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GEOGRAPHIC



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OUT OF THE WATER, INTO THE LAB

with Andrej Gajić

National Geographic Explorer and marine biologist Andrej Gajić studies a shark's jaw.

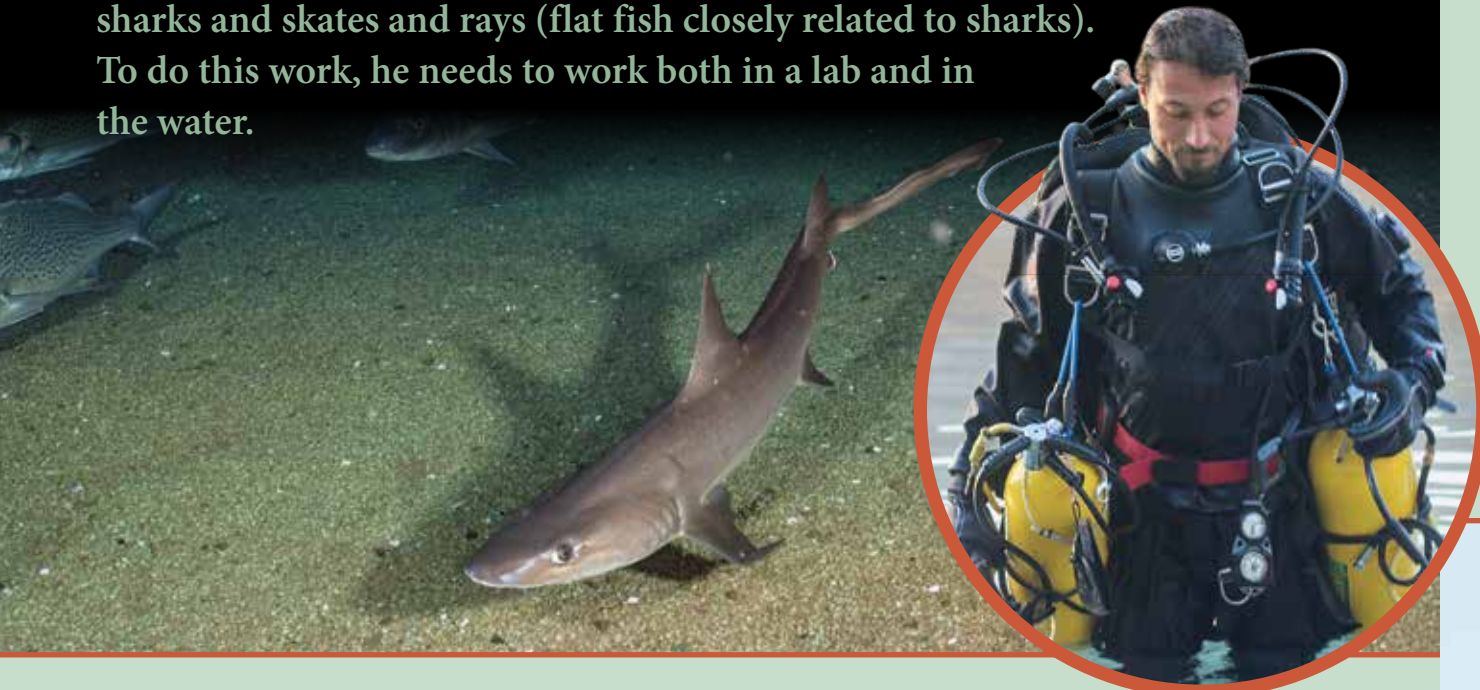
Our Changing Planet

LIFE SCIENCE

As you read, think about how scientists use observations and collect evidence to solve problems.

Andrej Gajić usually dives alone. At night. In shallow, murky water. He dives under these conditions because that's where and when he'll find sharks. And Gajić needs to find sharks.

Gajić is more than just a diver. He's a National Geographic Explorer and marine biologist dedicated to understanding the effects of pollution on sharks and skates and rays (flat fish closely related to sharks). To do this work, he needs to work both in a lab and in the water.



Difficult Dive

Many of Gajić's dives take place at Neum Bay on the Adriatic Sea. It's a hotspot for sharks, rays, and skates, and a good place for him to directly observe these **nocturnal** creatures.

He doesn't have to go far to reach bottom at Neum Bay—only about 30 meters (98 feet). The water here is thick with sediment and choked by colonies of plankton—small organisms that float in the sea. To him, it feels more like swimming through yogurt than water. Visibility at this depth is zero. Gajić can't see his hand in front of his face. He waits, letting his eyes adjust. After a few minutes, he can just make out some shapes around him.

His video camera carries a powerful light. He switches it on to cut through some of the gloom. And that's when he sees them: smoothhound sharks. They are swimming in lazy circles near the seabed. Gajić is excited to see them but knows that he is the visitor here; this is not his home. His job is only to observe. Avoid sudden movements. Be watchful.

It's that last piece of advice that is the most important. Most of the marine animals he encounters have no interest in people and are not likely to attack. But his presence must not cause stress to the animals. To ensure this, he pays close attention to the body language of the sharks. Do any of them seem aggressive? Is he seeing any sudden changes in movement toward him? No. The sharks appear curious, but not threatened by him. That's good.

By the light of his camera, he begins his observations. As they swim around him, he looks closely at their jaws and teeth. He studies their gills, skin, and muscles. He's looking for any swelling or abnormalities. He's looking for signs of disease.

Gajić spends close to an hour in this silent world, taking notes, photographs, and shooting videos before it is time to resurface. To his eyes, the sharks appear healthy. But Gajić knows that looks can be deceiving. To truly know the health of these animals, he needs to look much deeper.



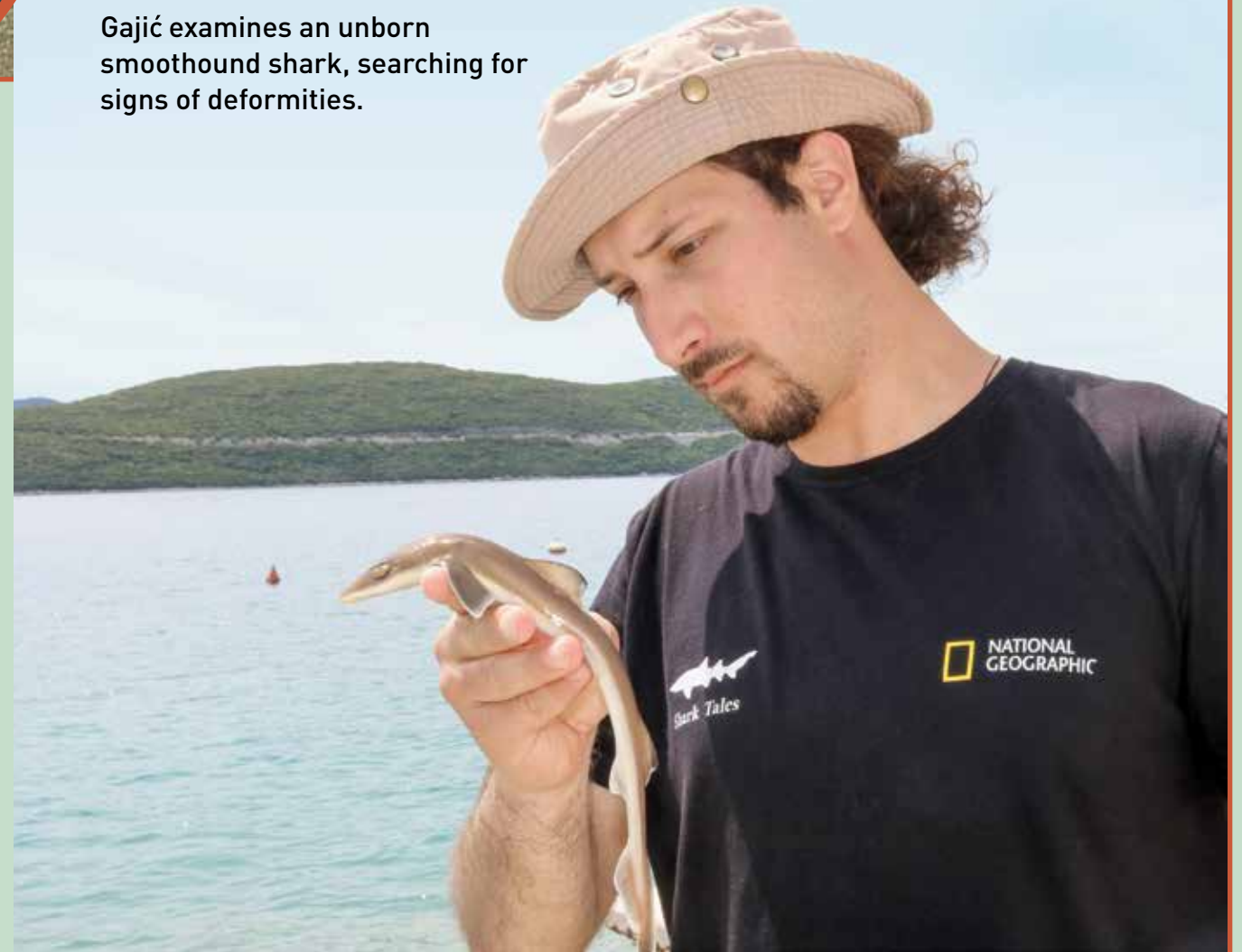
Sharks in the Adriatic

Research indicates that there are 33 species of sharks in the Adriatic Sea. Catsharks, smoothhounds, and dogfish are the most abundant. These sharks are fairly small and like to stay near the ocean floor.

In the open water, his team has encountered elegant blue sharks as well as lightning-quick mako sharks. Makos are one of the fastest marine animals, capable of bursts of speed up to 18.8 meters a second (68 kilometers or 42 miles an hour).

Another fascinating species found in the Adriatic is the thresher shark. Its body grows up to 6 meters (almost 20 feet)—half of which is an elongated tail fin. Thresher sharks encircle schools of fish and then stun the prey with their tails.

Gajić examines an unborn smoothhound shark, searching for signs of deformities.



Shark Sightings

In deeper water, Gajić has encountered bizarre-looking rough sharks and lanternsharks. Gajić doesn't need his powerful camera light to see lanternsharks. They glow! They are little fish, no bigger than 50 centimeters (about 20 inches) long. The light comes from many small organs called photophores, which dot their bellies and sides.

Gajić's interactions with rays and skates are a little less problematic than with sharks. He's able to get closer to rays, in particular. He interacts with common stingrays, eagle rays, and leopard whips as he studies them.

For Gajić, it is a dream come true to be among these animals. He grew up in war-torn Yugoslavia. His family moved many times when he was young, always looking for a safer and more stable place to be. He never lived anywhere near the ocean. Yet, he was fascinated by the sea and what lived in it, especially sharks. He was inspired by copies of *National Geographic* magazine. He vowed one day to visit some of the magnificent places he saw in the magazine and to one day swim with sharks.



researching unborn smoothhound sharks

Dangerous Waters

As much as he loves sharks, Gajić knows that they are in trouble in the Adriatic. Pollution is causing illnesses in many marine animals. Plastics, pesticides, heavy metals (like lead), and waste poison the sea. And in the Adriatic, war waste—ammunition, grenades, bombs—also contaminates the water. The coastline along Neum is a popular vacation spot. Yet, much of the town's sewage flows into the sea—some of it is unfiltered waste. Combined, these factors make conditions for sea life hazardous.

Outwardly, a marine animal might seem healthy. To know for certain, Gajić must take off his dive suit and put on his white lab coat. In the lab, he examines shark organs and tissue through a powerful microscope. Only then can he see what's really happening.

Gajić examines a deep-water rough shark in the lab.



This sevengill shark was bycatch off the coast of Malta in the Mediterranean Sea.

Under the Microscope

Gajić rarely collects samples from live sharks. If he needs a tissue sample, it is taken from an already-dead shark. These come in the form of bycatch—when a shark is accidentally caught in a fisher's net and killed. Many of the local fishers know that Gajić is studying sharks and their health. When a shark is caught by mistake, they contact him immediately.

In the lab, each specimen is given a full x-ray and a CAT scan. Tissue samples are taken. From these samples, Gajić can learn a lot. In one shark, he found an usual amount of fat in the shark's liver. It is normal for that type of shark to have up to 50 percent of fat within the liver. This shark had far more than that. In another shark, he found the disease hepatitis. That's an inflammation of the liver. It might be caused by high concentrations of heavy metals in the water. In other sharks, he found disease in both kidney and brain tissue. At one particular site, around 90 percent of the tissues sampled showed some evidence of disease.



Gajić studies sharks in captivity, too.

More Signs of Trouble

Gajić also examines sharks' other organs. He found signs of trouble there, too. Many sharks had eaten plastic. He found fragments in their stomachs and their intestines. This may cause some of the problems and diseases in sharks.

These results are alarming. Were they isolated cases? He doesn't think so, but he needs more samples from more sharks to be sure. One thing is certain: Each of these diseases can be traced to pollution.

Next Steps

Gajić has a lot of work ahead—not just in further shark studies, but in conservation, too. He has a lot of questions. Can existing laws be strengthened to protect the environment? Can awareness be raised so that people understand how human actions are affecting marine animals? What can kids do to help keep sharks healthy?

Gajić says there are many things that kids can do to help. Some might surprise you. For example: Take a look at the toothpaste you use. Some toothpastes contain **microplastics**. Microplastics are small plastic pieces less than five millimeters (0.2 inches) in size, which can be harmful to aquatic life. You can also help by not using disposable plastic bags or plastic drinking straws. Many of these things end up in our waterways.

He says that you can help by participating in **citizen science**. Is there a beach near you? Take a walk. Look at what you find there—you may find the egg cases of some shark or skate species. Take a photo and upload it to iNaturalist. This may help researchers like him learn precisely where shark nursery grounds are.

Most of all, learn as much as you can about sharks and their environment. Then share what you know with others. The more we know about our world and how our actions can affect it, the easier it will become to help build a planet in balance.

iNaturalist is a citizen science project and online network of naturalists and citizen scientists built on the concept of mapping and sharing observations of biodiversity across the globe. To learn how to use this free program, go to: www.inaturalist.org



skate egg case found on a beach in Malta

WORDWISE

citizen science: the collection and analysis of data relating to the natural world by members of the general public, often done in collaboration with professional scientists

microplastics: small plastic pieces less than five millimeters (0.2 inches) in size, which can be harmful to oceans and aquatic life

nocturnal: active at night



Gajić encounters a huge jellyfish in Neum Bay.



Meet Andrej Gajić!

Here's your chance to meet National Geographic Explorer and marine biologist Andrej Gajić. He'll be participating in National Geographic's Explorer Classroom program on April 20, 2020. Find out what it's like to swim with sharks and study them in a lab. This live event is hosted on YouTube. There's no cost to join, and your classroom could be on camera with Andrej to ask him questions.

If you miss the livestream on April 20, the recording will be posted on YouTube, so you can tune in later.

Sign up at NatGeoEd.org/ExplorerClassroom

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Cover: wildland firefighter Magen Dufurrena
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APRIL 2020

COVER: JEN WENTWORTH. WHO TAKES CARE OF OUR FORESTS?; PAGES 2-3 CHASE DEKKER WILD-LIFE IMAGES/MOMENT/ GETTY IMAGES; PAGES 4-9 (ILLUSTRATIONS) ELENA PALETSKAYA/ SHUTTERSTOCK; PAGE 4 (LEFT) ANGIE PRICE; (RIGHT) COELI HOOVER; PAGE 5 JEN WENTWORTH; PAGE 6 (LEFT) CADY LANCASTER; (RIGHT) OWEN SLATER PHOTOGRAPHY; PAGE 7 ADAM COBLE; PAGE 8 LIZ COBB/SILVICULTURE FORESTER/OTTAWA VALLEY FOREST; PAGE 9 (LEFT) KIM KENNEDY; (RIGHT) IAN MORRELL. DIGGING UP HISTORY: PAGES 10-11 (TOP) WIM.WISKERKE/ALAMY STOCK PHOTO; (BOTTOM) © JEAN SHAPIRO CANTU; (BACKGROUND MAP) EVERETT HISTORICAL/SHUTTERSTOCK; PAGES 12-13 (GARDEN MAP) GEORGE WASHINGTON'S MOUNT VERNON; (LEFT PHOTO) PAT & CHUCK BLACKLEY/ALAMY STOCK PHOTO; (CENTER PHOTO) DAVID STUCKEL/ALAMY STOCK PHOTO; (RIGHT IMAGE) GEORGE WASHINGTON'S MOUNT VERNON; PAGE 14 GEORGE WASHINGTON'S MOUNT VERNON; PAGE 15 IMAGE PROFESSIONALS GMBH/ALAMY STOCK PHOTO. OUT OF THE WATER, INTO THE LAB: PAGES 16-17 FERNANDO CAAMANO/NATIONAL GEOGRAPHIC; PAGE 18-19 (SHARK) © DOUG PERRINE/ NPL/MINDEN PICTURES; (ANDREJ A. GAJIĆ BOTH) ADLA KAHRIĆ/SHARKLAB ADRIA; (MAP) MAPPING SPECIALISTS, LTD; PAGES 20-21 (LEFT PHOTO) ADLA KAHRIĆ/SHARKLAB ADRIA; (CENTER PHOTO) SHARKLAB ADRIA; (RIGHT PHOTO) ANDREJ A. GAJIĆ/SHARKLAB ADRIA; PAGES 22-23 (TOP LEFT) OGUZ CAYDIR; (BOTTOM PHOTO) ADLA KAHRIĆ/SHARKLAB ADRIA; (RIGHT PHOTO) FERNANDO CAAMANO/ NATIONAL GEOGRAPHIC. MEET ANDREJ GAJIĆ; PAGE 24 FERNANDO CAAMANO/NATIONAL GEOGRAPHIC.

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