Analysis of the Influence Factors of Climate Change on the Mangrove and Relevant Solutions

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Abstract. This article is aimed to study how climate change affects mangroves and how to prevent them from being damaged by climate change. Nowadays, the climate is becoming more and more unstable, and extreme weather occurs frequently, such as hail in the Tropics. However, the stability of climate is very important for human beings, because climate comes from nature, and nature is the basis of human survival. Therefore, in order to better observe climate change and improve current climate, the mangrove has become the Savior to human, which means that the mangrove is also significant to human beings. While some group of the mangrove have been damaged by climate change. Therefore, this paper will analyze the impact of climate change on mangroves from the perspective of climate factors of acid rain and global warming. The conclusion is that strengthening monitoring and creating more habitats for mangroves may be the appropriate solution. At last, this paper will be useful to cope with climate change better and be helpful for the future research.

1. Introduction
The mangrove is a shrub or small tree that grows in coastal saline or brackish water. The mangrove is beneficial to human beings and the environment. Firstly, it can withstand wind and waves and it also protect the diversity of wetlands by protecting silt and shoals [1]. Secondly, it will also make the water and the air fresher, which can keep the local climate more stable and makes it easier for people to adapt [1]. Besides, it provides habitat for aquatic life and birds, protecting biodiversity [1]. Therefore, it is important to protect the mangrove due to these advantages. Moreover, the mangrove plays a significant role in improving the climate, which has become abnormal in recent years. However, in the past few decades, mangroves have been destroyed by human activities and the climate change, among which global warming and acid rain are two main factors. To analyze the influence by the climate change on the mangrove, this paper concentrates on acid rain and global warming. Meanwhile, there is an experiment about the influence of the acid rain and some data from the research about the effect of the global warming.

2. Situation
There are many groups of mangroves in our world, especially in tropical zone [2]. In the fig. 1, there were many mangrove forests living in the lower latitudes, and with the rising of the latitudes, the number of mangroves decreased in 2000. Besides, fewer mangroves are living in the western part of the continent in the southern hemisphere, because the ocean current is cold near these areas and the it is not suitable for mangroves to live. Besides, there are more habitats for mangrove living in Southeast Asia because of the number of wet land. Actually, however, the distribution and number of mangroves
is much smaller than remote sensing data that shown in the fig. 1. The fig. 2 shows the distribution of quantity of mangroves species in the world. Also, we can conclude that the more mangrove species lived in the Southeast Asia and the north of Australia. In addition, there are some changes of mangrove trees between 1980 and 2010 in Asia in fig. 3. As fig. 3 shows, there are about 8000 ha mangrove area in Asia in 1980, making Asia the largest mangrove-living-area in these years, while the mangrove area reduces to 6000 ha in 2020.

Figure 1. Mangrove forests distributions of the world – 2000[2].

Figure 2. Species of mangroves of the world.
3. Related factors

3.1 Acid rain

There is an experiment about the effect of acid rain on related components in the soil, which were Eh (an index reflecting the ventilation of soil), pH, salinity, nitrogen, phosphorus, organic carbon, Cu and Zn [6]. The following three tables showed the data of that experiment. In this experiment, the researchers set acid rain with three different pH values for the experiment (pH 4.0, 3.0, 2.0). Meanwhile, the experiment with distilled water (pH 6.5) was used as the control check group. There were four experimental groups in total, and each experimental group repeated the measurement experiment three times.

The experiment firstly showed the influence of acid rain on Eh, pH and Salinity of solid. From that data, these chemistry properties would be changed by the depth of the solid, but under the different pH of rain, the difference among these groups were not big. However, in this experiment, although the changes of sediment Eh, pH and salinity are not only affected by acid rain, but also truly affected by tides, geomorphic conditions, geochemical characteristics and microorganisms, etc. Therefore, it is a complex change of the sediment, and that leads to the fact that the constraints in this experiment are not controllable. Besides, Acid rain can also significantly promote the leaching of nitrogen and organic carbon from sediment and affect the distribution nitrogen in different depths. Last but not least, the research showed that acid rain had a significant influence on the content of Cu and Zn in sediment. In conclusion, acid rain will speed up the loss of nutrients in sediment by affecting the nitrogen, phosphorus and organic carbon, which can also cause some mangrove trees to wither, because mangroves cannot get enough nutrients to maintain their life, which could make them not as healthy as before [4]. In addition, with the increase of the pH in sediment, the content of heavy metal ions in the soil is increasing, which indicates that the solubility of heavy metals is improved, leading to the intensification of heavy metal pollution. Although there is a coordinating role of external factors, such as the scouring effect of seawater. Therefore, acid rain has a great impact on the heavy metal pollution in the soil, leading to death of mangrove trees.

Actually, as acid rain becomes more acidic, I think that the situation of mangrove habitats will be changed greatly, which may transfer the gene of mangrove with a long time period, and that should be
proved by further researches. Besides, through the research about influence on gene of mangrove by acid rain, we can gain a chance to watch how mangroves change themselves, which should also be concerned with, because we do not know this change could be a positive trend or a negative trend for mangroves.

3.2 Global warming
In fact, the impact of global warming on mangroves is complex [1]. From the macro perspective, global warming means the rise in temperature, which is likely to be beneficial to mangroves. Mangrove plants are mostly thermophilic plants, and temperature is the main factor limiting the diffusion of mangrove plant distribution to the poles [1]. Mangroves prefer living in a warm place. Hence, with the temperature increasing, they may have chance to move father north or south to extend their growth area. However, this change could be slower than people expected, because there is a lag period for mangroves to adapt to the environment.

In fact, both the air temperature and water temperature can affect the distribution of mangroves. Commonly, every plants will dissipate heat from sunshine when they are in a situation with high air temperature through transpiration, and in this process, they will absorb water. However, the specific heat capacity of water is large, so water temperature is not easily affected by air temperature, leading to the small difference between water temperature in the morning and evening. Therefore, if the air temperature is high, mangroves can use transpiration to dissipate heat so that mangrove trees can maintain their lives. Besides, once the water reaches a temperature that the mangroves can not adapt to, the temperature of the air can be imagined, and it must be particularly high. In conclusion, water temperature has a greater impact on the distribution of mangroves.

Moreover, global warming could lead to another problem, the sea level rise, which also can influence the habitats and distribution of the mangroves.

Firstly, the rate of the sea level rise is a significant factor. When the sea level rises faster, it will cause a large loss of mangroves. If it is stable or slowly rising, the distribution of mangroves will be affected little or expanded. For example, in the early Holocene, sea level rises faster, large mangroves disappear, only sporadic pieces are distributed in the Miocene, the sea level is relatively stable, and large mangroves appear in the sheltered areas [7]. Stratigraphic records indicate that during the Holocene sea level change, mangroves could accept the speed of sea level rises by 8 cm per 100 years. However, if the speed of sea level rise is more than 12 cm per 100 years, habitats of mangroves will be damaged by waves or the pressure of the water, which will kill mangrove trees. Besides, for mangroves on high-altitude islands and continental coastal zones, these species can cope with faster sea level rises because of the river's ability to deposit more sediment.

Secondly, the extent of the tides caused by sea level rise can also affect the living environment of mangroves. Mangroves are inter-tidal plant communities that grow above low tide level. Elevated sea levels will cause some plants to live in areas that below low tide level. If mangroves are flooded for longer periods due to tides which have large extent, their roots will not have access to breathe.

As the sea level rises, mangroves will migrate to the land. If his migration speed can keep at the same rate as that of sea level rise, the mangrove population will not change much, otherwise the number of mangroves will decrease. In addition, different mangrove plants will respond differently to sea level rise. However, in the estuary area, salinity limits the migration of mangroves along the river. The rise in sea level on the one hand expands the estuary range, and on the other hand leads to the intrusion of seawater, which makes the mangrove range extend inward along the river. Therefore, in the absence of expansion barriers, the slow rise of sea level is beneficial to the expansion of mangrove plants in some places.

3.3 Other factors
There are some factors except those related to the climate change. First one is the salinity of water. Mangroves can grow in all salinity environments from complete seawater to freshwater, but the root activity of mangroves under complete seawater conditions is lower than those in freshwater conditions
so seawater salinity is particularly important for mangrove growth. The other one factor is the gribble, an insect. In the last few years, there were many death of mangroves caused by the gribble which is a type of marine bored animals living in the inter-tidal warm waters. The gribble is widely distributed in mangrove areas around the world and it can damage the aerial roots of mangroves, but there are few reports of death of mangroves caused by the gribble. In August 2012, the media released a gribble outbreak in the Dongzhaigang Mangrove Reserve in Hainan, which led to the death of a large mangrove forest. This is the first event that happened in China where gribble killed mangroves [5].

4. Solutions

4.1 Protecting wetlands

The habitat of mangrove is wetlands. Besides, wetlands are important to help improve the climate change and keeping biodiversity. Therefore, protecting wetlands is significant to protect mangrove. To protect wetlands, support of national policies is needed. For example, the nature reserves and wetland parks like Dongzhaigang in Hainanis one of the effective ways to protect wetland resources. Firstly, it is a good way to promptly stop the blind exploitation and utilization of wetland resources and take legal protection measures. Secondly, the establishment of wetland nature reserves or wetland parks can not only help protect the ecological balance within the wetlands, but also help prevent the extinction of biological species. During the construction process, all professionals must actively guide and participate in order to ensure the effectiveness and scientific nature of wetland protection. Thirdly, in the planning and construction of wetland nature reserves and wetland parks, it could be better for the government to pay attention to the value of wetland resources and give play to the functional value of wetlands [8]. Besides, it is good way to do a good job in propaganda and education on wetland protection to arose public awareness of protecting wetlands. Due to the late understanding and development and utilization of wetlands in China, people's understanding of wetlands is seriously insufficient. Therefore, the government and relevant departments need to publicize and educate wetland protection so that people can fully realize the importance of protecting wetlands. In real life, we can use various modern propaganda methods to enable the masses to have a fuller and more comprehensive understanding of wetlands and take the initiative to protect wetland resources. In addition, the government can set up billboards around the wetlands and some prosperous streets to tell people the importance of wetlands and help more people to establish the concept of protecting wetland resources [8].

4.2 Supervising

Furthermore, the supervising should be done in the mangrove area. For example, if there are some bad symptoms in the mangroves, the department should take appropriate measures to protect the mangroves in time. Or at the time of regulation, regulators can adapt mangroves to the future environment by changing the microclimate of mangrove habitats. Besides, there are some destruction of mangrove habitats made by real estate agencies. For example, in April 2019, the destruction of mangroves caused by the construction of Hainan Fuli real estate project was exposed. The enterprise has damaged mangroves five times before, accumulating about 4700 [3]. Therefore, supervising is not only significant to the change of environment, but also important to prevent the mangrove from human damaged activities.

5. Conclusion

In this paper, it is revealed that how acid rain and global warming exert influence on the mangroves. The corresponding solutions are to establish protected areas, strengthen supervision put new technologies into use to manage the climate change. However, in terms of the global warming, this paper does not analyze and find out whether temperature have a big effect on mangroves for temperature is also a factor that affect the reproduction of mangroves. Therefore, in the next research, the author will continue to focus on the temperature influencing the mangrove.
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