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European Commission

Science for Environment Policy

Marine ecosystems at risk from multiple, interacting pressures

The combined effects of pollution and rising levels of atmospheric greenhouse gases, including CO_2, may have effects on marine ecosystems that are more damaging than expected, warns new research. The study found that bacteria capable of breaking down oil pollution were far less abundant in sediment in acidified waters. Although increased ultraviolet-B (UV-B) light reduced these negative impacts, the researchers caution that deeper waters or other waters with less UV-B, may still suffer.

Marine ecosystems across the globe are facing a variety of pressures. For example, habitats are degraded by pollution such as agricultural run-off and oil contamination. On top of this, rising CO_2 leads to ocean acidification and temperature increases, while other greenhouse gases can also interact with atmospheric ozone potentially affecting UV-B exposure.

Many studies have examined the individual effects of pollution and elevated CO_2 on marine ecosystems. However, in reality these factors do not occur in isolation of each other. Few studies have looked at them together to determine if and how they interact.

This research — partly supported by the EU-funded COMPETE[1] project — examined how acidification and UV-B exposure and oil contamination could interact to affect marine sediment and the organisms that live there.

To do this, the researchers took sediment cores from the Ria de Aveiro estuary in Portugal and transferred them to microcosms in the laboratory. The microcosms consisted of sediment and water in glass containers that simulated the natural marine environment, including light cycles, tides, water temperature and acidity.

The microcosms were set up to examine the effects of oil contamination, acidification and UV-B exposure individually, as well as their combined effects. CO_2 was bubbled through water before being added to microcosms. Different pH levels were maintained in the microcosms depending on the treatment: 7.94 to simulate present conditions in the Ria de Aveiro estuary (the control) and 7.62, to simulate the pH reduction expected to occur by 2100 (IPCC IS92a scenario 1).

The researchers focused on how oil contamination, acidification and UV-B affect the structure and function of bacterial communities and two invertebrate species, used as indicators of the environmental quality of estuarine ecosystems.

The combination of acidification and oil contamination, excluding UV-B, had a significant effect on bacterial communities. For example, microcosms undergoing this treatment had reduced abundance of *Desulfobacterales*, a group of bacteria capable of using oil as an energy source, which help to remediate contaminated environments.

The loss of such organisms suggests that sediments in acidified aquatic environments may suffer longer from the effects of oil contamination. The invertebrate species in acidified microcosms also showed signs of 'oxidative stress' - an indicator of toxicity.

UV-B exposure, despite its known harmful effects, was found to offset the negative interactive effects of acidification and oil contamination. Microcosms treated with UV-B in conjunction with oil contamination and acidification had abundant *Desulfobacterales,* at levels similar to control microcosms. This may be due to UV-B itself breaking down oil components. However, the authors of the study caution that since water can be an effective blocker of UV-B wavelengths, deeper and polluted waters subjected to acidification may not benefit from the offsetting effects of UV-B radiation.

This research shows that the combined effects of pollution and rising atmospheric CO_2 can spark difficult-to-predict interactions in marine environments, which could potentially exacerbate the effects of such environmental pressures.