ENVIRONMENTAL SCIENCE JOURNAL FOR TEENS

NOVEMBER 2022

How does sunscreen make corals sick?

Authors:
Djordje Vuckovic, William Mitch, John Pringle, and others
Associate Editors:
Daniel Watkins, Tracey Ruff

Abstract

Picture yourself diving into a tropical ocean. The sun is bright, and the water is clear and warm. What do you see? Colorful fish, playful dolphins, waving seaweed? Maybe you even see something that looks like a beautiful underwater garden – a coral reef!

Coral reefs are important habitats for a huge diversity of animals. But sadly, warming oceans and pollution threaten most coral reefs. An example of this threat is actually sunscreen! **Oxybenzone** is a chemical found in many sunscreens that can harm corals and other animals. But scientists didn't know exactly how oxybenzone harmed corals.

We set up an experiment to find out how **corals** and **sea anemones** (which are closely related to corals) reacted to oxybenzone in the water.

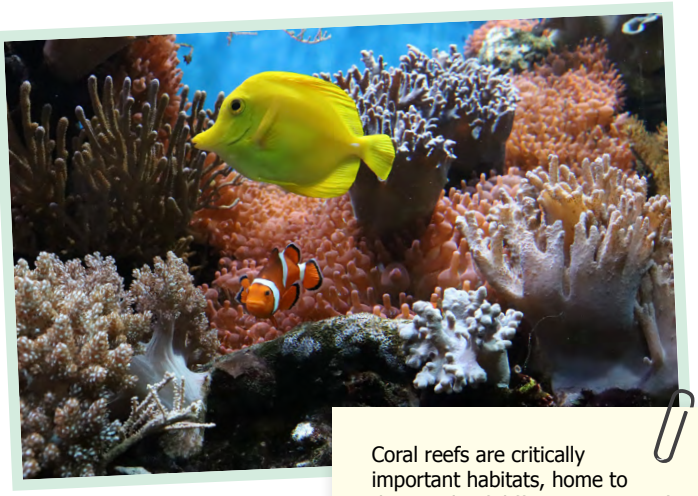
Introduction

Coral reefs are home to many different species of animals and **microorganisms**. Nearly 1 in 4 ocean species lives in a coral reef! Coral reefs are built up by the **exoskeletons** of thousands of tiny animals called coral **polyps** (sea anemones are also polyps). Often, polyps live together with **symbiotic algae**. The algae help the polyps get nutrients and energy.

Unfortunately, climate change and pollution are dangerous to coral reefs. But there are other threats to them too, like sunscreen! Many coral reefs are in places where we like to go swimming. And when we go swimming, it is important to wear sunscreen. But some sunscreens contain a chemical called oxybenzone.

Oxybenzone may not be very toxic (harmful) to humans. But scientists noticed that some animals were getting sick in water with high levels of oxybenzone. Because of this, Hawaii banned sunscreens with oxybenzone in 2018. There are lots of other chemicals that sunscreen makers can use. But what if the replacements for oxybenzone are as bad or even worse for corals?

To keep this from happening, we need to know what it is about oxybenzone that makes it harmful to ocean life. Scientists already knew that oxybenzone can interfere with (mess with) **hormones** in some animals. So why is oxybenzone especially harmful to corals?



Coral reefs are critically important habitats, home to thousands of different species of animals and microorganisms.

Methods

We used *Aiptasia* sea anemones for most of our experiments for two reasons: they are closely related to corals and are much easier to experiment with in the lab. Like coral polyps, *Aiptasia* polyps usually carry symbiotic algae. We also looked at a mushroom coral called *Discosoma*.

1. We set up saltwater tanks with artificial sunlight. This included **ultraviolet light (UV)**. The lamp was on a timer to follow the 24-hour cycle of night and day.
2. We added oxybenzone to most of the tanks - these were the experimental tanks. We did not treat some tanks with oxybenzone – these were our **controls**.
3. Over some of the experimental tanks, we put an extra piece of plastic that blocked the UV light (Fig. 1).
4. We did separate experiments with the *Aiptasia* with their symbiotic algae and then without their symbiotic algae. We also did experiments with the *Discosoma* corals.
5. We measured the concentrations of oxybenzone **metabolites** in the algae and in the anemone polyps. (**Metabolism** is the process where a living thing breaks down some molecules and forms new ones. Metabolites are the molecules made during metabolism.)

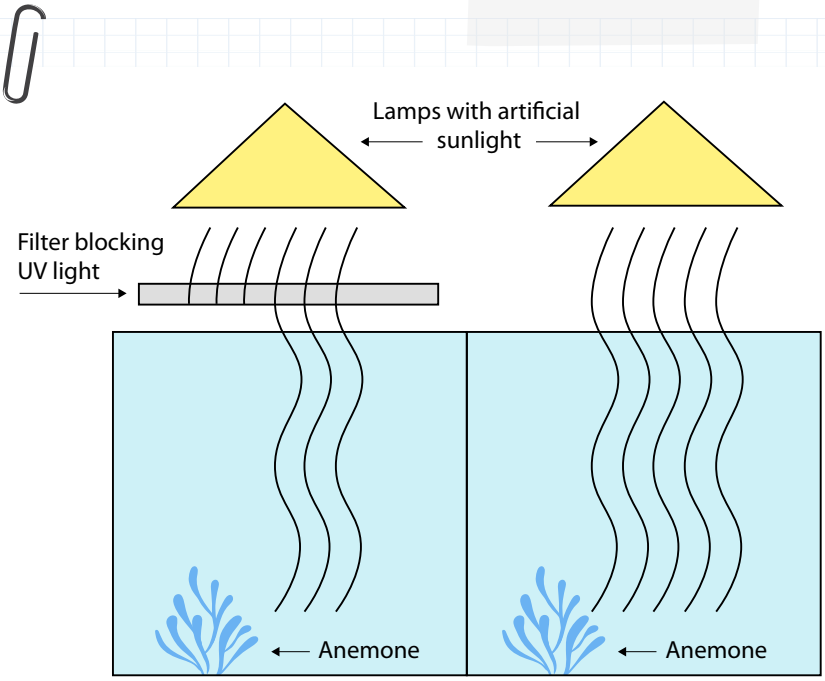


Figure 1:
Our experimental setup showing one tank with a UV filter and one tank without it.

Results

Here's what we discovered from our experiments:

1. When we didn't block the UV light, none of the anemones survived with oxybenzone in the water (Fig. 2).
2. When we blocked the UV light, almost all the anemones survived with oxybenzone in the water.
3. Anemone and coral polyps that still had their symbiotic algae survived longer than the anemones that were missing their algae.
4. We found more oxybenzone metabolites in the algae than in the polyps. The polyps that were missing their algae had higher amounts of oxybenzone metabolites in their bodies.

Please see Figure 2 on page 3

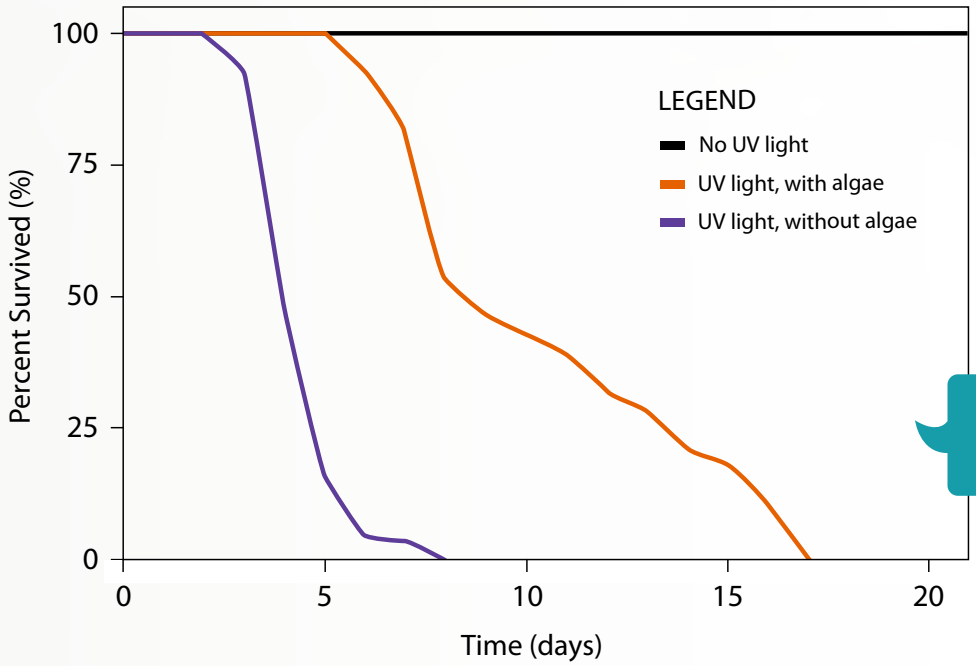


Figure 2:
The percentages of anemones that survived in water with oxybenzone from the start of the experiment.

How do the symbiotic algae affect the survival of the anemones?

Discussion

We were surprised that UV light was so important. After all, oxybenzone is designed to protect us against the harmful effects of this light. So what could be happening? Why were the anemones so sensitive to the combination of UV light and oxybenzone?

Our experiments show a possible answer. We found that the anemones and corals absorbed the oxybenzone from the seawater and transformed it into new chemicals (metabolites). This is not unusual. But in this case, the new molecules formed by the anemones and corals were **phototoxic**. This means these molecules are harmless on their own, but they form dangerous new chemical species under UV light.

We also found that in healthy anemones and corals, the algae store the phototoxic metabolites. This helps protect the polyps. But we know that stressed-out corals get rid of their symbiotic algae. This is called **bleaching**. Coral bleaching is happening more often than it used to because of higher sea temperatures due to climate change. Without their symbiotic algae to protect them, bleached corals are especially vulnerable to the phototoxic metabolites.

Conclusion

It's important to protect your skin when you go to the beach. Sunscreens help protect our skin from harmful UV light. But clearly, some kinds of sunscreen can be harmful to undersea life. Sunscreen makers must keep looking for different recipes so that their products are safe for both people and ocean life. You can help keep the environment healthy by learning the rules for places you visit. And you can always look for ways to leave a place better off than you found it!

Acknowledgment:
This article was funded by a grant from the United States Department of State. The opinions, findings, and conclusions stated herein are those of the authors and do not necessarily reflect those of the United States Department of State.

Glossary of Key Terms

Algae – microscopic photosynthesizing organisms. Some live within corals and anemones.

Bleaching – when corals are stressed (for example, due to climate change warming up the ocean), they get rid of their symbiotic algae. This leaves the corals looking white because the corals' color comes from the algae.

Control – the part of the experiment that isn't changed. We need this to make sure our experimental treatment actually made a difference.

Corals – ocean animals that usually live in colonies (communities). Many corals are reef builders. Most coral polyps get a large portion of their energy from symbiotic algae.

Exoskeletons – hard structures on the outside of an organism, like those around coral polyps or the shell of a crab.

Hormones – chemicals produced by organisms to stimulate some cells into action.

Metabolism – chemical reactions that happen inside organisms, such as food breaking down to give energy and various nutrients.

Metabolites – chemicals that form during metabolism.

Microorganisms – organisms so small that we can only see them through a microscope (for example, bacteria, many algae, and fungi).

Oxybenzone – a chemical that blocks UV light. It is often used in sunscreen.

Phototoxic – a substance that becomes toxic when it absorbs light.

Polyps – aquatic animals with soft, cylindrical bodies and stinging tentacles surrounding their mouths. Corals and sea anemones are examples of polyps.

Sea anemones – predatory ocean animals. Most sea anemones live on the sea floor.

Symbiotic – living in a close relationship with another species.

Ultraviolet (UV) light – the part of sunlight that causes sunburns.

Check your understanding

1. Why are bleached corals more vulnerable to damage from oxybenzone?
2. Why is it important to know how oxybenzone damages corals?
3. Rising water temperatures due to climate change make it harder for coral reefs to survive. How is climate change affecting your community? How can your community make itself more resilient (able to survive) to these changes?
4. Think of an aquatic environment near your home, such as a pond, creek, lake, or ocean. How do people affect the life of aquatic plants and animals? Think of at least one positive influence and one negative influence. How could you reduce the negative influence?

REFERENCES

Djordje Vuckovic, Amanda I. Tinoco, Lorraine Ling, Christian Renicke, John R. Pringle, and William A. Mitch (2022) *Conversion of oxybenzone sunscreen to phototoxic glucoside conjugates by sea anemones and corals.* Science. **https://www.science.org/doi/10.1126/science.abn2600**

Environmental Protection Agency: Basic information about coral reefs. **https://www.epa.gov/coral-reefs/basic-information-about-coral-reefs**

The Nature Conservancy: 8 ways you can help save coral reefs. **https://www.nature.org/en-us/what-we-do/our-priorities/protect-water-and-land/land-and-water-stories/8-easy-ways-you-can-help-coral-reefs/**