# COMMOTION IN THE OCEAN

WOW! DOUBLING FOUR TIMES!

THAT'S ... UM ...

2 × 2 × 2 × 2 OR... AH... WHAT

IS THAT?

EXPONENTIAL

GROWTH.

# FOR MARINE ANIMALS, HUMANS ARE DANGEROUSLY NOISY NEIGHBORS.

BY SARAH WEBB ART BY KETCH WEHR

Underneath the waves, the ocean is awash with sound. Humpback whales sing to seek out mates. Snapping shrimp make clicks and pops to stun prey and ward off predators. Dolphins whistle to each other. Midshipman fish make booming noises.

All ocean animals that have a backbone can hear, Darlene Ketten says. She studies hearing in humans and many other animals at Woods Hole Oceanographic Institution in Massachusetts.

You depend on your ears to communicate with others. You also rely on sound to know what's around you, as when you walk down a dark hallway or when you realize that someone is sneaking up behind you. Ocean

creatures have to rely on their ears even more, since light doesn't penetrate very far into water, and the deep ocean is very dark. For this reason, Ketten says, "Virtually all marine animals have hearing as their primary sense." Whales and dolphins rely on sound to find food, to communicate, and to find a mate.

We humans spend most of our time on land. But the sounds we create, particularly with our ships, add to the underwater din. The amount of noise in the oceans has doubled every 10 years for the last 40 years. Researchers are trying to understand how our din affects animals—and how to keep them safe.

## DROWNING OUT THE OCEAN

Imagine that you're standing in a noisy gym. Other kids are playing and cheering. It's so loud that even if your friend tried to warn you about a basketball headed toward the back of your head, you wouldn't hear him.

Animals face the same challenges when humans add noise to their environments. The biggest problem is not that sound will harm fish and whales physically, but that they won't be able to hear important messages, says Arthur Popper. He studies fish and their hearing at the University of Maryland. The extra noise can change how these animals relate to their environment, he says. "It affects their ability to get the world around them, something called the acoustic scene."

Humans add a variety of sounds to the oceans. As large ships carry cargo to ports around the world, their motors rumble just like trucks on a highway. Human military and fishing vessels use sonar, a tool that bounces sound waves off of objects in the ocean, to find out what's nearby. Seismic airguns are tools that use compressed air to create loud noises, sending waves like earthquakes through the ocean floor. Scientists use the sounds these airguns produce to study the earth below the ocean, and oil and gas companies use them to look for new sources.

As humans build bridges or place wind turbines to harness energy, they have to set A heavy supports, called piles, deep underwater. To place those supports safely, the construction teams drive the piles deep into the ground below rivers and harbors. Just like the jackhammers on a construction site on land, that process creates a racket in the water.

Underwater noise can be deadly in some cases. Scientists became particularly interested in the problem of noise in the ocean after several events in which beaked whales washed up on beaches and became stranded. These strandings happened when navy ships had been using sonar nearby. Some of the whales died, but scientists still don't understand exactly what happened to them. The sound might have been like nails on a chalkboard to the whales, Ketten says, leading them to flee the ocean.

Whale strandings related to sound are rare, though. In the vast ocean, animals can often escape from loud noises safely, by simply swimming away. But what if a loud noise occurs someplace an animal really needs to be? If it's too noisy where humpback whales feed, or if loud noises steer sea turtles off course, we could change how they live—and whether they survive.

Many marine mammals and sea turtles, and some species of fish, are endangered. We can't stop all of our drilling, construction, and sonar just to protect them. But a United States government agency, the National Oceanic and Atmospheric Administration (NOAA), has written guidelines so that human activities have as little impact as possible on these animals.

> Building these guidelines has been challenging, says Amy Scholik-Schlomer, a biologist at NOAA. We know very little about how these animals live and how they respond to noise. But scientists are finding ways to learn more, which will help Scholik-Schlomer and others create better guidelines.



### HEARING TESTS FOR SWIMMERS

Studying animal hearing and behavior changes isn't always easy. Scientists can't give whales hearing tests in the ocean, for example. We can't deliberately expose them to loud noises to see what might happen, because those experiments would be unethical. And even if they were ethical, they might not be practical with such large animals in the ocean—we can't exactly follow a whale everywhere it goes.

One way to understand animal hearing is by studying the ears of animals that have died. Ketten and her colleagues have studied the ears of whales, dolphins, and other animals to better understand how they work and how the environment might have affected them.

The scientists can see that dolphins and whales have evolved ears that are good at hearing in water, rather than air. The shapes of their heads and the tissues that they use are different from ours, Ketten says. Dolphins devote a larger part of their brains to hearing. Additionally, she explains, "Their ears are much more complex. There are about a million little structures in a cubic centimeter."

Not all animals hear the same ranges of sound. Dolphins, for example, can pick up higher-pitched sounds than humans can. Humpback whales can hear lower sounds. Sea lions, seals, sea turtles, and many fish fall somewhere in the middle. For different animals, scientists are most concerned with the dangers of sounds that are within their hearing range. If a sound is higher or lower than what they can hear, it won't affect them. Most human-produced sounds are in the lower ranges, which means that baleen whales (species such as humpbacks that have rows of plates in their mouths to help them filter food) are often at the greatest risk.

Animals can lose their hearing temporarily or permanently if they're exposed to loud noises. Although researchers can't study live whales and dolphins in a laboratory, they can study fish. Arthur Popper is one of the researchers studying fish hearing in the lab. He and his colleagues have developed an instrument called the HICI-FT (he pronounces it "hissy fit") that allows scientists to expose fish to levels of sound similar to those that occur during pile driving. This lets them study how those sounds affect fish that can't swim away.

In some cases, the loud sounds temporarily damaged their hearing. But unlike humans and marine mammals, fish can repair the sensory cells in their ears and add them their whole lives, Popper says. That unusual ability made the hearing damage temporary rather than permanent.

#### WHAT TO DO?

To protect animals, humans might sometimes need to move our work to another location. Another option could be for humans to drill for oil, or build wind turbines, only during a certain time of year. While humans work in a particular area, scientists are often standing by to watch what happens to the animals.

But there are other ways to protect wildlife. One way to muffle loud underwater sounds is to create an air barrier with a curtain of bubbles, says Popper. Because sound waves travel more slowly through air, these bubbles help put the brakes on the noise. It's like closing a door or adding soundproof padding to a room.

Monitoring systems are helping researchers find whales underwater, he adds. Scientists have placed networks of hydrophones (underwater microphones) in areas where



whales gather, such as Stellwagen Bank National Marine Sanctuary off the coast of Massachusetts. These networks let ships know that whales are in the area so that they can slow down or change direction. They also record underwater noises—both those made by animals and those made by humans. Bubble curtains are pretty cool—but what would *you* invent to protect underwater animals from human noise? Share your ideas at www.musemagkids.com/townhall.

While we try to keep marine animals safe from the racket we make, there are still a lot of things we don't know. For example, we know almost nothing about how sea turtles live or how they use the sounds around them. This is because sea turtles spend years of their lives swimming in the ocean far from human observers. Their hearing might change over the course of their lives, since their bodies (including their ears) grow continuously, from the size of a half-dollar coin up to 900 pounds (400 kilograms).

We also know very little about hearing in invertebrates (spineless animals such as sea stars, jellyfish, or crabs). And these animals are often food for larger animals. So if a sound affects squid, for example, it could also affect the sperm whales that feed on them.

Every small change can cause a chain reaction involving many species in the food web. So understanding the complex effects of our noisy activities will be hard. But as we learn more about ocean animals and their hearing, we can figure out how to help wildlife that can't help but overhear us.

> Sarah Webb is a journalist and chemist who has written for Discover, Science News, and other publications. Her personal sound environment in Tennessee includes her husband, two cats, and what we can only assume is a pretty noisy Senegal parrot.