Haereticus Environmental Laboratory

PRESS RELEASE

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NEW SCIENTIFIC STUDY FINDS CORAL REEFS UNDER ATTACK FROM CHEMICAL IN SUNSCREEN LOTIONS

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A team of marine scientists from Virginia, Florida, Israel, the National Aquarium (U.S.), and the U.S. National Oceanic & Atmospheric Administration published a study today demonstrating that a common chemical in sunscreen lotions and other cosmetic products poses an ecological and existential threat to corals and coral reefs. The chemical, oxybenzone (benzophenone-3), is found in over 3,500 sunscreen products worldwide, and will pollute coral reefs from swimmers wearing sunscreens or through wastewater discharges from municipal sewage outfalls and coastal septic systems. Oxybenzone pollution predominantly occurs in swimming areas but could occur on reefs 5-20 miles from the coastline as a result of submarine freshwater seeps which can be contaminated with sewage.

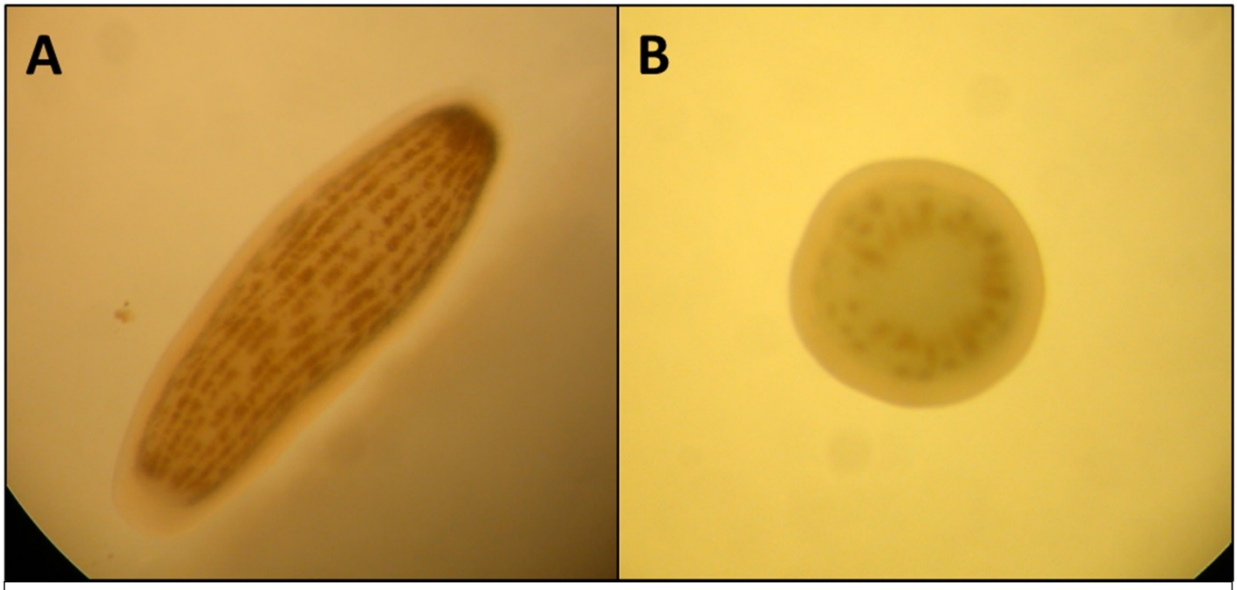
This study, published in the journal *Archives of Environmental Contamination and Toxicology* showed that the chemical, oxybenzone (benzophenone-3) is highly toxic to juvenile corals. There were four major forms of toxicity associated with exposure of baby corals.

- Oxybenzone induced coral bleaching - a phenomenon associated with global mass mortalities of coral reefs. Coral bleaching is a disease associated with high sea-surface temperature events, such as El Nino. Oxybenzone may increase the susceptibility of coral to bleach at lower temperatures. Hence, coral reefs near swimming areas may have a reduced resiliency to climate change.

- Oxybenzone damages the DNA of corals. Corals with damaged DNA may not be able to reproduce. If they do try to reproduce, their egg/sperm may not be healthy, giving rise to potentially deformed or sick offspring. Ecologically, this means that coral populations will continue to decline because they cannot create a healthy and strong next-generation.

- Oxybenzone is an endocrine disruptor. It causes the juvenile coral (planula) to inappropriately encase themselves with their own skeleton, ultimately leading to death. This is similar to some estrogenic-like endocrine disruptors in mammals that elicit bone growth.

- Oxybenzone causes the juvenile coral to become grossly deformed – it made the juvenile coral stop swimming, change shape, and increase its mouth five times its normal size (see inset).



Panel A is a normal, healthy juvenile coral (also called a planula). It is about 5 mm in length. Panel B is a coral exposed to oxybenzone for 8 hours. ***Used with permission from Archives of Environmental Contamination and Toxicology.***

The concentrations of oxybenzone that caused toxicity to the juvenile coral were environmentally relevant. The study discovered that the arguably lowest concentration to see a toxicity effect was as low as 62 parts per trillion – equivalent to a drop of water in six and a half Olympic-sized swimming pools. The highest concentration of oxybenzone was seen in Trunk Bay in the Virgin Islands National Park at 1.4 parts per million. The average concentration for other Virgin Islands National Park coral reef locations was about 250 parts per billion. The study also examined concentrations of oxybenzone on coral reef areas in Hawaii, on the islands of Maui and Oahu. In Hawaii, concentrations ranged between 800 parts per trillion and 19 parts per billion. Current concentrations of oxybenzone in these critically managed coral reef areas pose a significant ecological threat.

What does this mean for coral reef conservation and restoration? The lead author of the study, Dr. Craig Downs of Haereticus Environmental Laboratory said, “The use of oxybezone-containing products needs to be seriously deliberated in islands and areas where coral reef conservation is a critical issue. We have lost at least 80% of the coral reefs in the Caribbean. Oxybenzone can come from swimmers, recreational dive operations and resorts. Any effort to reduce oxybenzone pollution could mean a local coral reef survives a long, hot summer, or recovery for a degraded reef. Everyone wants to build coral nurseries for reef restoration, but this is an inconsequential effort if the factors that originally killed off the reef remain or intensify in the environment.”

Although the use of sunscreen is recognized as important for protection from the harmful effects of sunlight, alternatives to oxybenzone exist – including other chemical sunscreens, as well as wearing sun clothing on the beach and in the water. For example, the U.S. National Park Service has launched a pollution-mitigation campaign called "Protect Yourself, Protect the Reef." Its goal is to limit the amount of sunscreen chemicals that pollutes coral reefs.

The study also inspired an urgency of action for international and grassroots conservation non-profit groups, as well as commerce associations. Executive Director Pat Lindquist of the Napili Bay and Beach Foundation of Maui, Hawaii says, "This study raises our awareness of a seldom realized threat to the health of our reef life at Napili Bay: chemicals in the sunscreen products visitors and residents wear are toxic to young corals. As our mission is to protect and improve the health of our popular bay and beach, we appreciate scientific input regarding threats to that health. This knowledge is critical to us as we consider actions to mitigate threats or improve on current practices. We hope to promote more use of sun-protective swimwear which will benefit our reefs and bay, and have plans to investigate best options in the coming year."

According to MarineSafe[2], there may be as many as 82,000 chemicals from personal-care products polluting our marine environments, including coral reefs. This study is one of less than two-dozen scientific studies that closely examine the impacts of personal-care product chemicals on marine organisms and habitats. Professor Alex Rogers of the International Programme on the State of the Ocean (IPSO) at Oxford University said, "Far too little attention is paid to the chemicals entering the ocean and their destructive impact. We need better understanding, testing and management to ensure that we are not eroding vital ocean resilience through the careless use of marine-toxic chemicals." IPSO's 2012 State of the Ocean report called for action to "prevent, reduce and strictly control inputs of substances that are harmful or toxic to marine organisms into the marine environment" recognizing its critical role in eroding the resilience of the ocean to the impacts of climate change.

ENDS

Notes to Editors

The e-version of the study will be published on October 20, 2015 and will be available from the Journal at Archives of Environmental Contamination and Toxicology

[1] Downs CA, Kramarsky-Winter E, Segal R, Fauth JE, Segal R, Knutson S, Bronstein O, Ciner FR, Jeger R, Lichtenfeld Y, Woodley CM, Pennington P, Cadenas K, Kushmaro A, Loya Y. (2015) Toxicopathological effects of the sunscreen UV filter, oxybenzone (benzophenone-3), on coral planulae and cultured primary cells and its environmental contamination in Hawaii and the U.S. Virgin Islands. Archives of Environmental Contamination and Toxicology. DOI 10.1007/s00244-015-0227-7

[2]MarineSafe is a project set up by IPSO to increase understanding about and reduce the use of marine-toxic chemicals in domestic products such as personal care products.

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ABSTRACT

Benzophenone-3 (BP-3; oxybenzone) is an ingredient in sunscreen lotions and personal-care products that protects against the damaging effects of ultraviolet light. Oxybenzone is an emerging contaminant of concern in marine environments; produced by swimmers and municipal, residential, and boat/ship wastewater discharges. We examined the effects of oxybenzone on the larval form (planula) of the coral *Stylophora pistillata*, as well as its toxicity in vitro to coral cells from this and six other coral species. Oxybenzone is a photo-toxicant; adverse effects are exacerbated in the light. Whether in darkness or light, oxybenzone transformed planulae from a motile state to a deformed, sessile condition. Planulae exhibited an increasing rate of coral bleaching in response to increasing concentrations of oxybenzone. Oxybenzone is a genotoxicant to corals, exhibiting a positive relationship between DNA-AP lesions and increasing oxybenzone concentrations. Oxybenzone is a skeletal endocrine disruptor; it induced ossification of the planula, encasing the entire planula in its own skeleton. The LC50 of planulae exposed to oxybenzone in the light for an 8 and 24 hour exposure was 3.1 mg/L and 139 µg/L, respectively. The LC50s for oxybenzone in darkness for the same time points were 16.8 mg/L and 779 µg/L. Deformity EC20 levels (24 hours) of planulae exposed to oxybenzone were 6.5 µg/L in the light and 10 µg/L in darkness. Coral cell LC50s (4 hours, in the light) for 7 different coral species ranges from 8 µg/L to 340 µg/L, while LC20s (4 hours, in the light) for the same species ranges from 0.062 µg/L to 8 µg/L. Environmental contamination of oxybenzone in the U.S. Virgin Islands ranged from 75 µg/L to 1.4 mg/L, while Hawaiian sites were contaminated between 0.8 µg/L and 19.2 µg/L. Oxybenzone poses a hazard to coral reef conservation, and threatens the resiliency of coral reefs to climate change.