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Protecting marine ecosystems: A necessity for environmental conservation

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Abstract

Marine ecosystems play an essential role in maintaining the health and balance of our planet. However, these fragile ecosystems are facing unprecedented threats due to human activities, including pollution, overfishing, habitat destruction, and climate change. This research highlights the important needs to protect marine ecosystems and outlines key strategies for their conservation. Actually, addressing pollution is crucial in safeguarding marine ecosystems. Industrial waste, plastic debris, and chemical pollutants pose significant risks to marine life. Implementing stringent regulations on waste management and promoting sustainable practices can help reduce pollution levels and mitigate its adverse effects on marine habitats. Moreover, overfishing has led to the depletion of numerous fish stocks worldwide. Adopting sustainable fishing practices such as implementing catch limits, promoting responsible fishing techniques, and establishing marine protected areas can help restore fish populations and maintain the delicate balance within marine food webs. Furthermore, protecting critical habitats is essential for preserving biodiversity in marine ecosystems. Coastal development projects often result in the destruction of vital habitats like coral reefs and mangroves. Establishing protected areas and implementing strict regulations on coastal development can safeguard these habitats from further degradation. Finally, climate change poses a significant threat to marine ecosystems through rising sea temperatures, ocean acidification, and extreme weather events. Mitigating climate change requires reducing greenhouse gas emissions through transitioning to renewable energy sources and adopting sustainable land-use practices.

Keywords: Marine ecosystem; Protection; Climate change; Threat.

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1. Introduction

1.1. The ocean and its meaning

Seas and oceans cover 70% of the Earth's surface. All species of organisms known today evolved from life forms in the ocean, and large numbers still live there today. In addition to being the cradle of life, the oceans are also of irreplaceable importance as temperature regulators on Earth. Massive bodies of water act as temperature stabilizers (Ales Ruda, 2015). Sea currents are also important for the environment, which cool or, on the contrary, warm the land, thereby shaping the climate into its current form. For example, the climate of Europe would be much colder without the Gulf Stream (Fleshler, 2019).

Sea plants, algae, coral reefs and phytoplankton help mitigate climate change by sequestering carbon dioxide and producing oxygen. Phytoplankton even produces up to 50% of the oxygen on Earth (NASA, 2005). All these factors make planet Earth habitable. Without the oceans, life on Earth would not be possible.

1.2. The sea and its meaning for man

Man has also used the sea as a source of sustenance since ancient times. Even during the past decade, the products of industrial fishing accounted for about 16% of the animal protein in the human diet. The average person consumes up to 20 kg of fish per year (Vrtiška, 2013). Today, many "gifts of the sea" are processed in various industries - they are used, for example, in medicine or agricultural technology.

1.3. Marine ecosystems

An ecosystem is defined in the Czech Environmental Act as a functional system of living and non-living components of the environment, which are connected to each other by the exchange of substances, the flow of energy and the transmission of information, and which interact and develop in a certain space and time. The marine ecosystem is of extraordinary importance for humanity, it represents an important source of raw materials and food. The sea also represents enormous biological and energy resources, which many times exceed those on land and are still far from being fully utilized (ÚNIE, 2013).

2. Causes of threats to marine ecosystems

2.1. Sea currents

Ocean currents have a huge effect on climate all over the world. This massive circulation of water is caused by different sea temperatures or different salinity. Powerful currents can be either warm (moving from the equator to the pole) or cold (from the pole to the equator). To a large extent, they complete the climate on the globe in its current form. But if the oceans were to change temperature more significantly, the currents could change direction, slow down or even stop. For example, the Gulf Stream originates in the warm waters of the Gulf of Mexico and brings this warmth to Europe. Thanks to this, for example, Prague,

which lies on the 50th parallel, has a mild climate, while on the other side of the Atlantic, on the Labrador Peninsula, there is a cold maritime climate (Kotyzová, 2015).

The density of water is important for these phenomena. Water with a higher density sinks below toward to a lower density part. Colder water has a higher density (it has the highest density at 4 °C, with further cooling, the density decreases again). Saltier water also has a higher density. If there were drastic changes in their temperature or salinity in the area where the currents touch, one of them would no longer sink below the other, for example, but would push it away and thus change its path. This would result in large temperature changes in various parts of the world, which until now have been warmed or cooled by stable ocean currents (Kotyzová, 2015).

The southwest coast of Africa, the northern Indian Ocean and the southern Galapagos are the key areas from which water rises from the sea depths to the surface. Due to the influence of sea currents, the rotation of the Earth and the wind, cold water richer in oxygen and nutrients emerges from the deeper layers of the ocean in these places.

Another case is the so-called Kelvin wave from the west. It pushes warm water down into the depths of the ocean. But the basic mechanism of exchanging bottom water to top water continues, so instead of cold water, warm water compressed by waves, which has a significantly lower content of oxygen and nutrients, returns to the surface. The average sea temperature will rise by up to 6 °C to 26 °C during this phenomenon (Enfield, 2020). Algae stop reproducing. The fish that feed on them will not find enough food. So are seabirds and other animals. South American fishermen called this phenomenon El Niño. El Niño occurs once every 3-7 years and lasts a maximum of 12 months (Benestad *et al*., 2002). In recent decades, this phenomenon occurs more often and with higher intensity.

In addition, sea currents also bring food to many marine animals. By slowing them down or stopping them completely, the food chain will be disrupted and many species will be teetering on the edge of survival.

2.2. Ocean warming and the consequences of climate change

The temperature increase by the end of the 21st century is estimated at 1.1 to 6.4 °C compared to the end of the 20th century. As a result, the sea level will rise by 28 to 61 centimeters in the same period (IPCC., 2013a).

One of the main human-made causes of global warming are high emissions of so-called greenhouse gases such as carbon dioxide, methane, nitrous oxide and ozone. These rise to the upper layers of the atmosphere and cause the greenhouse effect, a phenomenon in which the atmosphere prevents the escape of heat radiation and the planet warms (CHMÚ, 2005). However, even if anthropogenic emissions were to stop immediately, the planet would still warm by about 0.6 °C. The reason is the heat accumulated in the oceans, from where it is slowly released, and the fact that the carbon dioxide in the atmosphere has a long decomposition time (IPCC., 2013b).

In any case, this phenomenon will have negative consequences for humanity and ecosystems. The water on Earth would increase in volume and ocean levels would rise by tens of centimeters, which would seriously threaten the inhabitants of low-lying, coastal and inland areas, which are inhabited by hundreds of millions of people.

Marine ecosystems are also at risk. In addition to temperature rise, sea level rise is also related to warming, which will decrease their percentage salinity. Many marine ecosystems are sensitive to environmental change, and for coral reefs, for example, this could mean their extinction. For all areas, the faster temperatures rise, the greater the risk of damage. In addition, animal species will migrate faster, the areas of plant and animal occurrence will shift towards the poles, where they will look for water with a temperature to which they are ideally adapted.

As the seas warm, the oxygen content in the water also decreases (Cheung *et al*., 2013). Fish caught by humans, i.e. mainly predatory fish that people prefer for their taste, are found in cooler, better oxygenated seas due to their greater oxygen requirements compared to herbivorous fish. The main fishing grounds are in the North Atlantic, the North Pacific and the southern seas near Antarctica (Herber, 2008). There are few fishing grounds in tropical seas. After warming, fish will move further north or south, and as a result of migration, they will live in a smaller area, which could cause food shortages.

2.3. Ocean acidification

An increase in the concentration of carbon dioxide in the atmosphere causes ocean acidification. Around one third of the emissions of this gas are absorbed. This is because the oceans weigh carbon dioxide from the air, resulting in the formation of carbonic acid, which increases the acidity of the world's oceans. At the same time, however, this reaction also consumes carbonates, which are used, for example, by corals, protozoa and molluscs to build their shells (Říhová and Juračka, 2010).

The pH value of the oceans has been in the range of 8.1 to 8.3 for the past 800,000 years (Room and Board, 2013). Since the beginning of the industrial revolution, the pH of the ocean has dropped by an average of 0.1 (Klimatická, 2022), and today we are already noticing major negative consequences for the life of corals (they grow more slowly and their fragile shells break down more easily) and entire aquatic ecosystems. By the end of the century, depending on how much CO_2 emissions we produce, the pH value will drop by another 0.06 to 0.32 (IPCC, 2014).

2.4. Excessive application

One of the serious problems facing the world's oceans is also unlimited fishing. Our demand for fish has devastating consequences for fish stocks. Difficulties arise when the population of a certain species loses its natural ability to reproduce - there are few animals, they are scattered over a large area, and successful and sufficient reproduction cannot occur between them. At that moment, the given species is on the verge of extinction.

An example of a relatively successful intervention is the situation of whales. In the first half of the last century, their hunting was not regulated. After World War II, the International Whaling Commission (IWC) was established with the aim of protecting whales from extinction (IWC., 2022). However, from the late 1950s to the mid-1960s, over 30,000 whales were caught annually (IPCC. 2014). This necessarily led to a dramatic decline in their population. Since then, catches have steadily declined, and in 1986 the IWC banned commercial fishing altogether (Commercial IWC, 2022). Since the 1990s, the populations of some species of whales have been increasing regularly (Estimate IWC, 2022).

A similar scenario can be repeated for commercially fished fish species. One of the most endangered species is the bluefin tuna. Bluefin tuna is not much better off either (IUCN, 2022). Moreover, their populations continue to decrease. It is therefore necessary to approach the sustainable management of fish stocks with increased attention.

Nevertheless, fishing benefits some species. People focus mainly on fish from the top of the food pyramid (predatory fish have tastier meat). Some marine animals thus lose their natural enemies and become overpopulated. One of the possible examples is jellyfish - they clog fishing nets in affected areas (Hays *et al*., 2012).

Last but not least, the chosen fishing methods have an effect on marine ecosystems. At the same time, highly efficient fishing methods using large nets dragged along the seabed have the greatest negative impact on the environment. Unwanted catches in the form of small or unwanted fish or sea urchins are caught in the nets. Animals are injured by the nets, and although they usually end up back in the sea, a large proportion of them die. Fishing nets also cause mechanical destruction of coral reefs, which are a natural habitat for small species of fish and other animals (Macháček, 2015). Other, gentler fishing methods may be less burdensome for the marine ecosystem.

2.5. Pollution

It is also very dangerous to "clean up" waste into the sea. Scientists from IPSO (International Program on the State of the Oceans) draw attention to dead zones, among other things (IPSO, 2015). These are areas in which the oxygen level has decreased so much that it is insufficient and uninhabitable for most life forms. The reason for the formation of these dead zones may lie in excessive eutrophication (increase in the presence of nitrogen and phosphorus in the water). Nitrogen and phosphorus enter the water, for example, from detergents, the discharge of municipal and industrial wastewater into waterways, or the atmospheric deposition of nitrogen from mass livestock farming and combustion emissions, for example from transport.

Oil spills are also a well-known example. In April 2010, an enormous oil spill (estimates range between three and five million barrels) occurred in the Gulf of Mexico as a result of the Deepwater Horizon floating oil rig accident. The resulting oil spill covered an area of 10,000 km^2 and nearly 6,000 sea turtles, 26,000 dolphins and whales, 82,000 birds and countless fish and invertebrates died as a result of this tragic event (NOAA, 2015). Other

examples of oil accidents can be the sinking of the Exxon Valdez (Evostc, 2015) or Prestige tankers (The guardian, 2012).

3. Extinction of marine animals

Extinction of animals means the reduction of the number of individuals of a given species beyond the critical limit of reproductive capacity, when the species is threatened with extinction due to the lack of its members. Extinction can have various causes, it can also be the effect of several unfavorable factors - lack of food, environment or other symbiotic species, or, conversely, the occurrence of editors or diseases. Extinct species are missing from the food chain and the result can be instability or the collapse of the ecosystem, or the extinction of other species in a chain reaction. For humanity, the sea and marine ecosystems are extremely important as a source of raw materials and food, and as a result of species extinction, these resources are disappearing (Holec, 2006).

3.1. Great extinctions of species in the past and their causes

Great extinctions have occurred in the past, but scientists are increasingly talking about the fact that we are on the threshold of the sixth great extinction of animal species. About 440 to 450 million years ago, the first major extinction of animal species occurred, perhaps due to the overpopulation of plants on land and the subsequent cooling of the planet due to the large amount of carbon dioxide in the atmosphere.

The Permian-Triassic extinction (about 250 million years ago) is said to be the most devastating catastrophe in Earth's history, 70% of terrestrial and up to 95% of marine animals died out. The cause was probably strong volcanic activity. The temperature of the planet increased, there was a large amount of poisonous hydrogen sulfide in the atmosphere, and the ozone layer became significantly thinner.

The most famous large extinction of species is the last one, the fifth, which occurred at the end of the Cretaceous period (about 66 million years ago). Organisms disappeared gradually – first plants and phytoplankton, which are fully dependent on the Sun, then herbivores and finally carnivores. The generally accepted theory speaks of the fall of a meteorite on the Yucatan Peninsula of Mexico, which raised a cloud of dust that for some time completely covered the sunlight (Than, 2006). This brought the end of the era of dinosaurs and, conversely, the development of mammals, which are still the dominant animal group today (Beneš, 2018).

3.2. Are we facing a sixth extinction?

In the past, all disasters were caused by natural causes, but now there is a great extinction of human activities. According to natural science standards, humans are an overpopulated species – in more problematic areas, people are running out of food and water, which leads to the depletion of resources and to damage the environment. People's needs, whether for

food or industrial products, burden the surrounding environment. In particular, the oceans are not only used to a large extent, but mainly overloaded.

Marine animals have been dying out for centuries due to human activities. In recent years, however, the pace of this development has accelerated, and the intervention of the international community is more necessary than ever. In recent decades, the rate of extinction has been increasing, as the oceans have to deal with a large number of factors, which are also multiplying each other. Let's mention, for example, the warming of the climate leading to a decrease in the oxygen level in the water or the acidification of the seas, which leads to the dissolution of the calcareous shells of animals, the pollution of the seas with chemical substances and overfishing. The combination of these factors presents a danger to life in the ocean that it cannot cope with (CEF, 2019).

Currently, many marine animals are endangered, and it is not just fish (tuna and cod are among the highly endangered fish). Seals, and especially their young, are hunted for their skins, in addition to the number of slaughtered seals, the cruelty of their hunting is widely criticized. The Caribbean fur seal, a species found in the Gulf of Mexico, was declared extinct in 2008 due to human overfishing (Ideje. 2015). Dolphins and whales are also endangered, whether because of pollution, traditions or because of luxury delicacies. Many other marine animals are also at risk. Octopus and cuttlefish are popular delicacies. Anemones and corals are mainly threatened by the destruction of their habitat, coral reefs. Four of the total seven species of sea turtles are critically endangered, the biggest problem being the collection of turtle eggs and the hunting of the turtles themselves (Svobodová, 2008).

4. Possible solutions to the natural causes of endangerment of animals

There are two directions for solutions - mitigation and adaptation that are explained as follow:

4.1. Mitigation

This term refers to the effort to respond to changes, to try to dampen them with a view to the future, to actively influence the climate, mitigate or prevent changes by reducing anthropogenic greenhouse gas emissions.

4.1.1 Iron fertilization

Supplying the trace element iron helps the formation of chlorophyll in the algae. Iron enters sea ice from deserts and steppes. Sandstorms carry it into the troposphere and air currents carry it over the ocean. Around 3.2 million tons of iron fall to the surface annually. Because it comes mainly from the desert regions of China, from the Sahara or Sahel countries mainly in the northern hemisphere, 90% of it ends up in the North Sea. The equatorial Pacific is "malnourished" in this direction and is becoming a biological desert. Therefore, plans are coming up, for the time being only on a theoretical level, to artificially fertilize this part of

the ocean with iron and thus reduce the greenhouse effect with the help of faster reproducing algae (Červenec. 2004).

4.2. Adaptation

By this term, we mean the effort to gradually adapt to climate changes and their impacts, by coming to terms with changing conditions and preparing effective adaptation measures in view of the expected development, an example can be the construction of dams in areas threatened by floods (Zdeněk Poštulka, 2015). Most experts agree that in the current situation we have no other option but to combine both approaches (mitigation and adaptation). It seems logical that it would be better to try to prevent problems in the first place and therefore concentrate on reducing emissions. But even if we could immediately stop the release of all greenhouse gas emissions, some warming of the atmosphere and its associated consequences would still occur because greenhouse gases persist in the atmosphere for hundreds of years and the climate system responds with a slight delay (Glasgow Climate Pact, 2021).

5. Possible solutions to anthropogenic causes of animal endangerment

In connection with the protection of specific animal species, marine reserves, aquaculture and the prohibition of industrial activity in endangered areas are being considered in particular.

5.1. Marine Reserves

The creation of areas where fishing, industrial use, mining and shipping are completely prohibited was not necessary until recently. However, with the development of industrial use of previously hard-to-reach marine areas, the need for them has increased. And so, at the instigation of the national community, these areas began to be created, which are protected from fishing, mining of mineral resources. At the beginning of 2015, the UN decided to create a legally binding agreement to protect marine life in areas beyond national territorial waters. However, they still make up only about 1% of the total ocean area, while on land, various national parks and reserves make up 18% of the area (Freidinger, 2021). Marine reserves are often a complication for the economy, especially for fisheries; nevertheless, it is an invaluable conservation tool for marine species, the environment and entire ecosystems.

5.2. Aquaculture

Just a few years ago, most of the sea fish on store shelves came from the open ocean, today it only makes up about half. The main fishing grounds are either used to their maximum capacity, or are even already "overfished" and exhausted. Marine fish are thus increasingly grown in aquaculture, in cages. However, this method often runs into problems comparable to the behavior of terrestrial livestock - problems with nutrients in the water in which large numbers of fish live, with diseases and environmental destruction, especially around the

coast. For example, significant amounts of tuna, salmon and shrimp are grown in aquaculture (Hargreaves *et al*., 2019).

5.3. Mitigation of pollution and prohibition of industrial activity

This solution, although very effective, is often not well understood by the affected state. It means significant restrictions for the economy and especially for those countries for which the ocean means a large part of income - in the field of fishing or mining of mineral resources. Of course, ecological transformation of the industry, which can be quite expensive, or fishing at a sustainable level are also options.

6. Activity of the international community

6.1. Activities of the United Nations

The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 under the banner of UNEP and WMO (World Meteorological Organization). Its role consists in evaluating information of a scientific, technical and socio-economic nature on a comprehensive, objective, open and transparent basis. The goal is to better understand the scientific basis of the risks of human-caused climate change, as well as to assess its consequences, mitigation and adaptation options. The IPCC issues an assessment report every five to six years that summarizes scientific knowledge about climate change. UNEP continues to deal with this issue, specifically, for example, the issue of ocean pollution with plastics or ocean acidification (Turley and Boot, 2010; UN environment programme. 2017; IPCC. 2021).

6.2. Bilateral treaties and regional organizations related to the protection of marine ecosystems

Bilateral and multilateral agreements to protect the oceans became necessary after they were established in the mid-1980s by the United Nations Convention on the Law of the Sea Exclusive Economic Zone up to 200 nautical miles from the coast. In 1982, the United Nations adopted the United Nations Convention on the Law of the Sea (UNCLOS) recognizing the right of coastal states to manage fisheries in adjacent waters. Although exclusive economic zones represent only 35% of the total area of the seas, they contain up to 90% of the world's fish populations (Nordquist, 2011).

UNCLOS applies not only to exclusive economic zones, but also to the high watersheds and encourages states to cooperate in the protection and management of living resources in the high seas through the creation of regional fisheries organizations. For states with fishing fleets operating in waters far from the coast, this has resulted in the need to enter into international agreements and/or other arrangements to gain access to resources in other states' exclusive economic zones or in the high seas managed by a regional fisheries organization.

Regional fishing organizations take different forms. Some were created under the auspices of the Food and Agriculture Organization of the United Nations (FAO), others are independent of it. Their functioning is also different. Some control biological resources in a certain zone, others a specific population or group of animal populations. They limit fish catch in two ways – by introducing global quotas or national quotas, by introducing restricted areas or fishing seasons, by banning or regulating the fishing gear used (Rayfuse, 2015).

6.2.1 Common fisheries policy of the European Union

The Common Fisheries Policy is one of several common policies of the European Union. In practice, this means that rules are adopted at the EU level that are binding and valid for all member states. Important parts of the European Commission's Common Fisheries Policy include reducing the overcapacity of European fishing fleets, developing sustainable aquaculture, moving towards sustainable fisheries, the Common Fisheries Policy should support traditional local fishermen whose fishing activities have a relatively low impact on the environment, but at the same time a significant they contribute to the economic and social well-being of local coastal communities, the cessation of counterproductive subsidies and the establishment of such a financing system that in practice supports the above-mentioned goals (Maddy Thimont, 2017).

Conclusion

In conclusion, protecting marine ecosystems is imperative for ensuring the long-term sustainability of our planet. By addressing pollution, overfishing, habitat destruction, and climate change through effective policies and international cooperation, we can safeguard these invaluable ecosystems for future generations.

The collapse of marine ecosystems can have serious consequences for the entire world. It could even result in food shortages or serious climate changes. In this paper, it was tried to investigate that how to face the outlined threats is decided by the delegates of the UN Environmental Assembly.

It is necessary to realize that while the burden of reducing pollution is mainly on the side of developed and industrialized countries, the need to adapt to the changed conditions that a warmer climate will bring lies (not only, but mainly) on the side of developing countries. It is the duty of developed countries to help developing countries not only with sustainable development, but also with adaptation to changes that can no longer be avoided. This principle is also called Common but Differentiated Responsibilities, and it is the basis of the entire negotiations on environmental topics at the UN, including the protection of marine ecosystems.

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