

Invasion in Deep

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ABSTRACT

Climate change causes air and seawater temperatures to differ from seasonal averages. This situation causes aquatic organisms to migrate to regions with more favorable conditions. It also changes the relationship between species by allowing many species to come into contact with that they should not normally come into contact with. Invasive species that reproduce and spread very rapidly due to the absence of predators and diseases in their new habitats cause national as well as international problems in aquatic environments. Climate change has negative effects on many sectors. Since the spread of invasive species is mostly in water resources, the biggest impact is experienced in the fishing sector.

This study focuses on invasive species that are important for biodiversity in aquatic ecosystems. Today, attention is drawn to the effects of increasing global climate change on invasive aquatic species and their spread. In addition, the precautions to be taken in aquatic ecosystems are emphasized.

KEYWORDS: *Climate change; Invasive species; Biodiversity; Ecosystem*

INTRODUCTION

People inevitably need natural resources to continue their lives and increase their quality of life. [1] Soil, air, water, minerals, plants, and animals, which are among the natural resources, are faced with depletion by humans and these limited resources are getting smaller and smaller. [2,3] Especially in the last century, global warming, which has emerged as a result of the accumulation of destructions made by human beings without considering nature, affects the earth as a whole. After the 1700s, as a result of the increasing use of fossil fuels, the destruction of forests, and misapplications in some sectors, some changes in the atmosphere began to negatively affect our world and human life as a whole. [4] Gases released into the atmosphere and creating a greenhouse effect have caused the thinning of the ozone layer, which keeps the earth at a certain temperature level, and brought the negative phenomenon known as climate change to the agenda. The solubility of carbon dioxide in seawater, which has the largest share among greenhouse gases in terms of contributing to climate change, is considerably higher than other gases in the atmosphere. [5] Also, Climate change causes visible changes in the environment. For example, the

decrease in lake waters, the melting of glaciers, increases in sea levels, changes in currents and precipitation patterns. These changes impact not only the environment but also the economy in the short or long term. Therefore, the calculation of how they will be affected in their society in the future should not be ignored. Because many sectors can be directly or indirectly affected by global warming. Especially agricultural activities are very important for humanity. Agricultural activities are an activity that can be sustained depending on nature. No matter how much technology develops, it can't lose this feature, that is, its connection with nature. It is necessary to have a certain temperature and water for plant and animal production. An increase in temperature and decrease in precipitation due to climate change negatively affect agricultural productivity. In addition, with the emergence of harmful plants and insect species in agricultural areas, a decrease in product diversity or a decrease in the quality of existing products occurs. For this reason, the gradual increase in food prices over time causes food crises and economic crises to become even stronger by feeding them.

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Climate change, which occurs with the effect of global warming, significantly affects ecologic diversity, which is one of the important elements of biodiversity [6]. Climate change is one of the main anthropogenic threats to aquatic ecosystems, which are important natural resources. Because climate changes can change both environmental characteristics and geographical distribution of species. [7,8,9,10] In the short and medium-term, the fragmentation of habitats by human action threatens especially biodiversity [11]. Climate change causes changes both in natural biodiversity and in the interactions of organisms with each other and with their environment. Thus, possible breaks in the ecological food ring are seen [12]. The most important factor causing biodiversity erosion with the effect of climate change is a biological invasion. In recent years, the movements of living things have gained speed and it has become easier to move them from one place to another. These species, which are defined as invasive species, are creatures that migrate from their places of residence to other places due to various reasons or spread in new places by expanding their habitat and establishing habitat in new locations where they migrated [13] Invasion in aquatic environments is defined as the displacement of living things in aquatic systems by crossing national borders, entering into the intro-species or inter-species competition, causing disease transmission and hybridization [14].

The limited number of data on the ecological impact and risk assessment of invasive species underlines the need for studies. Therefore, it is important to investigate the destructive effects of invasive species, whose numbers are increasing day by day, in aquatic environments, especially with the effect of climate change, by increasing international public interest. In this study, the distribution of invasive species in aquatic environments, their effects, and control methods are discussed in depth.

SPREAD OF INVASIVE SPECIES

Invasive species entry into ecosystems occurs mostly through human activities. In aquatic organisms, as in other living things, invasive species can be transported from one region to another in different ways. The first of these is realized through the removal of natural barriers. Oceans, seas, mountains, deserts, and geographical barriers form on earth. Thanks to these barriers, species-specific to each region, namely diversity, occur. If one of these barriers is broken, species will pass through the corridors to the other side and adversely affect biodiversity where they pass. For example, thanks to the Suez Canal, some creatures of Atlantic origin

passed to the Red Sea, while marine creatures of Indo-Pacific origin began to change their habitats by migrating to the Mediterranean. [15] Second, Aquatic organisms are transported to their new ecological sites via ships' ballast water and become invasive species [16] As a result of the increasing ship traffic in the seas and oceans, the eggs and larvae of many creatures can travel long distances in the bilge waters of the ships or by adhering to the surface of the ship under the waterline. Eggs and larvae entering a new environment in this way, if they can survive and adapt to the new environment, begin to spread rapidly [13] Third, it has been reported that some imported fish become invasive in their reproduction processes. [17] In addition, other species used to feed aquatic organisms are also among the reasons for the spread of infestations. [18]

CLIMATE AND INVASIVE INTERACTION IN BIODIVERSITY

Biodiversity, which constitutes the life support unit of the world, is an important component in the functioning of the ecological balance. It forms the basis of sustainable life in terms of including genetic diversity, species diversity, and ecosystem diversity. Increasing climate change, especially with anthropogenic effects, is destroying ecosystems and therefore biological diversity. Because it affects the structure and functioning of ecosystems; Climate change, biological invasions, and loss of biological habitats are listed as the main problems for the environment. [7, 14, 19]

Excessive use of aquatic resources, pollution, and climate change lead to significant changes in aquatic ecosystems. Temperature is the most important parameter in the reproduction and nutrition of living things in aquatic environments. Experiencing temperature increases with the effect of climate change causes changes in the reproductive cycles of organisms living in both seas and freshwaters. Temperature increases will cause species to migrate to new areas to reproduce and to compete for available suitable places. Invasive species, due to their strong environmental adaptability, spread rapidly and harm local species. [20] This means both changes in species distributions and increases in biodiversity. Every living thing struggles to exist, but some creatures are much more successful than others in this regard. If invasive species co-occupy or spread with closely related species, they may form hybrids with native species, causing changes in the genetic makeup of some species. As a result, they may reduce their success in life.

But also genetically, they can create hybrids that are much more susceptible to some insects and some

pathogens. On the other hand, it is stated that experiencing temperature increases with the effect of climate change may cause the glaciers to melt and the viruses and bacteria found frozen here to be released and cause deaths in other aquatic environments. [21]

COMBATING INVASIVE SPECIES

Rapid detection of the infestation is essential to keep the impact of aquatic infestations to a minimum. An invasive species should be identified and risk assessed before it reaches an effective population. It is valuable for responsible fishermen to ensure international coordination, as measures to deal with the possible impacts of invasive species are particularly relevant to the fishing industry. Alien species seen in the aquatic environment by fishermen should be reported. It is an important requirement to carry out genetic studies in the identification of invasive species. While evaluating the invasive potential of aquatic species, DNA barcoding techniques should be used and the species should be identified before they enter the logarithmic increase phase and struggle should be started. [22] It should aim to minimize the impact and distribution of these species to ensure sustainability, especially in aquatic ecosystems. Therefore, the invasive population can be suppressed, their spatial distribution can be limited, and practices should be initiated to prevent their spread within or between river systems. [13]

CONCLUSION:

Considering the intense pressures on biodiversity and the possible future effects of climate change, many scientists argue that a new extinction process may occur. The protection of biodiversity and ecosystems, which are the lungs of the world, in a way also means the protection of human welfare. Experiencing climate changes and increasing the number of invasive species will perhaps cause us more problems than Covid- 19 in the near future.

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