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Impact of CO_2 and Climate Change on Marine Ecosystems

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Abstract:

The carbon dioxide present in the atmosphere and the changes in the climate are linked with the coexisting shifting that are present in the temperature, input of nutrients, circulation, stratification and the acidification in ocean. All these parameters are large and have potential for the large degree of biological influences. The shifts in the levels of population are initiating due to the intolerance that is physiological to the new kind of environment that changes the patterns and the interaction between the species. The impacts are mainly strike by the tropics and the poles that has the sensitivity towards the ecosystem of solar system to the sea ice. California current is the Midaltitude upwelling systems that has powerful association exists between the species and the climate distribution, the phonologies and the demographics of the organization. The large number of impacts may alter the energy and the flow of material along with the biogeochemical cycles that leads to affect the entire functioning of the ecosystem.

Keywords: *Marine Ecosystems, Climate Change Impacts, Ocean Acidification*

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Introduction

Majorly, 70% section of the earth is covered by water and in this oceans plays a very significant role in major processes of the earth. Oceans are host to a numerous number of species of organisms. Carbon dioxide produced by the human activities is mainly absorbed by the oceans, which ultimately decrease the pH level of oceans and make it more acidic, this process is commonly referred to as ocean acidification. It becomes a matter of concern that increasing the level of atmospheric CO_2 is also increasing the level acidity level which will directly effect the marine ecosystem (www.pmel.noaa.gov).

European Science Foundation in their article *"Impacts of Ocean Acidification"* discussed the important recommendations and suggestions which are considered as necessary for European actions to understand about the of ocean acidification and its impact.

- Predicts the responses of biological and biogeochemical processes to acidification in ocean from the organismal level leads to the ecosystem level
- Integrate both sciences i.e., natural and social for understanding ocean acidification and developing adaptation strategies considering impacts of the socio-economic conditions on natural resources and human societies.
- Make sure that the marine ecosystem and environmental services are been monitored.
- The dissemination and capacity building is enabled that majorly helps in delivering scientific information-based advice to research fund providers and policy makers.
- Synchronize and reinforce the impacts of ocean acidification on the European research (archives.esf.org).

The EU Energy Outlook from 1999 to 2020 recommended that, as the energy production is increasing from the sources which are renewable and 80% depends on the fossil fuels. As per the recent research, the emission of Carbon Dioxide is approximately 50% higher than that research in the year 2030. Oceans has already taken 50% of the anthropogenic CO_2. The buffers are present in the oceans which have a concentration in a limited amount of CO_2 in the atmosphere. The atmospheric concentration of CO_2 is comparatively inert but it becomes reactive when it is dissolved in seawater. The takes part in the reactions of chemical, biological and geological, which are estimated but others are very much complex. The degree of oceans is impacted by the ocean warming using the change in CO_2 solubility. The ability of the oceans to absorb CO_2 in more concentration decreases the intake of CO_2. Due to the unlimited amount of release of CO_2 (fossil fuel), the concentration of CO_2 in the atmosphere can be predicted. The estimations are 770ppm by 2100 and 1900 ppm by 2300. These predicted value shows a decrease in the pH values of Surface Ocean having 0.3 and 0.8 units of pH from the levels of pre industries (Turley *et al* 2005). As according to the Intergovernmental Panel on Climate Change i.e., IPCC report of 2001 that in 21st century time, the CO_2 present in the atmosphere is expected to be get increased by 200ppm. This elevation in the concentration have no fossil fuel reduction in emission, then this can be as high as 2000ppm.The increase in the concentration of CO_2 results to lower the pH of surface oceans.

With the increase in the concentration of CO_2 that results in the fossil fuel burning, the atmosphere is also getting affected that majorly results in the change of climate and global warming. The complicated surface ocean chemistry is being altered by the CO_2 that causes them to contribute to making it acidic. The acid concentration in seawater differs across oceans that is having some sequential changes in the activity of biological agents and variations in the geography. All these variations simply depend on some of the other parameters which are the temperature of seawater and the depth. As the organisms are employed to the higher concentration of CO_2 that results in lowering of pH and increase in the acidity. The marine protein has contributed more towards the food security globally. There are various studies that study the impact of acidification of the ocean on the marine resources which are considered as recent.

For the purpose of understanding the functional genomics that helps in deriving the increased responses to the acidification. All the methodologies were described by Rost et al in 2008 which are used to properly investigate the impact of pH on the phytoplankton. Batch and Fabry in 2008 studied about the approaches that help in predicting the pelagic calcification changes and then a program is proposed for the purpose of quantification of effects of acidification on a very large scale. In 2008, the shift from the indicators which are growth based towards the indicators which are geochemical having the coral response to the environment. All these facts show that

the records of growth are the main source of detailed information (Browman 2008).

The measurement of the ocean acidification is performed by pH recording of the ocean. The concentration of hydrogen ions increased by 26% from the past 200 years and the acidity of the components increases. The acidification values of the ocean are 10 to 100 times more than the value that is found at the last stage of the ice age. The saturation state monitors the different forms of calcium carbonate i.e., aragonite and calcite that are considered as an indicator found in the ocean acidification. With the increase in the pH value of water, the saturation state also lowers down. As per the Fifth Assessment Report, the IPCC found that till 21st century the ocean will take up the emissions of carbon dioxide. The ocean pH got lowered that is having an extent of impacts. In some countries, various kind of efforts was taken for the purpose to monitor the acidification of the ocean and their impacts were assessed by the OA-ICC i.e., Ocean Acidification International Coordination Centre (http://www.cawcr.gov.au).

The plant responses to the restrictions of water, light and the availability of nutrients or another type of parameters may also get influenced by the elevated CO_2. Due to the increase in human activities which are the use of fossil fuels and change in the usage of land, the concentration of atmospheric carbon dioxide (CO_2) increases. Because of all these reasons, the chemistry of ocean changes that have the power to majorly influence the aquatic ecosystem that includes fecundity, calcification and the composition of species. All these parameters are the prime threats to the diversification, productivity and the care of the marine environment. The rise in the atmospheric levels of CO_2, the ocean acidification process continues and with that numerous other parameter which has indirect effects (Lenton, Matear and Mongin 2018).

As per the researchers, the vents of carbon dioxide which have occurred naturally provides a good environment to live in and in that scientists study the impact of ocean acidification. According to the 4th assessment report of the Intergovernmental Panel on Climate Change, the emissions of CO_2 are majorly at the reduction point in century end (https://saveourseas.com). Foundation

The Living on Earth article stated about the rising levels of CO_2 that threatens the aquatic life globally. The taxonomic groups in large quantity present in the ocean are affected by each other in different ways. The report that is prepared by the Adam Wernick includes the meta-analysis that is having the direct measurements in the ocean. The mesocosms which are developed by some of the researchers are the large containers which can be put inside the ocean that helps in enclosing a water body. The future conditions can be prevented by the addition of CO_2 in the different concentrations. The acidity was measured by the scientists using pH scale (from zero to 14). So the freshwater in normal conditions has a pH of seven approximately (www.pri.org). The volcanic events also help in knowing about the acidification of the ocean by the water surrounds the coast volcanoes which are having a high amount of CO_2 and low value of aragonite.

Review of Literature

Turley, *et al.* (2005) studied the effects that increase CO2 on the marine ecosystem are inevitable and can be measured. In numerous effects, some effects are negative whereas some are positive also and even the scientific community is not able to predict the impact of acidification accurately. Researchers are supposed to focus on whether the marine organisms have the ability to adapt to the changes in CO2 and pH. After the depth study, the authors concluded that we need to assimilate atmosphere, hydrodynamic and ecosystem modellers, for building experimental knowledge, and to validate models we require more system measurements.

Shirayama and Thornton (2005), studied about the influence of an increase in the concentration of atmospheric CO_2 found on the marine regions. This paper mostly emphasizes the CO_2 impacts that have long-term chronic effects as well. The growth of gastropods and sea urchins influences the increases of about 200ppm in the concentration of CO_2.

Harley *et al* (2006), studied the influence of climate change in the systems of coastal marine. This paper stated that the climate change that is induced globally has so many implications for the marine ecosystem, the social and the economic depends on them. The circulation in the ocean that helps in deriving the transport of larva also gets change having some of the important consequences in the dynamics of the population. The community-level changes that are resulted from the impacts of climate. The synergic effect present in the climate and the other variable of anthropology results in the changes which are climate-induced. The improvements require for the management and the conservation of living system in

marine life and there are some of the directions which are used in the future research work that involves the alteration in the community level that influences the population, also estimates the changes in the dominant species ecologically.

Guinotte and Fabry, (2008) reviewed the various articles related to the atmospheric concentration of carbon dioxide that provides a usual process of synthesis of known and/or hypothesized respons4es for biological and ecosystem for the purpose of increasing the ocean acidification. Further research is needed in ocean acidification for determining the biological responses of marine taxa to increased pCO2. Development of certain tool is required for making reliable predictions of future ocean acidification effects on marine ecosystems.

Doney, *et al.* (2012) studied about the climate change impacts on marine ecosystems, according to them in marine ecosystems rising level of atmospheric CO2 and change in climate are connected with concurrent shifts. After the depth study, the authors found that the rising atmospheric CO2 is increasing atmosphere and temperature of the ocean which ultimately rising sea level, vertical stratification, etc. Rising level of CO2 and climate change may modify the properties of ecosystem i.e. trophic structure, food-web dynamics, and aggregated functioning etc.

Navarro, *et al.* (2016) explored the effects that are integrated and increases the seawater temperature and pCO_2 on the physiological performance. Conclusively, they found that rise in temperature within the natural range experienced by *M. chilensis* shows the positive effect on the processes associated with energy gain to be allocated to growth.

Burdett *et al* (2018) Studied about the change in the degree of carbonate chemistry in oceans are considered as an important determinant for the observation of effects. The exposure of acute CO_2 is increasing which are the problems faced by the Benthic marine ecosystem and all these risks can be natural or it can be derived from anthropogenic variables such as activities related to engineering and industries. The *in situ* influence of CO_2 present on the ecosystem of coralline algal is also studied in this paper. Coralline algal ecosystem is considered as a universally ubiquitous that is economically and ecologically necessary habitat. This particular study researches about the carbonate in biogenic form present in the marine region for the enrichment of acute CO_2. All the concerns were raised through which the system gets a bounce back.

Hannan and Rummer (2018), described the acidification in the aquatic region that causes when the levels got increased of atmospheric CO_2 in fresh water and the marine ecosystem across the world. In this paper, most of the data is non-existing and the fishes which are under investigation has some influence of increased values of CO_2. This recommends that the maintenance of $_{the}$ metabolic performance can be done at the time of acidosis.

Lenton, Matear and Mongin (2018), worked on the impact of climate change on acidification of oceans in the Pacific islands. According to this paper, the ocean has more acidity is considered as the most compelling evidence in respect of the CO_2 levels rising in the atmosphere. These changes in the rate and magnitude are directly proportional to the pathways of carbon emission. In this paper, there is a requirement to recognize the influence of environmental stressors in different forms, as the acidification of the ocean is done by the warming of the ocean and the other concerns of the environment such as the species which are invasive. For the purpose of studying the stressors of the environment, the viable pathway for the proper emission is implemented to reinforce the development having the adaptation in a sustainable environment and some of the options which are resilient (www.weforum.org). The influence of the temperature in the ocean and the implicated chemistry sometimes changes the behavior, functioning which is psychological and the characteristics which are demographic such the organism productivity that mainly results in size, spatial degree and the population which is in abundance. All these turns to species interaction that is altered and having the trophic directions from trophic levels of primary producers to the upper level of the trophic system. The upper level of trophic includes fish, aquatic mammals, and the seabirds. All these having the signals for the climate that propagates by the ecosystem in both bottoms and top-down pathways. The CO_2 impact of rising have some other parameters such as regional pressures on the ocean that involves the fertilizers usage, coastal and the degradation of habitat.

Conclusion

After studying this paper, it can be concluded that the carbon dioxide rise in the atmosphere causes the rise in the atmosphere and in the temperatures of the ocean. All these factors responsible for the rising the sea

levels, the vertical stratification increases, the sea ice and the changes in the precipitation and runoff regions. The circulation in the warming and changes in the circulation of the ocean decreases the concentration of subsurface oxygen and the rise in the levels of atmospheric carbon dioxide results in the ocean acidification. The changes in the climate and in the levels of carbon dioxide are influenced by the organization and the functions of biological regions. The physiology and the behavior got affected by the direct temperature and the effects of a chemical that results in the influences at the population level.

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