

# Researchers study how environment affects dolphin microbiomes at Shedd Aquarium

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Researchers collect biological samples from the participating dolphins to better understand their microbiomes. Credit: UChicago Medicine

Research conducted at Shedd Aquarium with the University of Chicago revealed new details about the microbiome of Pacific white-sided dolphins at the aquarium and how it is influenced by the surrounding environment.

The large-scale study, recently published by the American Society for Microbiology Journals, looked at thousands of [biological samples](#) from the dolphins, the habitat and the animal care staff to determine the ways in which factors like air, water, food and probiotics affect the cetaceans' [microbial communities](#).

Among the findings, researchers found that the diet of the dolphins and the air they breathe play a larger role in impacting their microbial health than factors like water or skin-to-skin contact. The research, alongside efforts in the [aquarium](#)'s Microbiome Project, expands our understanding of microbial community structures and host associations, which may have major implications in future animal health and management practices.

"This study came about from an interest in learning more about the [microbiome](#) of aquatic environments and animals," said Cesar Cardona, primary investigator of the study and a UChicago graduate student. "My hope is that this study opens the door to further research that evaluates the microbiome of these animals and environments, with the goal of informing optimal living conditions that ensure the animals remain healthy and thriving."

Over a period of six weeks, scientists collected biological samples from three sites on the four participating dolphins—the skin, the rectum and the respiratory tract (exhalation from the blowhole referred to as chuff). Specific areas of the environments in which the animals came in contact were also sampled, such as the water, air, food and animal care staff. 2,370 samples were processed in total. For the last half of the study, animal care staff introduced probiotics into the diet of the dolphins to measure the potential influence to the dolphins' microbial communities.



Researchers took samples of the water that the dolphins came in contact with to study environmental factors. Credit: University of Chicago

## Study findings

- Direct oral stimulation with a foreign microbial source (probiotics) had the most profound impact on the dolphins' microbiome, with data suggesting that the probiotic stabilized the community dynamics.
- Beyond the probiotics, the air the animals breathe and their diets had the biggest influence on the dynamics of dolphins' microbiome, while contact with animal care staff and changes in water composition, play a more minor role.
- The study resulted in a "census" of 19,000+ documented microbes in the aquarium's Abbott Oceanarium—1.9 percent of which have not been previously identified by science.

- The blowhole of the dolphins provides a unique environment for microbes, including those discovered during this study that were not previously identified by science. In some samples from the aquarium, close to 20 percent of the total microbes found are unknowns.
- The blowhole was also the only dolphin site that presented a unique microbial signature that remains common across dolphins in different habitats or wild environments, which was concluded by comparing samples from other facilities and wild dolphins to those at the aquarium.

Shedd Aquarium provided an extremely valuable and unique environment for exploring complex host-microbe relationships due to the legacy of high quality environmental data collected using scientifically sound methods. The aquarium operates as a closed [environment](#), where the animals are closely monitored and air, food and water quality are strictly maintained. Shedd had also already been working in the microbiome space and collecting samples from the oceanarium as part of the Microbiome Project, which launched at Shedd in 2015.

"Scientific collaborations with facilities like Shedd Aquarium add tremendous value and are critical to advancing scientific understanding," said Prof. Jack Gilbert, faculty director at the UChicago Microbiome Center. "Gleaning this sort of information in human studies is incredibly difficult due to the challenges of controlling the environments and exposures in people."

"We began the Microbiome Project with the health of the animals at Shedd top of mind," said Bill Van Bonn, vice president of animal health at Shedd Aquarium. "Conducting research like this allows us to gain valuable information and as our understanding grows, we may be able to influence our environments at a microbial level to further benefit the

health of the [animals](#) we care for every day."

**More information:** Cesar Cardona et al. Environmental Sources of Bacteria Differentially Influence Host-Associated Microbial Dynamics, *mSystems* (2018). [DOI: 10.1128/mSystems.00052-18](https://doi.org/10.1128/mSystems.00052-18)

Provided by University of Chicago

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