and ammo to our allied

countries, we should be sending the resources needed to help the world rather than hurt it. This, of course, is no easy feat. It would require a change in the world's political structure. It would require countries to trust each other and work together to solve some of the world's major environmental issues before it's too late. It is our job as people who live on this planet to convince national leaders that allocating renewable, sustainable resources is, at times, more important than military equipment.

Finally, Pagett talks about governance in general. He believes we need to shift our political mindset to one that focuses on helping those less fortunate than us. Right now, so much of what we prioritize is focused on bettering ourselves and our own countries so that we have an advantage over everyone else. However, Pagett stresses, "common sense for the common good for the common future" (Pagett, 131). He is saying that it is through helping each other and leading by example that we can all have a successful future. Without the common good, without every country working together to keep every person alive and well, we will not all survive everything that is to come with the environmental crisis. The political mindset of every country for itself will not work in solving these issues. We will have to work together.

3.4.2 Economics

There are three main stances that are taken when it comes to how economics affects biodiversity loss. The first is a stance that doesn't privatize nature or try to scientifically come up with a solution to environmental problems. It is the stance that nature should be respected and protected through natural means. Second, there is the green capitalist stance that believes that there is an economic solution to environmental issues and that we should be finding a way to

solve them economically (not through privatization, the shift from something being government owned to privately owned, or through a respect for nature's values). Finally, the neoliberalist stance is one where its followers believe that environmental issues should be privatized because it helps us grow the economy. This neoliberalist stance has been expanding in recent years (especially since the stock market crash in 2008) and can be a very dangerous contributor to biodiversity loss. I will argue for the first stance and against the neoliberalist stance.

The book, *Food for the Few: Neoliberal Globalism and Biotechnology in Latin America* by Gerardo Otero discusses just how dangerous neoliberalism can be. Neoliberalism promotes social polarization, which is the segregation between low income and high income families within a society. Privatizing agriculture allows industrial farming and biotechnological corporations to supply everyone who can afford to buy from them with whatever genetically modified agriculture the groups choose. By doing this, they displace many smaller farms from production and leave them with no other way to make money. This privatization is a form of capitalism, where low income families and countries have no access to money or even food in some cases due to their unemployment, and those who can afford it continue to buy from industrial farmers without ever noticing an issue. Not only does this social polarization cause many families and countries to struggle economically, but it also has a direct effect on biodiversity loss. Privatizing agriculture means allowing private industry to decide exactly what is grown, how it is produced, and where it is sold. Many large corporations that run these industrial farms have a different agenda besides just supplying food to people around the world, which is making more and more money. This other agenda influences the plants that are grown and the chemicals that are used on them. If using dangerous pesticides and fertilizers made these companies more money, why would they choose not to do it, especially if every other competitor

is doing the exact same thing? Why would they choose to grow a variety of plants when they would make more money from monocultures of the exact same genetically modified wheat seed that they can buy in bulk and keep consistent? This neoliberal and capitalist view that we must continue to strive for more money and beat out all other competitors is a central cause of the loss of biodiversity.

Neoliberalism, as mentioned before, is not the only economic stance that can be taken when it comes to the environmental crisis. To avoid some of this biodiversity loss, we must take a different stance, one which includes respecting what nature has to offer us, working with it, and regarding its boundaries. We need to stop taking such an economically focused perspective when it comes to agriculture. The economy is not the only important factor involved and, if we continue down this capitalist path, there soon will not be an economy for us to protect anymore. This is something we must work towards because neoliberalism is very widespread. Only by following the alternatives will we have the best chance of saving biodiversity.

3.4.3 Culture

Culture is a major contributor to biodiversity loss and is a very difficult cause to mitigate. The reason for this is simple: changing our culture to align with the needs of biodiversity protection requires changing the way we live our daily lives, which many people are hesitant to do. We are so stuck in our ways and refuse to sacrifice the things we want to save biodiversity, even if it means losing the things we need. This section aims to discuss some of the things we can change in our own lives (or advocate for change of things that are too often normalized) to avoid biodiversity loss.

The first major contributor of our normalized culture to biodiversity loss is hunting. As consumers, we are often influenced by society around us, whether by social media, television, or just by word of mouth. This influence can be strong and cause us to envy things like the most "high end" furs, pets, or wood, all of which require the killing, capturing, or destruction of homes of endangered or rare species. It is our overindulgence in food and fancy, unnecessary things that lead us to destroy biodiversity for pointless reasons. A prime example of this is the ivory trade in Africa, where "harvesting ivory" really means the killing of baby and female elephants, along with the brutal extermination of rhinoceroses simply to obtain their horns. This isn't the only example of overindulgence that leads to hunting and biodiversity loss. Overfishing is another issue we face today, as many fish species (such as the northern cod) are becoming extinct in some fisheries due to the world's overindulgence in cod for food. Birds are another example. In the 1900's, it was very popular in European fashion for women to wear feathered hats, with the eccentricity of the feathers being the measure of how chic the hat was. In this time period, many bird species were becoming endangered, especially those with colorful feathers. Despite this, society was unwilling to give up their "fashionable" hats for the sake of the birds. Finally, also during the 1900s, whaling, or the killing of whales, became a source of food and oil for many coastal countries. It got so bad to the point where thousands of whales were dying every year. They were getting so close to extinction that commercial whaling was made illegal in most countries by 1969 (Adams).

Many of these examples began with good intentions, such as a new source of food, a new profitable commodity, or a new fashion item. However, it was almost always the overindulgence of the resources and the normalization of hunting that led to the dangerous loss of biodiversity. This culture is more than economics because it isn't just a systematic issue, but also a problem in

our daily lives, which is separate from the economy. If society had no desire for their neighbor's items or ate only what was needed without wasting or overindulging, many of these examples never would have gone far enough to put biodiversity in danger. Similarly, if the hunters had truly considered the lives they were taking away and avoided bad faith, many of them may have realized that what they were doing was destroying the environment and, at times, just plainly morally wrong. But our culture, our inability to sacrifice, and our justification of certain actions to avoid conflict allows for hunting and extermination to continue.

Hunting, of course, is not the only way that our culture contributes to biodiversity loss. Another example is our overconsumption of meat. At first glance, meat-eating does not necessarily seem like a source of biodiversity loss, however, we as a society eat so much meat that we are constantly looking for more ways to farm animals. Animal farms take up much more space than agricultural farms, so we are constantly cutting down trees and clearing land to make more space for the animals. Not to mention, we waste a lot of the energy that goes into animal farms. A lot of our agricultural produce goes back into feeding animals in animal farms which, of course, is a completely inefficient way of allocating our resources. There's an increased risk of disease, along with larger contributions to greenhouse gasses and the ethics of whether farming animals is even morally acceptable. Our overreliance on meat causes so many problems, many of which have a direct connection to biodiversity loss. Despite this, we refuse to sacrifice eating meat simply because we don't want to. Not only this, but our refusal to sacrifice makes it easier for our culture to affect our economy. Those in charge of the economy can capitalize on our weaknesses when it comes to caring for the environment. By the time we realize that we need to sacrifice and change our ways, it will be too late (McClements).

In addition to hunting and meat eating, there are many other aspects of culture that contribute to biodiversity loss that we can put a stop to. Firstly, we should encourage the youth (and those disconnected from the world) to go outside and reconnect with nature instead of using motorized toys and industrially manufactured items. We can do small things, such as turning off the lights, turning down the thermostat, reusing what we can, recycling, and so much more. We can choose to take public transport, ride a bike, or simply walk to our destination. Although pesticides and fertilizers cause issues on a much larger scale (as we've discussed), we can still choose to use natural fertilizers or no fertilizers at all for our own gardens and lawns to avoid surface pollution and the destruction of our local ecosystems. We can choose not to buy from unsustainable fast fashion stores or any items that use real fur or feathers. When it comes to ways we can help protect biodiversity, it simply comes down to the choices that we make everyday (Jackson).

There are so many different ways that our culture normalizes actions that cause biodiversity loss. Some of these actions are issues rooted in society that take the work of everyone to change how we act and how our leaders act. Other actions can begin in our own individual lives and spread to everyone else through inspiration and leading by example. People often underestimate how big of a difference they can make on their own. And, of course, we should all be working towards changing society's culture to be much more sustainable. But how can we expect a society to change if we don't accept the changes in our own lives? We must take responsibility and change individually, because that change will inspire others to do the same. We must ignore the centers of culture that lead us astray from environmental issues, such as religions, celebrities, and education. We must focus instead on the centers that inspire change.

3.4.4 Science

Science and the trust that we put into it is the leading cause of biodiversity loss. So much of our lives are engulfed in science and what we believe to be rationality, that we fail to recognize all of the problems that arise from this dependence. Our reliance on a science dominated world and the dangers that come from it are explained in *The Domination of Nature: New Edition* by William Leiss.

Leiss first details the modern day connection between science and domination. He discusses the concept of Herrschaftswissen, which is the idea that nature is controlled through science and technology. He also discusses Nietzsche's will to power, which is the idea that people want to dominate everything all the time, which leads to a misunderstanding of the way our society works (Leiss, 105). Relating this to biodiversity, our attempt to control nature for our own gain (such as using monocultures of the same wheat or pouring dangerously high concentrations of pesticides onto industrial agricultural farms) causes us to lose so much of the nature that had already adapted to the local environment and learned the limits of the ecosystem.

Leiss doesn't just detail our attempt to dominate nature, but he also explains our shift in mindset from old science to new science. Old science, he believes, has respect for the metaphysical and religious sciences, whereas new science only focuses on the positive science of control. This new science devalues nature and ignores the cognitive aspects of it. In the shift between these sciences, we have forgotten that science was originally based on social forces. We now ignore those social forces or metaphysical aspects, and instead only believe in the science that will advance us the furthest and the quickest (Leiss, 125). This relates directly to biodiversity since, without a consideration of the social aspects of nature and without attempting

to understand nature, we are left with only one approach to nature: the domination of it. If we don't respect nature and its boundaries, we will dominate it, and this domination, as mentioned previously, will cause us to lose biodiversity.

Leiss also explains our connection to science and nature. He explains how modern science separates the subjective and the objective and values the objective while disregarding the subjective. However, this should not be the case, as there are two spheres of human activity, the objective mathematization of nature (which is the only sphere that we value), and the life world, which is our common sense and everyday experience with nature (Leiss, 128). Rational and objective science is not the only way to learn from nature. Actually going out and experiencing nature firsthand is a different and important way to learn what else nature has to offer. Focusing on science disregards this method of learning, leading to a misunderstanding of nature's limits and needs. Without knowing where these limits are or what nature needs for success, it is impossible for us to know when to stop dominating it and when to care for it. It is impossible to know what biodiversity we are losing if we never knew it was there in the first place or if we never considered experiencing it. For example, spending our time outside and experiencing nature first-hand can lead us to a deeper understanding of the world. It can make us feel smaller and give us a spiritual connection that cannot be found elsewhere.

After stressing the importance of our everyday experiences with nature, Leiss discusses the connection between technology and domination. He begins by critiquing what we call reason. He believes that we disregard subjective reason and use objective reason to justify the mastery of nature (similar to how we ignore the subjective aspect of science). Therefore, since this subjective reason exists, we cannot just use the objective reason to justify the mastery of nature. The mastery of nature can never be justified since subjective reason would not allow for it. Leiss

also argues that social conflict and our attempt to dominate each other contributes to our domination of nature. This is how technology plays a part in the domination. Propaganda of technological marvels lead to the environmental crisis and societal imbalances lead to more fear and tension over the environment (Leiss, 145). For example, the creation of the automobile seemed like it could only have positive effects at the time since it revolutionized travel. We failed to recognize the carbon emissions that resulted from this technological marvel. Despite the good it has done, the creation of the car did objectively contribute to the environmental crisis. Similarly, the societal imbalances in the Green Revolution led to further environmental issues. Since America had a much larger societal advantage over India, it was easier for America to force their agricultural technological methods on Punjab. Our need to dominate each other and nature is dangerous to both the environment and our lives, yet, we continue to fall for the disguise of this domination as technological advances and bettering societal imbalances instead of seeing it for what it really is.

Science is not some “quick fix” remedy to all environmental issues. If anything, it has heavily contributed to the environmental crisis and biodiversity loss in many ways. To name a few, the creation of the automobile, the creation of toxic pesticides and fertilizers, the creation of better weapons, the creation of the monoculture “miracle” seed of wheat, and so much more. Yet, society has convinced us that these technological advances have actually helped us in such a significant way that all the problems they have caused are low priority and can just be fixed later with more technological advances. But what happens when these new problems are solved with science yet again? It is only safe to assume that the same situation will occur. More problems will arise and we’ll have to work harder to find more solutions. Solving problems with science that were created by science propels us into a vicious, dangerous cycle of using technology to

create more problems. Unless we take a step back and realize just how dangerous science can be, we will fail to come up with a viable solution to biodiversity loss.

3.5.0 Why Science Cannot be Trusted

By this point, we have reviewed how economics, politics, culture, and science directly relate to biodiversity loss in the context of the Green Revolution. Not only this, but we have further described each of these causes, how they contribute to biodiversity loss, and, briefly, what can be done to avoid this happening in the future.

So, the question is, if we know that these are all contributing to the environmental crisis and we know steps that can be taken to help prevent them from happening, why haven't fixed the issue and why do some people still refuse to see the environment as a priority problem? An answer is: people put too much trust into science to solve their problems and believe that science is the answer to everything. The evidence of science being a major contributor to so many of the world's problems is there, yet, society refuses to believe it. At this point, if we continue to allow science to "solve" these issues for us, we can no longer blame science as the leading cause in biodiversity loss. We can only blame ourselves for allowing science to take control and refusing to take responsibility for all of the ways technology has harmed us and the environment. We must stop placing all of our trust in science, because science cannot be trusted for a multitude of different reasons.

The first step in illustrating exactly why science cannot be trusted is by switching one's mindset from one that only recognizes the good that science does. As mentioned before, society

does a great job of hiding all of the terrible effects of science behind the good that it does. Society disguises how dangerous science can be by only marketing the good aspects or the possibility of technological advances. To escape this, we must first learn to look at the bad as well as the good by practicing with real life situations.

The article, "Controversial research: Good science bad science" by *Nature* describes real life scenarios where scientific research has the possibility of both helping and hurting the world. The first example provided is one where a team of researchers works to mutate a rare virus to find new emerging viruses that may be deadly to those infected. However, mutating a rare disease could also lead to a genetically modified disease which can be used by bioterrorists to kill a dangerously large number of people. Another example is one where separating radioisotopes is being studied to help find an efficient, sustainable energy source for nuclear power plants. However, if this team can figure out how to separate certain isotopes on such a large scale, this would also mean for a much easier way to make more dangerous nuclear weapons. In another example, a scientific research team is currently looking for the creation of a mind reading device for police officials to use on criminals or for family members to use on patients in hospitals who cannot otherwise move or interact. But this opens up the possibility of those in power with access to the device taking advantage of those below them by using the device on people against their will. Although it may help in a lot of ways, a mind reading device could be insanely dangerous. The next example was a team of researchers studying how to determine the future health or behavior of an embryo. This could cause a series of ethical dilemmas, such as whether this discovery will increase the number of abortions, whether this will eradicate the birth of people with disabilities, or whether this is a form of genetic selection.

The final example is one directly related to what we've been discussing. A research team is currently working towards finding a solution to global warming through geoengineering, or changing the Earth's environment on a planetary scale. Many of those who trust science like society encourages may not see a problem with this. But, as explained, it is our responsibility to shift our mindset and recognize the ways that this may harm us or the environment. Messing with nature and its limits has only proven to cause more problems in the future. So, we must recognize that this is not a solution to the problem. Like all of the other research examples, it is a way for science to solve an issue by creating a multitude of other issues (Brumfiel).

Every single one of these examples has negative side effects by using science to solve an issue. Therefore, we should stop trusting science to solve all our issues, and instead search for solutions that don't create further problems. Science simply cannot be the answer if it causes more problems than it solves. For that reason, science cannot be trusted.

3.5.1 Research

We have just explained the first step in removing our trust in science: by shifting our mindset to recognize the adverse effects of scientific solutions. However, there is another caveat in trusting science that is often overlooked by society. How can we trust science to solve our problems when the people controlling science themselves do not have our best interests at heart? Those who decide what science gets researched in the first place cannot be trusted since they often have ulterior motives. If we cannot trust the intentions of those in control, we most definitely cannot trust those in control to perform said scientific research. This section aims to

diminish the credibility of scientific researchers and show society just how untrustworthy these researchers can be.

The book, “Bending Science: How Special Interests Corrupt Public Health Research” by Thomas O. McGarity and Wendy E. Wagner details seven different reasons why we shouldn't allow for our current method of determining research to continue. Each reason simply upholds the basis that those with a lot of money corrupt scientific practices and make science completely unreliable.

The first reason is that scientists are the ones who ultimately decide whether others are good or worthy scientists. We often hear about the “scientific community” deciding whether or not certain research findings are reliable. But, who were the ones that decided which scientists were knowledgeable enough to make judgements about all research everywhere? And why are we supposed to just trust that these unknown, said to be intelligent, community members know exactly what is true and, even less believable, what is best for the general public? It is the “scientific community” that decides which researchers get grants, funding, and support. But, especially in the realms of public health and environmental policy, it makes no sense that these unknown community members get to make these decisions for the public. It is just accepted that these scientists can be trusted when, in reality, we actually know nothing about them, their beliefs, or their ulterior motives (44).

The second reason that scientific research cannot be trusted is because of the process that advocates take when deciding what to research. It is impossible for anyone to be completely impartial, and it is usually quite obvious when someone’s ideology comes through in their work. Advocates have the ability to control what exactly gets researched since, many times, they are

the ones funding the projects. Therefore, it only makes sense that advocates would invest in projects that align with their own ideologies. This usually comes in the form of a desired outcome. So, advocates are not choosing what to research because they are interested in being proven wrong. They invest in projects they know will result in the outcome they want to see. Many times, they aren't looking to learn something new, but instead are looking for ways to confirm to everyone what they already believe, making scientific research completely partial to whatever the advocates want (60).

Some may argue that, although the reasoning for research may be corrupt, the outcome itself can be trusted since research cannot always work out the way that advocates want it to. However, the outcome still cannot be trusted because, when it doesn't work out in their favor, advocates can simply hide their findings from the public. The process of scientific research is almost always conducted under a contract that allows the researchers and the funders to deny anyone from publishing what they found. They can simply mark it as "confidential business information" and go about their research looking for that alternative outcome. There is not a rule stating that any institution needs to report their findings, therefore, when it doesn't work out the way they intend, those in charge can simply pretend it never happened in the first place (97).

The next argument that someone may make is that there will always be independent scientists or competitors that come out with honest work that contradicts what the corrupt research shows. However, these independent scientists have no influence when compared to "respectable" advocates or institutions. Even most competitors have little to no influence if their research goes against what funders and advocates are searching for. Therefore, it is incredibly easy for the corrupt advocates to attack the independent scientists and competitors simply by saying that their science is wrong or unreliable. Considering the influence of corrupt institutions,

it only makes sense that the public falls victim to what the "respectable" scientists have to say. This becomes even more difficult to trust when competitors researching two opposite sides of an argument start to attack each other. How are we then supposed to know which one to trust and which one to ignore (128)?

A very similar reason not to trust research is the attack of the scientist themself. As mentioned, claiming that the science is unreliable or wrong is a simple way of shutting down any research that doesn't align with the views of the advocates. If that somehow doesn't work, it is also very easy for advocates to defame the scientist through scientific misconduct charges and defamation suits. The advocates, who can easily afford the best lawyers and can spend all of their time putting constant pressure on independent scientists, can often scare these scientists into stopping or changing their research into fitting the needs of the advocates. Advocates not only have the power to decide what gets researched, but also have the power to heavily influence the research of others. Therefore, even independent scientists cannot be trusted (157).

The next piece of evidence is that pronouncements can be chosen from "expert" scientists that allow for current research to be changed completely. Advocates have all the resources in the world. Therefore, when they say something about what should be researched, they can easily put together a team of "expert" individuals who all believe the same thing. They can handpick whatever scientists they want to fit whatever needs they want, simply because they have the money to. This creates extreme bias in the project before any research is even conducted (181).

The final reason that is detailed in the book is the result of public relations campaigns. These campaigns are used often by advocates to change what the public thinks about a competitor's scientific research, usually about the environmental crisis. Advocates have enough

money to spend hundreds of thousands of dollars on public relation campaigns that support the research that they are doing and find holes in the research of others. Similar to how companies pay to market their products, advocates can pay to make themselves be perceived much better by the public. If they can pay to make themselves look good, they can easily pay to make others look bad. The combination of these two lead to our trust in certain research groups over others, again isolating us from honest scientific work (204).

Overall, advocates control all there is to know about scientific research. They control what is researched, who is deemed reliable, what the outcome is, what is shared with the public, and every other aspect. And, even if these advocates really do hope to make a difference in the lives of the public, there is no denying their ulterior motive for gaining profit. They simply cannot continue to fund research without any money in the first place. Therefore, their only goal cannot just be to help the people. They must also find a way to make money. It is simply impossible for these advocates to have our best interests at heart at all times. Therefore, we should be much more careful in choosing who we want to believe and what science we should trust. Because not only does science usually solve problems by creating more problems, but it is also highly likely that the advocates who control the science are not considering the existing problems, or the problems to come.

3.6 Conclusion

This section has addressed many ways in which we are losing biodiversity. A key takeaway is that there are four main causes to biodiversity loss: culture, economics, politics, and science.

We first discussed a real life example of biodiversity loss that heavily impacted Punjab, India and is called the Green Revolution. The Green Revolution was the science-based transformation of third world agriculture in an attempt to make agriculture more successful and minimize poverty. Although it was intended to save Punjab, it ended up severely hurting it, especially environmentally. It destroyed so much of Punjab's biodiversity through the monocultures of wheat, the destruction of the useful soil, the avid use in pesticides and fertilizers that created new, stronger pests, and so much more.

The four main causes of biodiversity loss contributed very directly to the Green Revolution. Firstly, the shift in culture in Punjab from a view of working with nature to a view of dominating nature. This shift caused the farms to continuously expand without a regard for nature's boundaries, causing the destruction of the land. Secondly, political influence from America (specifically Lyndon B. Johnson) gave Punjab no choice but to go along with the Green Revolution, leading to all the environmental issues. Economically, Punjab was in so much poverty that they again had no other option but to give in to the influence. Finally, the scientific cause was the most detrimental, considering it was the miracle seeds and the pesticides that America trusted so wholeheartedly that ultimately destroyed Punjab.

After providing this example, a general description of the causes of biodiversity were addressed. With politics, we discussed how global weakness, national competence, and governance all lead to biodiversity loss and the environmental crisis. Since the environmental crisis is a global issue, it cannot be addressed without agreement and participation from each country. Also, we fail to allocate our resources responsibly, for example, spending too much money on defending ourselves rather than helping each other save the environment. Finally, we should be focusing on helping those less fortunate than us rather than just helping ourselves.

Economically, our shift to a more neoliberal society has made it much more difficult to help save biodiversity. Neoliberalism has led to social polarization and privatization of agriculture, making it much more difficult for smaller farms to be successful. It has led to industrial farming and has shifted the motive for farming from supplying food to those in need to making the most money possible. With society's culture, we have normalized aspects of our lives that lead to biodiversity loss. Some of these examples include hunting, the overconsumption of meat, and the overutilization of electricity. Changing small aspects of our everyday lives, along with working to change the normalization of larger aspects of our society's culture, can help us slowly fight back against biodiversity loss.

Science, of course, is the most dangerous of any of the causes. Its reason for being the most dangerous is that the world puts so much of our trust into it. No matter how many times science creates further issues, society continues to ignore it. The first step in realizing that science cannot be trusted is learning to recognize the possible adverse effects of new scientific "solutions," despite the way they're being marketed and the influence from the rest of society. Once these effects can be recognized, steps can be taken against this research and society can be warned.

Further proof that science cannot be trusted lies in the research. Advocates that fund so much of the world's scientific research control every aspect of it and often have ulterior motives. They get to decide what gets researched and how the information they find is presented to the public. They have the resources necessary to manipulate the perspective of the public however they want. We must be wary of this and refuse to just automatically trust what we hear from the "scientific community". There is a very good chance there is much more occurring behind the scenes than the public is aware of. Therefore, science in general cannot be trusted.

We have learned from the environmental crisis just how dangerous this trust in science can be. All science has done is create further problems for the environment. It leaves out the spiritual connection to nature one must have to understand it. It fails to include the subjective aspects of nature and instead aims to dominate it, leading to compounding issues. Now that we know, from the environmental crisis, that science cannot be trusted, what should we do next? How can we take a stand against what is happening and save biodiversity on our planet? What are we doing now?

4. Current and Future Solutions to Biodiversity

4.1 Eco-Friendly Technology

Eco-friendly technology is a key area in the field of technological innovation. These technologies are designed with the goal of reducing environmental harm and promoting sustainability. They aim to save natural resources, reduce pollution, and strengthen ecosystems. This kind of technology is very important for preserving biodiversity. Biodiversity, which refers to the variety of life on Earth, is essential for maintaining ecological balance and providing the resources that human societies depend on. Technology plays a crucial role in protecting this diversity. For instance, improvements in satellite imaging and data analysis allow for real-time tracking of deforestation and illegal wildlife trade, which helps to improve the effectiveness of conservation efforts.

Eco-friendly technology is closely connected to sustainable development, which aims to meet our current needs without harming the ability of future generations to meet theirs. Technologies that promote sustainability, like renewable energy systems and waste-to-energy processes, help to reduce the environmental impact of human activities. They point us towards a stronger and more sustainable economy that lives in harmony with nature instead of using it up. By incorporating sustainability principles into technology, we can create systems that benefit not only people but also the many different forms of life that make our planet unique. This

combination of technology and sustainability is key for the long-term preservation of Earth's biodiversity and the well-being of all its inhabitants.

Eco-friendly technology has given environmental conservationists a lot of hope. This type of technology has shown great promise in many areas, including energy, waste management, and farming. In the energy field, switching to renewable sources like solar, wind, and hydroelectric power has been key in cutting down on greenhouse gas emissions. Technologies for managing waste have changed how we deal with trash, with new methods like composting and recycling centers greatly lowering the amount of waste that goes to landfills. In farming, precision farming methods have let farmers use resources more efficiently and lessen the environmental harm caused by farming.

The creation and use of eco-friendly technology is important for fighting climate change. These technologies can lower emissions and improve energy efficiency, which helps lessen the impact of global warming. Eco-friendly technology can also help us adjust to changes caused by a changing climate. For example, technologies for conserving water are becoming more and more important in areas that are dealing with serious droughts.

The fusion of Artificial Intelligence (AI) and heat maps in the sphere of biodiversity conservation signifies a paradigm shift in environmental stewardship. AI, with its prowess in processing extensive data and discerning patterns, has emerged as an essential instrument in conservation biology. Conversely, heat maps serve as graphical representations of data, employing color gradations to denote different intensities of a specific phenomenon, such as species distribution or habitat alterations. Collectively, these technologies provide a robust mechanism for monitoring and safeguarding biodiversity.

AI's contribution to biodiversity conservation is diverse. It encompasses the examination of remote sensing data, predictive modeling of species distributions, and automated recognition of various species. AI algorithms can scrutinize images from camera traps, satellite imagery, and other surveillance devices to detect and categorize species, track their movements, and even forecast future population trends. This capability is vital for comprehending the effects of environmental shifts and human activities on wildlife.

Heat maps augment AI by offering a lucid and intuitive method to present intricate data. They can depict the density of species in a particular area, the degree of threat they encounter, or the changes in their habitats over time. Conservationists can utilize heat maps to pinpoint biodiversity hotspots, prioritize regions for protection, and observe the efficacy of conservation initiatives.

4.1.1 Spatial Planning for Area Conservation in Response to Climate Change (SPARC):

The SPARC initiative, a project led by Conservation International, is a comprehensive endeavor that employs a multitude of advanced technologies. Its primary aim is to anticipate and respond to the impacts of climate change on biodiversity. The project's methodology is centered around the use of remote sensing, artificial intelligence (AI), and statistical modeling. These tools are used to predict species movements and guide conservation strategies.

Remote sensing technology plays a pivotal role in SPARC's approach. It provides detailed data on land cover, vegetation health, and environmental changes. This information is

crucial for understanding biodiversity patterns. By analyzing this data, SPARC can monitor habitat changes that may compel species to migrate. This allows the identification of areas where biodiversity is most vulnerable to climate change.

Artificial Intelligence (AI) algorithms are used to process remote sensing data to identify changes in biodiversity. These algorithms have the capability to detect the presence of species, count individuals, and even predict future distributions based on current trends. Statistical models are subsequently employed to validate these predictions. They simulate potential future scenarios, offering a probabilistic forecast of species movements.

SPARC's sophisticated maps are more than just visual aids. They serve as strategic guides that highlight priority areas for conservation. These maps are used to identify regions that are critical for preserving biodiversity in the face of climate change. This assists policymakers and conservationists in focusing their efforts on where they are most needed.

A specific application of SPARC's work is in the conservation of migratory species. By understanding how climate change influences migration patterns, SPARC aids in safeguarding vital habitats that these species rely on throughout their life cycles. This is particularly significant for species that cross international borders, as it promotes cross-border conservation collaboration.

One of the key components of SPARC's approach is remote sensing technology. This technology provides detailed data on land cover, vegetation health, and environmental changes, which are essential for understanding biodiversity patterns. For example, by analyzing this data, SPARC was able to monitor habitat changes that forced certain species to migrate, thereby identifying areas where biodiversity is most vulnerable to climate change.

AI algorithms are used to process remote sensing data to identify changes in biodiversity. These algorithms can detect the presence of species, count individuals, and even predict future distributions based on current trends. Statistical models are then used to validate these predictions and simulate potential future scenarios, providing a probabilistic forecast of species movements.

SPARC's sophisticated maps are more than just visual aids; they serve as strategic guides that highlight priority areas for conservation. These maps are used to identify regions that are critical for preserving biodiversity in the face of climate change, helping policymakers and conservationists focus their efforts on where they are most needed.

A specific application of SPARC's work is in the conservation of migratory species. By understanding how climate change influences migration patterns, SPARC helps protect vital habitats that these species rely on throughout their life cycles. This is particularly important for species that cross international borders, as it promotes cross-border conservation collaboration.

Despite its advanced technology, SPARC faces challenges related to data quality and predictive accuracy. Remote sensing data may be affected by cloud cover or lack the necessary resolution for fine-scale biodiversity monitoring. Additionally, the predictive models heavily depend on the availability and quality of historical data, which may not be comprehensive for all species and regions. To overcome these challenges, SPARC is exploring new data sources and refining its models. The integration of drone imagery, bioacoustics data, and citizen science observations are among the innovative approaches being considered to improve data quality and predictive accuracy. This continuous improvement underscores SPARC's commitment to leveraging state-of-the-art technology in the service of biodiversity conservation. To overcome

these challenges, SPARC is exploring new data sources and refining its models. The integration of drone imagery, bioacoustics data, and citizen science observations are among the innovative approaches being considered to improve data quality and predictive accuracy. This continuous improvement underscores SPARC's commitment to leveraging state-of-the-art technology in the service of biodiversity conservation. This research paper aims to shed light on the significant work being done by SPARC in the field of biodiversity conservation. It is hoped that this will inspire further research and innovation in this critical area.

4.1.2 AI for Good's Biodiversity Series

Artificial Intelligence (AI) technologies, especially machine learning algorithms, have the capacity to scrutinize copious amounts of data from diverse sources such as satellite imagery, wildlife photography, and climate data. This analysis can unveil patterns and trends in biodiversity that would be unattainable for humans to perceive without assistance. For instance, AI can monitor alterations in animal populations, migration patterns, and habitat utilization over time, offering invaluable insights into how biodiversity is evolving.

Furthermore, AI can assist us in comprehending the causes of biodiversity loss. By correlating biodiversity data with other types of data, such as land use, pollution levels, and human population density, AI can help pinpoint the factors instigating biodiversity loss. This can lead to the formulation of more effective strategies for preventing biodiversity loss. For example, if AI analysis discloses that deforestation is a significant driver of biodiversity loss in a specific region, conservation efforts can be concentrated on protecting and restoring forests in that region.

Artificial Intelligence (AI) has been instrumental in monitoring animal populations. It can analyze images from camera traps to identify and count different animal species. A notable example of this is the Wildbook project, which uses AI to identify individual animals based on their unique patterns or markings, and track their movements and behaviors. This application of AI has led to more accurate population estimates for several endangered species, thereby informing conservation strategies.

In predicting deforestation, AI has shown significant promise. It can analyze satellite imagery to detect changes in land use and predict areas at risk of deforestation. The Global Forest Watch platform, for instance, uses AI to provide near real-time information about deforestation events worldwide. This has enabled quicker responses to illegal logging activities and has played a crucial role in protecting critical habitats.

AI has also been used to identify biodiversity hotspots. It can analyze diverse data sets to identify areas with high biodiversity that are under threat. The Zooniverse project, for example, uses AI to analyze citizen science data and identify biodiversity hotspots. This has helped to prioritize areas for conservation efforts and allocate resources more effectively.

Assessing the impact of climate change is another area where AI has been applied. AI can analyze climate data alongside biodiversity data to assess the impact of climate change on different species and ecosystems. Microsoft's AI for Earth initiative, for example, uses AI to model how species distributions might change under different climate scenarios. This has provided valuable insights for planning conservation strategies under a changing climate.

These examples illustrate the potential of AI in biodiversity conservation. However, it’s important to note that the effectiveness of these applications depends on the availability and

quality of data. They are not a substitute for on-the-ground conservation work and expert knowledge. AI is a tool that can enhance our understanding and management of biodiversity, but it needs to be used responsibly and ethically.

AI can play an instrumental role in prioritizing conservation efforts. Conservation resources are often scarce, and it's crucial to allocate them where they can yield the most significant impact. AI can help identify biodiversity hotspots that are most at risk and species that are most in need of protection. It can also predict the likely impact of different conservation strategies, aiding decision-makers in selecting the most effective strategies.

Despite its potential, the application of AI in biodiversity conservation is not devoid of challenges. One of the primary issues is data inequity, the unequal access to biodiversity data across countries and communities. This can restrict the effectiveness of AI in monitoring biodiversity and informing conservation efforts.

Moreover, while AI can provide valuable insights, it is not a substitute for human expertise and judgment. AI models need to be meticulously designed and trained, and their results need to be interpreted in the context of broader ecological and conservation knowledge.

Looking forward, there is a need for more research and development to surmount these challenges and maximize the potential of AI in biodiversity conservation. This includes developing more sophisticated AI models, enhancing data collection and sharing, and fostering collaboration between AI researchers and conservation practitioners.

4.1.3 Infrared Imaging for Koala Conservation

Following the catastrophic bushfires in Australia, conservationists leveraged technology to assist in their endeavors to locate surviving koala populations. They utilized drones outfitted with infrared imaging technology to survey the affected regions. Infrared imaging is particularly potent in this context as it captures heat signatures, enabling the warm bodies of animals to be distinguished against the cooler vegetation. This is especially beneficial for locating koalas as they spend numerous hours each day resting amidst branches, and their fur aids in camouflaging them against the vegetation.

The footage procured by the drones was subsequently analyzed by an AI algorithm. The AI was trained to differentiate koalas from other heat signatures, effectively pinpointing the location of the surviving koalas. This method is more reliable and less intrusive than traditional animal population monitoring techniques. The employment of AI not only enhances the accuracy of the detection but also conserves time and resources by automating the process.

The utilization of drones, infrared imaging, and AI proved to be particularly advantageous in the recovery efforts on Kangaroo Island. The AI system was capable of recognizing images of the endangered Kangaroo Island dunnart, a marsupial that can be challenging to distinguish from other small mammals. This technology has been instrumental in tracking the recovery of the endangered Kangaroo Island dunnart, despite the majority of its habitat being impacted by the fires.

4.1.4 Soundscape Analysis for Tropical Forests

In recent studies, the analysis of audio recordings from tropical forests has been performed using artificial intelligence (AI). These recordings, known as “soundscapes,” capture the sounds made by various animal species. Machine learning models, a type of AI, are then used to analyze these soundscapes, and animal species are identified based on their unique sounds.

One of the main advantages of this method is its non-invasive nature. Traditional methods of biodiversity monitoring often involve the physical trapping or direct observation of animals, which can be disruptive. In contrast, with soundscape analysis, the natural sounds of the forest are simply recorded, making it a much less invasive method.

Not only can individual species be identified through soundscape analysis, but it can also serve as a measure of ecosystem health. The diversity of sounds within a soundscape can act as an indicator of biodiversity, with a greater variety of sounds suggesting a more diverse and healthier ecosystem. Moreover, valuable insights into changes in the ecosystem, such as the arrival or departure of species, changes in population sizes, or shifts in behavioral patterns, can be provided by changes in the soundscape over time.

In another study, machine learning, a subset of AI, was used to analyze the soundscapes of coral reefs. The AI model was trained on a diverse set of tasks using three biogeographically independent datasets, each containing fish community, coral cover, or depth zone classes. The results of this study showed that machine learning can be used to unlock greater insights from reef soundscapes.

However, the use of AI in soundscape analysis is not without its challenges. One of the main issues is the need for large, high-quality datasets of animal sounds for training the AI models. The collection of these datasets can be resource-intensive and time-consuming. Additionally, the accuracy of the AI models can be influenced by various factors, such as the quality of the audio recordings and the complexity of the soundscapes.

Looking forward, there is a need for more research and development to overcome these challenges and make the most of soundscape analysis for monitoring biodiversity. This includes improving the quality of audio recordings, developing better AI models, and finding new ways to interpret and use the data from soundscape analysis.

While AI and heat maps are extremely helpful in protecting all the different kinds of life on our planet, they're not without their problems. One big issue is data inequity. This means that not everyone around the world has the same access to biodiversity data, which can make these technologies less effective in some places.

Also, how good the AI models are at their job depends on the quality and amount of data they get to learn from. This just goes to show how important it is to have lots of high-quality data for these models to learn from.

As we keep moving forward with technology, there's a real need for constant innovation to make AI even better at helping with conservation efforts. This includes making more advanced AI models, getting better at collecting and sharing data, and encouraging more teamwork between the people who work on AI and the people who work on conservation.

In conclusion, AI and heat maps are leading the way in a revolution in biodiversity conservation. By using these technologies, people working in conservation can make decisions based on data, respond quickly to new threats, and plan effectively to protect all the different forms of life that our planet supports. This highlights how important technology is in protecting our planet's rich biodiversity for future generations.

4.2 Role of Biotechnology in Aiding Biodiversity

Biodiversity, or the variety of life on Earth, is super important. It's all about the different organisms—like plants, animals, bacteria, and fungi—that exist in any given place. These life forms help keep our planet healthy by doing things like maintaining balance in ecosystems, providing oxygen, purifying water, decomposing waste, pollinating plants, controlling pests, and even adding aesthetic and cultural value. However, this rich biodiversity is under serious threat because of things we humans are doing, like destroying habitats, changing the climate, overusing species, and causing pollution. Each of these factors contributes to the loss of biodiversity in its own way. Rapid urbanization, deforestation, and changes in land use are leading to a big loss of habitats. Rising global temperatures, changing weather patterns, and increased frequency of extreme weather events are changing habitats and making it hard for many species to survive. Overfishing, hunting, logging, and illegal wildlife trade are causing many species to decline rapidly. Air, water, and soil pollution can harm various species, leading to health issues, reproductive problems, and even death. In this alarming context, biotechnology emerges as a powerful tool that can help in biodiversity conservation. Biotechnology, which includes techniques such as genetic engineering, tissue culture, and genomics, offers several ways to help

conserve biodiversity. Genetic engineering allows for the modification of an organism's genetic makeup, enhancing the survival of a species by introducing traits that increase its resistance to diseases, adaptability to environmental changes, or reproductive success. Tissue culture and micropropagation techniques involve growing cells or tissues in an artificial medium separate from the parent organism. This can be used for the rapid propagation of endangered species, thereby increasing their population size and genetic diversity. Genomics, the study of an organism's entire genetic makeup, can provide valuable insights into the genetic diversity within a species. This information can be used to develop effective conservation strategies. While the threats to biodiversity are significant and multifaceted, the tools we have at our disposal, like biotechnology, offer hope. By understanding and addressing the causes of biodiversity loss and leveraging technology, we can work towards preserving the rich tapestry of life that sustains our planet.

Genetic engineering is a powerful tool in biotechnology that lets us change an organism's genetic makeup. This can be used to help a species survive by adding traits that make it more resistant to diseases, better able to adapt to environmental changes, or more successful at reproducing. For example, researchers are thinking about ways to use genetic engineering for conservation, like getting rid of invasive rodents on islands or making American chestnut trees more resistant to an invasive fungus.

Tissue culture and micropropagation techniques are about growing cells or tissues in an artificial medium, separate from the parent organism. This can be used to quickly increase the numbers of endangered species, which also increases their genetic diversity. In vitro technology is offering new ways to improve biodiversity conservation in rare and endangered plant species.

Tissue culture has been a tool for quickly making a lot of identical plants while keeping their genotype the same.

Genomics, or the study of an organism's entire genetic makeup, can give us valuable insights into the genetic diversity within a species. This information can be used to develop effective conservation strategies, like identifying individuals with unique genetic traits for breeding programs. Genomic technologies can help these efforts by identifying biodiversity "hotspots" to prioritize for protection, using predictive models to help build natural communities that are resilient to environmental change, and informing management actions that try to reduce threats to endangered species.

In conclusion, biotechnology, including genetic engineering, tissue culture, and genomics, offers several ways to help in the conservation of biodiversity. By using these technologies, we can make informed decisions, take action when we need to, and work towards preserving the rich variety of life that keeps our planet going. However, it's really important to make sure that these technologies are used responsibly, considering the ethical implications and potential risks that come with their use.

While biotechnology offers a lot of advantages, it also has its challenges. Data inequity is a big concern, as access to biodiversity data isn't the same everywhere in the world. Also, the accuracy of AI models depends on the quality and amount of training data available. As technology keeps advancing, there's a need for more comprehensive datasets and continued innovation to improve how effective AI is in conservation.

4.3 Current Acts to Protect Biodiversity

Biodiversity, the rich variety of life on Earth, is indeed a crucial aspect of our planet's health. It provides us with an array of goods and services that are essential for our survival and well-being. These include food, clean water, medicines, and climate regulation, among others. However, biodiversity is increasingly under threat due to various human activities such as deforestation, pollution, overfishing, and climate change. These activities disrupt ecosystems, leading to habitat loss and species extinction.

People are having a big impact on biodiversity. The main reason for this is changes in land use, mostly because of large-scale farming, which is causing about 30% of the decrease in biodiversity. Overuse of resources, like fishing too much or cutting down too many trees, is causing around 20% of the decrease. Climate change is another big factor, causing 14% of the decrease, along with pollution. Alien species that invade new areas account for 11% of the decrease. Other things causing a decrease in biodiversity include cutting down forests, losing habitat because of cities spreading out, pollution from pesticides, and using too much fertilizer.

There are a lot of laws trying to protect biodiversity. Two big ones are the 1973 Convention on the International Trade in Endangered Species (CITES) and the 1992 Convention on Biological Diversity (CBD). These laws are all about managing biological resources in a sustainable way. Another key agreement is the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

The CBD has a goal to stop the loss of biodiversity, and this goal is legally binding. This obligation comes indirectly from international climate law and is based in human rights law. However, the CBD and other laws related to biodiversity, like the Aichi Targets and the Kunming–Montreal Global Biodiversity Framework, don't change the obligation to stop biodiversity loss.

In Europe, there are a lot of laws supporting biodiversity, like the EU Biodiversity Strategy for 2030, the Birds and Habitats Directives, the upcoming Nature Restoration Law, EU Forest Strategy, Marine Strategy Framework Directive, Water Framework Directive, and Soil Strategy.

But these laws have their limits. They only work as well as the political will and resources of each country that signed them. They also don't have good ways to enforce them, so it's hard to hold countries accountable for not meeting their biodiversity goals.

4.3.1 The Recovering America's Wildlife Act

The Recovering America's Wildlife Act (RAWA) is an important piece of legislation in the United States. Its main goal is to provide funding for state-led initiatives that aim to proactively conserve fish and wildlife species before they become endangered, thus protecting biodiversity.

In Michigan, significant contributions have been made to the conservation of the Eastern Massasauga Rattlesnake through RAWA. A recovery plan for this species was finalized by the U.S. Fish and Wildlife Service, in collaboration with partners. The plan aims to reduce threats to

existing populations by addressing habitat loss, impacts from flooding and drought, disease, and intentional killing. More than 2.7 million acres of land have been enrolled by the Michigan Department of Natural Resources through the agreement, which will be managed to benefit the snake, covering a large area of the species' range in Michigan.

RAWA has also played a significant role in the conservation of the Eastern Massasauga Rattlesnake in Michigan. Efforts to restore habitats for this species have been funded by the Act. As a result, a positive trend has been observed in the population of the Eastern Massasauga Rattlesnake in recent years. However, the species is still considered vulnerable due to ongoing threats such as habitat loss and human disturbance.

In California, RAWA funds have been utilized to lead active surveillance efforts for Pseudogymnoascus destructans (Pd), the fungus that causes White-nose Syndrome (WNS) in bats. These efforts were led by the California Department of Fish and Wildlife (CDFW) at 11 sites in California in spring 2023. The surveillance results suggest that the fungus causing WNS is now present in California. However, there is no indication that the disease itself has taken hold in California bat populations.

The funding has enabled researchers to study the disease and develop strategies to manage its spread. While these efforts have helped slow the decline of bat populations, White-nose Syndrome continues to pose a significant threat to bats in California and across North America.

RAWA has also played a crucial role in the conservation of pollinators like the monarch butterfly, rusty patched bumble bee, and Karner blue butterfly. These species play a vital role in our ecosystems and agriculture by pollinating plants. Conservation efforts funded by RAWA have helped protect and restore habitats for these species, leading to increases in their

populations. However, these species continue to face threats from habitat loss, pesticide exposure, and climate change.

RAWA has helped fund efforts to restore habitats for the monarch butterfly. The latest survey from the Xerces Society counted 247,237 butterflies across 283 sites in the 25th annual Western Monarch Thanksgiving Count. This is a significant increase from fewer than 2,000 individuals counted in 2020. However, the population is still far from the low millions seen in the 1980s.

RAWA has also contributed to the conservation of the rusty patched bumble bee. A plan to recover this endangered species was announced by the U.S. Fish and Wildlife Service.

The economic benefits of RAWA are substantial. Birds, bats, and butterflies contribute hundreds of billions of dollars to farmers by eating pests and fertilizing plants. Furthermore, outdoor recreation, which adds nearly $900 billion to the economy each year, often depends on healthy wildlife populations and habitats. However, these benefits are not evenly distributed and can vary significantly depending on local conditions and management practices.

Despite its benefits, RAWA's effectiveness is limited in several ways. Firstly, while it provides substantial funding, it relies heavily on state agencies' capacity to implement their plans effectively. This means that the success of the Act can vary significantly from state to state, depending on resources, expertise, and political will. Secondly, RAWA does not address the root causes of biodiversity loss, such as climate change and habitat destruction due to urban development. Lastly, lawmakers have yet to settle on a funding source for RAWA, which has led to uncertainty about the Act's future. This uncertainty can hinder long-term planning and conservation efforts. In conclusion, while RAWA has played a significant role in biodiversity

conservation, it is not a silver bullet. Addressing biodiversity loss will require a comprehensive approach that includes not only funding for conservation efforts but also policies to tackle the root causes of biodiversity loss.

4.3.2 The UN Convention on Biological Diversity

The United Nations Convention on Biological Diversity (CBD), a global treaty, is recognized for its three primary objectives: biodiversity conservation, sustainable utilization of biodiversity, and the equitable distribution of benefits derived from genetic resources. All domains, whether directly or indirectly linked to biodiversity and its role in development, are encompassed by this treaty.

Over the past decade, significant advancements have been made under the CBD. In 2010, the Strategic Plan for Biodiversity 2011–2020 was adopted by the Parties to the CBD. This ten-year action plan, designed for all countries and stakeholders to protect biodiversity, included the Aichi Biodiversity Targets. Despite this comprehensive approach, it is observed that biodiversity conservation targets have largely been missed due to the continued unsustainable use of the world's resources by nations.

In 2022, the 15th Conference of Parties to the CBD saw the adoption of the Kunming-Montreal Global Biodiversity Framework (GBF), which includes four goals and 23 targets to be achieved by 2030. The GBF emphasizes the importance of ecologically representative, well-connected, and equitably governed systems of protected areas. The GBF has

provided renewed momentum to ensure that the CBD is a treaty that benefits all and safeguards the biodiversity upon which life on this planet relies.

The CBD promotes actions that lead to a sustainable future. It serves as a framework for resource management and offers significant environmental, economic, and social benefits. However, the effectiveness of the CBD is constrained by the political will and resources of each signatory country. The absence of enforcement mechanisms makes it challenging to hold countries accountable for not meeting their biodiversity targets.

While the CBD plays an integral role in biodiversity protection, it is not without its limitations. Therefore, continual review and improvement of these legal frameworks are essential to ensure effective protection of our planet's biodiversity. Despite these challenges, the CBD remains a crucial instrument in the global effort to preserve biodiversity. Its success will largely hinge on the commitment and cooperation of all signatory countries and stakeholders involved. It is a collective responsibility that necessitates global action. The survival of many species and the future of our planet depend on it. The CBD is more than just a convention; it is a pledge to future generations to leave them a planet rich in biodiversity. It is a promise to sustain the very fabric of life on Earth. It is a commitment to protect the natural world that we all share and depend on for our survival and well-being.

In conclusion, it can be seen that significant roles in the protection of biodiversity are played by both the Recovering America's Wildlife Act (RAWA) and the Convention on Biological Diversity (CBD). However, it is also evident that these legal frameworks have their own limitations.

The RAWA, for instance, is a major legislation in the United States that aims at the proactive conservation of fish and wildlife species before they reach a critical state of decline. This is achieved by providing funding to state wildlife agencies, which are then responsible for implementing their State Wildlife Action Plans. However, the effectiveness of RAWA is often compromised due to its heavy reliance on state agencies for implementation, leading to inconsistencies in conservation efforts across different states. Furthermore, despite the substantial funding provided by RAWA, it may still fall short given the magnitude and urgency of the biodiversity crisis.

On the other hand, the CBD is an international legal instrument that is aimed at the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising from the use of genetic resources. Despite being ratified by many countries, making it one of the most universally participated-in conventions in the world, the CBD also has its limitations. The goals of the CBD are often hindered by conflicting national interests and a lack of enforcement mechanisms. Additionally, while the importance of traditional knowledge and practices for conservation and sustainable use is recognized by the CBD, it has been criticized for not doing enough to prevent biopiracy.

Therefore, while both RAWA and the CBD have contributed significantly to biodiversity protection, it is clear that they are not without their shortcomings. These limitations underscore the need for continual review and improvement of these legal frameworks. This could involve increasing funding for conservation efforts, strengthening enforcement mechanisms, and ensuring fair and equitable benefit-sharing. Moreover, greater collaboration and synergy between different legal frameworks at the national, regional, and international levels need to be fostered. Only through such concerted and adaptive efforts can we hope to effectively protect the rich

tapestry of life that constitutes our planet's biodiversity. In the face of the ongoing biodiversity crisis, the stakes could not be higher. The health of our planet and the survival of future generations depend on our ability to preserve and restore biodiversity. Hence, it is not just desirable but absolutely essential to continually review and improve these legal frameworks to ensure they effectively protect our planet's biodiversity.

4.4 Future Approach to Protect Biodiversity

As we stand on the precipice of a biodiversity crisis, it is imperative that we consider a future-oriented approach to protect the rich tapestry of life on Earth. The consequences of biodiversity loss are far-reaching and profound, affecting not just the environment, but also the economy, health, and social structures.

To overcome these consequences, our approach should be twofold, focusing on both short-term and long-term strategies. In the short term, immediate actions are needed to halt the loss of species and habitats. This could include stricter regulations on activities that harm biodiversity, such as deforestation and overfishing, as well as efforts to restore damaged ecosystems.

In the long term, we must work towards creating a sustainable society that values and preserves biodiversity. This involves changing our consumption patterns, promoting sustainable agriculture and forestry, and investing in green technologies.

In this context, we will explore four case studies that exemplify the future approach to protect biodiversity: Nature-Based Solutions, Climate-resilient conservation, The Resilient Land Mapping Tool, and Agroecological practices.

4.4.1 Nature-Based Solutions

Nature-Based Solutions (NBS) are actions that protect, manage, and restore natural or modified ecosystems while providing co-benefits to both people and nature. They are designed to address societal challenges effectively and adaptively, while simultaneously providing human well-being and biodiversity benefits.

Nature-Based Solutions (NBS) are indeed a promising approach to biodiversity conservation and offer a multitude of benefits. These solutions are actions that protect, manage, and restore natural or modified ecosystems while providing co-benefits to both people and nature. They are designed to address societal challenges effectively and adaptively, while simultaneously providing human well-being and biodiversity benefits.

One example of NBS is the creation of urban green spaces such as parks and community gardens. In urban settings, these spaces not only provide habitats for various species, enhancing local biodiversity, but also offer recreational areas for residents, improving mental health and community well-being. Moreover, they help in mitigating urban heat island effects, thus playing a role in climate change adaptation.

Another example is the restoration and protection of mangrove forests. Mangroves are vital ecosystems that protect coastal areas from storm surges and sea-level rise. By safeguarding

these natural barriers, we can support a diverse range of species and sustain local communities that rely on these ecosystems for their livelihoods. This is a prime example of an NBS that delivers both ecological and societal benefits.

Sustainable agriculture practices, such as agroforestry or organic farming, can also serve as an NBS. These practices enhance soil health, increase biodiversity, and ensure food security, while also sequestering carbon and mitigating climate change impacts.

Lastly, river restoration is another form of NBS. By removing obsolete dams and promoting natural water flow, we can improve water quality, restore fish populations, and enhance recreational opportunities. This not only benefits biodiversity but also boosts local economies through increased tourism and recreational activities.

The potential outcomes of implementing these NBS are manifold. They can help mitigate climate change, enhance biodiversity, improve human well-being, and promote sustainable economic development. However, it's important to note that the success of these solutions requires careful planning, stakeholder involvement, and adaptive management to ensure they are effectively addressing the targeted societal challenges and providing the intended benefits.

NBS offers a holistic approach to address environmental challenges while providing co-benefits for both people and nature. As we move forward, they should be an integral part of our strategies for biodiversity conservation and sustainable development.

4.4.2 Climate-resilient conservation

Climate-resilient conservation strategies aim to ensure the survival of species and ecosystems in the face of climate change. They involve identifying and protecting climate-resilient habitats, enhancing the adaptive capacity of species, and implementing management actions that reduce non-climate stresses on species and ecosystems.

Climate-resilient conservation strategies are crucial in our fight against climate change. These strategies aim to ensure the survival of species and ecosystems in the face of changing climate conditions. They involve identifying and protecting climate-resilient habitats, enhancing the adaptive capacity of species, and implementing management actions that reduce non-climate stresses on species and ecosystems.

One strategy is to identify habitats that are naturally resilient to climate change and prioritize them for conservation. For example, areas with diverse topographies often provide a range of microclimates, allowing species to move short distances to find suitable conditions. Protecting these areas can provide safe havens for a wide range of species.

Another strategy is to enhance the adaptive capacity of species. This could involve protecting genetic diversity, which can increase a species' ability to adapt to new conditions. For instance, coral reefs with high genetic diversity have been found to be more resilient to ocean warming.

Reducing non-climate stresses on species and ecosystems can also enhance their resilience. This could involve actions such as reducing pollution, controlling invasive species,

and preventing habitat fragmentation. For example, reducing nutrient pollution in rivers can help aquatic ecosystems cope with increased temperatures.

Implementing proactive management actions can also help. This could involve restoring degraded ecosystems, creating wildlife corridors to connect fragmented habitats, and implementing adaptive management practices that are responsive to changing conditions.

The potential outcomes of these strategies are significant. By protecting climate-resilient habitats, we can provide refuges for species under climate change. By enhancing the adaptive capacity of species, we can increase their chances of survival. By reducing non-climate stresses, we can enhance the overall resilience of ecosystems. And by implementing proactive management actions, we can ensure our conservation efforts are effective under changing conditions.

However, it's important to note that these strategies require comprehensive planning, ongoing monitoring, and adaptive management. They also require collaboration across sectors and scales, from local communities to international organizations. Despite the challenges, these climate-resilient conservation strategies offer a hopeful path forward in our efforts to safeguard our planet's biodiversity in the face of climate change.

4.4.3 The Resilient Land Mapping Tool

The Resilient Land Mapping Tool is a novel approach to biodiversity protection that uses spatial data and advanced analytics to identify and prioritize areas for conservation. This tool

helps decision-makers allocate resources effectively, implement targeted conservation actions, and monitor progress towards biodiversity goals.

The Resilient Land Mapping Tool is indeed a groundbreaking approach to biodiversity conservation. By leveraging spatial data and advanced analytics, it provides a robust framework for identifying and prioritizing areas for conservation. This tool helps decision-makers allocate resources effectively, implement targeted conservation actions, and monitor progress towards biodiversity goals.

One of the key applications of this tool is in forest conservation. The tool can be used to identify areas of forests that are most resilient to climate change and other environmental pressures. By prioritizing these areas for conservation, we can ensure the survival of a wide range of species and maintain the essential ecosystem services that forests provide. However, a potential drawback could be the exclusion of areas that are currently vulnerable but could become resilient with appropriate management interventions.

Another important application is in wetland protection. Wetlands are among the most productive and biodiverse ecosystems on the planet. The tool can help identify key wetland areas that need protection to maintain their ecological integrity and the services they provide, such as water purification and flood control. However, the tool's effectiveness could be limited in regions where high-quality spatial data on wetlands is lacking.

In urban areas, the tool can guide the development of green spaces and wildlife corridors to enhance urban biodiversity and improve residents' quality of life. However, implementing such plans could face challenges due to competing land-use demands and economic considerations.

For marine environments, the tool can help identify critical habitats like coral reefs and seagrass meadows that need protection to preserve marine biodiversity and support human livelihoods. However, the dynamic nature of marine ecosystems and the complexity of oceanographic data could pose challenges to the tool's application.

The potential outcomes of using the Resilient Land Mapping Tool are significant. It can guide the efficient allocation of conservation resources, enable targeted conservation actions, and help monitor progress towards biodiversity goals. By providing a clear picture of where conservation efforts could yield the highest benefits, it supports informed decision-making and promotes effective biodiversity conservation.

However, it's important to note that while the tool provides valuable insights, it should not be the sole basis for conservation decisions. Other factors, such as the socio-economic context, local community needs and aspirations, and the feasibility of conservation actions, should also be considered. Furthermore, the tool's effectiveness depends on the quality and resolution of the spatial data used, which can vary across regions and ecosystems.

The Resilient Land Mapping Tool offers a promising approach to biodiversity conservation, but its application should be complemented by a comprehensive understanding of the local context and continuous efforts to improve data quality and analysis methods. Despite the challenges, this tool offers a hopeful path forward in our efforts to safeguard our planet's biodiversity in the face of climate change.

4.4.4 Agroecological practices

Agroecological practices promote the sustainable use of natural resources in agricultural systems. They enhance biodiversity, improve soil health, and increase agricultural productivity, thereby contributing to food security and rural livelihoods.

Agroecological practices play a crucial role in promoting the sustainable use of natural resources in agricultural systems. These practices not only enhance biodiversity and improve soil health, but also increase agricultural productivity. This, in turn, contributes significantly to food security and the improvement of rural livelihoods.

One of the crucial applications of agroecological practices is crop rotation. This is a common practice where different crops are planted in a sequence over several seasons. Crop rotation enhances soil fertility and disrupts the life cycle of pests, thereby reducing the need for chemical fertilizers and pesticides. However, it requires careful planning and can be labor-intensive, which could be a potential drawback.

Another important practice is cover cropping. This involves growing a crop for the sole purpose of improving soil health. Cover crops prevent soil erosion, improve soil structure, and can add nutrients to the soil. However, they can compete with the main crop for resources if not managed properly, posing a potential challenge.

Agroforestry, the practice of integrating trees into farming systems, is another example of agroecological practices. Trees can improve soil health, enhance biodiversity, and provide additional products like fruits, nuts, and timber. However, trees can also compete with crops for light and nutrients, and it can take several years before the benefits of agroforestry are realized.

Organic farming, which avoids the use of synthetic fertilizers and pesticides, can improve soil health and biodiversity. However, it often requires more labor and can result in lower yields compared to conventional farming, which is a potential drawback.

The potential outcomes of implementing these agroecological practices are significant. They can lead to more sustainable and resilient farming systems, improved food security, and better livelihoods for rural communities. However, transitioning to agroecological practices can be challenging. It requires knowledge and skills, investment in time and resources, and often involves a trade-off between short-term productivity and long-term sustainability.

While agroecological practices offer a promising approach to sustainable agriculture, their implementation should be supported by appropriate policies, research, and extension services to overcome potential challenges and maximize their benefits. Despite the challenges, these practices offer a hopeful path forward in our efforts to create more sustainable and resilient food systems.

The strategies discussed represent innovative and effective approaches for biodiversity protection. They underscore the importance of a comprehensive approach that integrates biodiversity considerations into all societal aspects, from policy-making and planning to management and monitoring. By drawing insights from these strategies, we can devise and implement more effective measures for biodiversity protection, thereby ensuring the survival of our planet's rich and diverse life forms for future generations.

If the four strategies discussed - Nature-Based Solutions (NbS), Climate-resilient conservation, the use of the Resilient Land Mapping Tool, and Agroecological practices - are acted upon now, we can anticipate several positive outcomes over the next decade.

Firstly, with the implementation of NbS and agroecological practices, we could see a significant increase in biodiversity. These practices promote the creation and maintenance of diverse habitats, which can support a wide range of species. This would lead to enhanced biodiversity, contributing to the overall health of our planet's ecosystems.

Secondly, climate-resilient conservation strategies could lead to healthier, more resilient ecosystems. These strategies aim to protect landscapes that are most likely to endure climate change, helping to preserve ecological function and recovery from disturbances. This would result in improved ecosystem health, ensuring the survival of diverse species and maintaining the balance of our natural world.

Thirdly, the use of tools like the Resilient Land Mapping Tool could revolutionize conservation planning. By identifying and prioritizing areas for conservation, these tools can help ensure that resources are allocated effectively and that conservation actions are targeted where they are most needed. This would lead to more effective conservation planning, ensuring the survival of our planet's rich and diverse life forms for future generations.

Fourthly, the widespread adoption of agroecological practices could transform the agricultural sector, leading to more sustainable and resilient food systems. These practices balance food production with ecosystem preservation, contributing to long-term food security. This would result in sustainable agriculture, ensuring that we can feed our growing population without depleting our natural resources.

To sum up, if these strategies are acted upon now, we could see a future where biodiversity thrives, ecosystems are healthy and resilient, conservation planning is more effective, and agriculture is sustainable. However, it's important to note that these outcomes

depend on the sustained and concerted efforts of all sectors of society, from governments and businesses to communities and individuals. After all, our own survival depends on the health and vitality of our planet's ecosystems. We are all part of the web of life, and it is our responsibility to ensure its continuity for future generations.

4.4.5 Perspective

Biocentrism is a philosophical perspective in which all life has some intrinsic value. This concept calls on people to value all of life regardless of whether it is human or not. It pushes us to look at nature as more of a partner, where we may give and take in equal ways. We as humans in modern society have lost a level of appreciation of the natural world as we idolize the materialistic and technological world. This has led to us disrespecting and destroying nature. To change this view of nature we must begin to value the interconnectedness of nature to humans. We use nature for everything we have and rely on it for our health. A shift towards a biocentric view, allows us to understand the need to protect nature. Arne Naess, a Scandinavian thinker, talks about the individualistic and human centered view of atomistic individualism. A view that isolates humans from the world around them, this view is the one that has been pushed thanks to technology. The very isolation that is prevalent between us society and the environment is also prevalent between humans. The understanding of nature with isolation has led society into playing into the domination of nature. Deep Ecology, a biocentric philosophy, aims for a more pluralistic view. Pluralistic views would be shown in a perspective that shares care and respect to everyone, people and the environment included. To truly understand the foundation of this view would mean to understand the concept of interconnectedness, the world relies on each and every

part and works together to make a cohesive system. The final part of biocentrism is holistic mentality, this is also built on interconnectedness. To address the crisis, biocentrism will examine all points of illness to address the whole issue, this can then be used to make sure that the solutions address the whole system in a way that benefits everyone. The goal is to bring the most overarching good to everyone and every organism.although this view is very subjective and changes from person to person, resulting in many arguments on how to actively address the issues at hand.

The biocentric framework encompasses several crucial core concepts that facilitate biodiversity restoration, yet also harbors certain blind spots. Central to this framework is the recognition of interconnectedness, which underpins environmental stewardship by advocating for a balance between human and non-human needs. This emphasis on balance is rooted in the emotional and spiritual connection individuals can cultivate with their environment, driving a collective desire to restore and protect it. However, this commitment to environmental restoration sometimes results in rigidity, a primary critique of biocentrism. This rigidity can lead to a neglect of human needs, as the framework treats all life as equally valuable and may prioritize certain projects over others due to limited resources. While this approach is valid in principle, it raises concerns that marginalized communities, such as those living in heavily polluted areas, may be overlooked in favor of conservation efforts targeting less immediate human concerns. This potential prioritization dilemma can polarize individuals' views on environmental protection. Another significant issue is the reliance on technology, which can exacerbate problems and undermine confidence in the system. Some advocate for non-technological solutions like regulatory measures. Additionally, the pluralistic nature of

biocentrism can lead to conflicting priorities within groups, sometimes disregarding cultural beliefs. For instance, the use of genetic engineering to conserve species like the American Chestnut clashes with the beliefs of certain communities, such as the Catholic Church.

To shift focus to the opposite end of biocentrism, Anthropocentrism is the perspective in which humans are the focus above all else. This means that instead of actually dealing with the environmental crisis to help nature to help humanity, this is something like protecting bison to have more food sources or protecting a plant like American Ginseng for its use in medicine. A core value that can be clearly seen is the instrumental value that nature has in the minds of anthropocentrist, plants are simply tools. With this focus on instrumental value, the need for technology tends to be reinforced and pushed as it provides for humanity. Technology is the way to improve human life, in their minds, it provides ways to automate and ways to guide people, technology is the foundation of modern anthropocentrists.. Dualism is embraced in anthropocentrism, with human and nature being isolated. The goal of the isolation is to dominate the environment and utilize it for their own means.

Anthropocentrism has limited applications in the fight to help the environment. With many negatives that actively fight against the protections in place. But, one can see some benefits. Under anthropocentrism, humanity is not just in the spotlight, they are the spotlight, controlling what has value and what is worthy of living. This pushes a divide through nature making it split between useful to human need and unnecessary to human need. This is the purest form of human's domination of nature. The focus on value leads to all that "valuable" being harvested and used while all else is left to waste away and be forgotten. The domination of

nature is what has caused a split between human and nonhuman, since nothing has anything more than instrumental value, exploitation is the norm. Many industries use this to harvest regions of their natural resources and pollute into that same region, destroying the chances of repair. If there was a turn to address the crisis, humanity would focus on methods that help themselves and rely on technology which in many cases will just make the problem worse. Finally there is severe racial and sex based biases in this perspective. Many of those who control the narrative are white, rich, cis men who use their perspective and no one else's to push for their wants. This issue is reflected in the region of 'Cancer Alley,' an area in Louisiana that has a 40% black population that suffers greatly from severe illnesses. This is thanks to the extreme pollution that occurs here everyday. But, many people who advocate for anthropocentrism push for issues like this to be fixed and want people to receive more care than other places, a major blindspot in biocentrism.

When comparing the two perspectives, biocentrism would be the best from a more well rounded point of view, but has blind spots in human needs. Many would ask, "what about areas like Cancer Alley?" Some biocentrist are more focused on the overall picture and that may mean repairing regions that can provide more benefits than just helping some people, the goal is everyone not a few. In turn Cancer Alley is forgotten by many for the focus to be shifted to something like the Amazon Rainforest, where millions live, food is produced, and many important resources are. To address this blindspot, there is the environmental pragmatic view. The benefit of this view is that it balances the needs of everyone and looks for practical solutions for all major and life threatening issues. There is no throwing certain people to the waist side for others to be focused. The view prides itself on flexible thinking and realizing that everything has

intrinsic and instrumental value. In terms of biodiversity, every plant and animal doesn't just give value based on the fruits or pelts they provide. But, they have value for being living things with emotions and their own independent functions. With this to determine how to help the surrounding environment, dialogue is constantly occurring to determine needs and reasonable methods to help. This is shown in pluralism, the idea that there is no one solution or important idea. To put this into practice there are more moral discussions on how something may be positive and bring a bigger change, this is ethical pragmatism. With this comes more environmental stewardship and environmental justice, just to name a few. Overall the perspective is focused on problem solving, there is no invalid concern, all concerns are given air time so that all voices can be heard so a solution that is made can provide more for the area and world.With the problem solving comes a change in the relationship with technology as eco-friendly solutions are heard more often and the voices of nature can be heard through the dialogue. Finally, the best part of the pragmatic view is the adaptability. A solution is not rigid, there is constant change in a plan that encourages change from the community and flexibility with the change in the environment occurs. This also means experimentation is valid, more solutions end up being tried so that a better success rate can occur. This allows an overall more successful project that is built on the voices of the many, that truly addresses the root problems. There is a focus on people directly affected by the problem, in the case of Cancer Alley, the people living there will have their voices heard and the plan will be built so that their lives will not be uprooted and they can achieve the protection they need. Overall the solutions built with this view are more equitable and share ideas from everyone.

4.4.6 Beliefs

Just because our perspective has changed to look at the world differently doesn't mean change will occur. Perspective lacks form, it does not help guide people towards a better way of working with the environment. So along with the overall perspective there are some beliefs that are important that could play a big role in the way we should look at the environment and how we will interact with it. These such beliefs are spirituality, minimalism, and care ethics.

Spirituality is the glue to help connect the environment to society, the concept of spirituality revolves around the connection that humans have with the environment on a spiritual level. There is a more intrinsic connection to nature, it is not a simple relationship in which we use it for materials, but it's one where we give and take and gain more emotional and mental wellness from it. The goal with this belief is to foster a deeper appreciation for the environment and not to look at it for dollar signs. It is important to recognize the environment for its sacredness, it has stood for hundreds of billions of years without the touch of humans. Yet it has developed into a gorgeous interconnected web of plants and animals that rely on one another. This beauty shows the value that nature has, it is an inspiration for humans. From nature comes art and wisdom, the very foundation of technology stands on the shoulders of observations within nature. Nature provides a template for designs and medicines with many bio inspirations helping forge the world that we rely on. To look at this and appreciate it helps people understand the value that nature has and brings. The belief brings values for one to hold on to, that forges the way that they may look at life. One such value is stewardship with nature, this is the responsibility we have to ensure the wellness of the environment. The environment is not a toy in this belief, it is something to be admired and enjoyed for future generations. We must protect it

for what it is and guarantee that everyone has a chance to enjoy it. Another value may be the mindfulness one must have, with this there is a level of living in the moment, take your time to enjoy the present and the grace of nature. This teaches the idea that the environment is sacred and is nothing to abuse or take advantage of. The last value is the interconnectedness to nature and humans. We are much closer to nature than it seems, nature dictates our very lives. As the weather changes and animals move from place to place, our way of life changes with it. We build around nature, but as we destroy it our architecture changes and our health becomes impacted. By understanding the impact nature has on us, we learn the importance of nature. These are not foreign topics, they have manifested in other cultures and have formed their way of life. One such group is shamanism of the east, in this religion spirituality is the form of communing with the environment itself. Shamans can communicate with the environment and have a deep understanding of its needs and desires, they focus on ways to repair the relationship of nature and the people of the community. They have learned to heal illness with the use of nature and when a community is ill they can find the problem within nature that must be fixed and fix it. They have a deep interconnectedness to nature and wield it as a tool. This is the value of spirituality for the shaman, as they embrace this tradition, the community can flourish with good health and all their needs meet. Another group that has environmental spirituality built into their faith is the indigenous peoples of America. There is a deep understanding for ecological balance in native american beliefs, this is practiced in the form of taking what they need and not more and using all of an animal as a form of respect. By embracing this balance in the ecosystem and understanding it allows for people to find their place in the environment so that they can provide and protect while having their needs met. By following in the footsteps of people who have built the ground work, a greater appreciation and understanding of the environment can be developed.

Minimalism is the concept that less is more. To embrace this means that we as people will only take and have what is necessary for us. The pursuit of material possessions for pleasure have left many greedy for more than what is needed and caused the draining of resources beyond the current need. Having this abundance of possessions only makes the world a worse place, these objects only end up in landfills or in piles in the environment. By understanding the importance of an object within a person's life can lead to the understanding that not everything is needed to live life to fullest can help a person reach a level of mental clarity. By following specific principles a person may find inner peace and in turn help better the environment. One principle may be intentionality, this is the thought that an object must provide some value to the user. This can simply be looking at a sword that you find at a renaissance fair and compare it to a teddy bear that was given to you by your parents. One has sentimental value and provides meaning to one's life, while the other is an ornament that brings no value to one's life except the one time they get to say "wow, a sword!" Life is beyond the simple pleasures and one must realize that the things around them should have a level of intentionality for the most gain in their life. The next principle is simplicity, complexity in the world around oneself brings more pain than good. By inserting this value into your life and making routines more simple, the idea is that you will have more time to "smell the roses." Giving yourself more time to enjoy the world around you brings appreciation for that world. Another principle to follow is decluttering, this is the concept of getting rid of excess items that one may have. This principle, in the case of environmentalism, does not mean to simply throw away everything, but to donate and recycle. Give excess clothes to those who need more, give random appliances to people who may need them, and recycle the random unneeded objects. By following this those around you may gain

greater quality of life and you will gain more space. This principle is built on helping a person be free of excess and connect to oneself in understanding their needs. The final principle, similar to spirituality, is mindfulness. It is important to be connected to oneself and understand their needs. By developing this trait, allows an individual to take care of themselves in the best manner while developing a greater empathy for those around them. This belief fights against consumerism, the overproduction and the overspending that people do has caused damage to the world around them. Putting this to an end helps put less stress on them and the world around them. A Buddhist tradition of renunciation puts some of this to practice.

The final belief that will be discussed is Care Ethics. This belief is a specific approach to moral philosophy that emphasizes caring relationships, empathy, and interconnectedness in decision making. The foundation of movements to repair the environment are built on this concept. Nowadays, thanks to technology, people are severely isolated, some saying their only social interaction is through a screen. This applies to the environment as many only see green on their screens. This isolation has led to isolation for the world around us and people developing a level of apathy towards others. The only real empathy that we show others is if they are someone in a close circle to us. The environment is practically a foreign concept to people thanks to the technological isolation, people don't care for it due to the distance. With care ethics, there is a base level of empathy and care that we give to others, regardless of who they are. By looking at the interconnectedness of society and the environment, there is a focus of a holistic approach in analyzing situations to make approaches that may address the human experience. This has the goal of closing the emotional gap between people. As a person from India may not be related to you, does not mean that they don't have a level of empathy and respect. After learning this belief

it can be applied to the environmental crisis, by bridging the gap between humans and the environment on an emotional level. In turn, the understanding of the importance of the environment and how to help it in a humane and caring manner may be determined. Care ethics has its foundation in feminist thought, through the work of Carl Gilligan, two perspectives were highlighted, one of justice and one of care. The "perspective of justice" was a perspective common in men in which values of autonomy, rights, and independence were pushed. While women also showed the "perspective of justices" they also demonstrated values that focused on interpersonal relationships and basic empathy, the "perspective of care." This was pushed to be brought to others attention as a focus on interpersonal relationships that bring care are more valuable than those of distance relationships. Other feminist thinkers pushed the thought farther, saying that this belief is more than just limited to relationships but is applicable to the society and politics at large. Understanding the importance of simply caring for one another, can bring about big change not just socially but environmentally.

Synthesis of Findings and Final Remarks

This paper delves into the environmental crisis, a complex issue deeply rooted in the fields of Science, Technology, Engineering, and Mathematics (STEM). It discusses how society's focus on science and technology has led to a growing disconnect from nature. The spotlight is placed on biodiversity, its components, and its significance to the environment.

The importance of biodiversity, especially its relation to evolution and the adaptability of species, is highlighted. The potential consequences of biodiversity loss are examined from

various perspectives. The impacts on the food web, with a particular focus on ocean biodiversity threatened by ocean acidification and a loss of apex predators like wolves, are analyzed. An economic perspective of biodiversity's importance is presented, showing how capitalism benefits from it and the negative effects of industrial agriculture's monoculture practices.

The causes of biodiversity loss are identified as culture, economics, politics, and science. The Green Revolution is used as an example to illustrate how these factors can affect biodiversity. The paper discusses how society has allowed this to happen due to misplaced trust in science.

Potential strategies to prepare for and combat the loss of biodiversity are explored. The paper discusses eco-friendly technologies, current acts to protect biodiversity, and future approaches to biodiversity protection. The importance of Nature-Based Solutions (NbS), climate-resilient conservation, and agroecological practices are highlighted. Along with this, a call for a shift in the public perspective was brought up. Beliefs that help bring more mindfulness to the environment such as spirituality, minimalist, and care ethics. Finally to help combat environmental domination, an environmental pragmatic view was given.

In conclusion, the paper emphasizes that biodiversity is not just a concept confined to the realm of biology or ecology. It is intertwined with every aspect of life, from the food consumed to the air breathed. The importance of balancing technological advancement with biodiversity conservation is underscored. A call to action for continued efforts in biodiversity protection is made, not just for the sake of nature, but for survival and well-being. The future of the planet depends on it.

Works Cited

10 things you should know about industrial farming. UNEP. (n.d.). https://www.unep.org/news-and-stories/story/10-things-you-should-know-about-industrial-farming

A critical perspective on the concept of biocultural diversity ... (n.d.). https://besjournals.onlinelibrary.wiley.com/doi/full/10.1002/pan3.10040

A. Ozier-Lafontaine, et al. “Genome Biology.” BioMed Central, 3 May 2024, genomebiology.biomedcentral.com/articles.

Adams, W.(. (2004). Against Extinction: The Story of Conservation (1st ed.). Routledge. https://doi.org/10.4324/9781849770415

Adebayo O. (2019). LOSS OF BIODIVERSITY: THE BURGEONING THREAT TO HUMAN HEALTH. Annals of Ibadan postgraduate medicine, 17(1), 1–3.

Administrator. “What Is Eco-Spirituality? [+ Career Examples].” University of San Diego Online Degrees, 29 Mar. 2024, onlinedegrees.sandiego.edu/what-is-ecospirituality/.

“Ai in Conservation: Where We Came from and Where We Are Heading.” World Economic Forum, www.weforum.org/agenda/2024/03/ai-in-conservation-where-we-came-from-and-where-we-are-heading/. Accessed 1 May 2024.

“Ai Reveals Signs of Recovery in Areas Devastated by Bushfires - WWF-Australia: Ai Reveals Signs of Recovery in Areas Devastated by Bushfires.” WWF Australia, wwf.org.au/blogs/ai-reveals-signs-of-recovery-in-areas-devastated-by-bushfires/. Accessed 1 May 2024.

“Ai Reveals Signs of Recovery in Areas Devastated by Bushfires - WWF-Australia: Ai Reveals Signs of Recovery in Areas Devastated by Bushfires.” WWF Australia, wwf.org.au/blogs/ai-reveals-signs-of-recovery-in-areas-devastated-by-bushfires/. Accessed 1 May 2024.

“Ai Reveals Signs of Recovery in Areas Devastated by Bushfires - WWF-Australia: Ai Reveals Signs of Recovery in Areas Devastated by Bushfires.” WWF Australia, wwf.org.au/blogs/ai-reveals-signs-of-recovery-in-areas-devastated-by-bushfires/. Accessed 1 May 2024.

aiforgoodstg2. “New AI for Biodiversity Series: How Can We Use AI to Monitor Biodiversity and Support Conservation Actions?” AI for Good, 1 Mar. 2023, aiforgood.itu.int/new-ai-for-biodiversity-series-how-can-we-use-ai-to-monitor-biodiversity-and-support-conservation-actions/.

aiforgoodstg2. “New AI for Biodiversity Series: How Can We Use AI to Monitor Biodiversity and Support Conservation Actions?” AI for Good, 1 Mar. 2023, aiforgood.itu.int/new-ai-for-biodiversity-series-how-can-we-use-ai-to-monitor-biodiversity-and-support-conservation-actions/.

Baker, Alan. “Simplicity.” Stanford Encyclopedia of Philosophy, Stanford University, 16 May 2022, plato.stanford.edu/entries/simplicity/.

Bednaršek, Nina, et al. “Integrated Assessment of Ocean Acidification Risks to Pteropods in the Northern High Latitudes: Regional Comparison of Exposure, Sensitivity and Adaptive Capacity.” Frontiers in Marine Science, vol. 8, 10 Sept. 2021, https://doi.org/10.3389/fmars.2021.671497. Accessed 7 Feb. 2022.

“Biodiversity Creates Food Webs | Alliance of Climate and Environmental Stewards (ACES).” Www.aces-Alliance.org, www.aces-alliance.org/post/biodiversity-creates-food-webs. Accessed 4 May 2024.

Boutagayout, Abdellatif, et al. “Agroecology as agricultural practices for sustainable management in North African countries.” International Journal of Plant Production, vol. 17, no. 3, 28 May 2023, pp. 389–436, https://doi.org/10.1007/s42106-023-00251-6.

Brennan, A., & Lo, N. Y. S. (2021, December 3). Environmental ethics. Stanford Encyclopedia of Philosophy. https://plato.stanford.edu/entries/ethics-environmental/

Brumfiel, G. Controversial research: Good science bad science. Nature 484, 432–434 (2012). https://doi.org/10.1038/484432a

“Capture and Conserve: The Role of Genomic Sequencing in Biodiversity.” Genomics Research from Technology Networks, www.technologynetworks.com/genomics/articles/capture-and-conserve-the-role-of-genomic-sequencing-in-biodiversity-368417. Accessed 3 May 2024.

“Climate Explainer: Nature-Based Solutions.” World Bank, World Bank Group, 17 May 2022, www.worldbank.org/en/news/feature/2022/05/19/what-you-need-to-know-about-nature-based-solutions-to-climate-change.

“Connecting Spiritually with the Land and Each Other.” Reconciling Ways of Knowing, rwok.ca/dialogue7. Accessed 25 Apr. 2024.

Cultural Ecology, blog.culturalecology.info/2019/09/01/environmental-spirituality/. Accessed 25 Apr. 2024.

Dalyan, Dr Sener. “Nature-Based Solutions.” IUCN, www.iucn.org/our-work/nature-based-solutions. Accessed 3 May 2024.

Deforestation and illegal logging threaten the world’s forests. Greenpeace Australia Pacific. (n.d.). https://www.greenpeace.org.au/what-we-do/protecting-forests/threats/#:~:text=Illegal%20logging%20is%20having%20a,crime%20and%20human%20rights%20abuses .

“Effects - NASA Science.” NASA, NASA, science.nasa.gov/climate-change/effects/. Accessed 25 Apr. 2024.

Ekardt, Felix, et al. “Legally Binding and Ambitious Biodiversity Protection under the CBD, the Global Biodiversity Framework, and Human Rights Law - Environmental Sciences Europe.” SpringerOpen, Springer Berlin Heidelberg, 19 Sept. 2023, enveurope.springeropen.com/articles/10.1186/s12302-023-00786-5.

ENDING MOUNTAINTOP REMOVAL. Center for Biological Diversity. (n.d.). https://www.biologicaldiversity.org/programs/public_lands/mining/mountaintop_removal/index.html#:~:text=Contaminants%20from%20mountaintop%20removal%20even,releases%20carbon%20into%20the%20atmosphere.

Environmental Protection Agency. (n.d.). Ecosystems and Air Quality. EPA. https://www.epa.gov/eco-research/ecosystems-and-air-quality#:~:text=For%20example%3A%20pollutants%20such%20as,affects%20scenic%20vistas%20in%20protected

“Environmental Stewardship and Sustainability.” JMU, 8 Apr. 2024, www.jmu.edu/stewardship/what-is-environmental-stewardship.shtml.

“Explained: What Is the Convention on Biological Diversity, and What Does It Do?” Natural History Museum, www.nhm.ac.uk/discover/what-is-the-convention-on-biological-diversity-and-what-does-it-do.html. Accessed 3 May 2024.

“Extreme Weather Gets a Boost from Climate Change.” Environmental Defense Fund, www.edf.org/climate/climate-change-and-extreme-weather. Accessed 25 Apr. 2024.

EPA, Environmental Protection Agency, www.epa.gov/climate-indicators/weather-climate. Accessed 25 Apr. 2024.

Farrell, Justin. The Battle for Yellowstone : Morality and the Sacred Roots of Environmental Conflict. Princeton, Princeton University Press, 2017.

Feng, Yuhao, et al. “Multispecies Forest Plantations Outyield Monocultures across a Broad Range of Conditions.” Science, vol. 376, no. 6595, May 2022, pp. 865–68, https://doi.org/10.1126/science.abm6363.

Fenston, J. (2021, October 18). The American Chestnut was wiped out a century ago. could it make a comeback?. NPR. https://www.npr.org/local/305/2021/10/18/1047023029/the-american-chestnut-was-wiped-out-a-century-ago-could-it-make-a-comeback

“Five Ways Ai Is Saving Wildlife – from Counting Chimps to Locating Whales.” The Guardian, Guardian News and Media, 21 Feb. 2022, www.theguardian.com/environment/2022/feb/21/five-ways-ai-is-saving-wildlife-from-counting-chimps-to-locating-whales-aoe.

Food for the Few : Neoliberal Globalism and Biotechnology in Latin America, edited by Gerardo Otero, University of Texas Press, 2008. ProQuest Ebook Central, https://ebookcentral.proquest.com/lib/wpi/detail.action?docID=3443364.

“From AI to Robot Jellyfish, Here’s How Tech Is Protecting Biodiversity.” World Economic Forum, www.weforum.org/agenda/2023/05/ai-technology-international-biodiversity-day/. Accessed 1 May 2024.

Gottlieb, Roger S. “Dilemmas of Reason.” Cambridge University Press EBooks, Cambridge University Press, Feb. 2019, pp. 190–213, https://doi.org/10.1017/9781316493083.009. Accessed 4 May 2024.

Hadza. Education. (n.d.). https://education.nationalgeographic.org/resource/hadza/

Halina, M. (2023, September 6). Methods in comparative cognition. Stanford Encyclopedia of Philosophy. https://plato.stanford.edu/entries/comparative-cognition/

Here’s how five countries are reviving biodiversity. UNEP. (n.d.-b). https://www.unep.org/news-and-stories/story/heres-how-five-countries-are-reviving-biodiversity

Hyde, D., Casati, F., & Weber, Z. (2024, January 18). Richard Sylvan [routley]. Stanford Encyclopedia of Philosophy. https://plato.stanford.edu/entries/sylvan-routley/#Plur

Igini, M. (2024, January 2). Top 6 environmental issues the US is facing in 2024. Earth.Org. https://earth.org/top-environmental-issues-us/

Indigenous people and nature: A tradition of conservation. UNEP. (n.d.-c).

Interactive feature. How to beat pollution. (n.d.). https://www.unep.org/interactive/how-to-beat-pollution/

Jackson, Rob. The Earth Remains Forever : Generations at a Crossroads, University of Texas Press, 2002. ProQuest Ebook Central, https://ebookcentral.proquest.com/lib/wpi/detail.action?docID=3571857.

Jacob, Pierre. “Intentionality.” Stanford Encyclopedia of Philosophy, Stanford University, 7 Feb. 2023, plato.stanford.edu/entries/intentionality/.

Keele University. (n.d.). Cancer alley. https://www.keele.ac.uk/extinction/controversy/canceralley/#:~:text=Cancer%20Alley%20had%2C%20and%20continues,Plantation%20Country%E2%80%9D%2C%20is%20unsurprising.

Kolbert, E., Kleiner, J., Roux, J., & Kolbert, E. (2014). The sixth extinction: An unnatural history. Godwin Books.

Leiss, William. Domination of Nature. McGill-Queen’s University Press, 1994. JSTOR, http://www.jstor.org/stable/j.ctt80xq8. Accessed 26 Apr. 2024.

Light, A., & Katz, E. (2005). Environmental pragmatism. Routledge.

Magazine, S. (2016, June 1). New evidence shows peppered moths changed color in sync with the Industrial Revolution. Smithsonian.com. https://www.smithsonianmag.com/smart-news/new-evidence-peppered-moths-changed-color-sync-industrial-revolution-180959282/

Marselle, Melissa R, et al. Biodiversity and Health in the Face of Climate Change. Cham Springer International Publishing Springer, 2019.

Mata, Authors: Raul de la, et al. “BMC Ecology and Evolution.” BioMed Central, 3 May 2024, bmcecolevol.biomedcentral.com/.

McClements, D.J. (2023). “Meat and the Environment: How Livestock Are Taking a Big Bite Out of Our Planet.” In: Meat Less: The Next Food Revolution. Copernicus Books . Springer, Cham. https://doi.org/10.1007/978-3-031-23961-8_2

McGarity, Thomas O., and Wendy E. Wagner. Bending Science: How Special Interests Corrupt Public Health Research. Harvard University Press, 2008. JSTOR, https://doi.org/10.2307/j.ctv13qftkm. Accessed 26 Apr. 2024.

Mercado, Jocelyn. “The Spiritual Side of Environmentalism.” Pachamama Alliance’s Blog, blog.pachamama.org/the-spiritual-side-of-environmentalism. Accessed 25 Apr. 2024.

“Monarch Numbers Continue to Fall, Climate Change Working Faster than Conservation Efforts.” National Wildlife Federation, www.nwf.org/Home/Latest-News/Press-Releases/2024/1-30-24-Western-Monarch-Count. Accessed 3 May 2024.

Moore, Andrew. “Can Genetic Engineering Save Our Planet’s Biodiversity?” College of Natural Resources News, 24 June 2019, cnr.ncsu.edu/news/2019/06/the-future-of-conservation-can-genetic-engineering-save-our-planets-biodiversity/.

“Natural Custodians: Indigenous Lessons in Reconnecting with Nature.” Environment, 25 Jan. 2024, www.nationalgeographic.com/environment/article/paid-content-natural-custodians-indigenous-lessons-in-reconnecting-with-nature#:~:text=%E2%80%9CWe. Accessed 28 Apr. 2024.

Norlock, Kathryn. “Feminist Ethics.” Stanford Encyclopedia of Philosophy, Stanford University, 27 May 2019, plato.stanford.edu/entries/feminism-ethics/#EthiCareFemiGendApprMora.

Pagett, Richard. Building Global Resilience in the Aftermath of Sustainable Development : Planet, People and Politics, Springer International Publishing AG, 2017. ProQuest Ebook Central, https://ebookcentral.proquest.com/lib/wpi/detail.action?docID=4938527.

Peglar, Tori. “1995 Reintroduction of Wolves in Yellowstone.” Yellowstone National Park, 13 May 2022, www.yellowstonepark.com/park/conservation/yellowstone-wolves-reintroduction/.

Pew Research Center. (2021, May 26). 3. local impact of climate change, environmental problems. Pew Research Center Science & Society. https://www.pewresearch.org/science/2021/05/26/local-impact-of-climate-change-environmental-problems/

Philosophy. https://plato.stanford.edu/entries/feminism-environmental/

“Pteropods.” Alaska Ocean Acidification Network, aoan.aoos.org/impacts/species-response/pteropods/#:~:text=Pteropods%20are%20at%20risk%20to.

“Renunciation: The Highest Happiness.” Barre Center for Buddhist Studies, www.buddhistinquiry.org/article/renunciation-the-high-happiness/. Accessed 25 Apr. 2024.

Robbins, Paul, et al. Environment and Society: A Critical Introduction. 2nd ed., Hoboken, New Jersey, John Wiley & Sons, Inc, 2014.

Rodale Institute. “Crop Rotations.” Rodale Institute, 2018, rodaleinstitute.org/why-organic/organic-farming-practices/crop-rotations/.

Santamaría, L., & Méndez, P. F. (2012). Evolution in biodiversity policy – current gaps and future needs. Evolutionary Applications, 5(2), 202–218. https://doi.org/10.1111/j.1752-4571.2011.00229.x

“Shamanism.” Taking Charge of Your Wellbeing, www.takingcharge.csh.umn.edu/shamanism. Accessed 25 Apr. 2024.

Shiva, Vandana. “‘Miracle Seeds’ and the Destruction of Genetic Diversity.” University Press of Kentucky, 2016, pp. 61–102. Third World Agriculture, Ecology, and Politics, http://www.jstor.org/stable/j.ctt19dzdcp.6. Accessed 26 Apr. 2024.

Shiva, Vandana. “Chemical Fertilizers and Soil Fertility.” University Press of Kentucky, 2016, pp. 103–120. Third World Agriculture, Ecology, and Politics, http://www.jstor.org/stable/j.ctt19dzdcp.7. Accessed 26 Apr. 2024.

Shiva, Vandana. “Science and Politics in the Green Revolution.” University Press of Kentucky, 2016, pp. 19–60. Third World Agriculture, Ecology, and Politics, http://www.jstor.org/stable/j.ctt19dzdcp.5. Accessed 26 Apr. 2024.

Silliman, Brian R., and Christine Angelini. “Trophic Cascades across Diverse Plant Ecosystems | Learn Science at Scitable.” Nature.com, 2012, www.nature.com/scitable/knowledge/library/trophic-cascades-across-diverse-plant-ecosystems-80060347/.

Stange, M., Barrett, R. D., & Hendry, A. P. (2020). The importance of genomic variation for biodiversity, ecosystems and people. Nature Reviews Genetics, 22(2), 89–105. https://doi.org/10.1038/s41576-020-00288-7

Taylor, Bron, et al. “The Need for Ecocentrism in Biodiversity Conservation.” Conservation Biology, vol. 34, no. 5, 13 Aug. 2020, pp. 1089–1096, https://doi.org/10.1111/cobi.13541.

Taylor, Bron, et al. “The Need for Ecocentrism in Biodiversity Conservation.” Conservation Biology, vol. 34, no. 5, 13 Aug. 2020, pp. 1089–1096, https://doi.org/10.1111/cobi.13541.

The Blessing and Curse of Biotechnology: A Primer on Biosafety and Biosecurity - Carnegie Endowment for International Peace,

carnegieendowment.org/2020/11/20/blessing-and-curse-of-biotechnology-primer-on-biosafety-and-biosecurity-pub-83252. Accessed 1 May 2024.

"The Fifth Precept: The Power of Renunciation." Insight Meditation Center, www.insightmeditationcenter.org/books-articles/the-fifth-precept-the-power-of-renunciation/. Accessed 25 Apr. 2024.

"The Rise and Fall of Monoculture Farming | Research and Innovation." Projects.research-And-Innovation.ec.europa.eu, 13 Dec. 2021, projects.research-and-innovation.ec.europa.eu/en/horizon-magazine/rise-and-fall-monoculture-farming#:~:text=Raising%20a%20single%20crop%20has.

Thompson, Tosin. "How AI Can Help to Save Endangered Species." Nature News, Nature Publishing Group, 27 Oct. 2023, www.nature.com/articles/d41586-023-03328-4.

Understanding Ocean Acidification, www.fisheries.noaa.gov/insight/understanding-ocean-acidification#:~:text=Ocean%20acidification%20is%20expected%20to,that%20are%20difficult%20to%20value.

United Nations. (n.d.). The climate crisis – a race we can win. United Nations. https://www.un.org/en/un75/climate-crisis-race-we-can-win

University, Santa Clara. "Care Ethics." Markkula Center for Applied Ethics, www.scu.edu/ethics/ethics-resources/ethical-decision-making/care-ethics/care-ethics.html. Accessed 25 Apr. 2024.

US Department of Commerce, National Oceanic and Atmospheric Administration. "What Are Plankton?" Oceanservice.noaa.gov, 24 Aug. 2023, oceanservice.noaa.gov/facts/plankton.html#:~:text=Phytoplankton%20are%20microscopic%20plants%2C%20but.

Warren, K. J. (2015, April 27). Feminist Environmental Philosophy. Stanford Encyclopedia of

"Western Monarch Count Tallies over 330,000 Butterflies: Xerces Society." Western Monarch Count Tallies Over 330,000 Butterflies | Xerces Society, xerces.org/press/western-monarch-count-tallies-over-330000-butterflies. Accessed 3 May 2024.

What is biodiversity? why is it important?: AMNH. American Museum of Natural History. (n.d.). https://www.amnh.org/research/center-for-biodiversity-conservation/what-is-biodiversity

X, Science. “Researchers Boost Koala Spotting System.” Phys.Org, Phys.org, 21 July 2020, phys.org/news/2020-07-boost-koala.html.