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Building With Nature

Prof. Patrick Meire of the University of Antwerp discusses subtle interdependencies in marine ecosystems and the transformations that they undergo under the influence of climate change.

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What are some of the most serious problems currently facing marine ecosystems?

PATRICK MEIRE: Currently, the biggest threat to marine ecosystems is posed by rising sea levels caused by climate change. Rising temperatures on Earth cause the ice cap to melt, and this means that sea levels increase. If this process continues, and the sea level rises by the projected 1–2 meters, this will have disastrous consequences for coastal areas. This poses a problem for the entire world, because many people live near seas and oceans. If there were no people there, there would be no danger. But coastal areas are densely populated, so rising sea levels pose a threat to such countries in Europe as the Netherlands, Belgium, Germany, and Poland.

The public is aware of the danger posed by rising sea levels. But climate change has another serious consequence for marine ecosystems that attracts much less attention. What I mean is ocean acidification, which occurs when carbon dioxide, which comes from such sources as the burning of high-emission fossil fuels, is absorbed by oceanic water. This has serious consequences for the life of many invertebrates, especially those that produce calcareous skeletons. When the pH of seawater turns acidic, their shells dissolve, which may cause these animals to become extinct. Ocean acidification weakens coral reefs, which are additionally affected by a process referred to as coral bleaching (the expulsion of the algae that live inside corals, which then become a lot more vulnerable to other environmental factors).

In what other ways do these factors impact on the life of marine species?

Rising temperatures of the air and the water in seas and oceans impact very strongly on the species that live there, especially on their local distribution. When the temperature rises, some species move north, because the temperatures are cooler there. But this migration affects the animals that already live in the northern regions. The species that inhabit colder regions of the Earth have nowhere to migrate. But they may have difficulty adapting to higher temperatures and the presence of new species in their habitats.

Ecosystems are very complex systems in which species are linked together through various interdependencies and food chains. The appearance or disappearance of one species affects others.

What significant changes in ecosystems have you observed over the course of your career?

One of the well-documented examples of changes in the life of marine ecosystems is the northward migration of certain zooplankton species. This offers clear proof of changes in the spatial distribution of species. Also, it is evident that there are more fish species that are migrating north. These are clear indicators of the phenomena I've just mentioned, namely ocean acidification and rising temperatures.

Climate change compounds the effects of fisheries, and their impact on the ecosystems is enormous. They impact very strongly on the sea floor by causing the death of other plant and animal species. For example, 150 years ago 10,000 square kilometers of the North Sea floor were covered with oysters. These species are crucial for the ecosystem, because they filter out pollution. This huge underwater meadow was eliminated to meet the needs of fishermen, which is most probably the reason why water transparency decreased visibly. We know that the water in the region was once a lot


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more transparent. Of course, I haven't witnessed all those changes with my own eyes, because I haven't been around for that long.

What changes have been visible over shorter periods?

Over much shorter periods, we've been able to observe low levels of oxygen, referred to as hypoxia, for example in the Baltic Sea. Climate change is not a direct cause of this problem, but it has surely made it worse. As temperatures rise, the solubility of oxygen in water decreases, which lowers the concentration of this element.

Also, we can easily observe the climate change-induced changes in coastal habitats such as lagoons and beaches. We can see their loss in all regions of the world. Coastal structures cause what is referred as coastal squeeze – when sea levels rise, coastal habitats have nowhere to move, because they are blocked by coastal structures.

I recently conducted research into the impact of the melting of glaciers on coastal ecosystems in Greenland. In the past, most glaciers terminated in the sea, or ended at the fjords, forming icebergs there. But climate change has caused more and more of these marine-terminated glaciers to retreat, and so they melt inland, creating rivers. This alters the entire ecology of fjord systems. If we have marine-terminated glaciers, ice goes into water and melts underwater. The freshwater produced in this way is lighter than saltwater, so it flows to the surface, causing a constant exchange of nutrients and retaining high-productivity ecosystems. When glaciers melt on land, this doesn't happen. Consequently, a change in how a glacier terminates alters the whole of the ecosystem.

What could be done to prevent this negative impact that human activity has on nature?

First of all, we should reduce the emissions from the burning of fossil fuels, which causes climate change to accelerate. We should also protect coastal habitats, not only because we can use them to satisfy our needs. They are important carbon sinks. This role is played by seagrasses, among other things. In addition, such habitats mitigate the effects of rising sea levels. Example include dunes – if they are well-preserved, they act as a natural barrier against the flooding of land, and coral reefs and coastal vegetation, such as mangroves, attenuate wave energy. Consequently, taking care of coastal habitats and reconstructing them are in fact both mitigation and adaptation measures.

So we should let nature protect itself?

Exactly. That's the idea behind nature-based solutions. We need a paradigm shift: instead of building hard infrastructure such as seawalls and relying on hard engineering, we should turn to nature. Infrastructure impacts on the functioning of ecosystems, but it doesn't change, because it's not alive, so it doesn't adapt to changing conditions. In turn, such landscape elements as dunes, seagrasses, and coral reefs are systems that evolve. When sea levels rise, nature-based solutions also grow and change, adapting to external stimuli.

Sometimes it's impossible to avoid hydro-engineering interventions, but the trick is to combine these two approaches skillfully. For example, technological solutions can support natural processes. We must answer the question of how we can use the forces of nature to the benefit of humans not by destroying nature but by learning from it and letting it operate according to its own rules. Such an approach is a lot less expensive and a lot better for the environment. In my opinion, getting to know and understand the complex interdependencies found in nature is the only way to go in the future.

Interview by **Dr. Justyna Orłowska**