BRINGING THE OCEAN BACK

AN INTRODUCTION TO OCEAN CONSERVATION

NATIONAL GEOGRAPHIC

PRISTINE SEAS

INTRODUCTION

WHEN I WAS A KID GROWING UP IN THE MEDITERRANEAN, I was fascinated by the life I saw in shallow waters: algae, anemone, little crabs and small fish. But I never saw anything large—until I obtained my scuba diving license and dived in a fully protected marine reserve. I remember that first dive vividly. The big fish missing from the sea of my childhood were there: groupers, sea bream, seabass....

It took many years of education for me to learn how the ocean works, what we've done to it, and how to bring it back. I hope this handbook will provide a good introduction I wish I had when I was a kid wanting to be part of the sea.

ENRIC SALA
NATIONAL GEOGRAPHIC
EXPLORER IN RESIDENCE

PHOTO: REBECCA HALE

PRODUCED BY
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BRENNA MALONEY
EDITOR

PATRICK CAVANAGH
DESIGNER

TRANSLATION BY LANGUAGECARE
COVER PHOTO: ENRIC SALA, NATIONAL GEOGRAPHIC PRISTINE SEAS

Three lives have I.
Wet enough to quench your thirst,
Light enough to touch the sky,
Hard enough to break down rock.

What am I?

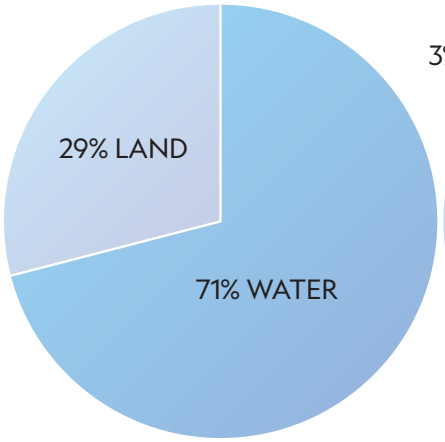
WATER.

Water is the only substance on Earth that naturally occurs in three physical states: solid, liquid, and gas. It is our planet's defining feature. Most of our water is found in the ocean. Water also exists as a solid in ice caps and as a vapor in the air.

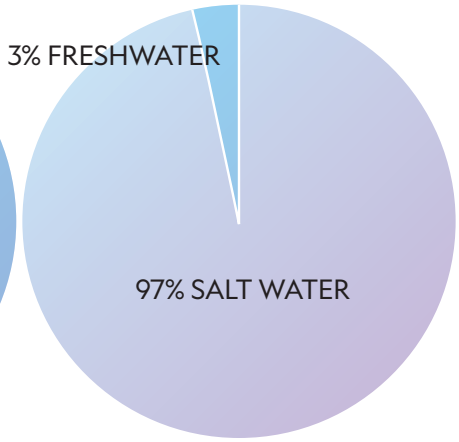
Earth is a closed system. Its water is finite. That means the amount of water in, on, and above our planet does not increase or decrease. Instead, it flows endlessly between the ocean, atmosphere, and land in a system we call the **water cycle.**

WATER CYCLE: THE CONTINUOUS MOVEMENT OF WATER WITHIN EARTH AND THE ATMOSPHERE

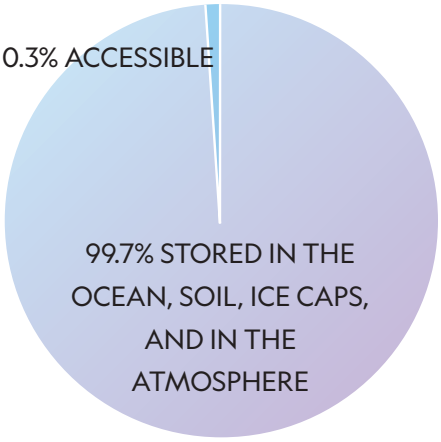
MOST OF EARTH IS COVERED BY WATER.



MOST OF OUR WATER IS SALT WATER



ONLY A SMALL PORTION OF EARTH'S WATER IS ACCESSIBLE TO PEOPLE



ON THE MAP

While **there is only one global ocean,** the vast body of water that covers our planet is geographically divided into distinct, named regions. The boundaries of these have evolved over time for historical, cultural, geographical, and scientific reasons. You may know these regions as the Atlantic, Pacific, Indian, and Arctic. Not long ago, the Southern Ocean, which encircles Antarctica, joined the list. All of these basins are connected and exchange water as part of a single world ocean.

Each ocean basin is made up of the seafloor and all of its geological features, such as trenches, islands, ridges, volcanoes, and seamounts. Each basin varies in size, shape, and features due to the movement of Earth's crust. Some of Earth's highest peaks, deepest valleys, and flattest plains are found underwater.

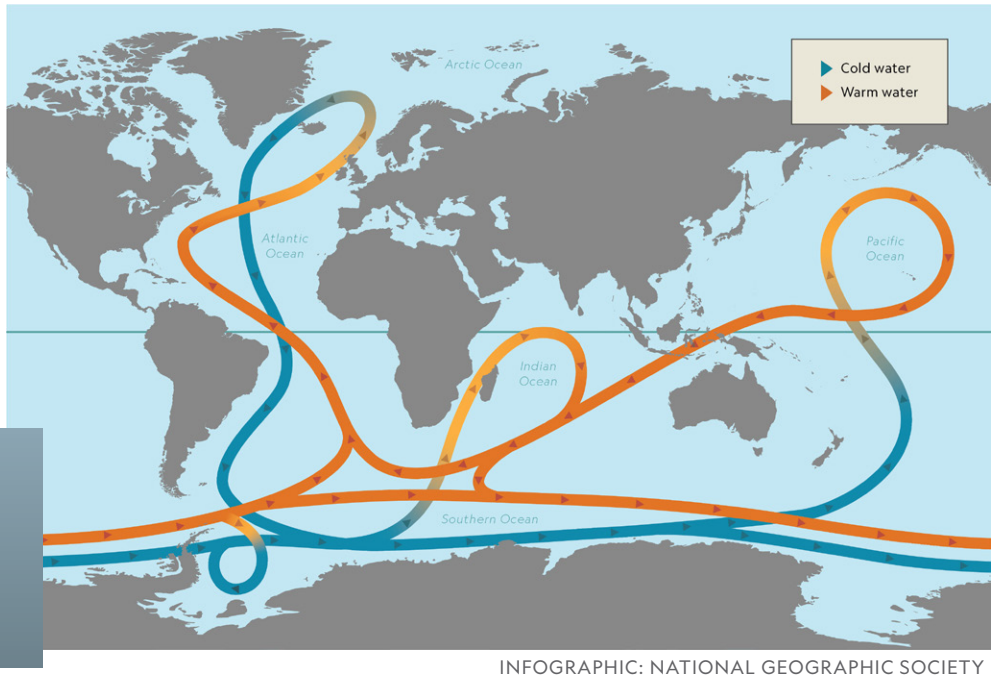
OCEAN IN MOTION

The ocean is never still. Both quick-moving surface currents and slower-moving deep ocean currents **circulate** water around the globe. Surface currents are mostly driven by wind and Earth's rotation. Deeper ocean currents are controlled by temperature and **salinity.** That's because both heat and salt influence the density of seawater. Saltier water is more dense than freshwater. Cold water is denser than warm water. Denser water sinks.

Ocean water always moves toward equilibrium, or balance. For example, if surface water cools and becomes denser, it will sink. The warmer water below will rise to balance out the missing surface water.

Ocean currents move a lot like a conveyor belt that delivers luggage at an airport. The ocean doesn't move as fast as luggage, though. Scientists estimate that it takes the ocean conveyor belt about 1,000 years to make one trip around the world.

THE "GREAT GLOBAL CONVEYOR BELT" REFERS TO THE MAJOR OCEAN CURRENTS THAT MOVE WARM WATER FROM THE EQUATOR TO THE POLES AND COLD WATER FROM THE POLES BACK TOWARD THE EQUATOR.



INFOGRAPHIC: NATIONAL GEOGRAPHIC SOCIETY

CIRCULATE: TO MOVE IN A CIRCLE OR PATTERN

SALINITY: THE AMOUNT OF DISSOLVED SALTS THAT ARE PRESENT IN THE WATER

This conveyor belt helps keep our planet warm. When sunlight reaches Earth's surface, the ocean absorbs some of this energy and stores it as heat. **Ocean currents help move heat around the world.** For example, warmer, surface water from the Equator moves toward the poles, and colder, deep water from the poles moves back to the tropics. Without this exchange, it would be even hotter at the Equator and colder toward the poles, and much less of our planet would be habitable.

As we know, increasing **greenhouse gas** concentrations are trapping more energy from the sun in Earth's atmosphere. Water has a much higher heat capacity than air, meaning the ocean can absorb larger amounts of heat energy with only a slight increase in temperature. As such, **our ocean has absorbed more than 90 percent of Earth's extra heat since 1955.**

Ocean temperature plays an important role in Earth's climate system, too, because heat from ocean surface waters provides energy for storms. As our climate warms, we're experiencing stronger winds, higher storm surges, and record rainfalls—which is also why these storms are becoming more destructive and costly.

GREENHOUSE GASES: ABBREVIATED GHGS, THESE ARE GASES IN EARTH'S ATMOSPHERE THAT TRAP HEAT. HUMAN ACTIVITIES ARE RESPONSIBLE FOR THE RAPID RISE IN GREENHOUSE GASES OVER THE LAST 150 YEARS. THE LARGEST SOURCE OF NEW GHGS IS THE BURNING OF FOSSIL FUELS FOR ELECTRICITY, HEAT, AND TRANSPORTATION.

PHOTO: ANDY MANN, NATIONAL GEOGRAPHIC PRISTINE SEAS

YOU MAY BE FAMILIAR WITH THE TERMS CLIMATE AND WEATHER. **CLIMATE** IS HOW THE WEATHER USUALLY IS OVER THE WHOLE YEAR IN A PARTICULAR PLACE. **WEATHER** IS THE SHORT-TERM ATMOSPHERIC CONDITIONS OF A PLACE. HERE'S ONE WAY TO THINK ABOUT IT. WHAT'S IN YOUR CLOSET? WEATHER IS HOW YOU DECIDE WHAT YOU'RE GOING TO WEAR TODAY. CLIMATE IS HOW YOU DECIDE WHAT KIND OF CLOTHES YOU HAVE IN YOUR ENTIRE CLOSET.

EARTH'S LUNGS

You may have heard Earth's rainforests sometimes described as a lung because they draw in carbon dioxide and expel oxygen. But just like most of us, Earth has *two* lungs. The ocean is its second lung.

PHYTOPLANKTON: MICROSCOPIC MARINE ALGAE

CARBON SEQUESTRATION: A NATURAL OR ARTIFICIAL PROCESS BY WHICH CARBON DIOXIDE IS REMOVED FROM THE ATMOSPHERE AND HELD IN SOLID OR LIQUID FORM

The ocean relies on tiny, single-celled organisms called **phytoplankton.** Though a phytoplankton cell is smaller than the width of a human hair, there are a billion billion billion phytoplankton in the ocean, and they are some of Earth's most critical organisms. **Phytoplankton generate about half of our planet's oxygen—as much per year as all land plants.**

Through photosynthesis, phytoplankton consume carbon dioxide and expel oxygen. Some of the carbon is carried to the deep ocean when phytoplankton die and sink. This removes greenhouse gases from the atmosphere in a process known as **carbon sequestration.** The ocean stores 50 times more carbon dioxide than our atmosphere, and the top floor of the sediment on the seafloor stores twice more carbon that the soils of the land.

Some carbon is transferred to different layers of the ocean as phytoplankton are eaten by other creatures. Phytoplankton are the foundation of virtually every aquatic food web. They are eaten by everything from microscopic, animal-like zooplankton to massive whales.

PHOTO: MANU SAN FÉLIX, NATIONAL GEOGRAPHIC PRISTINE SEAS

BIODIVERSITY

You may have heard that the ocean has the greatest **biodiversity** on our planet. Marine biodiversity refers to the variety of what lives in our ocean—all the animals, plants, and microorganisms. While that might sound simple, biodiversity is a fairly complex concept and can be measured in several ways.

BIODIVERSITY: THE VARIETY OF LIFE IN THE WORLD OR IN A PARTICULAR HABITAT OR ECOSYSTEM

SPECIES DIVERSITY (also called **SPECIES RICHNESS**) refers to the *number* of species in a place. A place might have many different species of fish, for example.

GENETIC DIVERSITY is the *range of inherited traits within* a species. If a population consists of individuals with a wide variety of different traits, it may have high genetic diversity.

FUNCTIONAL DIVERSITY reflects the ecological complexity of an ecosystem. Many organisms with different roles in the food web would indicate a high level of functional diversity.

We know that **each species is an integral part of its ecosystem,** and it performs functions that are essential to that ecosystem. Here's an example: Hard corals grow by forming skeletons made of limestone, which over the centuries, build coral reefs. Those reefs will act as a barrier that protects coral islands and atolls and provide habitat for many species of fish.

Here are some other functions species might provide in an ecosystem:

- Produce oxygen
- Produce organic material
- Decompose organic material
- Cycle water and nutrients
- Control erosion or pests
- Help regulate climate and atmospheric gases

Removing species from ecosystems removes these important functions. Therefore, the greater the diversity of an ecosystem, the better it can maintain balance and productivity and withstand environmental stressors. Biodiversity means that our ocean can be **productive, resilient,** and **adaptable** to any environmental changes. We say an ecological system is resilient if it can bounce back after a disturbance hits it—for example, a coral reef coming back after an ocean warming event kills some of its corals.

BIODIVERSITY HAS INTRINSIC VALUE BECAUSE ALL SPECIES:

—PROVIDE VALUE BEYOND THEIR ECONOMIC, SCIENTIFIC, AND ECOLOGICAL CONTRIBUTIONS

—ARE PART OF OUR CULTURAL AND SPIRITUAL HERITAGE

—ARE VALUABLE FOR THEIR BEAUTY AND INDIVIDUALITY

—HAVE A RIGHT TO LIFE ON THIS PLANET

BIODIVERSITY IS CRITICALLY IMPORTANT TO US IN TERMS OF:

—FOOD RESOURCES

—INDUSTRY

—BIOMEDICAL RESEARCH

—TOURISM AND RECREATION

PHOTO: ENRIC SALA, NATIONAL GEOGRAPHIC PRISTINE SEAS

FOOD RESOURCES

Fish are crucial to a nutritious diet in many areas across the world, especially among coastal communities. **Fish provide about 3.3 billion people with almost 20 percent of their intake of animal protein.** Global fish consumption increased 122 percent between 1990 and 2018, and that figure is expected to rise in the future.

INDUSTRY

We use our ocean as a roadway. As of 2021, maritime transport carries more than 80 percent of global trade by volume. It plays a critical role in the supply of essential goods such as food, clothing, shelter, and pharmaceuticals to countries. Fish fuel a $362 billion global industry. Millions of people in coastal communities depend on the fishing industry for their livelihood. Some 4.6 million fishing vessels of all sizes now ply the ocean, many with increasing capacity and efficiencies to catch more fish.

We drill for oil. Offshore oil drilling accounted for about 16 percent of the 12.2 million barrels of oil produced each day in the U.S. in 2019, according to federal records. But oil drilling pollutes our waters, land, and air. And drilling increases the risk of oil contamination to wildlife as well as destroys habitats.

BIOMEDICAL RESEARCH

We also mine our ocean for medicines. Most drugs in use today come from nature—many from flowers and plants on land. Aspirin, for example, was first isolated from the willow tree. As demand grows for new medicines, specifically anti-cancer and anti-inflammatory substances, researchers are looking to the ocean. Two such drugs are already in use—an anti-tumor medication made from sea squirts and a painkiller from a cone snail. More than a dozen other drugs are being tested, including ones to treat Alzheimer's disease and lung cancer.

One group of researchers is focusing on the layer of mucus that coats some species of fish. This coating protects fish from bacteria, fungi, and viruses. Could this fish slime protect people, too? Could it be copied in a lab and produced in large quantities? If so, we could avoid harvesting it from the ocean, leaving our marine ecosystems healthy and intact.

TOURISM AND RECREATION

Travel and tourism form one of the world's largest industries, supporting more than 100 million jobs. Many visitors come to the ocean for nature-based tourism, such as diving, snorkeling, or whale-watching. Others come to enjoy the less direct benefits of swimming in calm waters or lying on white sandy beaches. More than 350 million people annually travel to coral reefs. Some go to see specific animals. An estimated 600,000 people spend more than $300 million USD annually to watch sharks, for example. In Palau, a population of about 100 sharks support $18 million worth of shark diving each year.

PHOTO: MANU SAN FÉLIX, NATIONAL GEOGRAPHIC PRISTINE SEAS

A NEW FRONTIER

More than 80 percent of our ocean is unmapped and unexplored. Let that sink in for a minute. Despite its size and impact on the lives of every organism on Earth, we know more about the surfaces of the moon and the planet Mars than we know about our own ocean floor. How can that be? Well, as marvelous a place as the ocean is, it's also really challenging to explore and study.

Sunlight penetrates only the top 200 meters (645 feet) of the ocean. So, the deeper we go, the darker and colder it becomes. There's also more pressure. At any depth in the ocean, the weight of the water above pushes on an object below it.

On land, our bodies experience an internal pressure of one atmosphere (atm). Pressure in the ocean increases about one atmosphere for every 10 meters (32 feet) of water depth. So, for example, at a depth of 100 meters, the pressure is 10 times greater than the pressure at sea level.

If we wanted to join a sperm whale on its hunt for giant squid, we'd need to swim down to about 2,000 meters (7,000 feet). At that depth, the pressure would be 200 atmospheres. That's too much pressure for people; we'd be crushed!

To explore and study the full water column and the seafloor, we need specialized technologies such as SCUBA (Self Contained Underwater Breathing Apparatus), submersibles, and remotely operated vehicles.

PHOTO: ENRIC SALA,
NATIONAL GEOGRAPHIC PRISTINE SEAS

AT RISK

WITH EVERY BREATH WE TAKE, EVERY DROP WE DRINK, WE'RE CONNECTED TO THE OCEAN. BUT OUR OCEAN FACES MAJOR THREATS: OVERFISHING, WARMING AND ACIDIFICATION, POLLUTION, HABITAT DESTRUCTION, AND INVASIVE SPECIES. NEARLY 66 PERCENT OF THE OCEAN IS UNDER CUMULATIVE STRESS, AT AN ACCELERATING PACE, FROM HUMAN ACTIVITIES. EASING THESE PRESSURES IS CRUCIAL TO HUMAN SURVIVAL.

OVERFISHING

Overfishing happens when we take fish out of the ocean faster than they can reproduce. Fish are a "renewable" resource in that they reproduce and can replenish their own populations but not if we catch too many of them too fast.

Overfishing became a global problem in the last century, as large-scale, industrial fishing methods grew to meet the demand of a rapidly growing human population. This demand has contributed to the development of more intensive fishing methods.

When you think of "fishing," you probably don't think of dynamite. But **"blast fishing"** or "fish bombing" is a destructive fishing practice that uses explosives to stun or kill schools of fish for easy collection. This often illegal practice destroys the underlying habitat that supports fish.

Trawling is one of the most harmful fishing methods. Enormous nets as wide as a football field are dragged through the water or across the seafloor, capturing almost everything in their path. Vulnerable habitats are damaged in the process. Every year, trawlers around the world drag nets that impact an area equivalent to twice the size of the U.S. while producing carbon dioxide emissions similar to those of global aviation.

Gill nets are walls of netting that drift in the water. Gill nets can be up to 3.2 kilometers (2 miles) long. They are designed to trap fish around the gills when they try to swim through.

Longline fishers use lines that can extend for up to 80 kilometers (50 miles), with thousands of baited hooks branching off from the main line. These baited hooks often attract an array of other species, including diving birds.

These destructive practices have severe consequences for marine life: The global fishing catch has been declining since 1996. And today—according to the UN— **90 percent of our fish stocks are said to be overfished or fished to full capacity,** meaning they are close to reaching the level at which they will collapse.

Removing too many fish too fast can have a cascade-like effect across the marine ecosystem. It can reduce the size of fish remaining, as well as how much they reproduce and the speed at which they mature. Marine food webs are highly complex. Removing an apex predator, like sharks, or the base of the food web, like krill, could cause an entire ecosystem to collapse.

PHOTO: ENRIC SALA, NATIONAL GEOGRAPHIC PRISTINE SEAS

Overfishing is closely tied to bycatch—the capture of unwanted sea life while fishing for a different species. This, too, is a serious marine threat that causes the needless loss of billions of organisms, including hundreds of thousands of sea turtles and cetaceans.

Overfishing is only made worse by illegal catches and trade. Experts estimate illegal, unreported, and unregulated (IUU) fishing brings in up to $36.4 billion each year.

FOOD & ECONOMIC SECURITY

Demand for fish continues to increase around the world, and that means more businesses and jobs are dependent on dwindling stocks. Aquaculture is the practice of breeding and farming fish for food rather than taking them from wild populations. In 2018, about 60 million people were employed by the fisheries and aquaculture sector.

MARINE POLLUTION: ANY PERSISTENT SOLID MATERIAL OR CHEMICAL THAT IS MANUFACTURED OR PROCESSED AND DIRECTLY OR INDIRECTLY—INTENTIONALLY OR UNINTENTIONALLY—DISPOSED OF OR ABANDONED INTO THE MARINE ENVIRONMENT

MARINE POLLUTION

Our ocean is filled with items that do not belong there. Marine pollution is a combination of chemicals and trash, most of which comes from land sources and is washed or blown into the ocean. Huge amounts of plastic, metal, rubber, paper, textiles, and other lost or discarded items enter the ocean every day. Debris can range in size from small plastic pieces, called microplastics, to huge abandoned vessels and gear. Although some of these items may eventually break down, others are made to last a long time—sometimes hundreds of years. **Most marine debris is preventable.**

IMPACT OF MARINE DEBRIS

The National Oceanic and Atmospheric Administration (NOAA) tells us that marine debris can cause harm in the following ways:

INGESTION: ANIMALS MISTAKENLY EAT PLASTIC AND OTHER DEBRIS. MORE THAN 40 PERCENT OF SEABIRD SPECIES EAT PLASTIC. ALL SEA TURTLE SPECIES EAT DEBRIS.

ENTANGLEMENT: MARINE LIFE GETS CAUGHT AND KILLED IN ABANDONED GEAR, NETS, PLASTIC BAGS, OR OTHER DEBRIS. WORLDWIDE, MORE THAN 350 SPECIES ARE IMPACTED BY ENTANGLEMENT.

HABITAT DAMAGE: HEAVY MARINE DEBRIS CRUSHES SENSITIVE HABITATS, SUCH AS CORAL REEFS AND SEAGRASS.

The problem isn't just trash, though. Nutrient pollution from the overuse of fertilizers on farms runs into waterways that ultimately flow into the ocean. This increased concentration of chemicals, such as nitrogen and phosphorus, can be toxic to wildlife and harmful to people.

OCEAN WARMING

We know that our ocean is getting warmer as a result of the burning of fossil fuels and other activities. **Since 1971, the ocean has absorbed 90 percent of the excess heat generated by our actions.** Water can hold more heat than land or air, but this rate is alarming. The ocean's surface layer, home to most marine life, takes most of this heat. As a result, fish species migrate farther to find cooler temperatures and food sources. This impacts communities and economies that depend on fishing. **A warmer ocean can also change ocean chemistry, raise sea levels, and fuel extreme weather.**

OCEAN ACIDIFICATION

As the amount of CO_2 in the air increases from industry and other activities, the excess CO_2 enters the ocean. **This changes the chemistry of seawater.**

When CO_2 enters the ocean, it dissolves and reacts with water, making it more acidic. What can happen as a result?

- It can reduce fish size and populations. Some fish grow slower, others may have difficulty reproducing.
- Some types of marine life have more difficulty avoiding predators.
- Animals that rely on shells become vulnerable. One reason for this is less carbonate in the ocean water. Carbonate is a necessary building block in skeletons and shells. Animals like corals and mollusks are at risk.
- Phytoplankton and zooplankton, which are the base of the marine food chain, are destroyed.

RISING SEA LEVELS

Warmer ocean waters also contribute to rising sea levels. Since 1880, average sea levels have swelled about 23 centimeters (more than 8 inches), including about 7.6 centimeters (3 inches) in the last 25 years. **Every year, the sea rises about 3.6 millimeters (0.14 inch).** New research projects this rise to accelerate.

The change is driven by three factors. First, when water heats up, it expands. About half of the sea-level rise over the past quarter century is a result of the water just taking up more space. Second, persistent higher temperatures are causing our glaciers to melt. And third, increased heat is causing the massive ice sheets that cover Greenland and Antarctica to melt more quickly. Higher waters can mean big trouble. Even small increases can have devastating effects on coastal habitats—causing destructive erosion, wetland flooding, aquifer and agricultural soil contamination, and lost habitat for fish, birds, and plants.

EXTREME WEATHER

Rising ocean temperatures are also connected to weather extremes. **Warmer sea surface temperatures influence weather patterns and shift precipitation.** Some regions may experience intense rainstorms and flooding. Others may undergo drought conditions or wildfires. These changes spawn dangerous hurricanes and typhoons that move more slowly and drop more rain, which can strip away everything in their path.

PHOTO: ENRIC SALA,
NATIONAL GEOGRAPHIC PRISTINE SEAS

MARINE PROTECTED AREAS

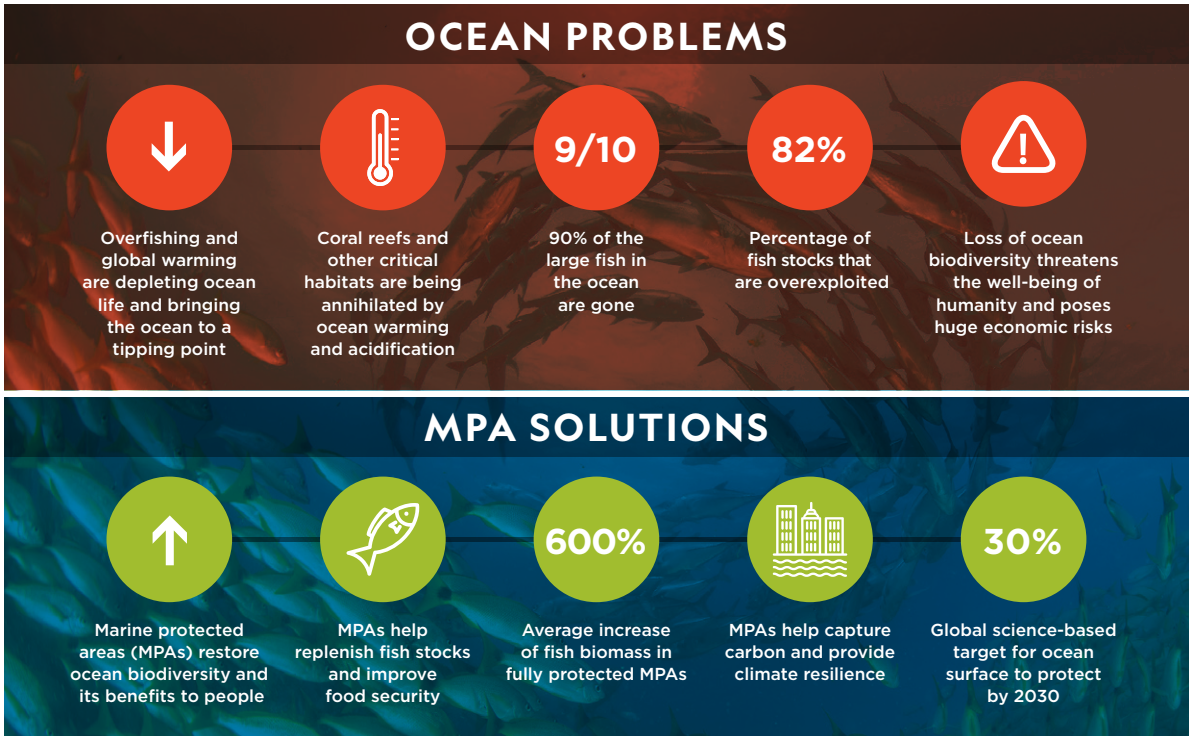
We know that our ocean and its rich diversity are threatened by human impacts at all levels, there are proven solutions. **Marine protected areas, or MPAs, are a key strategy for sustaining and restoring ocean ecosystems.** MPAs are like national parks in the sea. MPAs that ban overfishing or other damaging activities constitute the most effective solution to restore ocean life and all the benefits it provides to people. **Marine protected areas directly address three of the major problems affecting humanity: 1) the biodiversity crisis, 2) food security for a growing population, and 3) climate change.**

HOW MPAs PROTECT

If well designed, **MPAs can safeguard essential habitats,** such as nurseries and feeding and breeding grounds. They **shield vulnerable ecosystems and endangered species.** They **help maintain functional food webs.**

MPAs are an effective tool for **restoring ocean biodiversity and ecosystems and building resilience for future warming events and other natural disasters.** Protected areas are able to rebound at a faster rate than they would if they weren't protected.

Marine reserves **help boost the yield of fisheries,** increasing fish and food security for those who depend on the ocean for sustenance. They **help secure marine carbon stocks.** MPAs also **support coastal communities and economies.** They **create opportunities for recreation and tourism, research, and education.** Areas of cultural and historic significance, such as those of importance to Indigenous peoples, archeological sites, and shipwrecks, are often included in MPAs. And they help local fishing by replenishing adjacent fishing grounds through spillover of larvae and adult fish.



INFOGRAPHIC: NATIONAL GEOGRAPHIC PRISTINE SEAS

THE INTERNATIONAL UNION FOR CONSERVATION OF NATURE (IUCN) TELLS US THAT MPAs ARE **"CLEARLY DEFINED GEOGRAPHICAL SPACES, RECOGNIZED, DEDICATED AND MANAGED, THROUGH LEGAL OR OTHER EFFECTIVE MEANS, TO ACHIEVE THE LONG-TERM CONSERVATION OF NATURE WITH ASSOCIATED ECOSYSTEM SERVICES AND CULTURAL VALUES."**

LEVELS OF PROTECTION

Not all MPAs are created equal.

Fully Protected MPAs › No mining, prospecting, or exploitation. No active pipelines allowed with potential to leak. No dredging or dumping of any kind. Only small-scale, short-duration anchoring with low impact. Only minimal-impact, small-scale infrastructure for conservation, scientific, navigational, or sustainable tourism purposes. Aquaculture is allowed only for restoration, not extraction. No fishing of any kind. Non-extractive activities include only small-scale, closely regulated use with low impact (snorkeling, swimming, scuba diving, tide pooling), cultural/ceremonial gatherings, cultural education, teachings/knowledge transmission, and other uses.

Highly Protected MPAs › No mining, prospecting, or exploitation. No active pipelines allowed with potential to leak. No dredging or dumping of any kind. Only small-scale, short-duration anchoring with low impact. Low-impact, small-scale infrastructure allowed (facilities associated with sustainable tourism and aquaculture, renewable-energy structures, artificial reefs). Aquaculture is allowed but only unfed aquaculture that is small-scale and low density. Infrequent fishing with only a few (five or fewer) gear types that are highly selective and low impact. For non-extractive activities, only small-scale, closely regulated use with low impact (snorkeling, swimming, scuba diving, tide pooling), cultural/ceremonial gatherings, cultural education, teachings/knowledge transmission, and other uses.

Lightly Protected MPAs › No mining, prospecting, or exploitation. No active pipelines allowed with potential to leak. Limited dredging allowed for navigation, restoration, shoreline protection, and for coastal erosion and safety. Moderate unregulated anchoring, anchoring in sensitive habitats allowed only if anchored at the same location for a short time. Some infrastructure allowed—moderate-impact facilities associated with sustainable tourism and aquaculture, renewable-energy structures, artificial reefs (may allow fishing). Unfed aquaculture that is commercial scale and semi-intensive to intensive; or fed aquaculture that is small-scale and low density allowed. Also, low-density, small-scale/traditional use (fish, shrimp). Fishing is allowed but with moderate number (10 or fewer) gear types. Unregulated use or high-impact, high-density, and/or large-scale non-extractive activities allowed.

Minimally Protected MPAs › No mining, prospecting, or exploitation. No active pipelines allowed with potential to leak. Limited dredging allowed for navigation, restoration, shoreline protection, and for coastal erosion and safety. Large-impact anchoring allowed only if compatible with biodiversity conservation goals. Large-impact infrastructure allowed only if compatible with biodiversity conservation goals. Fed aquaculture that is commercial scale and semi-intensive is allowed; may be located in or close to sensitive habitats. Fishing is allowed with high number (more than 10) gear types that are large impact but not industrial. Unregulated use or high-impact, high-density, and/or large-scale non-extractive activities allowed.

The higher the level of protection, the stronger the conservation outcomes.

SCOPE AND SCALE

THERE ARE CURRENTLY MORE THAN **16,000** MPAs AROUND THE WORLD.

THAT MIGHT SOUND LIKE A LOT, BUT THEY COVER ONLY

ABOUT **8 PERCENT** OF OUR OCEAN.

AND LESS THAN **3 PERCENT** OF THE OCEAN IS IN HIGHLY OR FULLY PROTECTED MPAs.

363 MILLION KM^2

APPROXIMATE SIZE OF THE WORLD'S OCEAN

29 MILLION KM^2

TOTAL SIZE OF THE WORLD'S MARINE PROTECTED AREAS
(THAT'S A LITTLE MORE THAN THE COMBINED SIZE OF RUSSIA AND CANADA.)

8.8 MILLION KM^2

TOTAL SIZE OF THE WORLD'S HIGHLY AND FULLY PROTECTED MPAs
(THAT'S A LITTLE SMALLER THAN THE SIZE OF THE UNITED STATES.)

MPAs LEAD TO:

- MORE FISH
- BIGGER FISH
- GREATER DIVERSITY OF SPECIES
- PROTECTION OF CARBON STOCKS
- RESPECT FOR CULTURAL TRADITIONS AND PRACTICES
- OPPORTUNITIES TO STUDY AND LEARN
- HEALTHIER FISHERIES FOR JOBS AND FOOD SECURITY
- TOURISM THAT SUPPORTS ECONOMIES
- RECREATION

30×30

BASED ON SCIENTIFIC GUIDANCE, MORE THAN 100 COUNTRIES HAVE AGREED TO A GOAL OF PROTECTING AT LEAST 30 PERCENT OF THE OCEAN BY 2030.

MARINE PROTECTED AREAS MEAN:

1 › MARINE LIFE RECOVERS FISH ABUNDANCE INCREASES ON AVERAGE 600 PERCENT IN MARINE RESERVES AFTER FULL PROTECTION WITHIN A DECADE.

2 › BETTER FISHING FISH SPILL OVER THE RESERVE BOUNDARIES AND HELP TO REPLENISH ADJACENT FISHING GROUNDS. IN CALIFORNIA, LOCAL FISHERS ARE CATCHING 225 PERCENT MORE LOBSTERS AFTER PROTECTING 35 PERCENT OF THEIR FISHING GROUNDS—ONLY SIX YEARS AFTER THE RESERVE WAS CREATED.

3 › DIVING TOURISM WHEN THE FISH COME BACK, DIVERS COME IN. IN THE MEDES ISLANDS, DIVING TOURISM EMPLOYS HUNDREDS OF PEOPLE AND BRINGS IN 12 MILLION EUROS PER YEAR—24 TIMES MORE THAN FISHING.

4 › MITIGATE GLOBAL WARMING THE PROTECTION OF CARBON-RICH SEDIMENTS HAS THE POTENTIAL TO AVOID CARBON DIOXIDE EMISSIONS SIMILAR TO THOSE OF GLOBAL AVIATION, HELPING TO MITIGATE GLOBAL WARMING.

5 › GLOBAL BENEFITS PROTECTION ALSO PRODUCES BENEFITS LIKE OXYGEN PRODUCTION. THIS PHENOMENON HAS A GLOBAL IMPACT, SINCE ALL LIFE IS CONNECTED TO THE OCEAN.

PHOTO: MANU SAN FÉLIX, NATIONAL GEOGRAPHIC PRISTINE SEAS

NATIONAL GEOGRAPHIC PRISTINE SEAS

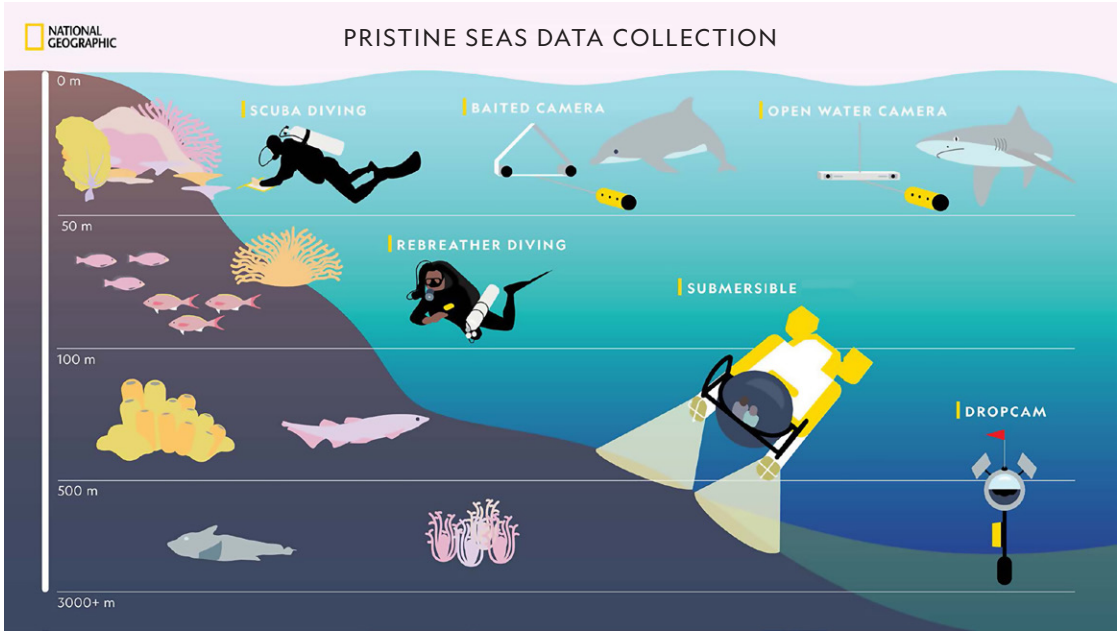
Feeling that as an academic scientist he was just writing the obituary of the ocean, marine biologist **Enric Sala** quit academia in 2008 to dedicate his life to ocean conservation as a National Geographic Explorer in Residence. Sala was a professor at the Scripps Institution of Oceanography in California when he decided to take a more active role in protecting our ocean and restoring richness and diversity to counteract the decline he was documenting.

PHOTO: MANU SAN FÉLIX, NATIONAL GEOGRAPHIC PRISTINE SEAS

Pristine Seas is the National Geographic Society's flagship ocean conservation initiative. It protects vital places in the ocean by combining exploration, research, media, economics, communication, and policy, in collaboration with local communities, Indigenous peoples, and governments.

HOW THE WORK GETS DONE

It takes months to plan and prepare for a Pristine Seas expedition. Experts and local partners from varying disciplines team up to document and assess a target area's biodiversity. Data gathered during the expedition are shared with the scientific community, government authorities, local communities, and Pristine Seas partners to inform the need for and design of a marine protected area. Traditional conservation practices of local and Indigenous communities—some of which have been in place for centuries—provide important models for the Pristine Seas team.



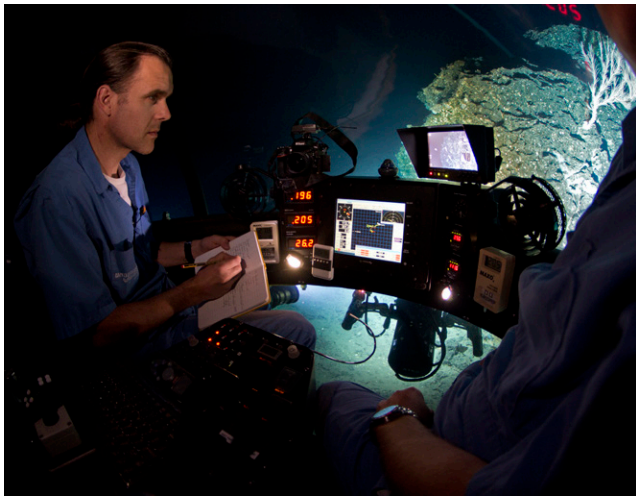
INFOGRAPHIC: NATIONAL GEOGRAPHIC PRISTINE SEAS

PRISTINE SEAS IN ACTION

DARIA MARTYNOVA FROM THE RUSSIAN ACADEMY OF SCIENCES COLLECTS SEAWATER SAMPLES TO STUDY THE DIVERSITY AND ABUNDANCE OF COPEPODS IN ARCTIC WATERS AROUND FRANZ JOSEF LAND, RUSSIA. COPEPODS ARE TINY CRUSTACEANS AT THE BASE OF THE ARCTIC OCEAN FOOD WEB. PHOTO: CORY RICHARDS

JENN CASELLE FROM THE UNIVERSITY OF CALIFORNIA, SANTA BARBARA COLLECTS JUVENILE REEF FISH FOR ANALYSIS. FROM THESE BIOLOGICAL SAMPLES, SCIENTISTS MAY COLLECT DNA, LEARN WHAT THE FISH EAT, OR RECORD OTHER DATA THAT VISUAL OBSERVATIONS ALONE CANNOT PROVIDE. PHOTO: BRIAN SKERRY

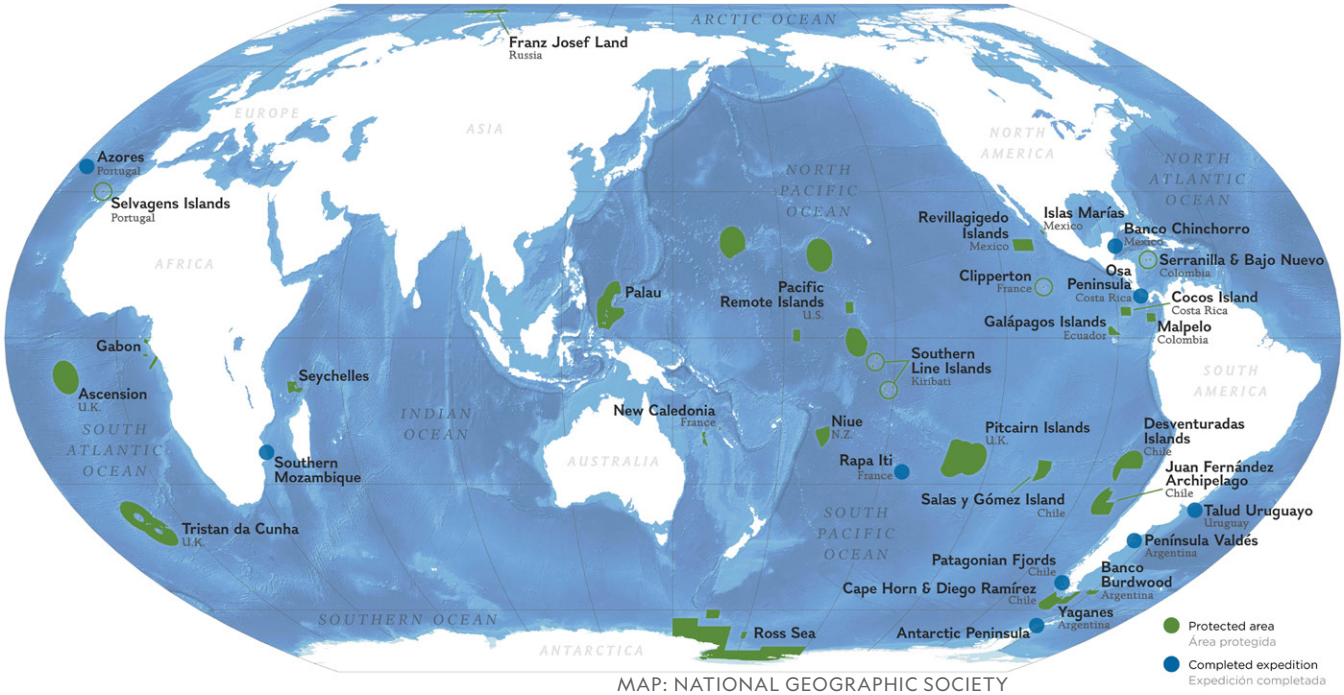
THE PRISTINE SEAS TEAM AND THEIR LOCAL SCIENCE PARTNERS TAG A TIGER SHARK IN THE CARIBBEAN WATERS OF COLOMBIA. TAGGING ANIMALS WITH ACOUSTIC AND SATELLITE TAGS ALLOWS THE TEAM TO UNDERSTAND THE MIGRATORY MOVEMENTS OF ENDANGERED SPECIES AND HELP DESIGN APPROPRIATE CONSERVATION MEASURES. PHOTO: MANU SAN FÉLIX, NATIONAL GEOGRAPHIC PRISTINE SEAS



ENRIC SALA DOCUMENTS MARINE LIFE FOUND IN DEEP WATERS OFF THE DESVENTURADAS ISLANDS, CHILE. SUBMERSIBLES LIKE THIS ONE ALLOW RESEARCHERS TO OBSERVE THESE HARD-TO-REACH ENVIRONMENTS FIRSTHAND, FAR BELOW THE DEPTHS ALLOWED BY SCUBA. PHOTO: ALEX MUÑOZ, NATIONAL GEOGRAPHIC PRISTINE SEAS

THE ESTABLISHMENT OF MARINE PROTECTED AREAS IS DRIVEN BY DATA AND OBSERVATIONS. ON AN EXPEDITION TO FRENCH POLYNESIA, PRISTINE SEAS USED BAITED CAMERAS IN OPEN OCEAN WATERS TO SURVEY AND DOCUMENT THE FISH PRESENT IN THAT AREA. PHOTO: MANU SAN FÉLIX, NATIONAL GEOGRAPHIC PRISTINE SEAS

TO DATE, PRISTINE SEAS HAS CARRIED OUT **36 EXPEDITIONS** IN MORE THAN **20 COUNTRIES** AND HAS WORKED WITH LOCAL COMMUNITIES TO INSPIRE THE CREATION OF **25 OF THE LARGEST MARINE RESERVES** IN THE WORLD. THESE MPAs COVER **MORE THAN 6.5 MILLION SQUARE KILOMETERS** OF OCEAN—AN AREA TWO-THIRDS THE SIZE OFTHE UNITED STATES—WHERE MARINE LIFE THRIVES AND HELPS REPLENISH SURROUNDING AREAS.



MAP: NATIONAL GEOGRAPHIC SOCIETY

PRISTINE SEAS WILL WORK WITH LOCAL COMMUNITIES, GOVERNMENTS, AND PARTNERS TO ESTABLISH NEW MARINE PROTECTED AREAS AND CATALYZE THE GLOBAL COMMUNITY TO PROTECT AT LEAST 30 PERCENT OF THE OCEAN BY 2030.

PHOTO: ENRIC SALA, NATIONAL GEOGRAPHIC PRISTINE SEAS

MPAs AT WORK: RECOVERING CABO PULMO

When Juan Castro Montaño was a boy in Cabo Pulmo, Mexico, fish were plentiful. "Fishing was very important for this community because that was our means of living," he said. Over time, commercial fishing took hold and grew to unsustainable levels. When the local community saw that their fish population was declining, they did something extraordinary. In 1995, they asked the Mexican government to create a national park in the sea to give their reef a chance to recover. This was not an easy choice. It meant that the people who made their living as fishers had to find a new path for themselves and their families.

"We stopped fishing from one day to the next," said fisher Mario Castro Lucero. "Now we work in ecotourism. It was very, very difficult, but we made it. It is a way of preserving the reef and dedicating ourselves to something else."

MAP: NATIONAL GEOGRAPHIC SOCIETY

The results were astonishing. **Cabo Pulmo National Marine Park has experienced the greatest recovery ever observed in a marine protected area.** During a 10-year period, **fish biomass increased by more than 460 percent**, bringing the reef to a level of biomass (the accumulation of living matter) similar to that of a reef that had never been fished. "I think that my dad, my grandfather, seeing how the reef has recovered, would think of how it was when they were young. And they would say: 'It came back. The riches that we had as kids came back.' I think they would have been very proud," said Mario.

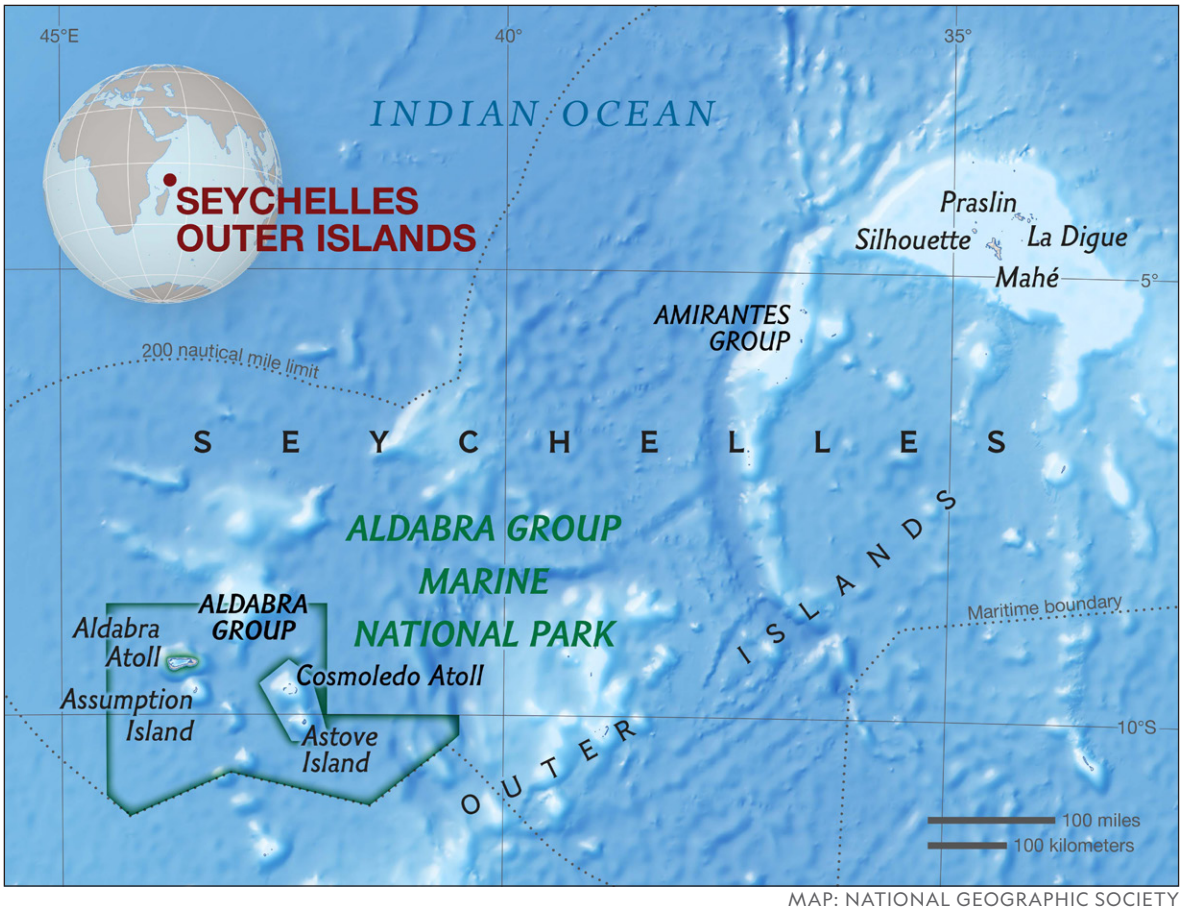
Juan agreed. "Other generations will see this when we're gone. We're the sentinels, watching over and taking care of it."

CABO PULMO BECAME A MODEL FOR **PRISTINE SEAS.**

PHOTO: MANU SAN FÉLIX, NATIONAL GEOGRAPHIC PRISTINE SEAS

MPAs AT WORK: PROTECTING BIODIVERSITY

Just north of Madagascar in the western Indian Ocean, 115 islands make up the **Seychelles Archipelago**. Aldabra is one of the world's largest coral atolls and has been a World Heritage site since 1982.



MAP: NATIONAL GEOGRAPHIC SOCIETY

THE ROLE OF PRISTINE SEAS

During 200 hours of scientific surveys at 39 locations, the Pristine Seas team assessed the biodiversity of the outer islands of the Seychelles. They found the island waters teeming with life. Working with local officials and nonprofit organizations, the team collected data that informed a proposal to create large no-take areas around the outer islands. Informed by their findings, **the government of Seychelles created a 74,400 square-kilometer highly protected MPA around the outer islands, covering 10 percent of their waters.**

FISHERS ROW HOME AFTER A MORNING OF WORK AT SEA. THE GOVERNMENT OF THE SEYCHELLES ENGAGED IN AN INTERNATIONAL AGREEMENT IN 2018 TO PROTECT 30 PERCENT OF THEIR WATERS WITH THE HOPE OF PRESERVING A HEALTHY OCEAN THAT CAN CONTINUE PROVIDING FOR THE SEYCHELLES PEOPLE. PHOTO: MANU SAN FÉLIX, NATIONAL GEOGRAPHIC PRISTINE SEAS

ALVANIA LAWEN LEADS A PARLEY FOR THE OCEANS BEACH CLEANUP. PHOTO COURTESY OF ALVANIA LAWEN

VOICES OF CONSERVATION: ALVANIA LAWEN, SEYCHELLES

For **Alvania Lawen,** a young ocean advocate living in the Seychelles, protecting these islands is a personal mission:

"Life in Seychelles is deeply integrated with the ocean. Protecting the ocean feels normal to me, like I'm meant to do it. I got my start in marine conservation at age 11 when I began snorkeling and experienced firsthand our diverse underwater life. From there I joined a successful campaign to ban certain single-use plastics led by the nongovernmental organizations (NGOs) Sustainability for Seychelles and SYAH-Seychelles. I advocated for plastic alternatives. Our combined efforts led to bans on the importation and distribution of items such as plastic bags and cups in 2017.

In Seychelles, our economy depends on tourism, and the tourism sector depends largely on the marine environment. The term 'blue economy' refers to this sustainable economic use of the ocean. NGOs play a big role in environmental protection here, and I am part of several women- and youth-led NGOs with an environmental focus.

Young people like me can make a difference. We can use social media as a tool to protect the ocean. You don't need to be Instagram-famous or have a ton of followers, as long as you stay focused on your goals and make connections with like-minded people and organizations. Try to treat any negative news, such as an alarming report about climate change, as a reason to persist in your work."

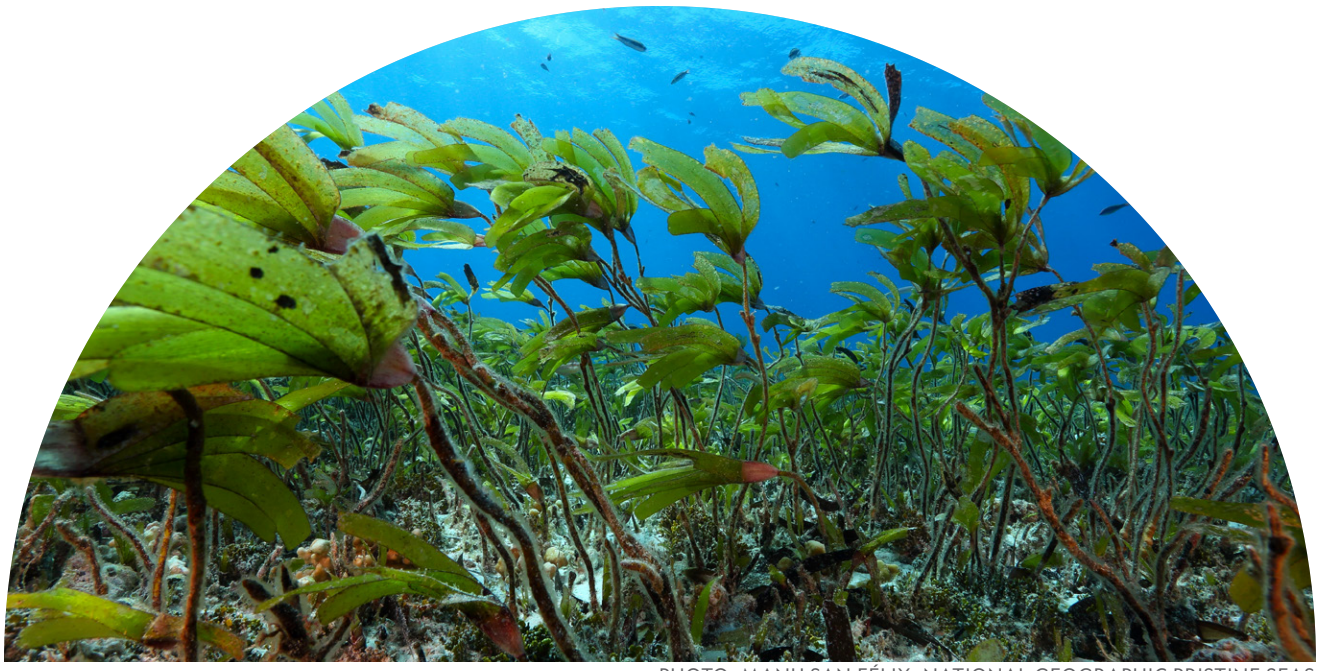


PHOTO: MANU SAN FÉLIX, NATIONAL GEOGRAPHIC PRISTINE SEAS

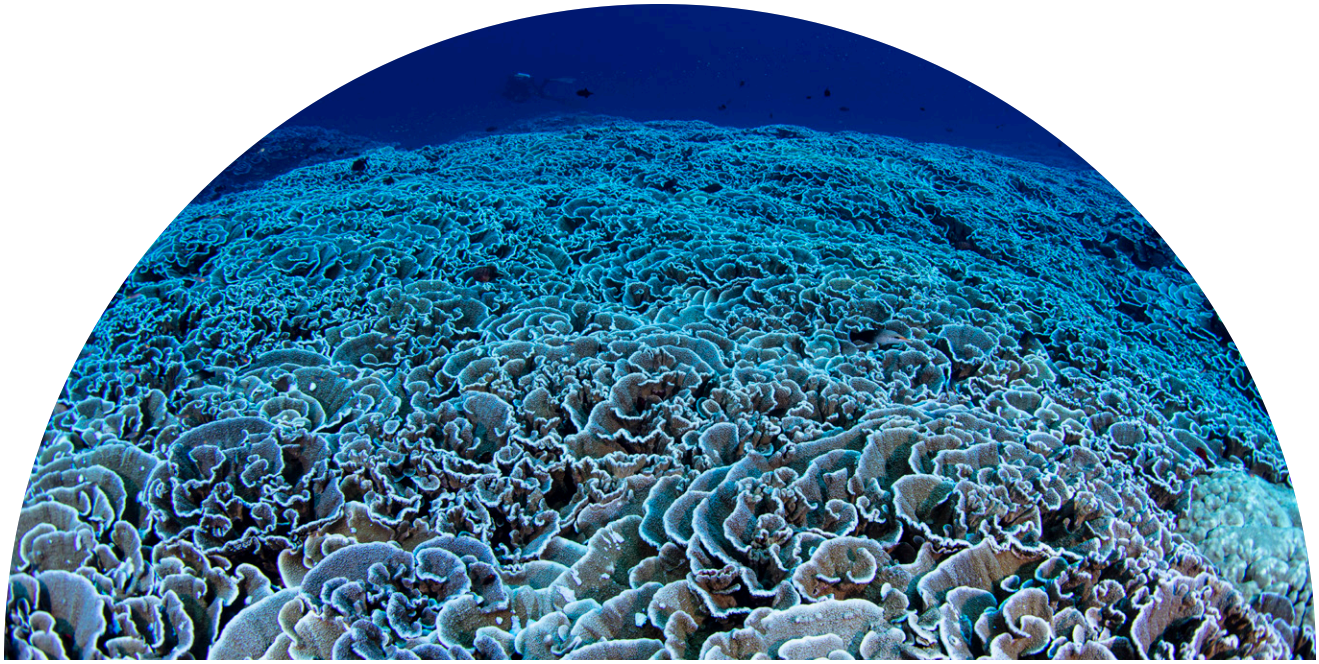
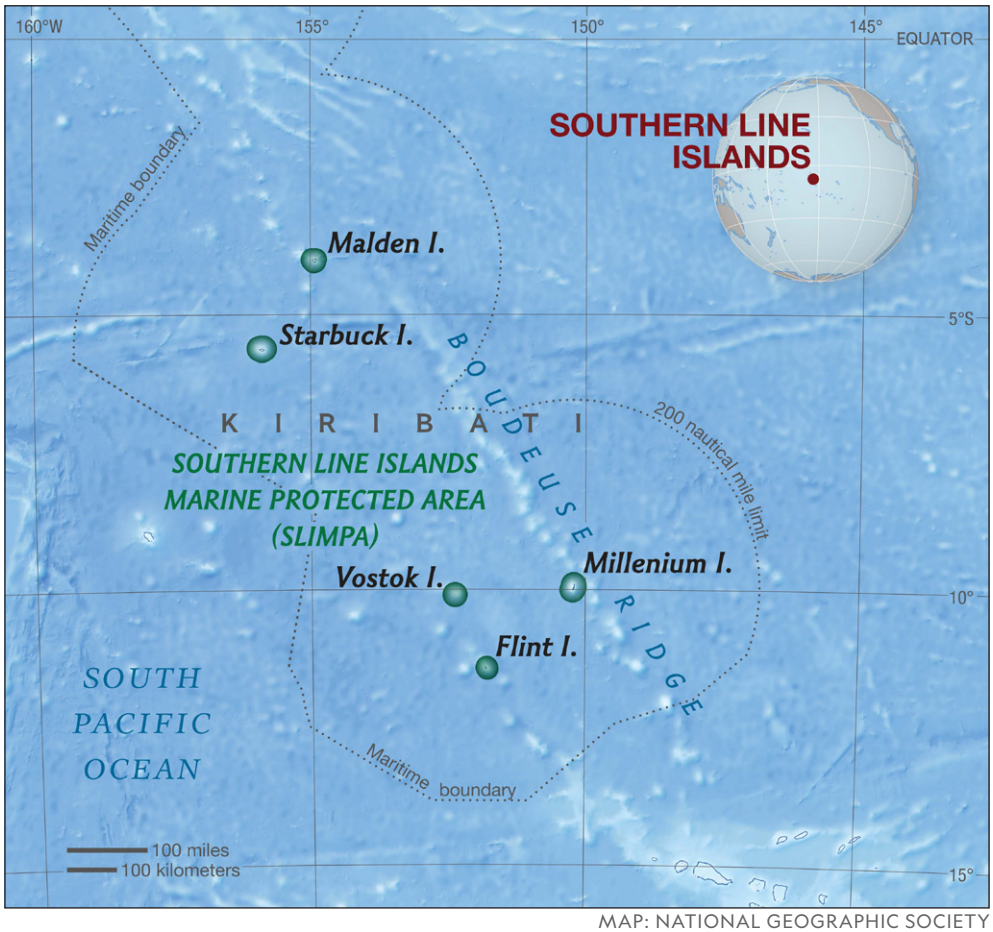


PHOTO: ENRIC SALA, NATIONAL GEOGRAPHIC PRISTINE SEAS

MPAs AT WORK: DISCOVERING NATURE'S RESILIENCE

In the remote Pacific Ocean, a chain of coral islands and atolls straddling the Equator make up the ecologically diverse southern Line Islands. Part of the Republic of Kiribati, these specks of land are among the most isolated atolls on Earth. They are uninhabited and rarely visited.



MAP: NATIONAL GEOGRAPHIC SOCIETY

THE ROLE OF PRISTINE SEAS

Divers spent more than a thousand hours underwater around the five islands in 2009. What they found astonished them. On some reefs, the corals were so dense they covered 90 percent of the seabed—vastly more than the average coral cover found in the Caribbean, which is typically less than 10 percent.

In parts of the lagoon at Caroline Island (Millennium Atoll), the density of giant clams reach up to four per square foot—an almost-unheard-of abundance for creatures highly sought for their meat and shells. These giant filter feeders act as water purifiers, cleansing the water of bacteria that can cause diseases in corals, fish, shellfish, and crustaceans.

As a result of the Pristine Seas team's findings, the government of Kiribati announced that **a 12-nautical-mile area around the southern Line Islands would be closed to commercial fishing beginning in 2015.** This area was to be protected so that it could remain pristine. But then disaster struck.

Across the Pacific, water-temperature spikes caused by El Niño weather events in 2016 killed off massive amounts of corals. The Pristine Seas team returned to the islands in 2021, expecting to see destruction. But the reefs of the southern Line Islands had bounced back spectacularly. How? Corals tend to be resilient in places where other elements of the marine ecosystem are flourishing, too. In the southern Line Islands, the large abundance of fish kept the dead coral skeletons free of seaweed and provided the conditions for corals to grow back. **As a result of its protected status, this place was resilient in the face of disaster.**

PHOTO: MANU SAN FÉLIX,
NATIONAL GEOGRAPHIC PRISTINE SEAS

A FIRE CEREMONY TAKES PLACE IN PUNTA ARBOL, A SYMBOLIC LOCATION FOR THE KAWÉSQAR INDIGENOUS TRIBE, NEAR CAPE FROWARD, IN FRONT OF MAGELLAN STRAIT. MEMBERS OF THE KAWÉSQAR, NOMADS, AND CANOEISTS HAVE LIVED HERE FOR OVER 6,000 YEARS. PHOTO: TOMAS MUNITA

MPAs AT WORK: SUPPORTING INDIGENOUS SOLUTIONS

Kawésqar National Park is one of the largest parks in the world and the second largest terrestrial park in Chile. The kelp forests off the coast of southern Chile are some of the healthiest on Earth.

MAP: NATIONAL GEOGRAPHIC SOCIETY

THE ROLE OF PRISTINE SEAS

In early 2020, Pristine Seas went on an expedition to the Patagonian fjords in partnership with the local Kawésqar and Yagan Indigenous communities. The explored area is threatened by intensive salmon aquaculture, which has become a major industry in Chile. Unfortunately, this industry has severe environmental, sanitary, and social impacts. The team conducted comprehensive scientific surveys of coastal and deepwater ecosystems and learned from members of the Kawésqar and Yagan about the cultural and ecological significance of the region. Pristine Seas is now supporting these communities to keep their culture alive and obtain full protection of their territories as a source of their identity, worldview, subsistence, and ancestral rights. The team produced a full scientific and cultural report from the expedition and a documentary film about this journey.

PHOTO: MANU SAN FÉLIX,
NATIONAL GEOGRAPHIC PRISTINE SEAS

WHAT TO DO

PROTECTING OUR OCEAN AND RESTORING IT TO FULL HEALTH IS A BIG TASK. THERE IS NO ONE-SIZE-FITS-ALL SOLUTION, BUT THERE ARE MANY THINGS THAT WE CAN DO—INDIVIDUALLY AND COLLECTIVELY—TO HELP.

› **Remember that our land and sea are connected.** Visit your local MPA, or local coast, river, or lake to explore, snorkel, dive, or connect with nature.

› **Boycott unsustainable fishing.** Don't eat unsustainable seafood. Look for labels that say "diver-caught" or "line-caught."

› **Reduce your carbon footprint.** Use less fossil fuel energy in daily life. Drive your car less or take public transporation. Reduce energy use by choosing energy-efficient appliances, and learn about solar initiatives in your community.

› **Reduce the amount of waste you produce.**

› **Reuse items when you can.** Choose reusable items over disposable ones. Recycle as much as possible. Avoid plastic bags. Buy second hand clothing instead of new.

› **Conserve water.** Freshwater is a limited resource, and it's scarce in many parts of the world. Using less water leads to less runoff and wastewater dumped into the ocean.

› **Volunteer.** Conservation groups need your help.

› **Lead or participate in a community cleanup**. By picking up the trash we find on our local streets, rivers, streams, or beaches, we can prevent that waste from becoming marine debris.

› **Plant trees.** Our trees and forests help reduce atmospheric carbon dioxide, taking pressure off our ocean.

› **Eat a plant-rich diet**. Buy local produce to reduce transportation and production emissions.

› **Watch what you flush!** Avoid flushing household cleaners, pesticides, drain cleaner, and cat litter, because those chemicals can seep into our ocean, rivers, and lakes.

› **Become a citizen scientist** by using **iNaturalist: inaturalist.org** or **Debris Tracker: bit.ly/3fUwVXm**.

› **Learn more with National Geographic** by taking the **Ocean Challenges and Solutions** course: **bit.ly/3rSJftX** or **Storytelling for Impact** courses: **bit.ly/3EN24Gu**.

› **Follow Explorer Enric Sala** and Pristine Seas social media and stay up-to-date on their efforts across the globe.
twitter.com/Enric_Sala
instagram.com/enricsala/

› **Learn, then teach.** When we understand how our ecosystems work, we can take steps to protect them. Learn as much as you can, then raise awareness by sharing what you know with others.

› **Speak up.** Advocate for the change you want to see in your community and in the world.

CALL TO ACTION

WHAT CAN YOU DO IN YOUR COMMUNITY? AFTER READING THIS HANDBOOK AND SEEING SOME OF THE SUGGESTIONS ON PAGE 31, CREATE A PERSONAL ACTION PLAN TO HELP CONSERVE THE OCEAN.

Ask yourself a few key questions:

1 › What do you think is the best way to promote ocean conservation in your community?

2 › What are the advantages of this action or solution?

3 › Can you think of any disadvantages?

4 › What more do you need to know or to research to make a full plan?

5 › Make a list of all the parts of your plan. What will you do first? What next?

6 › Is this a plan that you can accomplish on your own or will you need help?

7 › List some individuals or groups who might be willing to support your idea.

8 › How might you approach these people to get their help?

9 › Create a timeline for your plan. How long will it take to do each part?

10 › Share your plan with others and get feedback.

11 › Refine the plan according to the feedback.

12 › When the plan is ready, take action!

NEED TO KNOW MORE?

IF YOU'D LIKE TO KNOW MORE ABOUT OUR OCEAN, THE THREATS AGAINST IT, AND HOW YOU CAN HELP, CONSIDER USING SOME OF THESE RESOURCES:

PRISTINE SEAS

› **bit.ly/3MtS6vC**

FOR EDUCATORS

› Professional Learning Courses (Climate Change, Geo-Inquiry Process, ASK, Plastics): **bit.ly/3Cqdeyi**

› One Ocean Educator Guide (for Professional Learning): **bit.ly/3S4lXfb**

› Earth Day 2021 Guide focused on the ocean: **bit.ly/3fZjlSB**

› Geo-Inquiry: **bit.ly/3TljfDq**

FOR LEARNERS

Citizen Science

› iNaturalist: **inaturalist.org** and Seek: **inaturalist.org/pages/seek_app**

› Marine Debris Tracker: **bit.ly/3fUwVXm**

› Sea-to-Source Toolkit: **bit.ly/3Tio5kB**

Mapping:

› MapMaker Pristine Seas: **bit.ly/3g662jt**

OFFLINE RESOURCES

This section includes example resources that could be downloaded or transmitted to communities that may not have access to strong internet. Many of these resources can be printed or downloaded to PDFs or zip files. Look for the appropriate icons on each resource next to the social media icons, typically just below the resource photo: 🖶 ⇩

› **Marine Food Chains** Students use marine organism cards and trophic level classifications to identify and describe food chains in several marine ecosystems. Downloads to zip file containing multiple PDFs. **bit.ly/3CsNQbj**

› **Sustainable Fishing** A leveled encyclopedic entry that introduces the topic and defines key terms. Can print or save to PDF. **bit.ly/3erl3Mj**

› **Protecting the Ocean** Students discuss "who owns the ocean" and work in small groups to explore ocean use questions. Then they watch videos and discuss concepts related to the creation and designation of Marine Protected Areas (MPAs). Downloads to zip file containing two PDFs. **bit.ly/3yFilEa**

› **Our Interconnected Ocean** Students discuss the geography of the ocean and explore how the ocean has been categorized in the past and today. Downloads to PDF. **bit.ly/3CVU4Sm**

› **Marine Protected Area Management** Students read a case study and debate the pros and cons of a Marine Protected Area (MPA) in the region. Then they select a Marine Protected Area and develop and present a management plan for it. Downloads to zip files containing multiple PDFs. **bit.ly/3RVdxH3**