

# UV- filters in sun care products as an emerging risk for Caribbean coral reefs

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**Beach goers and bathers in the Caribbean often apply sunscreen to protect themselves against skin cancer and skin aging. Of course this is of great importance. However, this could be affecting reefs and marine life due to the emission of UV-filters, which are part of sun care products.**

Researchers from the Wageningen Marine Research, under the leadership of water quality specialist and ecologist Dr. Diana Slijkerman, have been working on the question whether sun care products are an emerging risk for marine life in the Caribbean. More specifically, UV-filters in sunscreen, such as Oxybenzone, were subject of study since these were recently reported to be of serious concern for corals.

Marine nature areas on Bonaire support various touristic and recreational activities, including diving, kayaking, surfing, swimming and snorkeling, whereby the majority of these activities depend on the quality of the ecosystems. Amongst others, Lac Bay consists of unique and environmental important habitats, including mangroves and seagrass beds which function as nursery hot spots, inhabiting a variety of life. The last years, the number of tourists at Sorobon in Lac Bay has been increasing especially due to growth of cruise

ship visits. The growing numbers of tourists may lead locally to significant sunscreen emissions. Alarmed by the study of Downs et al., in 2015, in which was demonstrated that field concentrations of UV filters might affect corals, STINAPA and Directie Ruimtelijke Ontwikkeling Bonaire (DROB) asked IMARES, now Wageningen Marine Research, what the risk of UV-filters for Bonairean ecosystems could be.

Restricted in funding, a limited study was set up with volunteers (Sabine Engel and co-workers) and the effort of student Iris Schaap, aimed to construct an environmental risk analysis. The study consisted of literature research, calculations on the predicted environmental concentrations at Lac Bay and measured samples at different locations at Lac Bay. More specifically, the study aimed at organic UV filters. By reviewing the physico-chemico- specifications of UV-filters, for example the lipophilicity of the chemical, an insight is provided in which ecosystem compartment the compounds most likely end up. The application of type of products per country was assessed to estimate which emissions are likely to occur in Bonaire. Studies describing the various types of effects of UV filters on different organisms were evaluated and used to prepare an environmental risk assessment.

Two field-sampling moments at Sorobon, near the mangroves, and Cai (figure 1) were selected to measure the concentrations in the water. Sorobon is assumed to be the busiest beach at Bonaire occasionally, and served in this study as a worst-case scenario situation since it is more or less a secluded area by i.a. reef. The sampling moments correspond with cruise ship visits in August (1 ship, 23rd of August) and in November (3 ships in few days, sampled at November 18th) 2016. With these two visits we anticipated on sampling during coral spawning (and thus a possible ecological worst case situation) and differences in UV filter levels between these moments. The latter is assumed because UV filters are considered to be stable and not easily break down. A built up in concentration was thus expected in November.

The findings of the literature study revealed that UV filters are distributed widely, and can sorb to organic matter and accumulate into organisms tissues- depending on the type of filter and organism. UV filters can consequently have a diversity of effects on the marine ecosystem in various ways. The marine environment can be affected directly and indirectly by UV filter toxicity. Besides reported developmental toxicity on coral planulae, various other effects are described to

result from exposure to UV filters such as narcosis, genotoxicity, endocrine disruption, reproductive and developmental toxicity to marine life. The range of effect concentrations varies per studied organism and ecosystem (e.g. fresh water or marine) by which the marine species tend to be more sensitive towards UV-filter exposure than fresh water species. Furthermore, sunscreen (products) releases additionally nitrogen and phosphorus components, which could potentially contribute to the risk of (local) eutrophication, and indirectly by algae blooms and food abundance.

Based on previous questionnaire studies found in literature, the majority of the visitors at Lac Bay are assumed to originate from the USA, UK and the Netherlands. Therefore, the study focussed on a specific selection of organic UV filters, which are predominantly applied in sunscreen products originated from these countries. The UV-filters of interest in Lac Bay are: octocrylene (OC),

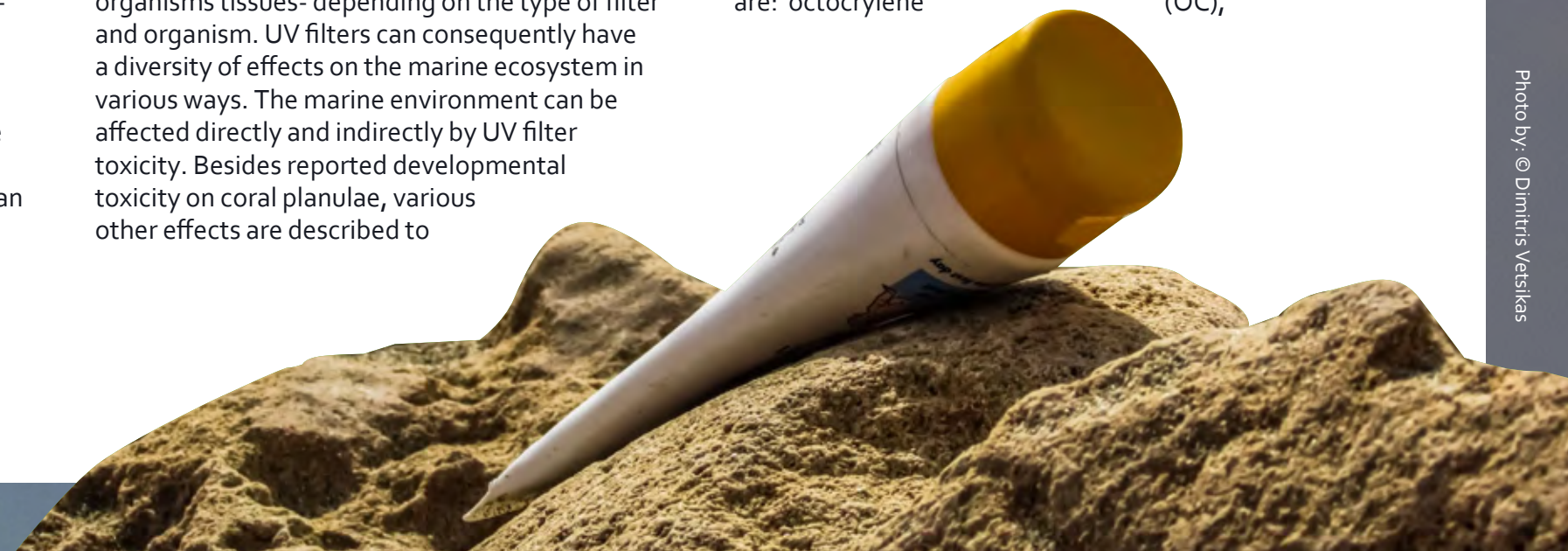


Photo by: © Dimitris Vetsikas

Figure 1: Field-sampling locations at Sorobon, near the mangroves, and Cai to measure the concentrations of UV- filters in sun care products in the water. The sampling moments correspond with cruise ship visits and coral spawning.



Photo by: © Sabine Engel

4-Methylbenzylidene camphor (4-MBC), Benzophenone-3, also known as oxybenzone (BP<sub>3</sub>), and Benzophenone-4 (BP<sub>4</sub>).

The basic field study showed that two out of the four selected UV filters were detected in both the surface micro layer (SML) and 30 cm below water level. In August, measured concentrations at Cai were too low for a quantitative detection. However, this does not imply that there is not a reason for concern, since several toxic effect concentrations for Caribbean corals are below the limit of detection. BP<sub>3</sub> concentrations in the SML near the mangrove rim were detected at levels indicating some risk. However, at Sorobon Beach, BP<sub>3</sub> was found in much higher concentrations within the surface layer (0.72 µg/L) and the water layer (1.23 µg/L). Additionally, significant concentrations of OC were detected with a highest concentration in the surface layer (1.23 µg/L) and a lower concentration in the water layer (0.51 µg/L). These concentrations seem low, but are of significant large amplitude considering sunscreen biomonitoring studies worldwide. Furthermore, the toxic effect concentrations are in the same order of magnitude. The risk estimation is performed on a limited set of reported effect data, and thus an uncertainty factor (or assessment factor) was applied to correct for this. The combination of low environmental concentrations in relation to equivalent effect concentrations resulted in a high estimated risk for this location. Estimated environmental risk factors are very high for both OC and BP<sub>3</sub> and confirm the concerns for environmental effects at the local level at Sorobon.

The expected built up of concentrations in November was not seen. Surprisingly, lower concentrations were found than in August, however the heavy showers around the time of sampling could explain this. Rainfall largely reduced the number of expected visitors to Sorobon, and it is known that rain also affects the concentrations of UV filters by dilution and water distribution. Since tourism is a major industry at Bonaire, healthy ecosystems are of great importance for the Bonairean society in terms of

financial as well as human wellbeing. A precautionary approach is advised because of the fringing coral reef of Lac Bay and the nursery function of its mangroves and seagrassbeds. Emissions can be reduced easily: e.g. wearing long sleeved shirts instead of using sunscreen while bathing will reduce the amount of UV filters largely up to an estimated of roughly 50% per person (shower or wipe off applied lotion first). Distribution and local supply of environmental friendly brands lacking these types of filters would be beneficial too.

Currently, the results are further processed and submitted to a peer-reviewed journal in order to share the results to a larger audience.

Additional monitoring would strengthen the proposed precautionary approach to take measures for example in the field of coral restoration programs. As world tourism is expected to grow, the prognosis of the emission and exposure of UV filters in the Caribbean is unfortunately predicted to increase too. An annual tourism growth of roughly 2% leads to approximately an estimated additional load of 747-5,979 mg EHMC, 498-3,986 mg OC, 467-3,737 mg 4-MBC, and 249-1,993 mg BP<sub>3</sub> and BP<sub>4</sub> around noon per day in Lac Bay (based on extrapolations on numbers of bathers at Sorobon beach, sun screen products applied and fractions washed off).

We aim to study the actual presence of these compounds in more detail along a larger spatial-temporal scale, and to define environmental effects of sun care products in order to contribute to the protection of the marine life of the Caribbean and more specifically Bonaire.

***We invite interested partners to contribute to this effort with additional ideas or funds. Please contact: Diana Slijkerman at [Diana.Slijkerman@wur.nl](mailto:Diana.Slijkerman@wur.nl)***

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