Night lights: New global atlas maps out artificial light at night under the sea

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Dr Thomas Davies. Credit: University of Plymouth

As coastal areas become increasingly developed, concerns are growing about levels of artificial light at night (ALAN) and its potential impacts on the marine environment.

Light pollution is well studied in terms of its effects on the night sky and astronomy, and on terrestrial ecosystems, but until now researchers

didn't know the full extent of ALAN in the oceans.

A new study, funded by the Natural Environment Research Council, maps out areas of the ocean most affected by light pollution, finding that up to 1.9 million sq km of the world's coastal waters are being exposed to biologically significant levels of ALAN.

The study brought together researchers from the University of Plymouth, Plymouth Marine Laboratory, University of Strathclyde, The Arctic University of Norway, Bar-Ilan University, The Interuniversity Institute for Marine Sciences of Eilat and Beit Berl Academic College.

By combining various techniques including computer modeling, satellite technology and in situ observations in the River Tamar with a pre-existing world atlas of artificial night sky brightness, the researchers were able to build up a picture of the coastal ocean areas being exposed to ALAN.

In order to gauge artificial light in marine systems, the study used the light sensitivity of copepods (a type of microscopic crustacean) as a metric to determine the depth of light penetration.

Setting light levels by how detectable they are to marine organisms is key, considering the possible impacts of ALAN pollution on the creatures that live in the sea.

Many marine species are accustomed to the predictable light changes that occur naturally throughout the day, across seasons and with the lunar cycle. However, light from coastal developments can scatter a long way out to sea and is spectrally quite different to moon and sunlight. It also differs in the wavelengths penetrating the water column.

The new global atlas of ALAN under the sea shows that at a depth of

one meter, 1.9 million sq km of coastal ocean are exposed to biologically important ALAN (around 3.1 percent of the global Exclusive Economic Zones). At 10m deep, 1.6 million sq km is exposed (2.7 percent) and by 20m down, 840,000 sq km (1.4 percent).

Dr. Thomas Davies, lecturer in marine conservation at the University of Plymouth and the study's senior author, said: "The extent of artificial light pollution on land has been known for many years now. Some people might consider that this light does not enter the Oceans, but it does, and in sufficient quantities to cause biological impacts. This atlas is the first to quantify the extent of ALAN in the Oceans. The severity of the problem in certain regions including the Mediterranean, Persian Gulf and South China Sea is really quite alarming."

Dr. Tim Smyth, PML head of science for Marine Biogeochemistry and Observations and lead author on the research, added: "Creating this atlas shows us how widespread the issue of artificial light at night is in our coastal seas and could hopefully lead to highlighting ALAN as a descriptor of disturbance in the same way we currently look at underwater noise as a concern. There's still a lot of investigation needed to understand the specific effects on marine organisms, the exact spectral nature of this light pollution and how it is changed by seasons or tides, for example. But recognizing its global presence in this way is a major step forwards in understanding ALAN and its consequences for the ocean."

The study, "A global atlas of artificial light at night under the sea," is published in *Elementa*.

More information: T. J. Smyth et al, A global atlas of artificial light at night under the sea, *Elementa: Science of the Anthropocene* (2021). DOI: 10.1525/elementa.2021.00049

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