THE SEAS OF MEXICO AND THE WORLD



GERARDO CEBALLOS

Rurik List · Lourdes Martínez · Donald A. Croll Rodrigo Sierra · Eduardo Ponce





Protection and conservation of the environment

he Carlos Slim Foundation and TELMEX support a wide strategy of biodiversity conservation and the sustainable development of Mexico. Therefore, strategic alliances have been established with the World Wildlife Fund (WWF), the Secretary of the Environment and Natural Resources (Semarnat), the Mario Molina Center, the National Autonomous University of Mexico (UNAM), the National Commission for the Knowledge and Use of Biodiversity (Conabio) and the National Commission of Protected Natural Areas (Conanp), amongst other equally relevant.

We highlight in this program the work carried out with the WWF in 6 regions of the country (Gulf of California, Chihuahua Desert, the Monarch Butterfly Biosphere Reserve, Oaxaca, Chiapas and the Mesoamerican Reef System), where 18 priority areas are grouped together.

Also, the Carlos Slim Foundation and TELMEX joined efforts since 2005 to support the national strategy for the conservation of jaguars and reduce the impact of the activities that threaten it, based on compatible policies to the sustainable development of each region. To date, eight national and an international symposia have been held and that have analyzed the jaguar problem and solutions and actions have been proposed for its conservation.

On the other hand, nine books have been published that disseminate topics on the biological diversity of Mexico, America and the world, their natural wealth, importance and threats they face and possibilities for its conservation in the long term.

Book I. Tierra mexicana: selvas, desiertos y mares (2007)

Book II. Naturaleza mexicana: legado de conservación (2008)

Book III. Fauna mexicana: esplendor de la naturaleza (2009)

Book IV. Los felinos de América: cazadores sorprendentes (2010)

Book V. Animales amenazados de América: el reto de su sobrevivencia (2011)

Book VI. Animales de América: migraciones y grandes concentraciones (2012)

Book VII. Mamíferos del Mundo: regiones biogeográficas (2013) **Book VIII.** Áreas naturales de México: legado de conservación (2014)

Book IX. Los mares de México y del Mundo (2015)

The Carlos Slim Foundation and TELMEX ratify their commitment with the natural surroundings and environment.





THE SEAS OF MEXICO AND THE WORLD











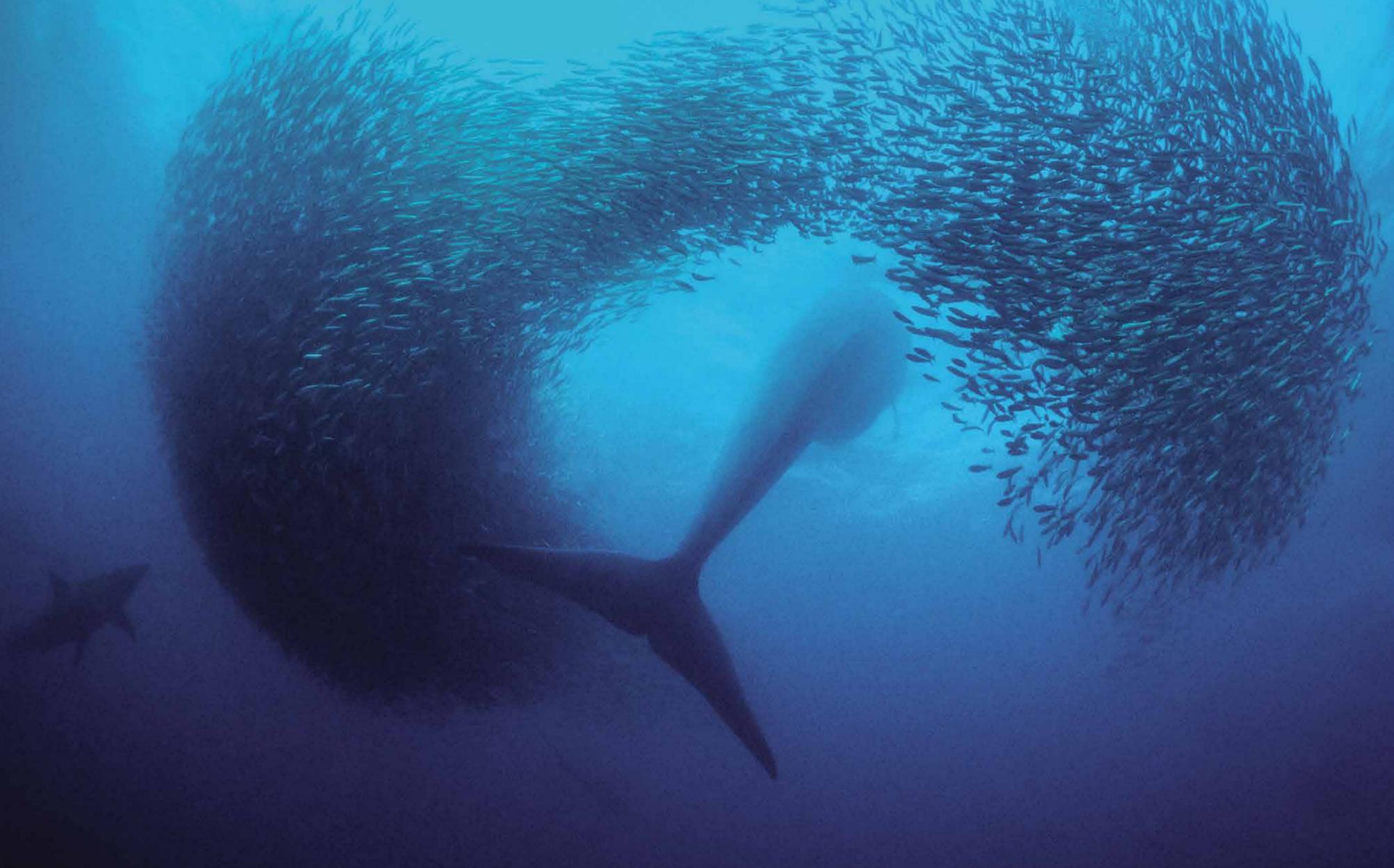


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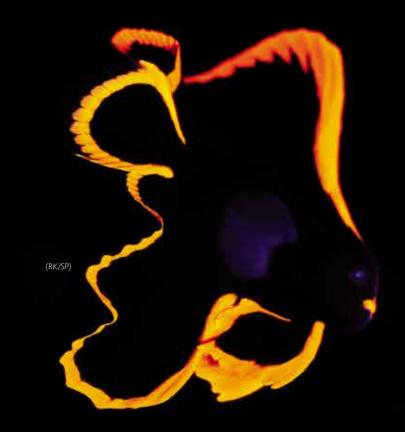




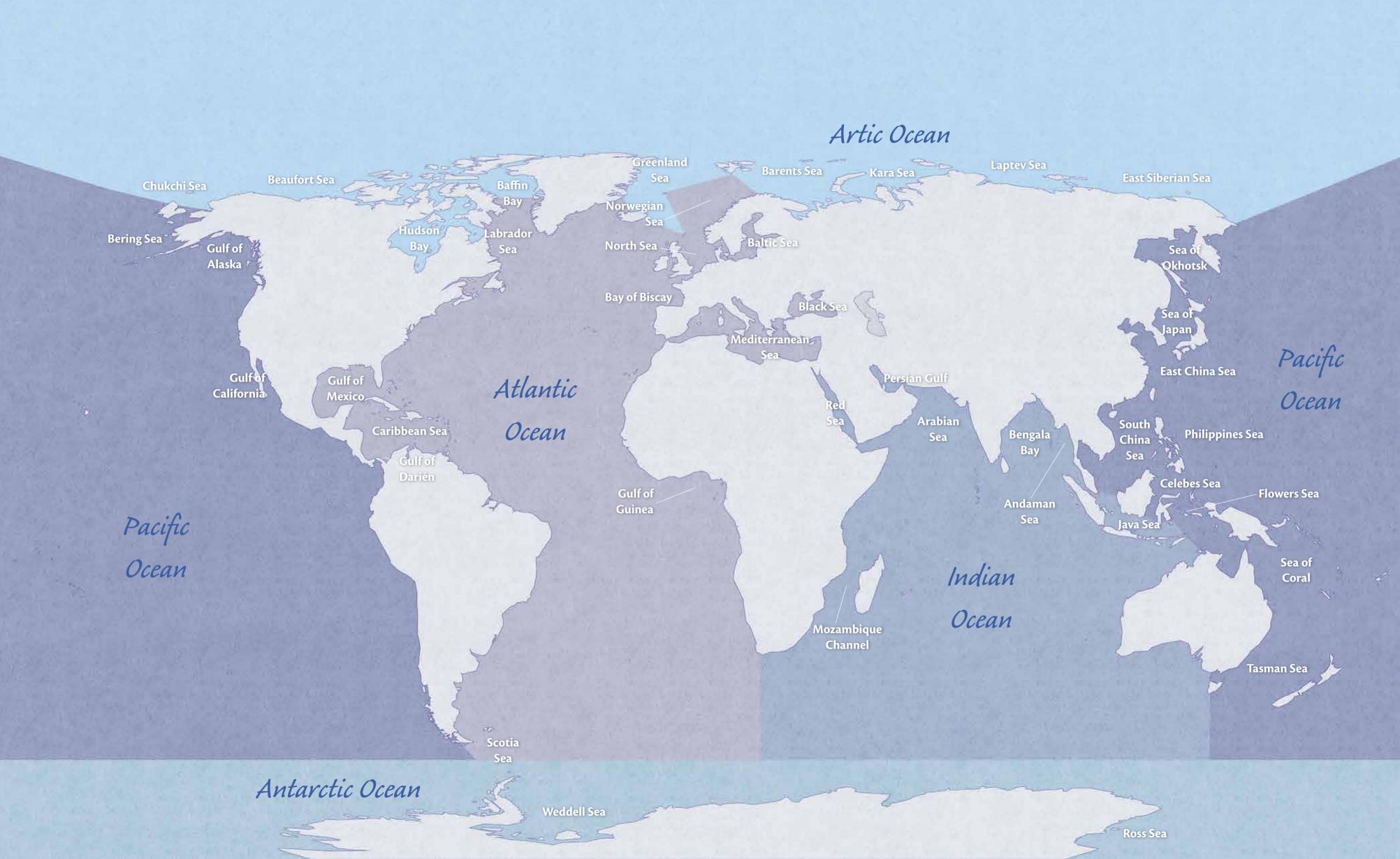


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PRESENTATION

being is dependent upon maintaining the health of this relationship. From global scale interactions such as nutrient cycling and climate maintenance to human enterprises such as fishing, mineral extraction, transportation and tourism, the health of the as a result of atmospheric climate change, pose serious threats oceans is a critical determinant of the success of the human species and the life support systems on which we depend. As human civilization evolve and become more complex and its needs change, it is imperative to understand the pressures and assaults human societies are placing on the oceans and to recognize that it is in our collective good and responsibility to protect them. Aside from providing basic services, the sea will continue to be a critical component of human culture: a source of inspiration, challenge and mystery.

As recently as two centuries ago, the term Mare Incognitum (Latin for "unknown sea") appeared on some maps to represent large areas of the oceans that were not explored or well known. Still today large areas of deep-sea abyssal depths have not been explored or mapped and are considered the last frontier of planet Earth. In fact, it is not uncommon to read that more is known about the surface of some celestial bodies such as the Earth's moon or Mars than is known about the seas of our own planet. Despite this gap in knowledge of the seas, their exploration began thousands of years ago. For example, the ancient Polynesians traveled in fragile barges thousands of kilometers from Asia as they colonized islands in the southern regions of the as the *vaquita*, sea turtles, and sharks, and adaptive strategies to western Pacific Ocean. Later, during the Age of Discovery (beginning during the 15th century), explorers such as Christopher Columbus, Vasco da Gama, Ferdinand Magellan and Vitus Bering seas also involve a commitment to simultaneously facilitate chartered routes that would later foster navigation throughout the world's oceans and discoveries of new lands and resources. The arrival by boat of Frederick Cook at the North Pole in 1908 and Roald Amudsen at the South Pole in 1911 marked end of moral imperative to protect the seas, and in doing so, we enrich discovery of unexplored and unchartered large land masses.

This book is about oceans and the unique place they occupy in our lives, as a storehouse of food and material, pathways to other parts of the world, source of inspiration, and object of beauty and wonderment. As vast and expansive as the oceans are, occupying 70% of the Earth's surface, their health and that of the organisms they support, is increasingly threatened. Human

Life on Earth is inexorably linked to the sea, and human well- assaults on the sea such as overfishing, loss of species diversity and the establishment of exotic species, chemical and radiation pollution, increasing numbers and sizes of floating garbage patches, and changes in sea water chemistry and temperature to the ability of the oceans to support the services and goods we need from them. The objective of this book is to highlight the importance of healthy oceans and the imperative to protect their biological and physical integrity, and to share some of their beauty and mystery. This book is the ninth in a series started almost a decade ago and is part of a program sponsored by Telmex and supported by the Carlos Slim Foundation. Working with the World Wildlife Fund for Nature (WWF) in Mexico since 2008, this program focuses on novel and inclusive initiatives that foster sustainable development while protecting the unique environments and rich biodiversity of Mexico's seascape and landscape. One of the most high profile components of the program, which includes six priority regions of Mexico, focuses on efforts to better understand and protect the Sea of Cortez. These multifaceted initiatives, supported by key national institutions such as the Secretaries of the Army, Navy, and Environment and Natural Resources, civil society organizations, and local communities, promote technological and management solutions for a sustainable fishing industry, a strengthening of the protected marine areas, enhanced conservation efforts of endangered species such address climate change challenges.

We recognize that efforts to protect the health of our community development. While this dual focus may present unique challenges, failure is not an option if we want to secure a better future for all Mexicans. We have a societal obligation and our lives. This book will help you understand the seas around us and challenge your imagination to contribute to their protection and enjoyment of the mysteries and beauty they hold.

> HÉCTOR SLIM SEADE Chief Executive Officer Teléfonos de México



PROLOGUE

The seas of Mexico and the World is a book even more special than it seems, because humans are sea creatures. The sea has always played a big role in what it means to be human. One hundred thousand years ago, some of the earliest people were fishing and looking for shellfish. Seafaring humans reached Australia at least 40,000 years ago. Polynesians fared throughout the vast Pacific with no metals and no compass. Humans have long moved and lived along rivers and coastlines and the open seas, and so do the things we make and trade. Nearly half of humanity lives within 16 kilometers of the seacoast. We remain largely an ocean-oriented species.

But the problem is: there are too many of us and we expect the sea to give us our food and to take our garbage. The wild fish of the sea cannot feed us any more than can the wild animals of the land. In many places the land has transformed and the animals are gone. What will happen in the sea?

Much of the ocean is still a lawless place, under the jurisdiction of no country, with no rules, yet deeply changed by legal and illegal fishing, fish depletion, pollution by fertilizer, sewage, mercury (from coal burning) and other toxic metals, plastics, and other things. We put into the sea what does not belong there, while we remove from the sea what belongs. This is not a healthy relationship, not for the trillions of living things in the sea, not for us, and certainly not for the next human generations. We like to think of ourselves as God's gift to the world, yet for almost everything that lives, we are nothing but trouble.

We are the only species that creates problems for life on Earth. (Not to mention the problems we create for each other.) Yet seem unable or unwilling to solve the problems we start.

For millions of years the ocean remained mainly outside our grasp. Then in the early 1900s, internal combustion engines allowed boats to pull nets larger than the world had ever seen. After World War II, radar and sonar and loran developed for fighting enemies at sea quickly were turned to fight what basically became a war on fishes. Radar let boats keep fishing in fog. Sonar allowed captains to see fish schools hundreds of feet beneath the surface. Loran allowed boats to return to any pile of rocks or any deep canyon where fish gathered. Before then, the fishes had two great safe places in the sea: one was called by fishermen "too far" and the other was called "too deep." But by the end of the 20th Century, fish could no longer hide. Wherever they swam or gathered, we could find them and send a net or a line to get them.

Fisheries managers learned in school that their profession was to help find and catch more and more fish. They never were taught the words, "enough," or "too many." Meanwhile all of this meant there were fewer and fewer fish in the sea and in the nets.

Starting in Latin America in the 1950s, countries alarmed that fishing boats from other countries were increasingly coming and taking the fish off their coasts began extending their territorial seas. They declared the waters out to 200 nautical miles from the coast as their "exclusive economic zones." Closures during the early '90s of much of Canada's Grand Banks and the U.S.' Georges Bank —which for 500 years had been the richest fishery on Earth— was recognition that an ocean could be depleted by fishing. By then it was realized by many people that overfishing by a nation's own fleet could destroy fisheries and fishing communities. The solution —reducing pressure on the fish— was not widely agreed. After the North depleted the fish there, European and Russian distant-water fishing fleets turned south, into the fishing zones of countries too desperate for foreign cash to say no, and too poor to enforce restrictions, especially in Africa.

In the last 30 years we have increasingly recognized the problems of: overfishing; catch of untargeted marine life; rising illegal and unreported fishing; a need to govern the open-ocean commons; the need to protect whales, dolphins, sharks, and sea turtles; pollution; plastics; warming; and acidification. But we have not solved these problems we now recognize.

The United States in 1998 enacted a law prohibiting fishery managers from allowing higher catches of fish than scientists recommend, and requiring plans

to let fish populations rebuild in about a decade. As a result, some populations of depleted species have shown substantial recoveries. Catches of endangered turtles have been significantly reduced in several places by putting trap doors called turtle excluders in trawl nets, and protecting their nesting beaches. In Mexico and many places turtle populations are increasing, especially on the Atlantic side. Albatrosses and most other seabirds can be kept away from lines or nets behind boats by using streamers to frighten the birds, and other simple techniques. The eastern Pacific tuna fishery's improved dolphin-release procedures have greatly reduced the numbers of dolphins drowned. The United Nations has a high-seas fisheries treaty and a Code of Conduct for responsible fishing that also acknowledges sharp declines in populations of sharks and seabirds. The Convention on International Trade in Wild Flora and Fauna, also known as CITES, has become involved in fisheries issues such as trade in seahorses, shark fins, and caviar-producing sturgeon.

In a world facing still-increasing human populations, sustaining and rebuilding life in the ocean will be challenging. Many assume that the answer is fish farming. Fish farming has grown so fast that more than half of seafood eaten by people is now farmed. But fish farms are often created by destroying natural habitats that support wild fish populations and human communities. Farmed fish and shrimp must be fed fish caught from the ocean—fish that could more efficiently and cheaply feed people. The way forward lies in developing less harmful farming methods.

Because many nations cannot afford patrols and enforcement, areas closed to fishing —marine reserves— may be the simplest, best way to secure a future for what lives in the sea. Nations as wealthy and developed as New Zealand and as impoverished as Madagascar now have established such reserves. One of the best examples in the world is Cabo Pulmo in Mexico's Baja California, where in a few years, fish populations rebounded inside the protected area. This place has become attractive to paying tourists. And fish swimming out of the reserve contribute to increasingly sustainable fishing. Another worldclass Mexican example is Punta Abreojos, where the fishing community established sizes and seasons more restrictive than national law allows, and set up a highly successful abalone hatchery, where young abalone are planted in the sea. I have witnessed in person the tremendous successes of the different approaches taken at Cabo Pulmo and Punta Abreojos. What they have in common is a desire for a better future and a willingness to limit today in order to make a promise to tomorrow —a promise that includes their children and their grandchildren.



Not every problem can be solved by no-fishing zones. On a finite planet, we cannot continue adding more people indefinitely. Warming, ocean acidification, and mercury caused by fossil fuel burning, increasing plastics and various kinds of pollution; for these we must find the will to cooperate globally to solve these big problems, creating new forms of plastic that biodegrade, and a whole new clean energy future.

But there is still time. And, always, there is hope. In Seas of Mexico and the World, world-class scientist and conservationist Gerardo Ceballos has convened the team, the photographs, and the story that lets the ocean make its own case for why we must allow it to survive and be healthy. I urge you to take the message deep. The case for the ocean's survival is also the case for our own survival. The ocean could exist without us —and for most of Earth's history it did, and very well. But we could never exist without the ocean. As Dr. Ceballos and his colleagues explain, the sea makes all life on Earth possible, including yours, and mine.

CARL SAFINA
Professor of Natural Science and Humanities at the Stony Brook University,
New York, and founder of the Safina Center

THE SECRETARY OF THE NAVY AND ENVIRONMENT



National Environment

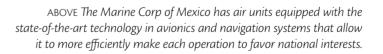
Mexico is the twelfth country in the world on coastline extension and sea surface —approximately 11 122 km of coastline and an exclusive economic zone of 3 149 920 km²—; characteristics that give it high levels of wealth in species and ecological diversity. The interaction between tropical and temperate waters, the junction of geographic zones and the coastline's physical geography of the country are translated into a high heterogeneity of coastal and marine environment that host an essential component of the mega diversity of Mexico. Specifically, the high index of sea species, comparable to the continental species, makes of our Nation a benchmark for preparation of programs for the preservation of each species in its natural habitat.

In the case of marine ecosystems, the Gulf of California and the coral reefs of Yucatan and Quintana Roo are outstanding due to their contribution to the great biological diversity. The Gulf of California is one of the most diverse whale zones and hosts 35 per cent of the marine mammals of the world, namely, 28 species. It is also documented that of the 439 mammal species in the world, 139 live in Mexican waters, or 32 per cent.

At global scale, the main threats affecting marine and coastal biodiversity —besides compromising the capacity of the coasts and oceans to provide services and environmental goods— are pollution, overfishing, illegal fishing, degradation or destruction of habitats due to land use change, climate change and the acidification of the oceans.







CENTER Inspections and surveillance are priorities for the Secretary of the Navy-Marine Forces of Mexico, new Defender FC-33 ships have been distributed to Search and Rescue Naval Stations and Maritime Surveillance to take care of all emergencies and avoid acts that impact the ecological stability of the sea.

BELOW Patrol and surveillance operations in territorial waters and in the exclusive economic zone allow the Marine Corp of Mexico to dissuade people from performing illegal acts at sea.





ABOVE Operating use of the air units and intercepting patrols contribute to combat, amongst other illegal actions, illegal fishing and also to protect the maritime environment of the country.

BELOW The development of a scheme called "operation trinomium" formed by a vessel, an intercepting boarded ship and a helicopter allows providing a versatile, agile and expedite response.





In this sense, the Secretary of the Navy, besides the surveillance, defense of the national territory and safeguard of human life at sea actions, has implemented measures to maintain the biological diversity, the productivity of the marine ecosystems and the habitats subject to their national jurisdiction.

These measures include doing marine and coastal diversity studies; the preparation of species inventories whether they are or are not in a category at risk, and of their corresponding habitats; the establishment of a protected zone; and also the scientific support and the dissemination of its results. Likewise it is in charge of effectively enforcing the environmental laws on marine environment protection matters, in efficient, effective, expedite and transparent issues in coordination with the authorities involved and promotes sustainable development of socioeconomic projects in national coastal areas. In addition, amongst other activities it participates in the National Program for the Handling and Sustainable Use of the Mangrove, in the Conservation and Protection of the Sea Turtles Program and the monitoring for the detection and identification of the blooming of harmful algae.

At inter institutional level, the Secretary has signed several collaboration agreements to monitor, preserve, protect and restore the ecosystems and natural resources of marine zones such as the Revillagigedo Archipelago, the Alacranes reef, Upper Gulf of California and the Colorado River Delta, the marine *vaquita* (porpoise *Phonoena sinus*) protection polygon, Guadalupe and Marietas, islands in the Gulf of California, besides the main beaches where the sea turtles nest. Basically the objective is to increase the protection of priority species such as the sea cucumber, the marine *vaquita*, the Totoaba, the sea turtles, the grey whales and the hunchback whales, the white shark, the corals ad the seahorses. For that purpose on March 1, 2015 in the Gulf of California the convention was implemented in order to expand the protection polygon, to restrict the fishing activity, to reinforce the inspection and surveillance and to promote the use of new fishing forms in order to preserve the marine *vaquita* and the Totoaba.

Also, the Navy of Mexico received 17 Defender FC-33 vessels to be sent to the Navy Stations of Sea Search, Rescue and Surveillance and increase the naval presence and the employment of new technologies in those maritime zones, that due to their geographic position and large amount of natural resources therein, are susceptible of being used for illegal activities or exploited despite the law. In parallel, this naval institution shall create new Naval Search, Rescue and Maritime Surveillance Stations in the Upper Gulf of California, specifically at the Libertad Port in Sonora; Santa Rosalía and Loreto in Baja California; Topolobampo, in Sinaloa; and also in San Felipe where, also, a new Naval Sector shall be built.

With these actions and the permanent presence of the navy in strategic places in our country, Mexico's Secretary of the Navy helps in the preservation of the Biosphere Reserves and inhibits actions that may affect the National Security.







ABOVE School Ship Cuauhtémoc, worthy representative of our Homeland, on those decks its crews have, are and will continue to be the spirit of the very ship.

CENTER The worn steel of the hull refreshes in the Atlantic and Indian seas, blue oceans identified at the abysmal depth.

BELOW Showing off its white sails together with all the gears, this Aztec Emperor, begins each year it starts a voyage that overcomes all the challenges imposed by the oceans.

PAGE 39 Majestic and with the peace brought about by the calmed sea, the sailboat Cuauhtémoc tirelessly sails around the wold complying with its mission in favor of our Nation.

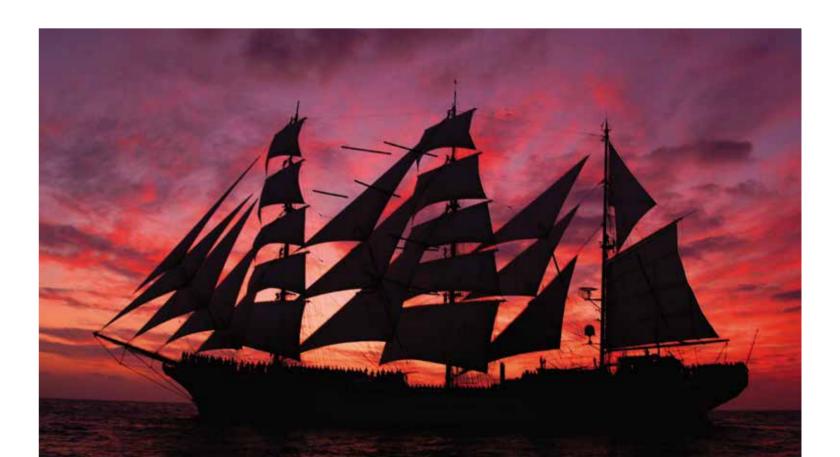
International Environment

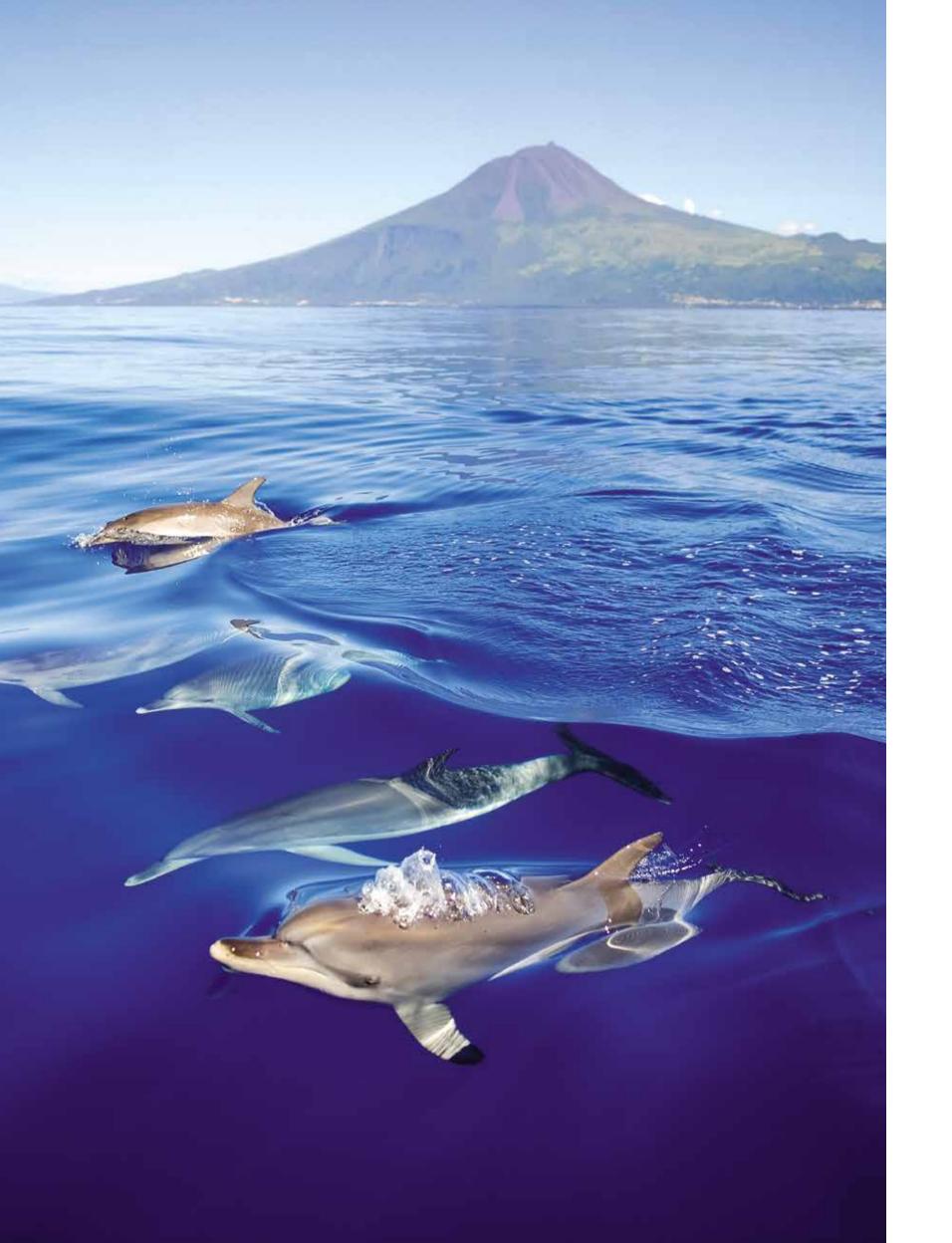
Since the conservation of marine and coastal biological diversity is an area of interest for the world, Mexico has joined the protection of oceans, seas and coastal zones, and also the rational use of its living resources. In order to manage in an integral and sustainable way the oceans and the coasts, it established the creation of the Inter-secretarial Commission for the Sustainable Management of Seas and Coasts (CIMARES), the formulation of the National Policy on Seas and Coasts and the preparation of national strategies on specific issues, such as the national strategy case of attention to marine and coastal biodiversity, and also for the protection of priority ecosystems such as mangroves.

Compliance with the regulations on marine environmental protection is another issue that is carefully being surveilled; an example of this is the compliance with the International Convention on the Prevention and Control of Pollution of the Sea from Disposal of Waste and Other Matters, its corresponding Protocol and Regulations.

The Secretary of the Navy of Mexico, as a defending body of the goods of the Nation in the sea, is represented by the emblematic Lord of the Seas, the Sailboat Training Vessel Cuauhtémoc, when it is navigating the seas of the world, carries not only a message of peace from the Mexican people, but also the love that Mexican seamen feel for the sea itself and the legal regulations they require. On board, the cadets in training, asides from the navigation arts learn that the distribution, composition and structure of the marine communities respond to seasonal variations of environmental factors and that they are determined by a large number of physical and biological interactions. Likewise, they see that there is a dynamic exchange of energy and materials between the land, maritime and atmosphere ecosystems associated to phenomena such as changes in the patterns of the winds, the temperature and the rainfall that influence the circulation and parameters of sea water such as salinity, temperature and density, which in turn set the limits of the space where the species are found.

Therefore, the cadets and the crew during their crossing know the art of navigating and are motivated by the body spirit, because they are aware that the conservation of the biological diversity and the sustainable utilization of its components, preserve the sea which is their inspiration, their everything.



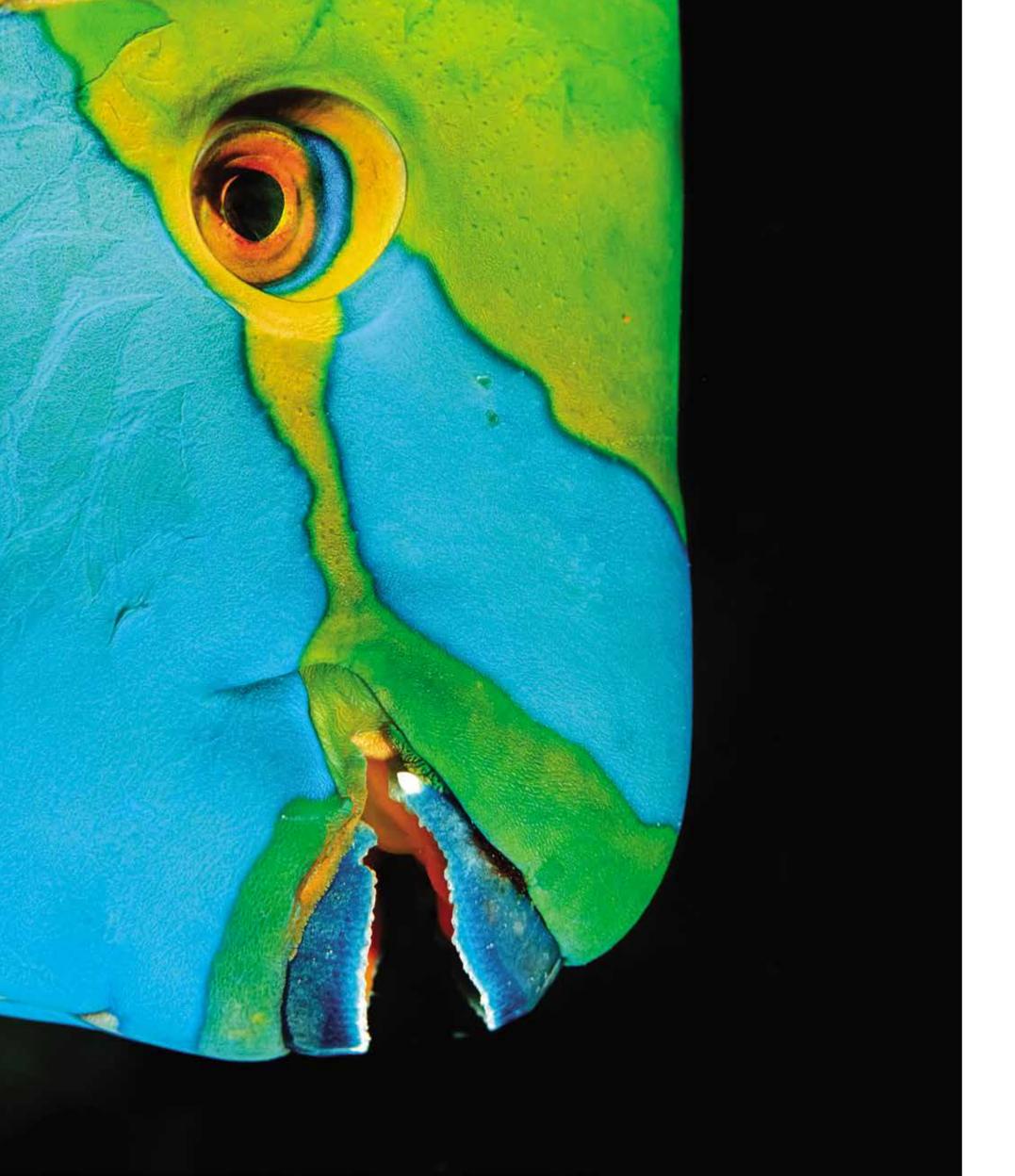


GERARDO CEBALLOS

THE BLUE PLANET

Scientific discoveries and explorations continue to reveal elements of the amazing story of the origins and progression of events that shape Earth and the life it supports. An image of Earth taken on December 7, 1972 from a distance of 45,000 kilometers by the Apollo 17 astronauts on a mission to the moon shows Earth as a body suspended in a dark and vast universe. This photograph evoked a sense of loneliness and awe and helped us understand and appreciate the fragile and finite nature of our planet. In this iconic image, Africa and the Antarctic are illuminated by sunlight, clouds cover other regions, and Earth appears as a blue sphere. This color and the overwhelming extent (more than 71 per cent of the surface area) of the oceans have given rise to the nickname of our world, the Blue Planet.

Water is a primal or key ingredient for life as we know it. Simple in its chemical structure, a water molecule consists of two hydrogen atoms attached to one oxygen atom. The unique ability to dissolve a large number of substances is central to the role of water in life. More than 96% of all the water in the world, or about one billion three hundred million cubic kilometers, consists of the salt water of the oceans. The remaining 4% is the freshwater compliment and includes rivers and streams, soil and atmospheric moisture, water held in aquifers,



and water locked up in glaciers and other frozen structures. The overwhelming extent of the Earth's surface covered by oceans and the unique physical and chemical properties of water are major determinants of the planet's climate. The oceans play a major role in the temperature profile and circulation of the atmosphere, the hydrologic cycle, and as regulator of carbon dioxide concentrations in the atmosphere.

The age of Earth is estimated to be about 4.6 billion years, and its appearance and structure were not unlike that of other "lifeless" planets in the universe when it first formed. While there are still unanswered questions about the mechanisms of how life began on Earth, there is substantial evidence to show that it began about 3.5 billion years ago. During the early history of Earth and the beginnings of life, the atmosphere was very different than current conditions: very low concentration of oxygen and a high concentration of other gasses that would be poisonous to most life forms alive today. The emergence and expansion of life changed the composition of the atmosphere and the concentration of oxygen increased substantially.

Beginning in the early part of the 20th century, pioneering work of scientists offered theories how life emerged on the newly formed planet. The Origin of Life (1924 and 1936) by the Russian biochemist Alexander Oparin proposed a plausible theory about the origin of life and noted the similarity in the composition and structure between live organisms and inert matter. Oparin wrote, "The complex combination of manifestations and properties so characteristic of life must have arisen in the process of the evolution of matter". Subsequent research, such as that by Stanley Miller (1953), suggested mechanisms by which some of the molecules of life could have formed on the young planet Earth. What happened during the first billion years of life on Earth still is not well understood and is open to many theories. However, it is clear that the first unicellular organisms evolved into macroscopic and more complex multicellular bodies, and, at a later period, the first visible plants emerged. Later, about 700 million years ago and during the Cambrian Period, there was an explosion of different macroscopic marine animals. Suddenly (in the scale of geological times) the seas were populated by many types of animals, varying in form, appearance and behavior. Millions of years later fish and other vertebrate groups evolved from. About three million years ago our ancestors appeared.

The identification of the flora and fauna species that existed before humans is based on the fossil records such as petrified traces of plants or animals parts such as such as bones, shells or scales. The discovery in 1987 of fossils of an archaic form of microscopic cyanobacteria in layered formations called stromatolites confirmed that life probably began in the Archean Eon, or at least as early as 3.6 billion years ago. Some recent findings suggest the date of the first life on Earth may be even earlier.

PAGE 40 The Pico Island is found in the Portuguese Azores archipelago, on the North Atlantic. It is locally called Ponta do Pico, it rises 3 351 meters, the highest elevation for this set of volcanic islands. The spotted dolphins are common in the Atlantic and they get to be 2.3 meters (JQ/SP)

Andaman is located in the Indian Ocean, to the South of the Gulf of Bengal, and it surrounds the coastline of Thailand and Sumatra. Thanks to its warm waters it has significant extensions of coral reefs, where it is possible to see the blue throat parrot fish, who feeds with seaweed. (RD/SP)

Diversity of life

I have had a tremendous fascination for the sea since childhood. The first time I was close to a beach I was attracted by its mysteries and magic, the breathtaking sound and force of the waves, the shells on the sand and the immensity of the curved horizon. And I also felt fear because of its awesomeness. At the time I did not know that life originated in the seas and the composition of sea water and animal blood are roughly similar. Many years passed before I had a chance to immerse myself in that silent world, as Jacques-Yves Cousteau called it. My first plunge into the warm ocean waters, off the Quintana Roo coast, was a childhood dream come true and opened a dimension of our planet that until then was unknown to me. While I observed and enjoyed the sea, my experience was limited and knowledge of it was only superficial. It is an immense, alien and remote world that slowly reveals an almost limitless treasure. Playing in the water I observed a new world around me: algae floating on the surface, minute needle fish, schools of mullets, and the reef about six meters below. I was totally astounded, fascinated and excited by the riot of color, shapes and texture of the corals, sponges and fish crabs I saw on the reef. I marveled at the explosion of yellow, red, green, blue and orange tones of the marine organisms. By the end of the day I had seen dozens, maybe hundreds, of species that were new to me and a spectacularly beautiful place. Subsequently I have felt that fascination and excitement in other areas where I have dived such as Baja California, Borneo, Australia and Brazil.

There are millions of species in the ocean, and they are more numerous than on land. While there is more species diversity of plants on land, almost all animal phyla are represented by species living in the oceans including several that are absent from the continents and islands. The coral reefs and adjacent seas of Australia, Indonesia, Philippines and the Mexican Caribbean coasts are the most marine diverse regions in the world; they are the marine equivalent of tropical forests such as those in the Amazon basin in South America. The seas in the temperate regions of the world, however, have the highest concentrations of fish of economic value and therefore are fundamental for our fisheries.

The range in size highlights the diversity of marine life, from single-celled organisms to the blue whales, which, at 190 tons, are the largest animals that have ever existed on the planet. More than 16 thousand fish species have been described to date, and it is estimated that thousands more have yet to be discovered. Globally, there are approximately 130 species of marine mammals such as whales, dolphins and seals and a large and undetermined number of invertebrate species such as shrimp and crabs. Every year new species of new marine life are discovered including some large specimens such as whales and dolphins, For example, in 2014 genetic studies revealed that the Bryde's whales of the Gulf of Mexico probably represent a new species.

Until a few decades ago it was commonly believed that most marine life was restricted to the first 300 meters below surface and that only a small number of species lived in the permanent darkness of the deep regions. Modern equipment and advanced technologies have helped us explore more precisely the biological diversity of the seas, and some recent discoveries are truly staggering. For example, the disintegration of a large, ancient ice plate in the Antarctic Ocean in 2008 revealed countless new species living in total darkness on or near the ocean floor in a region that had been covered by ice for hundreds of thousands of years.

The complexity of the sea

When viewing the surface, the seas generally seem to be uniform in behavior and composition. However, this perspective fails to recognize the significant diversity of the physical and energy characteristics among the different seas of the world. While the average depth of the sea is 3,600 meters, the deepest part, recorded in the Mariana Trench in the western Pacific, is almost 11,000 meters, or more than three times greater. At the global scale, the marine areas are divided into five large regions or oceans: the Pacific, Atlantic, Indian, Arctic and Antarctic. In turn, the oceans may be subdivided into areas called seas which have unique characteristics, such as the Mediterranean or the Caribbean seas. Sea and oceans can also be grouped based on characteristics such as depth and distance from shores. The Mariana Trench is an example of a deep sea, the Gulf of Mexico an open sea, the Arctic and the Antarctic seasonally frozen seas, tidal seas alongside the coastline, and coral seas where coral formations are an integral part and influence the behavior of the marine ecosystem, such as those around Indonesia.

The geographic location of the oceans is a strong influence on water temperature and productivity, which in turn, have a profound importance to human activities such as fishing, transportation and recreation. The seasonal seas of the temperate zones, such as those off the coast of Peru, Baja California and California, are examples of some of the most productive marine environments in the world. The upwelling, resulting from the movement of deep marine currents hitting against the near shore continental mass, pulls nutrients from the bottom of the sea to the surface. These nutrients, in turn, support a myriad of marine plants and animals. In contrast to these areas, the deep seas are very unproductive areas and food resources for marine organisms are scarce. Water depth, shape of coastline, proximity to landmasses and shape of the

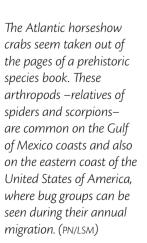
seabed impact ocean currents. In turn, ocean currents impact the water and overlaying air temperatures.

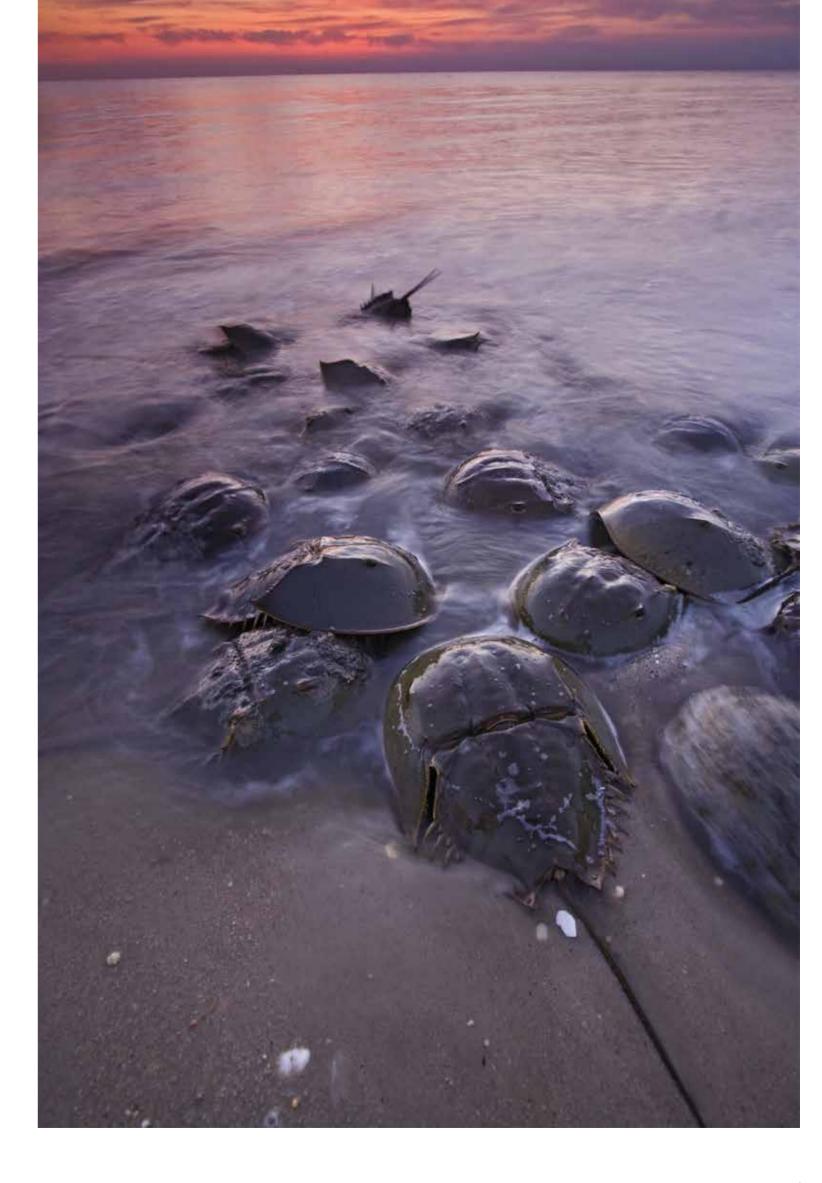
The conquest of the sea

Humans have attempted to conquer the oceans for thousands of millennia. Cave paintings, thousands of years old, depict boats sailing bodies of water with large waves. Early humans, who probably originated in Africa, crossed large bodies of water to reach distant lands such as Australia and New Guinea. Waves of humans migrated thousands of kilometers from Southeast Asia into the island areas of Melanesia and Micronesia at least three thousand years ago using small wooden barges. Centuries later and originating from Europe, a surge of explorers, such as Christopher Columbus, Vasco de Gama, Fernando de Magellan and Vitus Bering traveled to areas unknown to the western world and helped establish navigational paths throughout the world.

Fifteenth century Spain and Portugal were the most powerful empires in the western world in large part because their well-developed fleets and maritime discoveries led to new trade routes and markets. Enticed by the possibility of finding new markets, the Genovese explorer Christopher Columbus attempted to find a new route between Europe and India. His three vessels, the Pinta, Niña and Santa María, set sail from the port of Palos on August 3, 1492 towards the enigmatic Atlantic, and, on October 12th Columbus arrived where he believed was India. However, he has actually arrived in the Bahamas. By the end of October Columbus and crew landed in Cuba and then Santo Domingo. Disappointed that he failed to establish the route to India as originally planned, Columbus's expeditions were the first of many and the eventual migration to and colonization of the North American continent. About the same time as the Columbus journeys, Portuguese explorer and seaman Vasco de Gama established trade routes to India by passing through the Cape of Good Hope, South Africa, before continuing on to India.

I remember the excitement I felt when I first visited the Cape of Good Hope. From Cape Town in South Africa, an exquisite city that mixes the colors and vibrance of European and African cultures, I traveled south to the point of land where the continent and sea convergence. At the Cape, protected as a national park, cold air from the subantarctic seas blends with the more moderate, temperate climate, and colonies of the African Blackfoot penguins populate the beach area. The sign at the end of the road reads: "Welcome to the Cape of Good Hope, the southernmost point of the African continent."





Voyage to the End of the World

The exploration of the seas along the coasts of Siberia started in a systematic way in the early part of the 18th century. Concerned about the consolidation of imperial sovereignty in the *terra incognita* of Siberia and securing its abundant natural resources, the Czar of Russia, Peter I the Great and his successors commissioned Danish navigator Vitus Bering to explore and chart the coastal areas of what is now Siberia and Alaska. Years later, between 1733 and 1743, Bering headed the Great Northern Expedition, an ambitious scientific exploration that was organized by the Science Academy of Russia and involved almost 10,000 scientists, assistants and military. The focus of the expedition was the Kamchatka Peninsula and the mapping of the Arctic coast of Siberia. A German medical doctor and naturalist on this expedition, Georg Steller, was the first to describe many species of animals not previously known to science, including the Steller's sea cow, a large marine mammal. Within 27 years of the first sightings by this expedition team, the species was hunted to extinction.

By the end of the 19th century humans had explored most areas of the world's landmasses and oceans with the exception of the North and South Poles. In the early part of the 20th century, the United States, Russia, England, Norway and other world powers embarked on ambitious campaigns to explore these last two remaining regions. While historical accounts differ, Americans Frederick Cook and Robert Peary are credited as the first explorers of the North Pole in 1908 and 1909, respectively and the Norwegian Roald Amundsen for being the first human to reach the South Pole, in 1911.

The journey between the southernmost city of the world, Ushuaia, in the Tierra del Fuego in Argentina and the Antarctic Peninsula passes through some of the most challenging and beautiful landscape and seascape. The path crosses the Drake Channel, the meeting place of the Pacific and the Atlantic oceans, famed for its extreme and dangerous conditions of rough seas, winter temperatures (89 degrees centigrade below zero) and strong winds (reaching 300 kilometers per hour). The famous naturalist and writer, Peter Matthiessen, describes this area in his book, *The End of the Earth*, as the farthest away place in the world because of its seclusion and hostile environment. Yet today, cruise ships sail in the summer from Ushuaia to Antarctic Peninsula as part of an expanding tourism business drawn by the spectacular beauty and uniqueness of the area including large iceberg of deep blue colors, penguins, seals, whales and an overwhelming sense of seclusion and awe.

In the southern tip of Southafrica is the Good Hope Cape. The name was given to this place because when the ships arrived here from Europe they hoped they would be able to reach the Indian Subcontinent. Its coasts, conversely to their name, are famous due to strong winds and currents due to the confluence of a warm current from Mozambique-Agulhas, coming from the Indian Ocean, and the cold current from Bengal that comes from the Antarctic Ocean. (GC)





The Last Frontier

The collision of a United States submarine into an underwater mountain south of Guam in January of 2005 was a reminder that despite many centuries of naval exploration, the world beneath the surface of the seas still holds many secrets and is the last unexplored frontier on the planet. Less is known about the seafloor and deep seas than the surface of the moon. A few years ago famed marine explorer and oceanographer Sylvia Earle asked why the United States National Aeronautics and Space Administration was more interested in space than in the sea. The answer was revealing: "Because the sky and the starts are above; below the deepest darkness." While much of the oceans below the surface remain unexplored in large part because of its vastness, this last frontier is slowly yielding its secrets. In 1934, American engineer Otis Barton and naturalist William Beebe made the first deepsea dive in the submersible Bathysphere off the coast of Bermuda and reached a depth of more than 900 meters. This marked the first time deep sea animals were observed in their native environment. Describing his experience, Beebe noted "These descents to the depthness of the sea had a true cosmic nature. In the first place was the total and absolute seclusion and isolation; a completely different sensation to the isolation you feel when you move away from your neighbor just by mere distance ... It was a seclusion more similar to the first incursion to the Moon or Venus than that of a plane in the middle of the ocean or to be on top of Mount Everest. It was not more wonderful than those achievements, but it was different." In the year 2012, film producer James Cameron descended alone in a specially constructed submarine to the bottom of the Mariana Trench, the deepest point on the planet at 11 kilometers beneath the ocean's surface. During the transit to this deep part of the ocean, Cameron saw many new forms of life (species) which had never before been observed.

The future of the sea

The immensity of the sea and its inaccessibility mask the true nature of the threats it has encountered historically and it endures currently. The rich biological diversity and life-supporting ecological services of the seas are threatened by human activities. As species are lost and natural systems modified by these threats, the quality of life for humans, collectively and personally, is diminished. These threats and assaults are varied and complex, and

The dragon fish, 15 to 20 cm long, lives in the Atlantic's deep waters, including the Gulf of Mexico. It is a keen hunter that attracts its victims (other fish) using its "beard" as a keen bait. (SZ/NPL)

some, very long-lasting. Millions of liters of polluted waters are dumped into the oceans daily introducing biological pathogens and chemical compounds that threaten marine life. Plastics and other non-biodegradable material now clog huge swaths of the ocean, some patches larger than the size of the state of Texas in the United States. Noise pollution from an increasing number of vessels, machines operating in the marine environment, and weapons testing are threats to the health and behavior to many marine species, especially some iconic animals such as whales. Fishing activities, especially the illegal and unregulated, plunder a wide variety of marine life with impunity, and their loss cascades throughout the marine community. Reckless mining and scouring of the sea floor permanently alters communities we are just now beginning to discover and understand.

A silent crisis is unfolding today in the Sea of Cortez. It is an example of our relationship with the seas and a litmus test of our ability and willingness to address human-caused activities which threaten their health and integrity. The vaquitas, an endemic porpoise restricted to the upper portion of the Sea, are facing extinction because of illegal fishing activities, and today their population numbers less than 100. The President of Mexico this

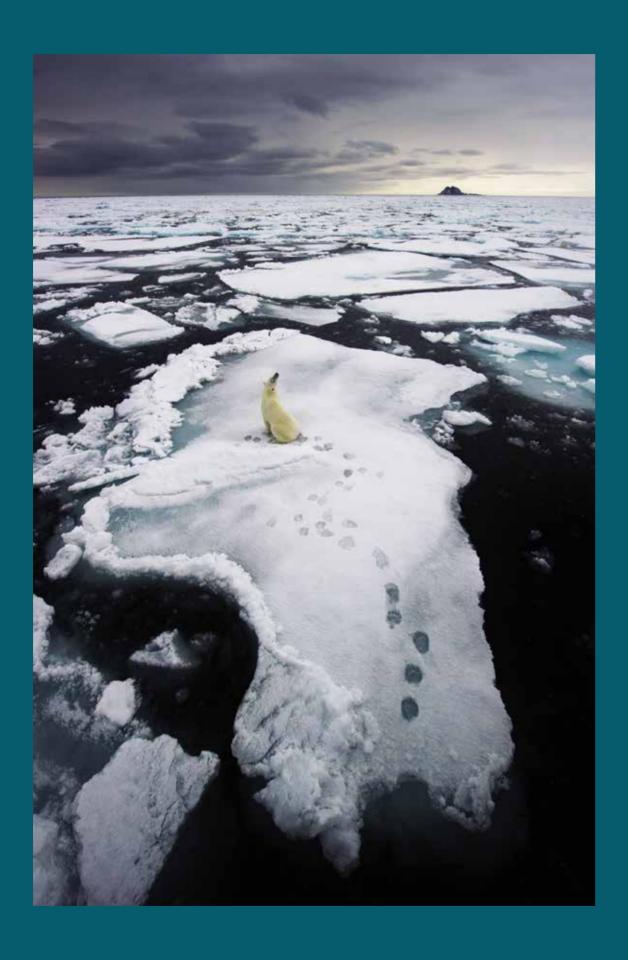
year (2015) took the unprecedented measure of decreeing a total closure to fishing in the region of the vaquita, and the Navy will enforce this declaration. This action may be the best and last hope for this species and a harbinger of how we will address similar challenges to the sea in the future.

The sea, the cradle of life, is in danger, and with it, life on Earth as we know it and the well-being of civilizations. Whether for ethical reasons or simply because it is convenient, it is necessary to recognize that the path we have chosen is not sustainable. While a plethora of voices, from scientists, academicians, religious figures and some political leaders have sounded the alarm, we as a community continue on the same path, indifferent to the destructive ways that imperil ourselves and other species. As the famous marine explorer Jacques Cousteau eloquently expressed, "The sea, the great unifier, is the only hope for man. Today, more than ever, the old phrase has a literal meaning: we are all on the same boat." We are now responsible for the future of the sea. Time will be the best witness of our love, wisdom, attention, understanding and willingness to help preserve the oceans, and ourselves.



The North American portion of the North Atlantic's waters offer spectacular views of big portions of frozen water. This is the habitat of species like the polar bear, big carnivoroes that walk and swim through these valleys of ice looking for food. (TM/NGC)





In the winter the sun hides for three months, plunging the Arctic in darkness and freezing the ocean until it reaches an area of 15 million square kilometers.

By the spring the energy of the sun melts the ice and by the end of the summer it only covers half the area it occupied before.

Under this low temperature environment, fish are able to survive due to the antifreeze proteins that inhibit their blood from freezing, while marine mammals have a thick layer of fat under the skin that isolates them from water. Other species inhabiting this ocean migrate south for the winter. As in the case of grey whales that migrate from the Arctic Ocean down to Baja California to mate and to give birth to their calfs. Due to the increase in global temperature, the extension covered by ice in the winter has decreased almost a million square kilometers and its thickness in the central portion has shifted from 3.59 to 1.25 meters in 35 years. This change threatens some of the most emblematic species of this ocean as the polar bear which depends on the ice to hunt seals on which it feeds.



PAGE 54 The Barents sea is part of the Arctic Ocean and is located between the northern border of Norway and Russia; the last piece is on Russian territory. Thanks to the North Atlantic current this sea is much more productive than any other at the same latitude, and is therefore very important from a biological stand point –due to its great diversity—and economic –due to its valuable fisheries. (PN/NGC)

PAGE 56 The Svalbard Archipelago is in Norwegian waters on the southern part of the Arctic Ocean. Two thirds of this archipelago are protected, safeguarding the environment in an excellent conservation condition. Close to 60% of its surface is covered by glaciers and inclement climate conditions, there are scarce places permanently inhabited. (OJL/NPL)

The Radstock bay is located in the Baffin region in the Province of Nanavut, Canada, in the Arctic Ocean. During the winter its waters froze completely and only icebreaker ships cross there and leave trails of broken ice as they pass. (JJP/BP)







PAGE 60 The Narwhals are charismatic cetaceans who only live in the Arctic Ocean, from the Hudson Bay in Canada, to Greenland and Russia. Like the dolphins and whales, they have to come to the surface to breathe; therefore the fractures of the ice are fundamental for their survival. (FN/LSM)

LEFT AND ABOVE In order to withstand the icy waters of the Arctic the seals and other marine mammals generate thick layers of fat that isolate them from the below zero temperatures and keep their inner body temperature. The Greenland seals basically feed on fish and invertebrates and they are, in turn, food for the killer whales, sharks, woves and human beings. (DD/NGC; NR/NGC)



The Sea of Barents – between Norway and Russia – is separated from the Kara Sea – in Russia – by a thin extension of the Ural Mountains. Both seas are in the southern tip of the Arctic Ocean. The southern part of the Sea of Barents remains free from ice during the entire year thanks to the warm waters that comes from the Atlantic current. (CR/NGC)

PAGE 67 The bearded seal is a charismatic species that lives in the North Atlantic and the Arctic. Its food is basically made up of animals from the bottom of the sea, including clams, squid and fish. This species is one of the main food of polar bears and the Inuit communities in the far north. (TR/LSM)

64

For us, an inhospitable world, for them, their home ...





The Chukchi Sea is located between Siberia and Alaska, on the Bering Strait, and it normally is covered with ice 8 of the 12 months of the year. The walruses of famous moustaches and long tusks are part of the local fauna, occupying ice covered areas where hundreds of animals gather. These teeth, amongst other things, allow them to drag their bodies over the ice as if they were crutches, asides from opening holes on the ice to have access to their food. (SG/NPL)





The Atlantic Ocean is the second largest ocean in the planet with an area of 106.4 million square kilometers. For centuries European navigators considered it a barrier until the race to reach the Indies made them sail west to discover the New World. Therefore it has played a major role in the recent history of the cultural and economic exchange between the two continents. This ocean is, perhaps, the one that has seen crossing more human immigrants, from the unfortunate slave trade from Africa to the arrival of Irish people to North America fleeing the famine. It is also the first ocean to be crossed by ship and by airplane.

This ocean maintained the most important fisheries of the world, but these have collapsed due to overfishing. The intense transformation of its coasts, the over exploitation of its resources and comparative access to its waters in relation to other oceans have contributed that many of its native species to be threatened.



PAGE 70 The Feroe Islands form a small archipelago formed by 18 islands that belong to Denmark. It is located on the northern part of the Atlantic Ocean between Scotland, Norway and Ireland. The landscape of these islands is characterized as by the lack of tees and a small diversity of plants and animals that are a contrast with the wealth of the waters that surround them, because several species of cetacean and endless number of fish, mollusks and other forms of marine life, live there. (AB/NPL)

PAGE 72 Close to the Equator, the warm and transparent waters of the Atlantic get full of life. A group of royal shads feed from a shoal of small "tinicalos" inside a coral cave in the Cayman Islands, in the Caribbean Sea. (AM/NPL)

The Bonne Bay is located in the Gulf of San Lorenzo on the western tip of the Canadian Island of Newfoundland, and which is considered to be the largest estuary in the world, The native vegetation of this island is characterized by the thick forests inhabited by beavers, reindeers and bears. Here lion's head jellyfish crosses the cold and calmed waters. (DD/NGC)



PAGE 76 The summits around the Kirkefjorden Fiord in the Norwegian northwest offer spectacular views of the waters towards the Norwegian Sea in the North Atlantic. This is delimited to the south by a great submarine cliff that runs between Island and the Feroe Islands. The waters of this sea are very deep because they can be 2 kilometers deep under the surface. Its fish-rich coasts are famous because of the cod. (OH/NPL)

The "old Storr man" is a famous rocky formation on the Skye Island, the biggest island of the Hebrides Archipelago in Scotia. The strong winds that cross this area every year can reach 128 km/h and they are the biggest limitation to the growth of trees. The influence of the Atlantic Ocean and the Gulf of Mexico currents generate a pleasant climate, contrary to what one would expect in this location, with a mean temperature of 6.5°C in the winter and 15.5°C during the summer. (DN/NPL)





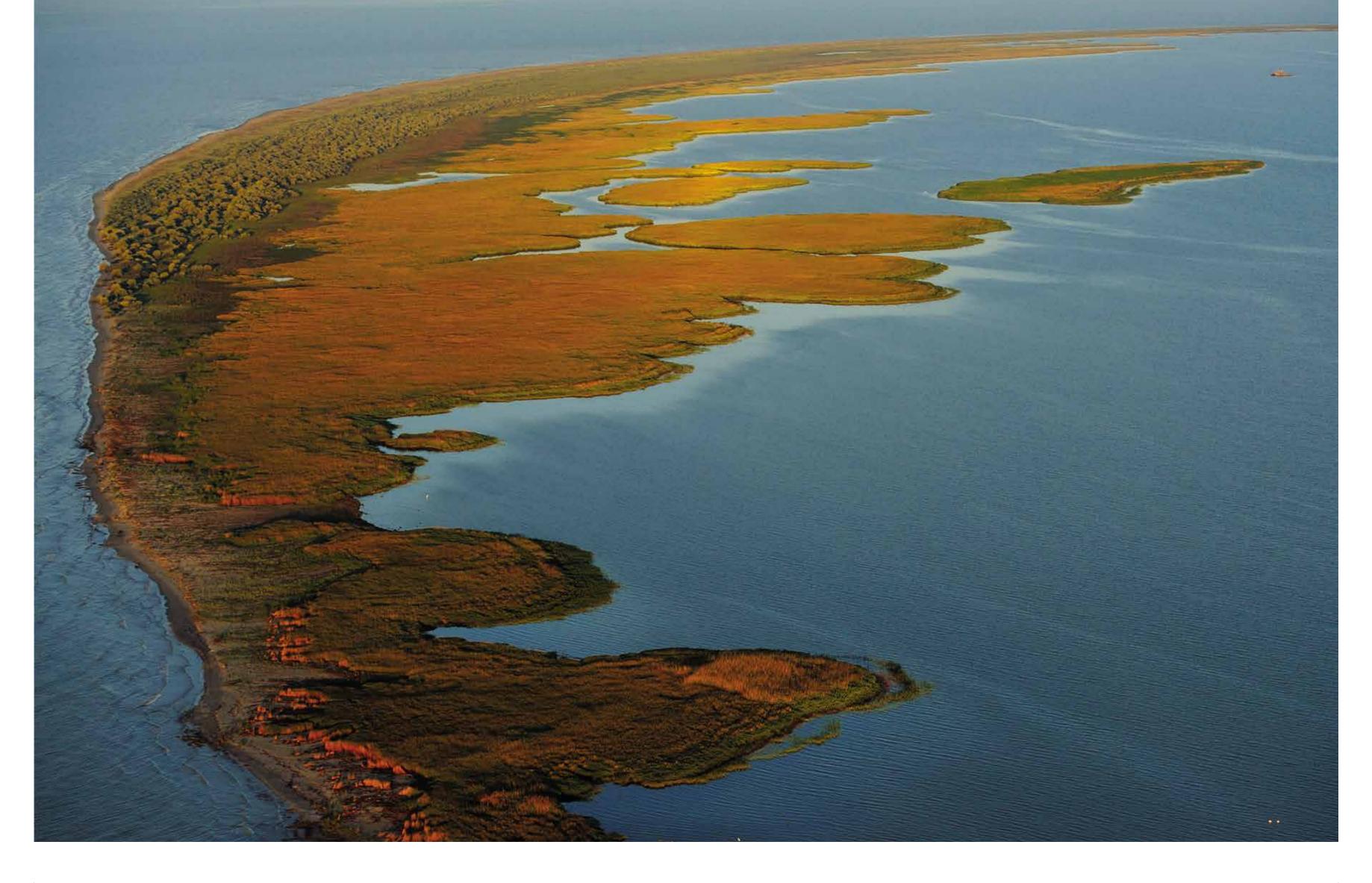
PAGE 80 The Island of Coll is part of the Hebrides Archipelago in Scotia, and is one of the sites with better conservation conditions in this famous country due to its spectacular fauna. During the summer, large areas are covered with algae, simulating forests where the grey seals look for food. (AM/NPL)

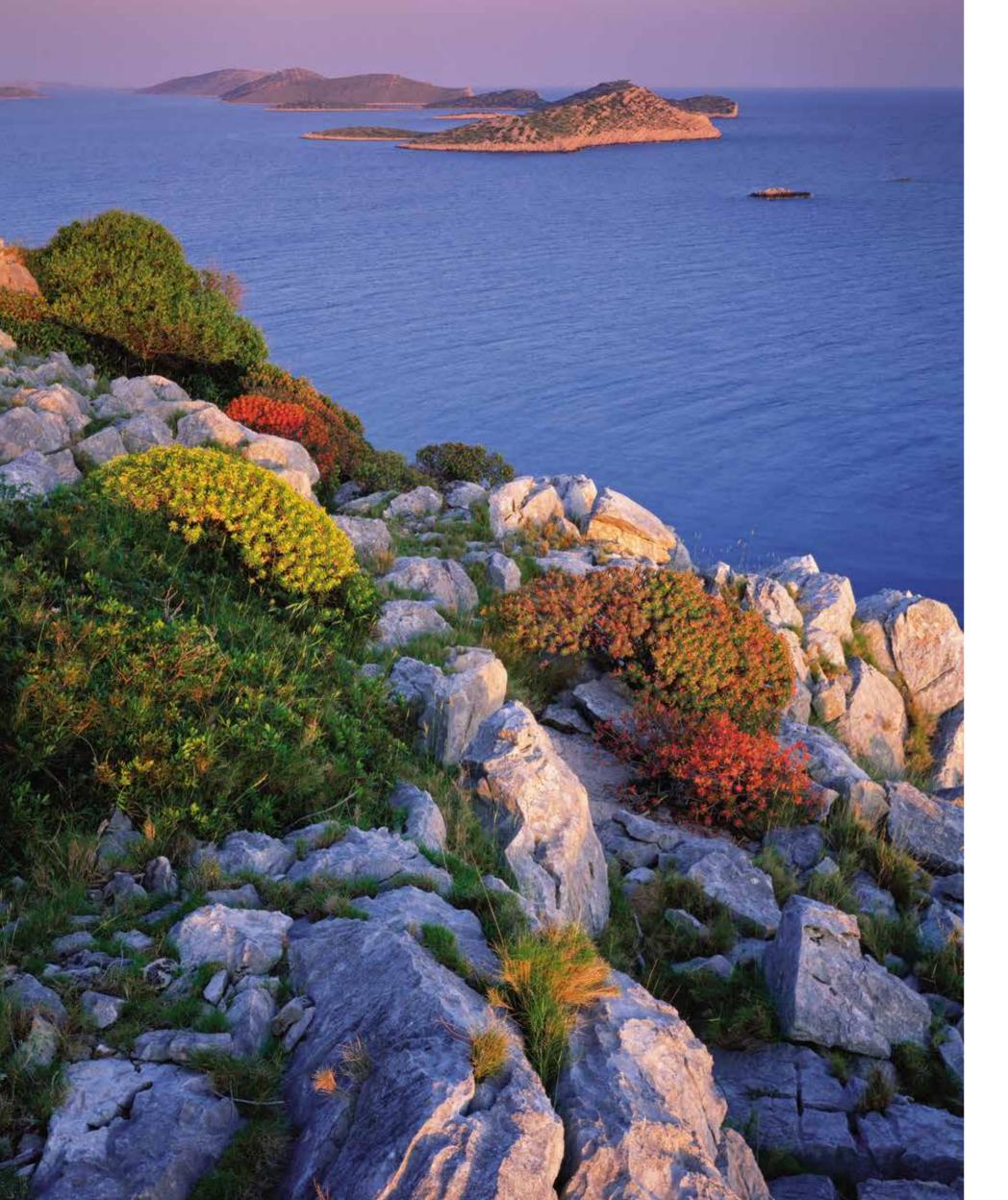
BELOW The Seven Sisters Regional Park is located in the National South Downs Park, in Essex, England. This park is famous for its 280 hectares of limestone cliffs, as well as its tolerant grazing land to this soil. (GE/2020V/NPL)

PAGE 84 The Botnia Gulf is in the northern tip of the Baltic Sea, between Sweden and Finland. This sea is delimited by the Scandinavian Peninsula, Finland, the Baltic countries and the highlands in the north of Europe. Besides the Gulf of Botnia, the Baltic Sea includes the Botnia Bay, the Finland Gulf and the Riga Gulf. (LAA/NGC)









PAGE 86 The Danube delta is the second largest one in Europe and marks the place where, in the countries of Rumania and Ukraine, the water of this river goes to the Black Sea. The Danube is born on the Black Forest, in Germany, and is a little more than 2 800 km long, to its mouth; it is an important support to the agricultural activities in this region. (WWE/W/NPL)

LEFT The Kornati National Park, in Croatia, is formed by 89 islands, islets and reefs in the northern end of the Mediterranean Sea, between Italy and Croatia. The Mediterranean sea communicates with the Atlantic Ocean through the Strait of Gibraltar with the Black Sea through the Bosphorus and Dardanelles Straits, and lastly with the Red Sea via the man made Suez Canal. This sea is the most contaminated sea in the planet due to the high level in it of hydrocarbons and other pollutants. (WWE/PH/NPL)

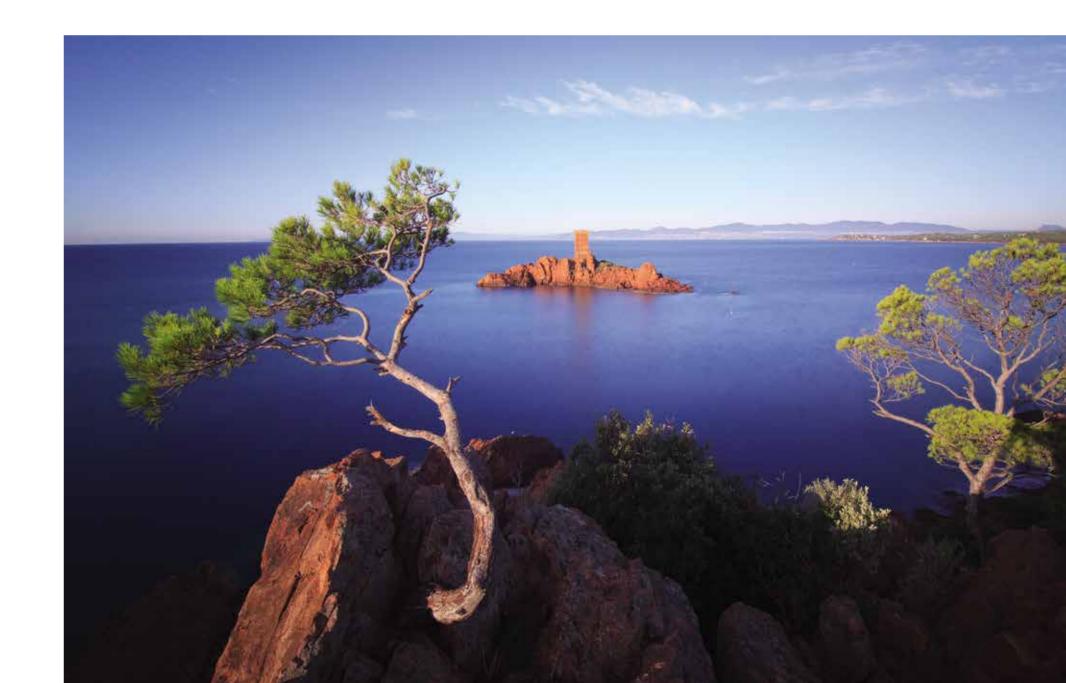
BELOW The Mediterranean Sea is the home of interesting species such as the cardinal fish. This fish, broadly distributed, can be 15 cm long and prefers to live in the coral reef area at 10 and 200 meters from the surface of the sea. In this species it is the male who incubates the eggs in his mouth, thus protecting its progeny. In this picture we can see the moment when the female transfers the eggs to the male's mouth. (BF/BP)



The Mediterranean reefs, especially those that are in the natural protected areas on the coasts of Italy and Spain, are in good conservation condition. Conversely, those that are in the coasts of Turkey and Greece have practically disappeared because of the pollution and overexploitation of their resources. Its fauna includes multicolor fish like the Painted comber. (below WP/BP; right MC/BP)

PAGE 92 The Spanish Canary Archipelago is in the north of Africa and South of Spain and is formed by seven big islands. It is of volcanic origin and its great beauty attracts thousands of tourists whose presence supports most of its economy. (MC/BP)









The Point of San Lorenzo is to the east of Madeira, Portuguese Archipelago located 400 km to the north of Tenerife, which is part of the Canary Islands. Tourism is attracted by its natural beauty and contributes a little bit more than 20% of its GDP, and one of the activities that grows more is whale watching. (LF/BP)



The autonomous region at the Azores, better known as Azores Islands is a Portuguese Archipelago found 1400 km west of Lisbon in the Atlantic Ocean. It is possible to watch in its waters incredible scenes like this one, in which an adult leatherback turtle –that can be up to 2.3 meters long and weigh close to a ton– feeds on a Pyrosoma, that is no more than a free floating colony of Tunicates (small animals with nervous system). (BJS/NGC)

PAGE 98 The sperm whales are enormous cetaceans that can be 20 meters long and weight close to 57 tons. These majestic animals have the largest brain as compared to any other animal in existence. In a vertical position they stand very close to the surface of the water to rest. This image of a group of sperm whales resting was taken at the Azores Islands. (WWE/L/NPL)











PAGE 100 The Bioko Island is a volcanic island located 32 kms west of Cameroon, Africa, and includes the west side of Equatorial Guinea. Like many other islands, its isolation from continental land has allowed the development of a unique land species and they are frequently threatened by human activities. Here 10 subspecies of endemic primates live, highly threatened by the consumption of their meat. (TL/NGC)

PAGE 102 The Namibia Desert and the Atlantic Ocean are on the Skeleton Coast. This is a powerful image due to their opposite systems. Due to the fact that dominant winds go from the continent to the ocean the rains here are practically non-existing and the influence of the ocean on the coast is minimum. This site got its name because asides from the multiple remains of ships, in the past when the rowing boats were used every day you could disembark on these shores but could not set sail again and thus it forced the unfortunate sailors to walk hundreds of kilometers where of course many died.(GS/NGC)

LEFT In the tropical waters of the Atlantic in African archipelagos and solitary islands of incredible beauty and invaluable biodiversity are found. The Saint Helen Island, 2 800 km from the coast of Angola, is British territory where fishing is the main economic activity. (KK/NGC)

ABOVE The Democratic Republic of Sao Tome and Principe, 225 km off the coast of Gabon, is part of the volcanic range where fishing, oil exploration and banking services generate the biggest economic contribution. (MP/NGC)



The El Cabo sea wolf lives on the coasts of Namibia, Angola and South Africa, in Africa, and also in Australia and Tasmania. This species is an important source of food for predators such as the white shark, here seen in the Falsa Bay, limited by the Cape of Hangklip and the South African Cape Peninsula, close to the place where the Atlantic and Indian Oceans meet. (CMF/NPL)

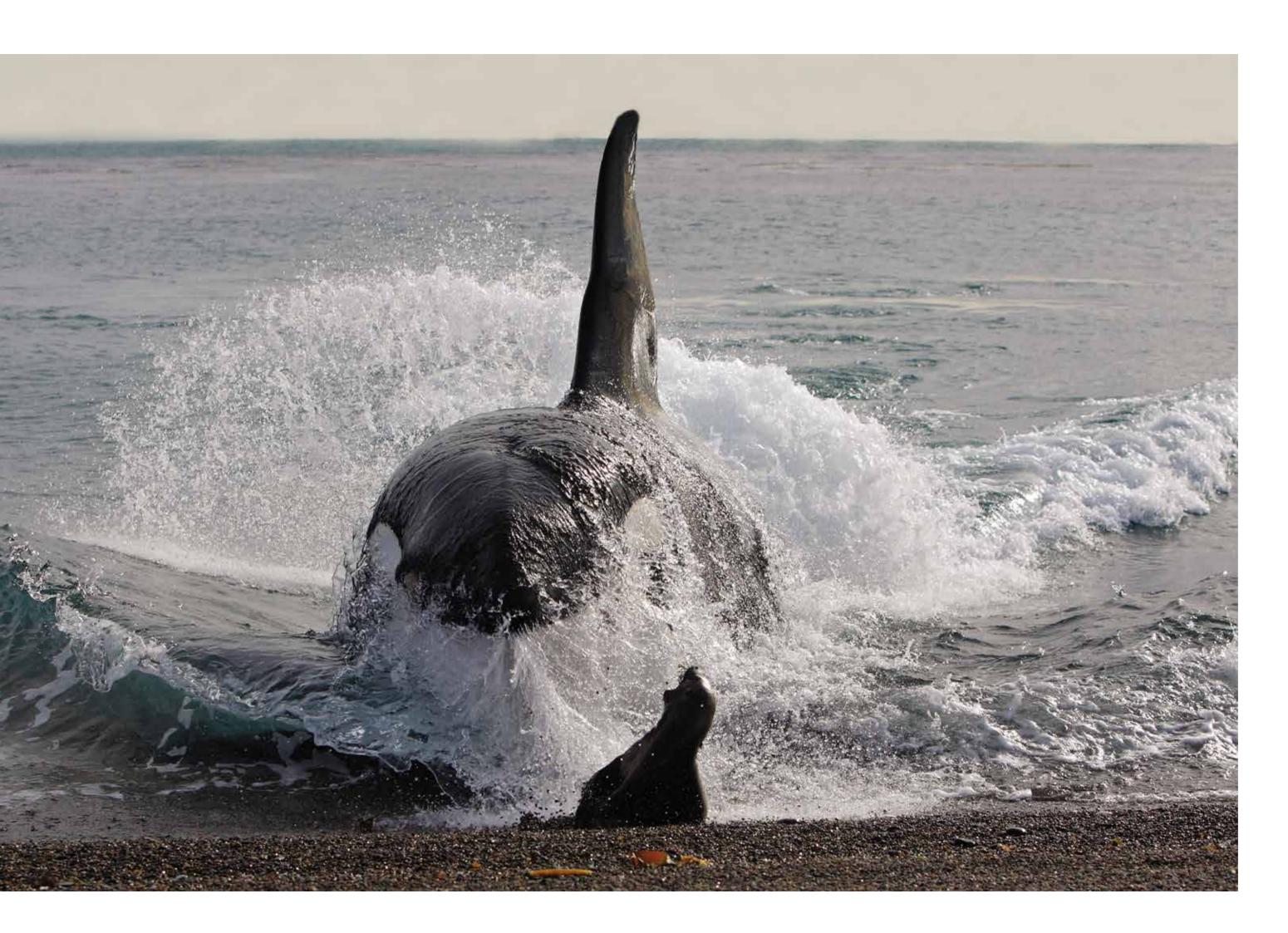
Seabirds, as the name tells us, spend long periods of their lives on the waters of seas and oceans around the world. In the southern tip of our planet one can see many of them. In the British Gough Island, macaroni penguins live (PAGE 108), non-flying birds that despite that they are not very graceful on land; they are true submarines in the water. In comparison with these penguins, the Yellow-nosed Albatross (PAGE 109) spends most of its life in the open sea, going back inland only to nest. This Albatross is an endangered species. (TR/LSM)











PAGE 110 The Lapataia bay in the Argentinean Patagonia, is really a fiord produced by the action of glaciers located on the north border of the Beagle Canal, close to where the Atlantic, Antarctic and Pacific Oceans meet. In these waters huge forests of algae called giant cachiyuyos grow and they are surrounded by sea lions and sea elephants, Magellanic penguins, dolphins and Southern Right Whales. In the fresh water affluents that get to the sea we can find salmonids like the brown trout and the silver trout, introduced from Europe and North American respectively. (CC/LSM)

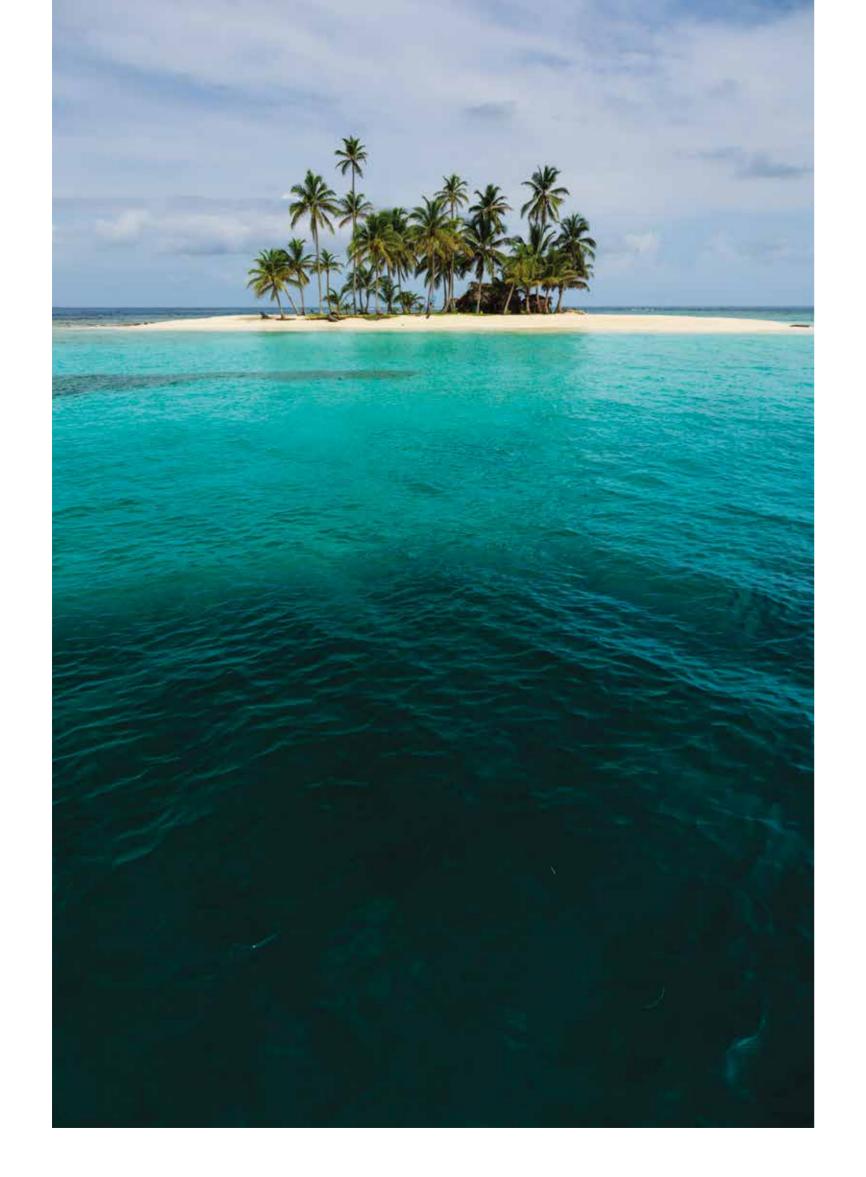
The coasts of Patagonia are the only place where the killer whales hunt outside the water. Here the resident population of these dolphins has learned to capture sea lioS's offspring directly on the beach, coming suddenly off the waves and capturing them by surprise. These attacks are also spectacular and show how intelligent these predators are. (SC/BP)

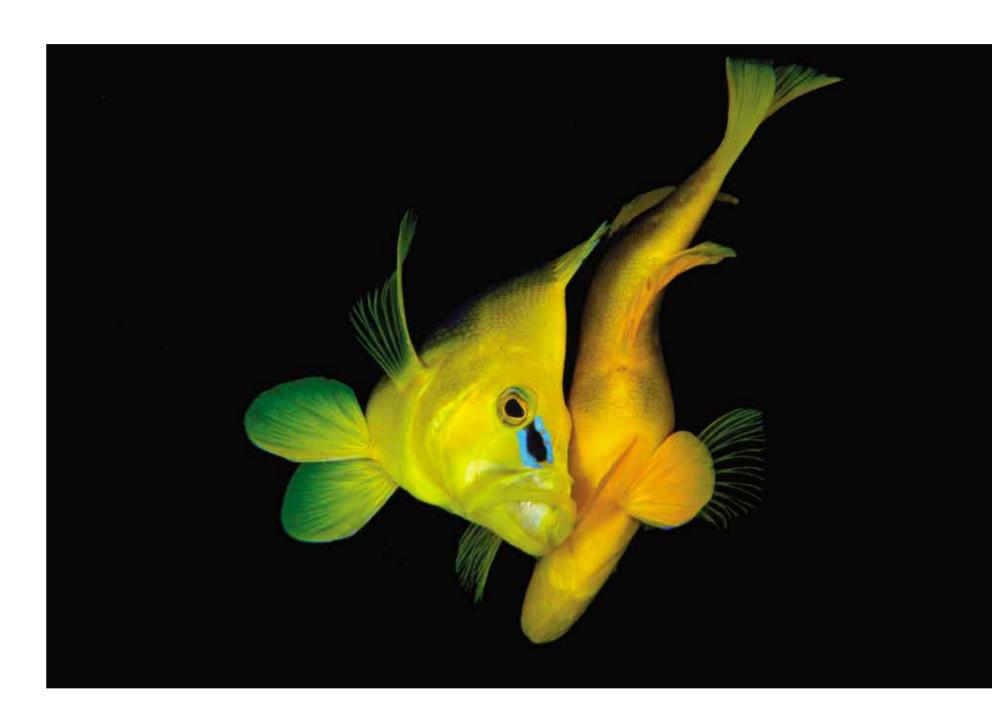


The volcanic Archipelago Fernando de Noroña is found on the eastern most part of Brazil. It is formed by 21 islands and only one of them is inhabited, and thus gives it a unique wild nature. These inhabited islands and their waters form a Marine National Park that has been declared World Heritage Site by UNESCO. (AS/SP)

PAGE 116 The big blue hole is found 70 km off the coast of Belize and it surrounded by the El Faro reef. This hole is a calcarean origin cave which ceiling has collapsed, filling its structure with Caribbean Sea waters. From the air, the dark tone of this cave denotes is bigger depth as compared to the waters that surround it. It is inhabited by spectacular species such as bull sharks and reef sharks. (GJ/DD)

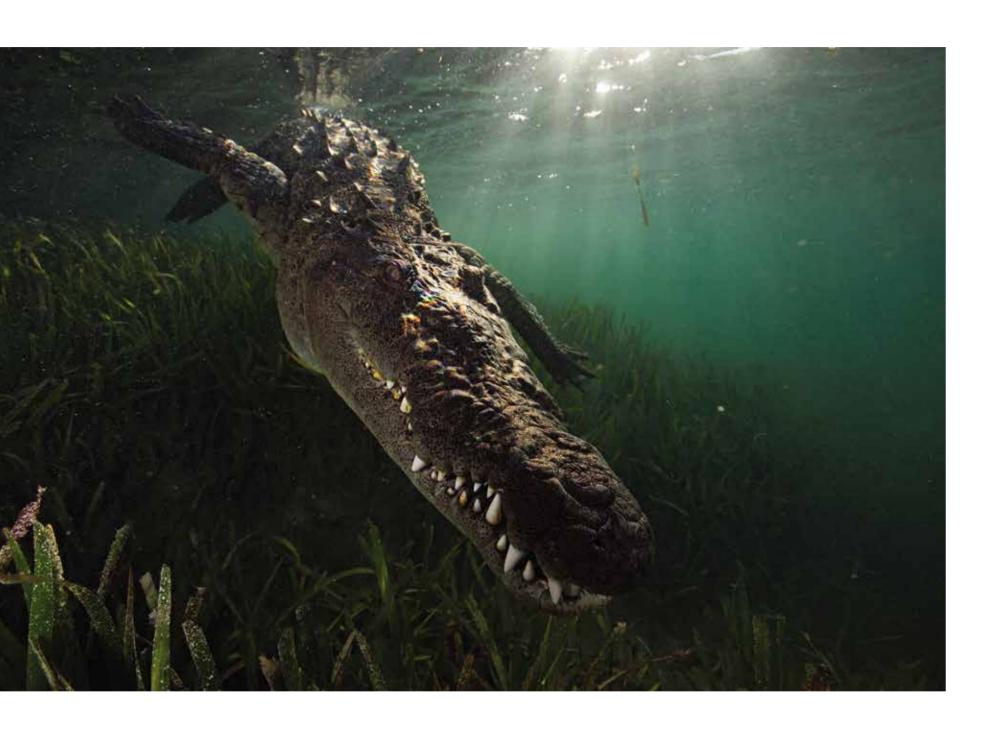


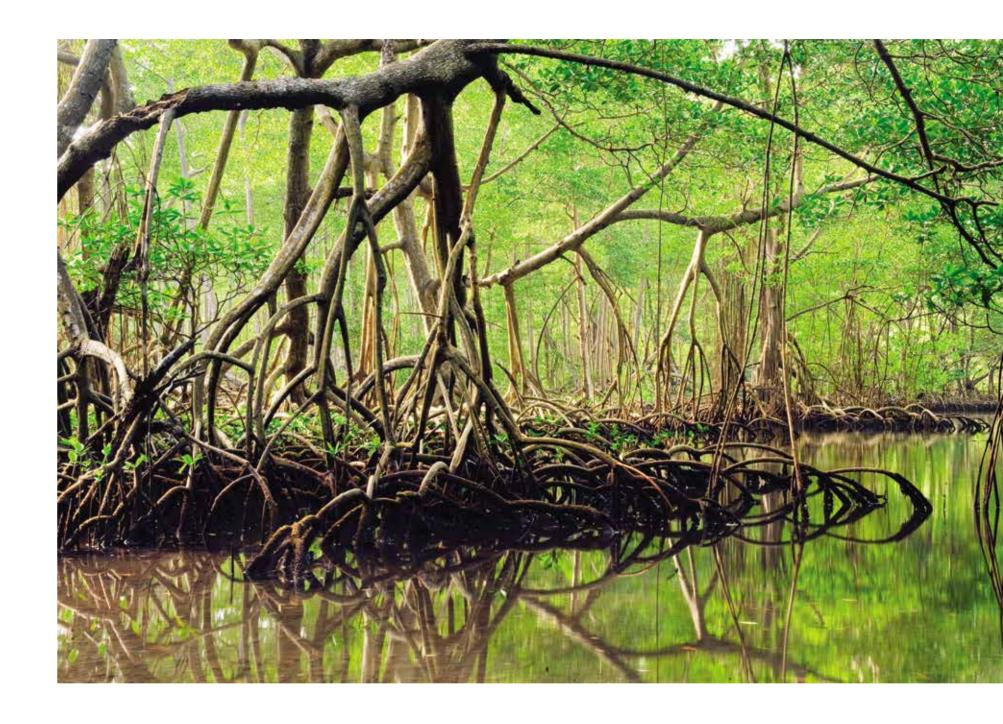




The Caribbean Islands were the first part of land that Christopher Columbus saw when arriving at the American Continent. He called the West Indies thinking that he had arrived to Westernest part of the Indian Subcontinent. Subsequently, the human groups that lived in these islands were called "Caribbean" and hence the name of this sea. In the image, you can see a Shy hamlet, native of these waters. (left JCM/BP; above AM/NPL)







PAGE 120 The Los Haitises National Park, on the northeastern end of the Dominican Republic coasts, protects forests in excellent conservation condition. These attract many ecotourists who want to know these beaches, caves and admire the flora and fauna, which includes endemic species such as the rodent called Hispaniolan hutia. (KS/LSM)

LEFT Within their distribution in the Atlantic coast, American crocodyles inhabit the Southwestern United States, the Gulf of Mexico to Venezula and some islands of the Caribbean. In the Pacific, they are found from southern Mexico to Peru. Here, an adult, which can reach five meters, dives in the National Park Jardines de la Reina. (CCK)

ARRIBA Mangrooves are coastal wetlands formed by trees resistant to the high salinity of the water. They are found across all tropical coastlines around the world. These forests are fundamental for fisheries since a high number of species use them as refuge during the eary stages of their development. (KS/LSM)



Rurik List

THE SEAS THROUGHOUT TIME

Two years ago I took a solitary 1,200 kilometer trip through one of the most arid regions on the planet, the Atacama Desert located on the Chilean coast. The Atacama, like all the other large deserts of the southern hemisphere, is located where ribbons of high atmospheric pressure systems generate trade winds that displace the humidity to the east. In addition, this desert receives very little moisture from the Pacific Ocean because of the minimal evaporation owing to the cold temperatures of the Humboldt Current which is fed by the cold waters off the Antarctic continent.

Visibility in the desert is impressive and the distant landscape features such as rock formations are clearly visible. The clarity of the air is a result of the absence of suspended water particles. In this region of very low humidity, plant growth is severely restricted and the geologic formations and rocks were the overwhelmingly dominant feature of the landscape. Despite the proximity of the of the road to the ocean, I did not see a single trace of grass, a cactus or even lichen, and for three days I not see a single bird. There was no wind, and when I walked outside the vehicle the only sound I heard was that of my own steps. I felt a strong sense of solitude because of the absence of signs of life for hundreds of kilometers. On the third day after setting out on the trip I saw my first plants when I arrived at the Pan de Azúcar National Park; the cactus and bushes hinted

at the presence of increased humidity. When I saw a heard of guanaco through the thick fog that was folded around me, I queried myself these and other animals survive in a place the environmental conditions are so extreme.

The answer to my question points to the ocean; the fog is generated by the cold offshore waters and the wind blows it to the coast. As the fog embraces the plants, small drops of water slid down the stems to the ground where the roots can absorb it. Even in this environment with extremely limited water supplies, the presence of plants also supports animal populations. This simple example of the life sustaining influence of the oceans eloquently displays the sea-land linkage and the importance of oceans in supporting life and shaping human civilizations. The extraordinarily complex organization and interaction between the physical and biological components of the environment must be safeguarded for our well-being and the welfare of all living organisms.

At the equator the intense tropical heat from the sun evaporates the water from the ocean and saturates the air with humidity. The rising heat air generates low pressure zones close to the sea surface and facilitates the formation of clouds. Supplied by a constant stream of humid air, these clouds continue to grow and store energy and may develop into tropical storms, or the more powerful cyclones (or hurricanes or typhoons; name varies depending region of the world). These cyclones concentrate enormous amounts of moisture, and winds near their center may exceed 300 kilometers per hour. Sometimes the winds surrounding the cyclones push them onshore where the combined rain and winds and accompanying title surge may pose significant threats to life and property through flooding and landslides. Despite the destructive nature of cyclones to the human-dominated landscape, these tropical storms are important for the transfer of energy and moisture from the tropical regions to the more temperate environments.

In Mexico, tropical cyclones from the Pacific are weakened and their moisture extracted when they run against the formidable barrier of the Sierra Madre Occidental. While major tropical storms are basically coastal phenomena, they can influence the land-scape hundreds of kilometers inland. For example, rain reaching the Chihuahua Desert, more than one thousand kilometers from the nearest coast, is puddles critical to the reproductive cycle of many plants and animal species. Many toad species in the Chihuahua Desert are awakened from their months or years-long hibernation, or estivation, by soils moistened from the rains, and the ephemeral puddles serve as nurseries for the thousands of eggs deposited in them. Because of the fleeting and erratic nature of the occurrence of puddle formation in this environment, the reproductive cycle tend to be very rapid. Plants and animals in the interior of the continents depend upon the humidity that comes from the oceans and is transported as rain, snow, ice or fog by air currents.

PAGE 124 The Pan de Azúcar National Park is on the central coast of Chile in the Antofagasta and Atacama regions. Species such as the Guanaco, Humboldt Penguin and the Peruvian Diving Petrel live here. The vegetation is the xerophilous due to the arid conditions of the land, relieved only by the sea breeze that takes inland the so much needed humidity. (AMH/DD)

Weather patterns, especially storm events, are critical factors in biodiversity. These events carry plant seed stocks to areas where they previously did not exist, and successive generations mutated to accommodate the conditions of the new environment, ultimately becoming a new species. Morphological characteristics of many bird species on the Galapagos Islands shows that they are descendants of species that evolved from other bird populations and were isolated by climatic conditions and other natural forces. Climatic patterns are just one of many mechanisms that help shape biodiversity patterns.

The ocean currents

Invisible at first sight but known from ancient times by sea voyagers, the marine currents are a complex web-work that link islands and continents. Shallow, surface currents may extend to a depth of about 400 meters and a breadth of one thousand kilometers. Generated by the wind, changes in water temperature, the force of gravity and the rotation of the Earth, the direction of these currents is affected primarily by the contour of the continents and islands. These currents have played a key role in human history and the distribution of the species around the world.

Many plant species have been widely distributed by marine currents. The coconut palm tree is a classic example of the transport mechanism and plant adaptations. Armored by a highly resistant and waterproof external wrap and a thick and porous mesocarp which protects the seed and provides buoyancy, the coconut palm fruit germinate once it is on drier environments even after it has been in the ocean for many months. The success of this marine dispersal mechanism has ensured a natural global distribution of this species in the tropical regions and provided an important food and material source.

The uniqueness of the fauna on the island nation of Madagascar is an example of the role of ocean currents in biodiversity of larger animals. Located more than 400 kilometers from the east coast of Africa, Madagascar at present has only five orders of naturally occurring land mammals, all of which are descendants of animals that arrived there approximately 65 million years ago carried by sea currents natural vegetation rafts, such a fallen trees. Over the course of millennia, these ancient colonizers evolved into the animals we recognize today as lemurs and tenrecs, endemic to Madagascar. Distance between points of origin and settlement and biological needs of the migrating taxa are constraints on the role of currents in biodiversity patterns. For example, the drifting of land mammals between Australia and New Zealand on natural rafts in sea currents was not feasible because of the long distance (1,600 kilometers) and the need fresh water and food. However,



The bitter force of the Pacific ocean has molded the abrupt coasts of the Guadeloupe Island in Mexico, where life goes on triumphantly. (CCK)

reptiles, whose biology allows them to be without food or water for long periods, were able to travel to New Zealand on ocean currents from distant areas. Tuataras, the only surviving member of a distinct reptilian order that lived alongside early dinosaurs, is endemic to New Zealand, is one example of a species that may have arrived millions of years ago on floating debris.

There are many examples of plant and animal species that arrived in Mexico on air or water currents. For example, in the Island Guadalupe, 260 kilometers off the coast of northern Baja California, there are 34 endemic species of plants, including the Guadalupe Palm and the Guadalupe Cypress and in the islands in the Sea of Cortez, 42 endemic species of reptiles such as the chuckwallas and 15 species of mammals such as the Guardian Angel mouse.

Ocean currents, essential for the migration and outward dispersal of humans into new areas, have been studied since ancient times. Some of the earliest mariners mapped their sea routes by following the currents as the Chinese did in Asia and the Carthaginians in the Mediterranean region. The well-being of the Roman Empire depended in large part on knowledge of currents and good navigational skills because of its reliance on trade with distant lands around the Mediterranean, Indian, Red seas and the east coast of Africa. Over a period of many millennia, inhabitants of Southeast Asia used the ocean currents to extend their occupation to vast areas of the south Pacific, often hundreds of kilometers from point of origin. The arrival of Polynesians in New Zealand about 800 years ago signaled a cosmopolitan mega-community, connecting different cultures and peoples such as the Rapa Nui of Easter Island, the Maori of New Zealand, the Hawaiians and Tahitians. Centuries later during the Age of Discovery, European navigators used the ocean currents to explore and conquest new lands to enhance their trading markets and defense capacities. Knowledge of marine currents today is still important because of savings on fuel and time in the transoceanic shipment of goods.

The collective knowledge of currents developed over time from the earliest marine explorations has enabled us to chart the oceans and understand the basic physics of the movement of ocean waters. Ongoing research is providing higher resolution mapping and better insights into their mechanics such as seasonal changes, formation and movement of gyres and eddies, their interaction with other they have with other currents, and the forces that control their speed and direction of movement. While scientists employ a wide assortment of specialized equipment in their studies, some important insights have been gleaned by following the pattern of floating objects such as bottles or other floating objects lost at sea. Floating material that breaks free from shipping from the more than 2,500 containers lost at sea annually generate a great deal of information on the ocean currents.

Over the course of 10 years following the unintentional release of 28,000 rubber ducks and other bathing toys, these items were reported from sites on the North Pacific coast, the Kamchatka Peninsula and Southeast Asia.

The study of sea currents has shown that there are five major ocean gyres or circular ocean currents. Floatable garbage that is swept into the oceans by currents or intentionally deposited there is trapped and flows in a slow moving circular pattern. Much of this garbage consists of plastics and other similar material, and all are byproducts of our lifestyle and reflect inappropriate solid waste disposal management practices. The nearly indestructible properties of plastic guarantee that even though the items will break down into smaller particle sizes, their eventual degradation may be on the order of hundreds of years. This material poses serious immediate and long term threats to marine life through ingestion and chemical pollution. There are many such patches in the world's oceans, and the largest, the "Great Pacific Garbage Patch", covers an area of several million square kilometers. Floating in the water column, many of the objects are mistaken as food by turtles, birds, whales and other animals, and when ingested, they may cause suffocation or blockage in the digestive system. Drifting fishing nets and other plastic objects such plastic rings used to bind drink containers together are other major threats to marine life. Studies suggest that 15% to 40% of the plastic discarded every year ends up in the ocean. This is a serious problem considering that some of the plastics become trapped in the food webs and the chemical substances of which they are composed taken in by marine organisms and passed up the food chain to other animals including humans.

Source of food

The sea has been a major provider of food and other resources for most of human history, and those populations living on islands or along coastal areas throughout the world developed industries and technologies to meet their needs. The harvest of marine life, from shellfish to marine mammals and aquatic plants, such as seaweed, promoted the development of specialized tools and equipment such as hooks, harpoons, traps and nets, and their basic design has persisted over millennia. For most of human history, fishers were limited to the near coastal zone for their harvests because of the limited capacities of fishing vessels and their harvesting equipment. The development of larger vessels capable of remaining at sea for months at a time and traversing to most places in the world, increased capacity, and improved capture and storage equipment set in motion an intense competition among fishing communities to increase fish catch. In the 1960s synthetic



The Mexican Caribbean waters are so biodiversity rich. Here the sailfish in the Atlantic Ocean feeds from a shoal of sardines in waters close to Isla Mujeres. At present these fish attract a large amount of tourists who want to watch them feeding, and thus generate a significant economic contribution to the region. (PO/LSM)

fiber replaced the natural material used on the nets because they were cheaper, easier to maintenance and use, and they lasted longer.

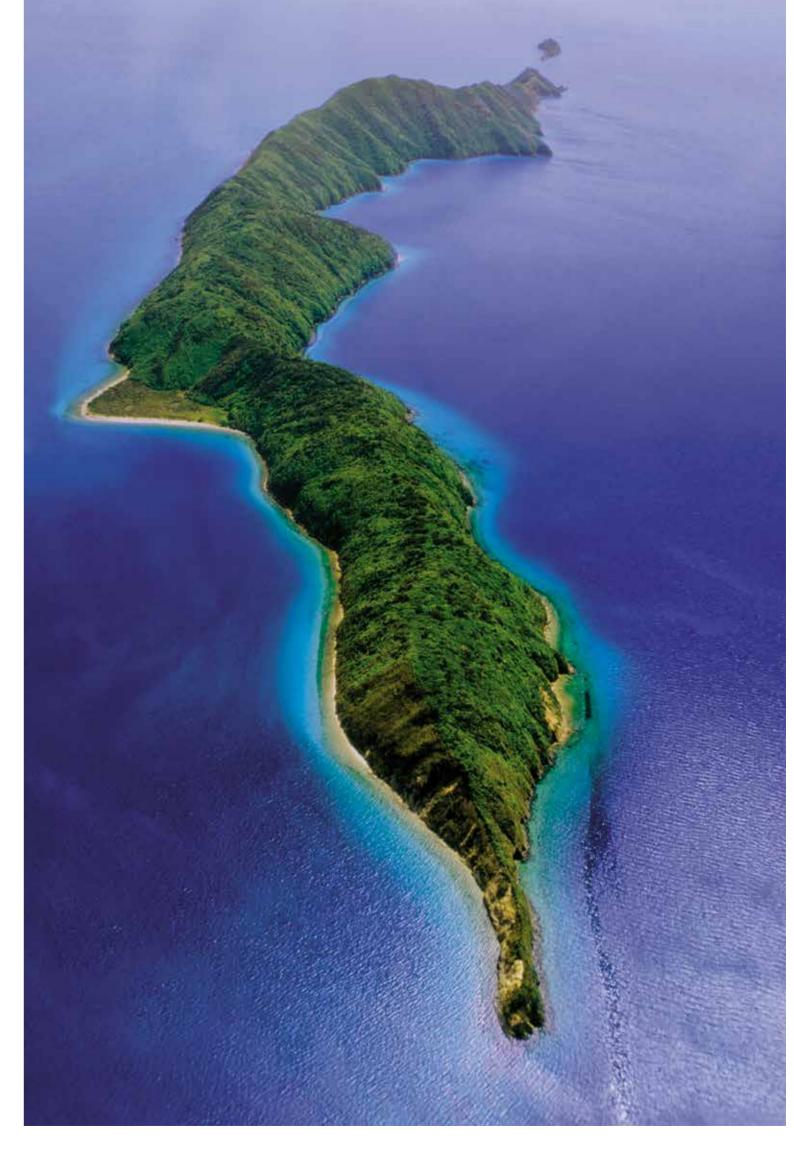
The most productive fishing areas are the upwelling zones characterized by strong currents which move nutrients from the lower levels to the upper reaches of the water column. Photosynthetic organisms that benefit from sunlight utilize these nutrients. In turn, the phytoplankton is consumed by the zooplankton and on to other, higher trophic levels ensuring the transfer of energy and critical elements through the food chain. Some of the food chains are relative short and can support large animals, such as the baleen whales which filter out phytoplankton. Other food chains, such as those that support many shark species and marine mammals, are long and may involve many different typed of food resources. The death and decay of marine organisms sends the nutrients to the seabed where it remains until it is brought to the surface again by upwellings and the cycling is repeated.

Some upwellings tend to be seasonal and frequently are associated with extraor-dinary biological phenomena such as large concentrations. Hundreds of whale sharks and manta rays, two very large marine species, congregate near Holbox Island in the Mexican Caribbean to forage on plankton blooms during the summer. Other upwellings persist throughout the year and the biodiversity in the area tends to be high. For example, the high productivity associated with the upwellings in the Whale Channel in Baja California support 16 species of cetaceans.

There are four main currents associated with upwellings: the surface wind-driven, southwest flowing Canary current off the northeastern corner of Africa, the north flowing Benguela off the southwestern corner of Africa, the south flowing California current that parallels the Oregon and California coast and reaches the southern end of Baja California, and the cold, north flowing Humboldt current off the western coast of South America. Some of the most important fisheries in the world have developed in these currents because of the high level of marine productivity. The mouths of rivers, coastal lagoons and mangroves are other highly productive marine areas.

Historically, the Peruvian anchovy fishery was an important industry for the national economy. The nutrient-rich Humboldt Current supported large schools of anchovies and other fish species, and at the height of production in the late 1960s to 1971, the fishing industry annually harvested 10 million tons of anchovies. Before the 1950s, the fish were used primarily for human consumption. Soon after, commercial production of fishmeal for use in feed for livestock, poultry and farmed fish became the dominant market and this fishery was one of the largest in the world. However, beginning in the early 1970s, production fell off dramatically, partially in response to the El Niño event and because of





the heavy fishing pressure during the previous decade. More than forty years later, the anchovy stocks have not rebuilt and the fishing industry has not recovered.

Improvements in fishing equipment have significantly increased the production and efficiency of the operations. The use of sonar and satellites to help fishers identify locations and improved catch and haul equipment to harvest fish has helped the fishing industry meet demand. However, this success has some undesirable consequences. Large driftnets, which are commonly used, are indiscriminate and are responsible for a high portion of bycatch, or marine organisms that are not targeted, such as marine mammals, sea turtles, sea birds, sharks and other finfish that do not have any commercial value. Despite the fact that almost all the countries forbid the use of driftnets longer than 2.5 kilometers in their territorial waters and international covenants forbid their use in international waters, they are still used by rogue fishers, and some measure 50 kilometers in length. Additionally, damaged and abandoned driftnets or "ghost nets" become floating death cells causing the death of thousands of marine organisms and wasting tons of potentially useful marine resources. Use of trawl nets has also contributed to overfishing, bycatch loss, and disruption of the benthic environments. As the name implies, these nets are trawled by ships and depending upon the target fish community, they are towed close to the surface, at an intermediate depth or at the bottom of the sea. In the case of shrimp, the trawl nets drag through the bottom of the sea destroying corals and sponges, picking up sediments that alter the quality of the water and causing the resuspension of accumulated contaminants that may pose a threat to marine organisms.

It is estimated that 90% of the larger fish of many different species have been removed from the oceans by overfishing, and that much smaller fish constitute the bulk of the hauls. This shift in size of fish caught has serious biological implications for the success and timing of the recovery of threatened stocks as well as the health of the marine ecosystems. It is widely agreed that globally many stocks are overfished, exploited or depleted and may never recover to the point where they can be harvested commercially. The loss of species is an ecological assault on the marine environment and a critical issue for food and job security and economic stability. The world production of fish exceeds the combined amount of cattle and poultry. More than 200 million persons working in the fishing industry worldwide and 4 billion people, most of who are in developing nations, depend on fish as their primary source of protein.

With a world population of more than 7 billion people and annually increasing by about 80 million, our consumption decisions have consequences at the planet scale. Oceanographer Dr. Sylvia Earl has suggested that we stop eating fish because of their critical role in the maintenance of the marine ecosystems and, to a lesser extent, terrestrial

ecosystems. The impact of marine organisms frequently goes beyond the shoreline. For example, salmon and other fish species that migrate between freshwater and marine habitats provide food to terrestrial animals such as bears and birds of prey such as hawks, eagles and osprey, and the decay of their bodies release nutrients to areas removed from the sea.

The choice of eating the larger fish species has an environmental impact that reverberates through the marine food chain. At each link in the food chain, about 90% of the energy stored in the food is lost. For example, the production of one kilogram of fish concentrate to feed farmed fish such as salmon requires 4.5 kilograms of small fish taken from the oceans, such as sardines. The production of each kilogram of farmed tuna requires 25 kilograms of sea food such as squid, mackerel and eel. The point of this argument is that human consumption of fish lower in the food chain, usually the smaller fish such as sardines and anchovies, would significantly decrease the pressure on the marine environment and would shift the fishing industry from the larger, carnivorous species to the smaller, herbivorous species where "turnover" is much more rapid and less demanding of marine resources. The presence of elevated concentration of methylmercury in fish tissue is another argument for minimal consumption of carnivorous fish which are high in the food chain. Methylmercury, responsible for a suite of human health maladies including neurological damage in developing fetuses and young children, is released into the environment from the combustion of fossil fuels such as coal and oil and from some industrial processes. It is taken in by the fish from the water column, sediment and food resources. The issue of mercury contamination in fish is significant enough to warrant consumption advisories issued by the United States Food and Drug Administration. These advisories are especially significant for pregnant and nursing mothers and young children.

Another option to increase fish harvest is the development of fish farms in the high seas. As proposed by ocean explorer Dr. Jacques-Yves Cousteau, these facilities would provide food for human consumption while better regulating the harvest of wild fish stocks

Choices

There are some examples of a symbiotic relationship between fishers and marine animals which promote conservation efforts. In Laguna, Brazil, some wild dolphins "assist" fishers capture the red mullet, a fish species used for food. Because of the murky condition of the waters, fishers cannot see where to drop their nets or when to do so. However, dolphins identify prey by echolocation, and the subtle movement of their heads or tails is a signal to the fishers of the best location and timing to set their nets.

First appearing in the oceans three-and-a- half billion years ago, life on Earth is still dependent on the marine environment. Human civilization is not immune from this dependency. The oceans are a central part of the climate and weather mechanisms throughout the world, a major influence on species distribution and biodiversity, a critical source of food for humans and indispensable for movement of goods. In addition to these utilitarian roles, oceans are part of what makes humans, human. Cultural expressions of civilizations, such as literature and art are replete with depictions of the interface between oceans and humans as are historical events and political intrigues. Belief systems, from mythology to contemporary religious beliefs and practices incorporate the role of the seas in human existence. Despite the central role of the oceans in our lives, human activities are threatening the well-being of the marine environment. While there is an increasing awareness of the linkage between human societies and the oceans, our assaults on the physical, chemical and biological components of the oceans are intensifying. We have the knowledge and tools to change the way we use the oceans, to protect them and to integrate them in a more healthy and sustainable way while meeting our needs for survival as a species. The path we follow is a choice we must make, and this choice must be made soon. It is a given that while the oceans and its marine community and will long survive in the absence of humans, humans cannot survive without healthy oceans. It must be our mission to protect the oceans for our own well-being and that of the generations that will follow us.

The Gulf of California, in Mexico, is one of the most biodiversity regions in the world, and has therefore been called the "aquarium of the world". Amongst its endemic and seriously endangered species are the Totoaba –fish whose meat is highly valued– and the marine vaquita –small dolphin. Overfishing constitutes the major problem in this natural paradise, and it is therefore urgent to regulate this activity. (OA)







The Indian Ocean is the world's third largest ocean and it covers 73. 427 million square kilometers. Its coasts saw the origin of early civilizations —as the Egyptian and Mesopotamian around the Red Sea and the Arabian Peninsula— and also some of the most ancient sea trade routes. At present it harbors the busiest ports in the world. Its southern position gives it a warm condition and therefore the phytoplankton productivity which is the base of the marine food chains and also the fisheries are reduced when compared to the rest of the oceans. It is estimated that 40% of world oil reserves are in this ocean and therefore it holds a larger amount of hydrocarbons.



PAGE 138 The Ao Phang Nga National Park is in the southern part of Thailand. Its vegetation is formed by mangroves on the coasts and rainforests inland. Its coasts border the waters of the Andaman Sea where the best preserved coral reefs of the world are, asides from the large extensions of sea grasses and deep marine valleys, that gives this region an exceptional biodiversity. (EJ/NPL)

PAGE 140 Leafy sea dragon is a close relative of the sea horse. This peculiar fish lives Indian Ocean's waters specially in the south and east coasts of Australia, in sandy areas with the presence of sea algae and grasses between 4 and 30 meters deep, where it is taken as floating pieces of algae. Its diet is small crustaceous and fish larva, which It absorbs with its trunk. (JW/NGC)

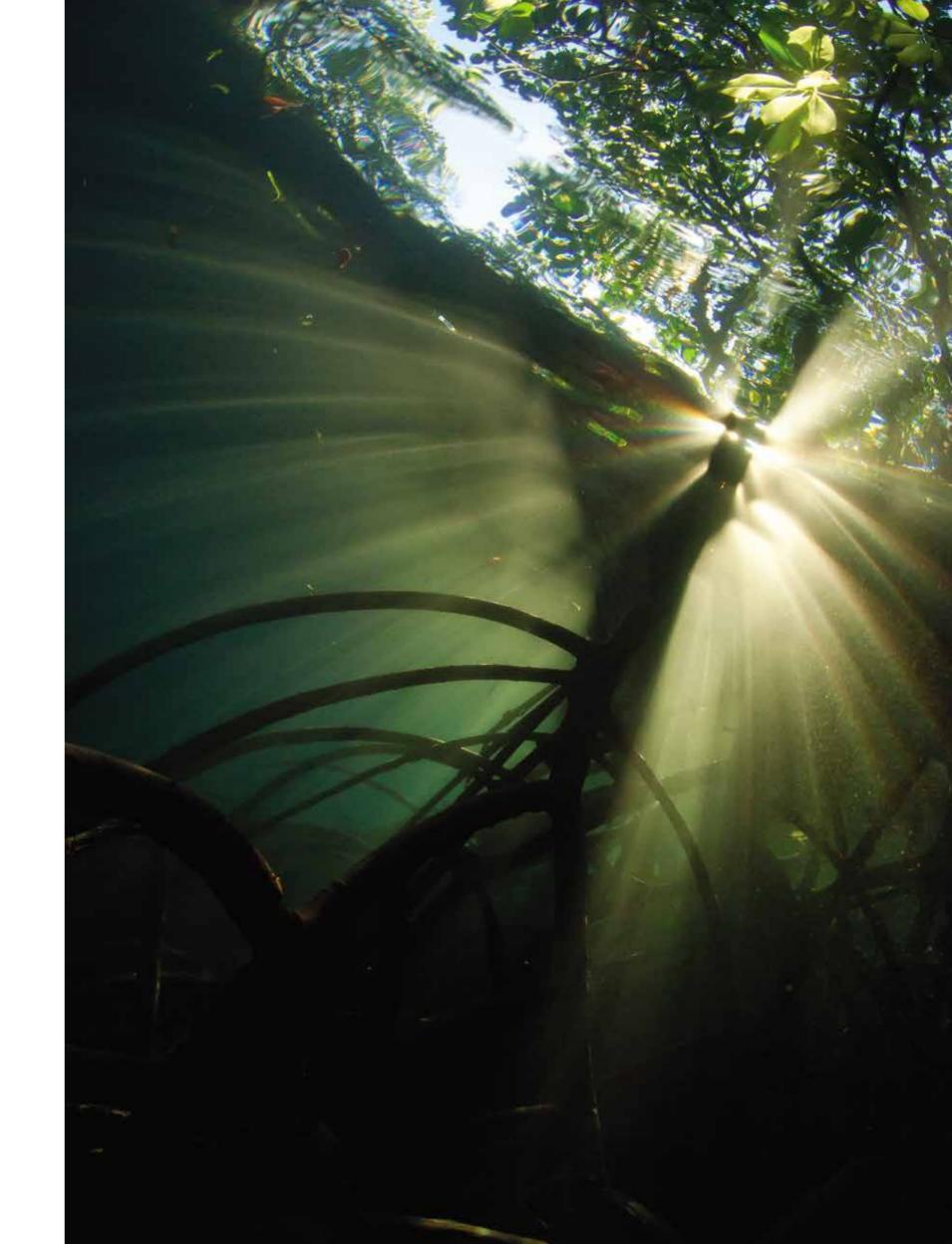
The region known as Wild Coast is found in El Cabo's eastern coast, in South Africa. It is formed by 250 km of rugged coastline, constantly subjected to ocean attacks. (DP/SP)

Island of Madagascar (Republic of Madagascar) is in front of the east coast of South Africa. The Masoala National Park in the northeast of the island is the protected largest area of the country and it includes rainforests and marine areas. The main attraction of its waters are the coral reefs with multicolor species where numerous species of commercial interest feed and reproduce. (AH/NPL)





The Ponta Du Oro marine reserve is on e of the few reserves of this type that includes two countries. It is located in the border area between Mozambique and South Africa and includes more than 600 km² of land and marine areas. This is one of the most important sites for the nesting of the leatherback turtle and it is considered a World Heritage site. Its coasts just like those of tropical areas have significant mangrove cover. (TPP/NGC)







The Republic of Seychelles is an archipelago formed by 115 islands located in the northeast of Madagascar on the African coastline. Its spectacular biodiversity and its beauty asides from being important from the biological standpoint are fundamental for the local economic activities. This small nation depends entirely on tourism and tuna fishing, and therefore their maintenance in the long term is critical. (MH/BP)





PAGE 150 The Tanzania waters are the home of Aldabra Atoll, the second largest in our planet. It is formed by four oceanic islands that together form a ring. Their unicity and excellent conservation status have earned it to be declared World Heritage site by UNESCO. In this atoll are the green turtle, the hawksbill turtle populations and even an endemic land turtle: the giant Aldabra turtle. (WM/LSM)

The Pate Island is the biggest island of the Lamu archipelago, on the coastline of the North of Kenia, close to the border with Somalia, in Africa. The coastline of this island is characterized because it is practically covered by thick mangroves, with a few open beaches. Charismatic species such as dolphins and dugongs live in its waters, besides coral reefs. (MSY/NGC)





The Ras Muhammad National Park in Egypt is on the north end of the Sinai Peninsula and to the west it is adjacent to the Suez Canal and to the east to the Golf of Aqaba. This park is the home of major coral reefs and is known as one of the best ten places in the world to practice scuba diving. The economic contribution of this activity is so big that commercial fishing was forbidden due to the negative effects this would have on the ecosystem and the tourist activity. (DD/NGC)

The Abu Dabab waters on the Red Sea in Egypt are the home of dugongs or sea cows (and it should not be confused with the Mexican marine vaquita). Unlike its relatives the manatees, this one strictly lives in the sea, and this makes it the only marine mammal strictly herbivorous. Therefore, it depends on large extensions of land covered by sea grasses. Although it is a protected species it is at risk due to the illegal hunting, the accidents with fishing arts and the destruction of their habitat. (WP/SP)



No water, no life.

No blue, no green.

SYLVIA EARLE





PAGE 156 The Tiran strait is a thin sea passage between the Sinai Peninsula and the Arabian Peninsula that separates the Golf of Aqaba from the Red Sea. Here are some of the best conserved reefs of the Red Sea, the Jackson reef in the north end and the Woodhouse and Thomas on the central part and the Gordon reef to the south. (DD/NGC)

PAGE 158 The Vaadhoo Island, in the Maldives Islands, is world famous for the light phenomenon that happens on its beaches. The light in the waters of these beaches is generated by millions of microorganisms that are part of the plankton. These are capable of generating this brightness through chemical reactions that transform the chemical energy into light. Not only the microorganisms are capable of this because there are examples of bioluminescence in fish, insects, fungi and echinoderms. (DP/NPL)

The Republic of Maldives is in the Indian Ocean, 450 km away from the coast of India and is formed by 26 main atolls (coral islands) and more than 1200 minor islands. This republic is one of the most threatened places by global warming, because it is estimated that the increase in the sea level will entirely cover its territory in the short term. (ID/NGC)





The Lacepede islands are 120 km away from the coastline to the northeast of Australia. It is a group of four islands that together are 12 kms long. They are important due to the numerous species of seabirds that go there to nest, asides from being the most important nesting site of the green turtle in Australia. (DD/NGC)

Parrot fishes from Singapore feed on corals in the waters of the Andaman Sea. (GD/NPL)





LEFT The Port Campbell National Park in Victoria, Australia, has impressive views thanks to the presence of structures sculpted by the waves throughout hundreds of years. Perhaps the most famous is the Twelve Apostles, and it attracts tourism from all over the world (GD/LSM).

ABOVE The Shark Bay on the west side of the Australian Continent has a rich ensemble of ecosystems. Here are the main sea grasses of the world where the dugongs go grazing. It is also the home of one of the largest stromatolite colonies and is the home of five endangered mammal species. (FL/NGC)





The Pacific Ocean is the largest in the world and it covers more than 165 million square kilometers which represents one third of the Earth surface area. The deepest part of the oceans is located here, the Marianas Trench, whose deepest point is almost eleven kilometers below the surface. Although most of its coasts and islands have been inhabited for thousands of years, they were first sighted by Europeans in 1513 and a few years later it was baptized by Ferdinand Magellan as Pacific.

Its waters join 42 countries and due to its size it harbors the most remote islands in the planet. The Great Barrier Reef which is the largest formation of coral reef in the world with an extension of 2300 kilometers long and the only one visible from outer space, is located in this ocean off the coast of Queensland in northeastern Australia. Unfortunately, these waters also harbor the largest concentration of garbage in the world, the Great Pacific Garbage Patch, where circular currents —or gyres—collect and maintain the waste produced in the countries bordering its waters. This ocean is also known to exhibit, at irregular intervals, the warm current known as El Niño. It deviates Humboldt's current, usually cold, reducing marine productivity and causing the collapse of fisheries in Peru and Chile; it also modifies the weather and the food production in a significant part of the American continent.



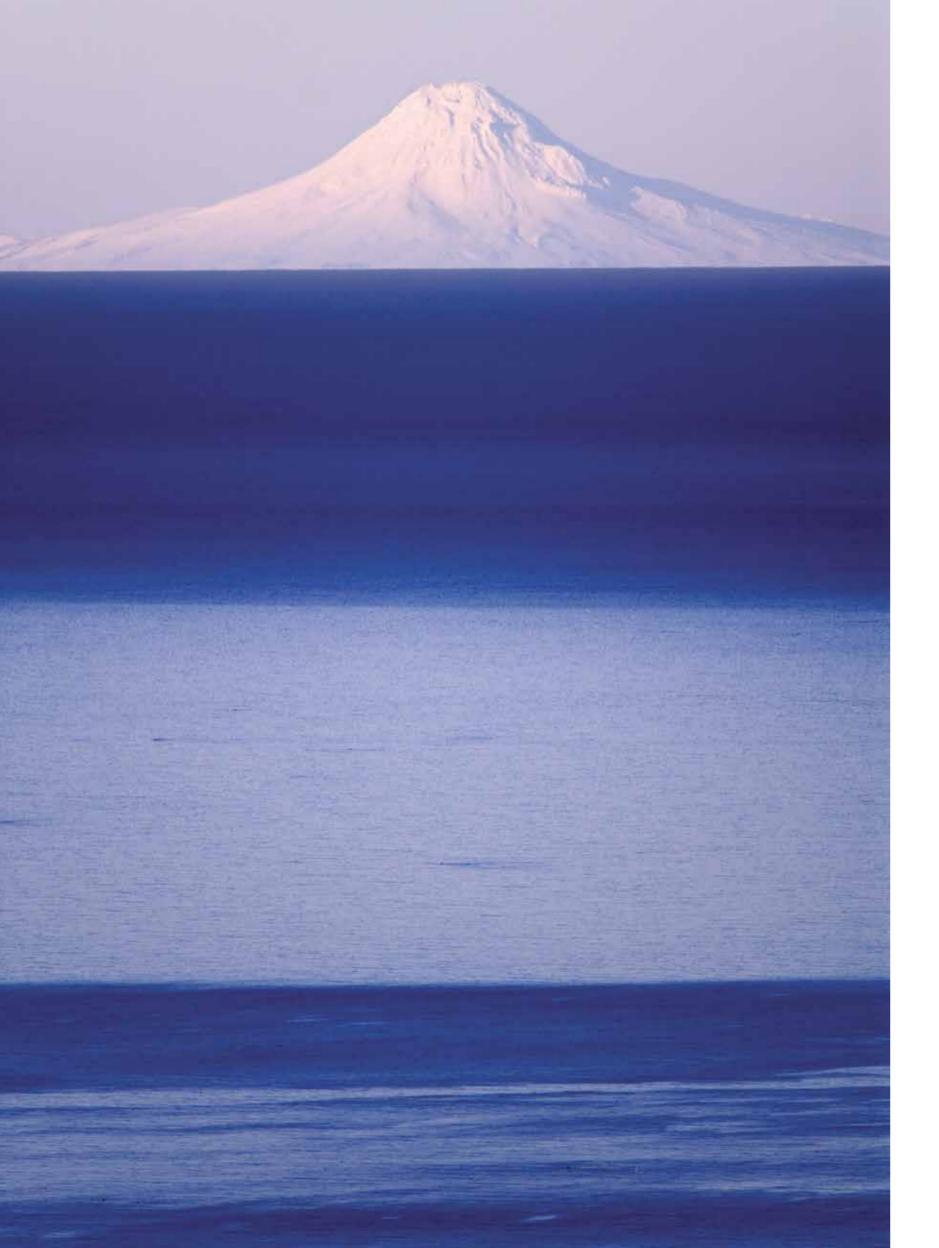


PAGE 166 The Archipelago of the Rock Island or Chelbacheb is in the Palaos country, formed by close to 300 small islands. These are really coral reefs and proof of that is the limestone material on the ground. The archipelago is practically uninhabited but its forests, beaches and reefs attract visitors throughout the year. (MT/NGC)

PAGE 168 The warm waters of the Hawaiian islands offer refuge to close to 10 000 humpback whales during the winter. If we consider that this species numbers approximately 21 000 individuals, the waters surrounding this volcanic archipelago in the Pacific Ocean is by far important for the long term conservation of this charismatic whale. (DF/NPL)

LEFT The Japanese Island of Hokkaido is the most northern one of the four main islands of Japan. On the west it is limited by the sea of Japan, to the north by the Okhotsk Sea and to the east and south by the Pacific Ocean. (VU/NPL)

ABOVE The Steller sea eagle is the largest of the sea eagles and is up to two meters long and weighs 9 kg; lives in Korea, Japan and the eastern end of Russia, mainly in the Kamchatka Peninsula. (BC/NPL)



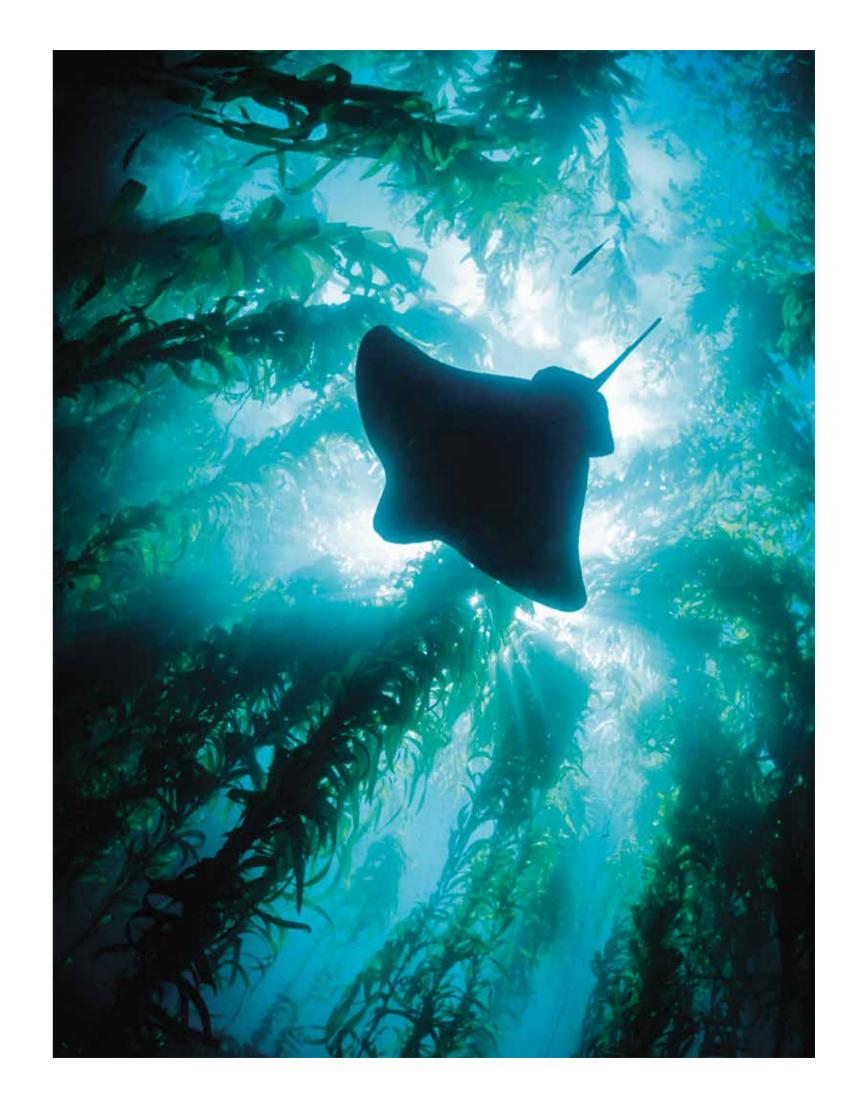


LEFT The volcano Augustine is in the south of the Cook Mouth in the Kenai Peninsula in Alaska. This is the more active volcano of the Aleutian Arch and its last catastrophic eruption was recorded in 1883 when major sections of its dome collapsed. (ASI/NGC)

ABOVE The killer whales are a kind of cosmopolitan marine mammal, that means that it lives practically in all the oceans and seas; only after human beings it is the second species more broadly distributed. They are spectacular hunters and represent the top on the food chain. (MM/NGC)









PAGE 174 The Pacific Ocean has more islands than any other ocean in the world, because there are 20 000 to 30 000 of them. Until a few centuries ago human activities were limited to the continental areas, and this allowed the conservation of some islands to be exceptionally good. For example, the Island of Vancouver, is a sanctuary of wildlife that is outstanding due to the abundance of whales, seals, otters and sea lions. (PN/NGC)

PAGE 176 During the summer the very cold water of the Alaska coasts increase their temperature up to 10 °C. Despite the fact that they seem to be cold as compared to the warm waters of the equatorial area in the Pacific which temperature fluctuates between 25 and 30 °C, these zones are also full of life and surprising shapes. (FB/NPL)

PAGE 177 The Kelp forests are common on the temperate coasts in the Pacific. These forests, formed by algae that can grow up to a meter per day and grow several meters until they are limited by the surface, are extremely productive. In them, an entire community of animals that form a food web that includes microscopic beings and algae that feed small invertebrate and vertebrate animals who in turn feed larger vertebrate animals such as manta rays and sharks. (PC/SP)

The intense activity of the earth's crust on the California coastline join the sea and form big cliffs and rocky beaches. The golden coast, as the California coast is also known, honors its name when at sunset sunrays light the cliffs and mark a contrast against the blue sky and sea. (CC/LSM)







PAGE 180 The Pacific Ocean covers and goes around with its calm waters the most active volcanic zone in the plant. Volcanoes like those in Hawaii are in constant eruption and slowly make the increase make the islands size grow. The growth of an island goes together with the violent shock between the incandescent lava and the sea water, but in a few decades, these new portions of rock will have a calmed look that will be beneficial to a large diversity of plants and animals that will find their home on top and below the surface of the sea. (SA/NGC)

LEFT After the eruptions, soil with a large amount of volcanic ashes is the ideal land for plants and animals to colonize these new areas. Gradually this barren land starts to cover itself with life and during the following decades the plants brought by marine currents or by birds settle in this fertile soil so that, little by little it forms vegetation islands in the middle of the ocean. (FL/NGC)

ABOVE Seals integrate the group of mammals which ancestors, like whales and dolphins, left the mainland millions of years ago to find in the seas in the primitive world a place where they could feed and protect themselves. Hawaii natives know the seal as ilio-holo-i-ka-uaua, name that means "dog that runs in turbulent waters" and mentions the transition of these animals from the land to the sea. (DP/SP)





PAGE 184 Untiringly sharks roam the Pacific waters but they also seek to benefit from great diversity of fish and invertebrates who live in the coral reefs close between Hawaii and Samoa, just over the Equator line, and it is one of the most preserved sea spots on or over the Equator line, it is one of the best marine places preserved where one can find the largest concentrations of reef sharks in the world. (BJS/NGC)

As we come closer to the Equator, pursuant to the sea water temperature, it becomes more stable throughout the year, while humidity and rainfall increases in the inland zones. In Costa Rica, the El Corcovado National Park is one of the most famous and accessible parks to observe wildlife. Here, every year at least 5 000 mm of rainfall nourish rain forests and rivers, from where the water goes back to the sea to close the cycle and keep planet Earth alive. (MPF/LSM)



Lost in the vastness of the Pacific, the Galapagos volcanic archipelago is a site of great geological activity. The 13 islands and more than 100 islets that form it have faced for millions of years the force of the waves that slowly have been eroding and converting these large masses of rock to sand, which is transferred by sea currents to beaches and bays in other regions of the Pacific Ocean. (FL/NGC)



ABOVE Hundreds of currently active volcanoes are under the surface of the sea. Thanks to the accumulation of magma on the hillsides, it becomes solid rock when in contact with water, and it continue to increase its size until it comes above the surface of the water and forms islands. The Pacific seas are classified by a large number of archipelagos and islands formed throughout centuries of intense volcanic activity. (FL/NGC)

RIGHT The birds able to start several day flights are capable of locating and naturally colonizing islands hundreds of kilometers away from the coast that no other animal, except human beings, may reach. The magnificent frigate bird, that is more than two meters long, may fly nonstop whole days —even sleep while flying— using air currents that cross the Pacific Ocean. (OJ/NPL)





The Galapagos Islands marine lizard is the only iguana adapted to life at sea, where it exclusively eats algae that grow at the rocky bottom of the sea. Once it has eaten, it spends most of its time basking in the sun on the volcanic source rocks. The Galapagos Island community is a living laboratory that shows the effects of isolation on the forms of life that live in it. (PS/NPL)

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To the south of the Equator, the tropical climates continue all the way to Colombia, Ecuador and Peru. In these seas the salinity is lower due to the high precipitation that bathes the humid forests on the South American Pacific. In El Darien jungle, one of the places with more rain in the planet, each year with more than 9 000 mm of rainfall, and this forms the rivers and the coastal lagoons that connect the land to the sea. (AW/NPL)

The conditions in the American coastline drastically change with the impressive presence of the Atacama desert in the southern part of Perú despite the fact that it is on the coast, the driest desert in the world does not receive humidity due to the fact that temperatures are lower and thus not sufficient humidity evaporates to carry it inland. This union between the Chilean desert and the Pacific waters shows the major effect that the sea can have on continental areas. (TR/LSM)



The largest concentration of islands on the western coasts of the most southern part of the American continent. The large number of islands is the result of the extension of the Andes Mountain range that gradually submerge in the southern seas, leaving the hilltops and the highlands surrounded by the water and forming hundreds of islets and archipelagos. (BW/NGC)

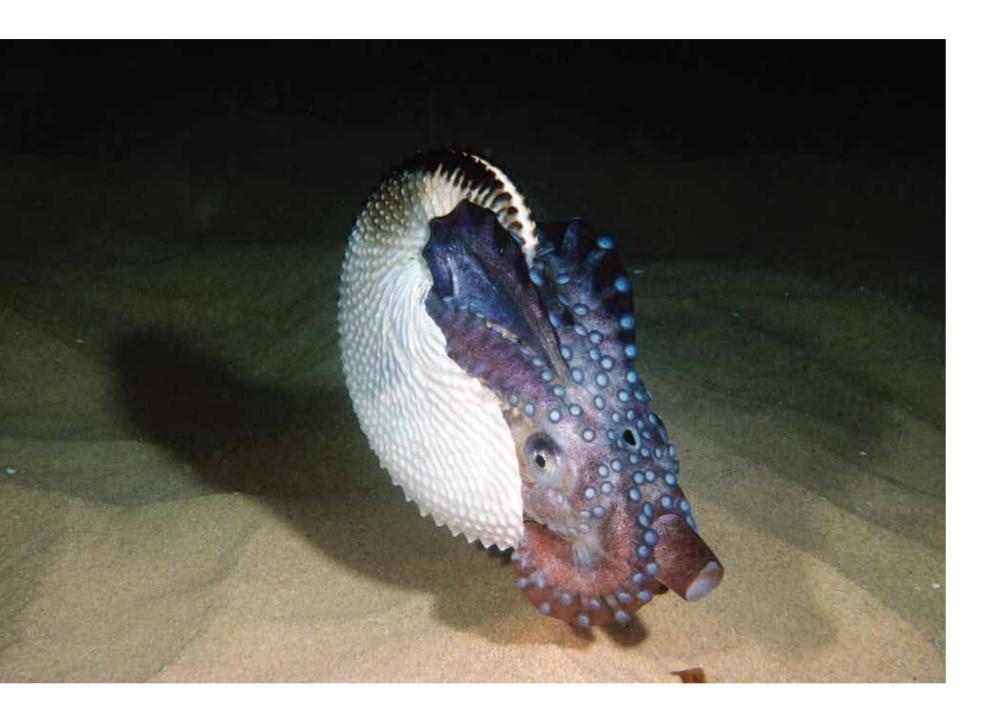
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During the summer, sea currents drag the nutrients towards the most southern seas favoring mass growth and reproduction of algae and microscopic organisms that are the basis of the food chain. The high productivity of the southern waters, higher than that of other seas, allow the existence of large populations of fish and whales, and also the development of fisheries like those in New Zealand. (FN/LSM)

PAGE 200 The movement of tectonic plates and the fluctuations of the sea level have been important factors in the isolation and diversification of fauna on the islands that have been formed, flooding and drying repeatedly throughout the history of the planet. For example, New Zealand started to separate from Australia 60 million years ago taking with it the flora and fauna that prevailed in that region at that time. As centuries went by, the fauna previously shared with Australia suffered changes that allowed it to adapt to the new conditions, and unique species appeared and currently they can only be found in that region in the Pacific. (MM/NGC)







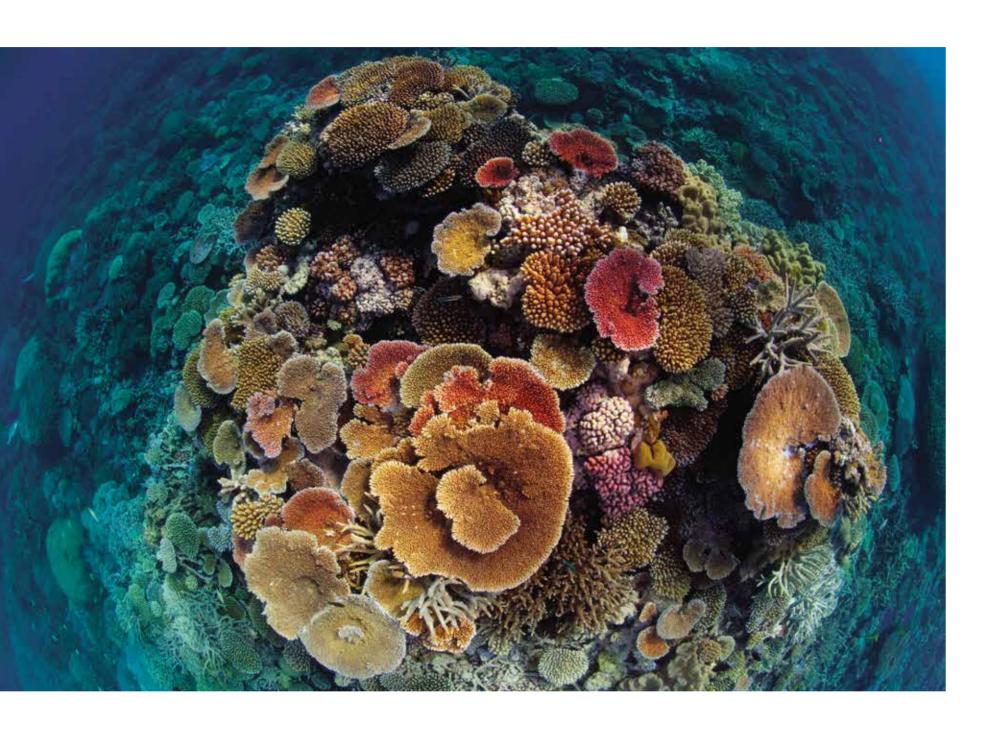
ABOVE Even today the ocean continues to keep many mysteries from humanity. We know very little of the ways of life that live in open waters or in the deep ocean. Extraordinary animals such as the nautilus have been present for millions of years in the southern hemisphere seas, and they have been able to stay away from human beings in the immensity of the Pacific Ocean. (DP&EPC/LSM)

RIGHT The handfish has adapted to shallow waters. Instead of swimming like other fish, this organism uses its pectoral and ventral fins to "walk" at the bottom of shallow waters. Like this species there are hundreds of unique species in the South-Western seas in the Pacific Ocean. (AM/NPL)

PAGE 204 In Pacific Ocean waters is the biggest coral barrier of the world; it is visible from outer space. This group of reefs has grown during 25 million years and thanks to the fluctuations of the sea level large portions of it have been left uncovered, hence giving pace to more than 900 Atolls –islands formed by coral– throughout the 2 300 km where it lies. This region has been extremely important for human societies, from the first inhabitants of Australia to modern cities, because the reef represents a source of food and, today, of numerous tourism services. (IA/NPL)

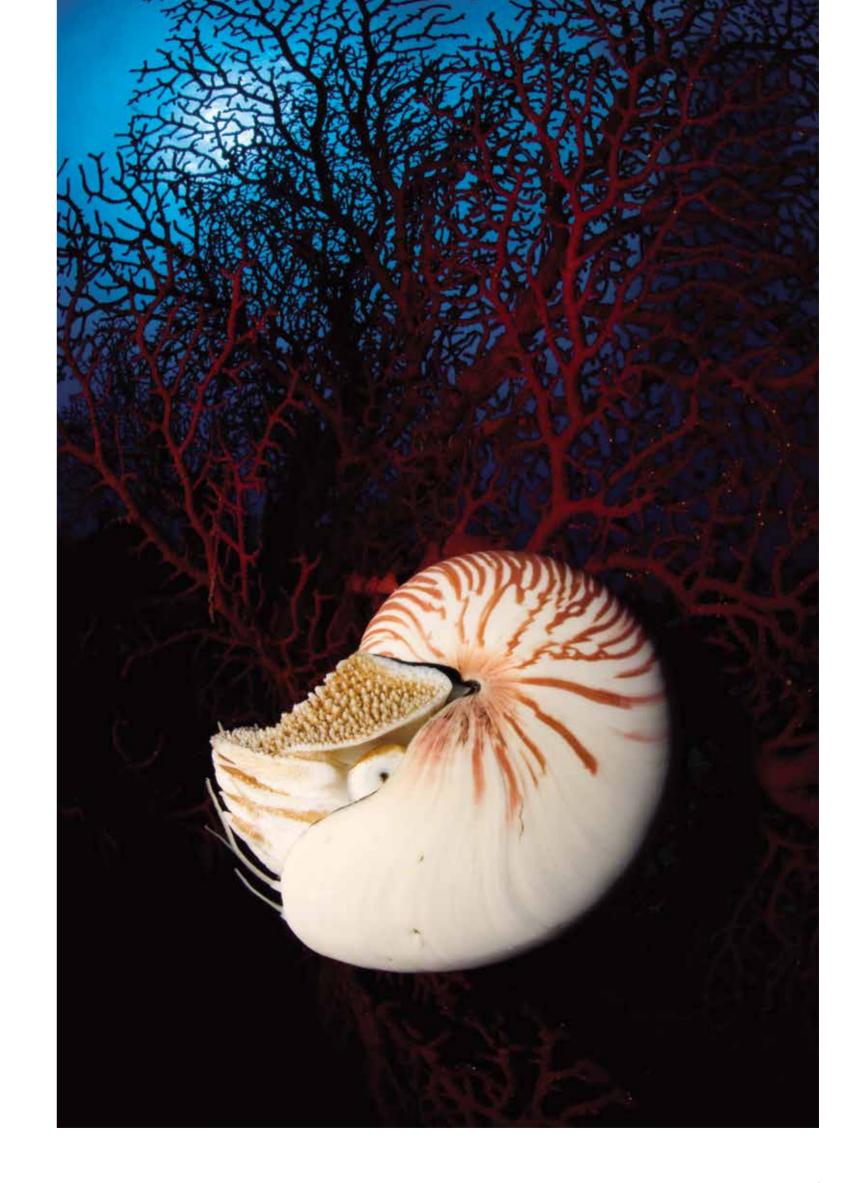
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ABOVE Corals are sea invertebrates that may or not be associated to algae that in shallow waters where they get sunlight, they get energy. Corals are fixed to the sea stratum and secrete calcium carbonate that gradually forms a skeleton; subsequently, new generations of corals continue to contribute to the growth of the calcium structure. The Great Coral Barrier, in front of the coasts of Australia, has been formed by millions of generations of more than 400 species of corals. (DD/NGC)

RIGHT The stable temperature conditions in the tropical seas has allowed some forms of life to stay practically the same throughout millions of years. The nautilus, like the corals, have witnessed the appearance and extinction of thousands of species, because they have been present for more than 500 million years in the planet's seas. (JF/NPL)







PAGE 208 The Raja Ampat archipelago, in the southeast end of the Pacific Ocean, is formed by more than 1500 islands and it is one of the most diverse sites of the plant. This biologic diversity maintains more than 120 million people who live off commercial fishing and tourism. Estimates are that the services provided by this region generate close to 6 billion dollars every year. (TM/NPL)

ABOVE The lion fish or the scorpion fish have characteristics that allow them to camouflage in the corals and surprise the fish and invertebrates they eat. This is a very common species in the aquariums and, unfortunately, it has been released in tropical seas of other regions, including the Mexican Caribbean, where it has become an invading species that is a predator for native fish. (TL/NPL)

RIGHT On the Southeast end of the Pacific Ocean, where the waters mix with the Indian Ocean waters, two very different fauna regions meet. In this region you can find the so called Coral Triangle, between Indonesia, Malaysia, Philippines, Papua New Guinea and the Salomon Islands. This area concentrates the highest marine diversity of the planet with more than 3 000 fish species and 500 of corals. (IF/NPL)



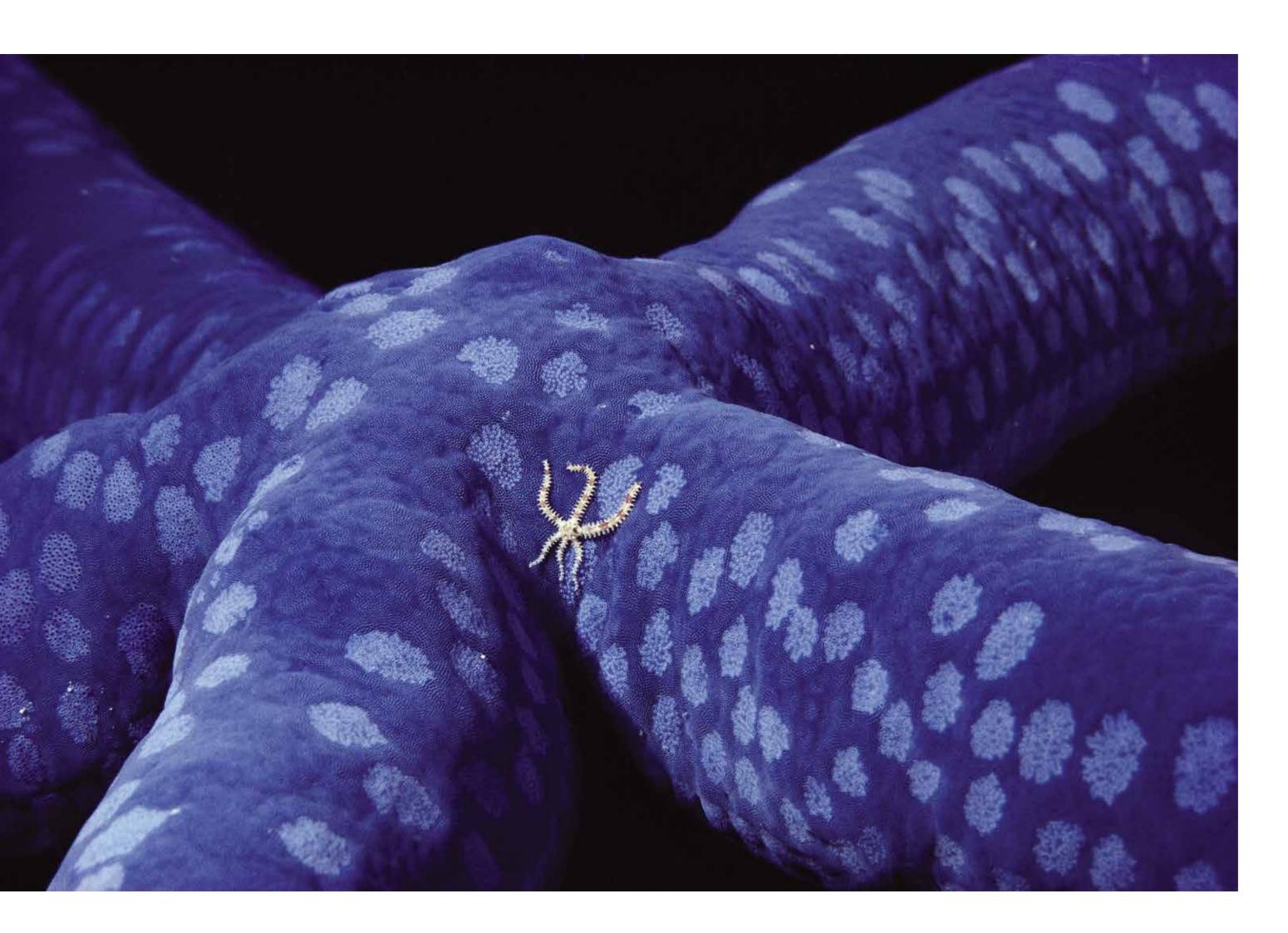




The Komodo dragon is a southeast Asia emblematic reptile. Confined to the Indonesian islands, it is a direct descendant of the giant reptiles that lived in Indonesia and Australia during the Pleistocene and that dispersed when the sea levels dropped during the last glaciations. At the end of the glacier era the sea levels increased again and left this dragon populations isolated, far from the mammals that displaced the reptiles from the rest of the world. (SB/LSM)

The Indonesia Archipelago is the largest of the planet, formed by 17000 islands of all sizes. Despite the large number of islands, the Komodo dragon is distributed basically in the Komodo, Rinca, Gili Montong and some of the Flores region, where a population of 5000 dragons is estimated. (CR/LSM)

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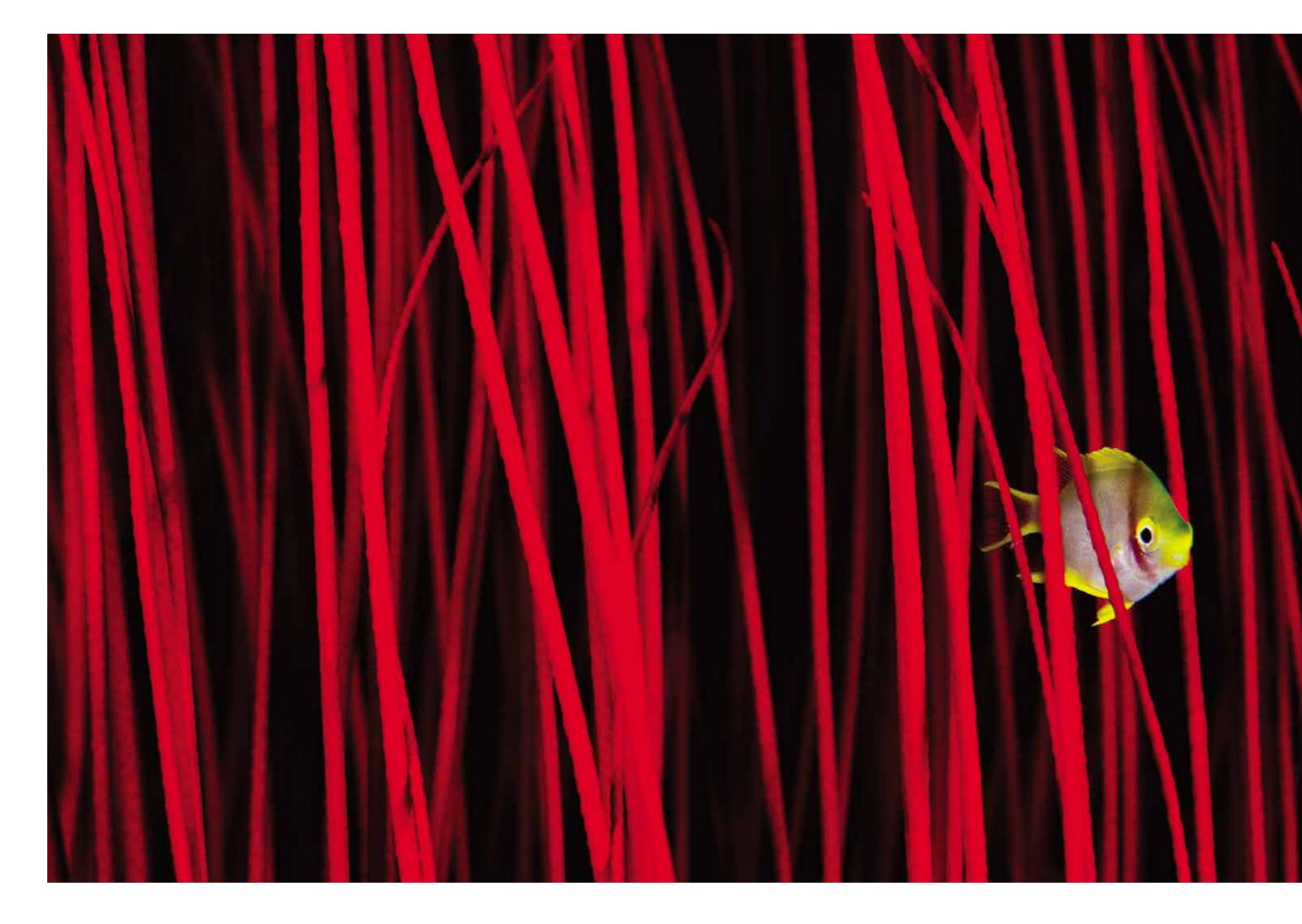


The sea stars are a very old group that has been present in the planet at least 400 million years. Throughout this time, they have adapted to multiple conditions, diversifying their forms, sizes and tones. Normally red, orange, blue, grey or brown, their brilliant colors allow them to camouflage or frighten their possible predators. They have an outstanding capacity to regenerate their arms should they lose any. (BW/LSM)

PAGE 216 Undoubtedly the coral reefs are the most colorful in the planet. This color richness is probably associated to the protection strategies against predators; fish may camouflage between the corals or rather announce that they are toxic or able to cause damages. (AM/NPL)

There are still some blue whales. There are still Krill. There are still some oysters in the Chesapeake bay. Half of the coral reefs are in good conditions, a jewelry belt around half the planet. There is still time, to change things.

SYLVIA EARLE

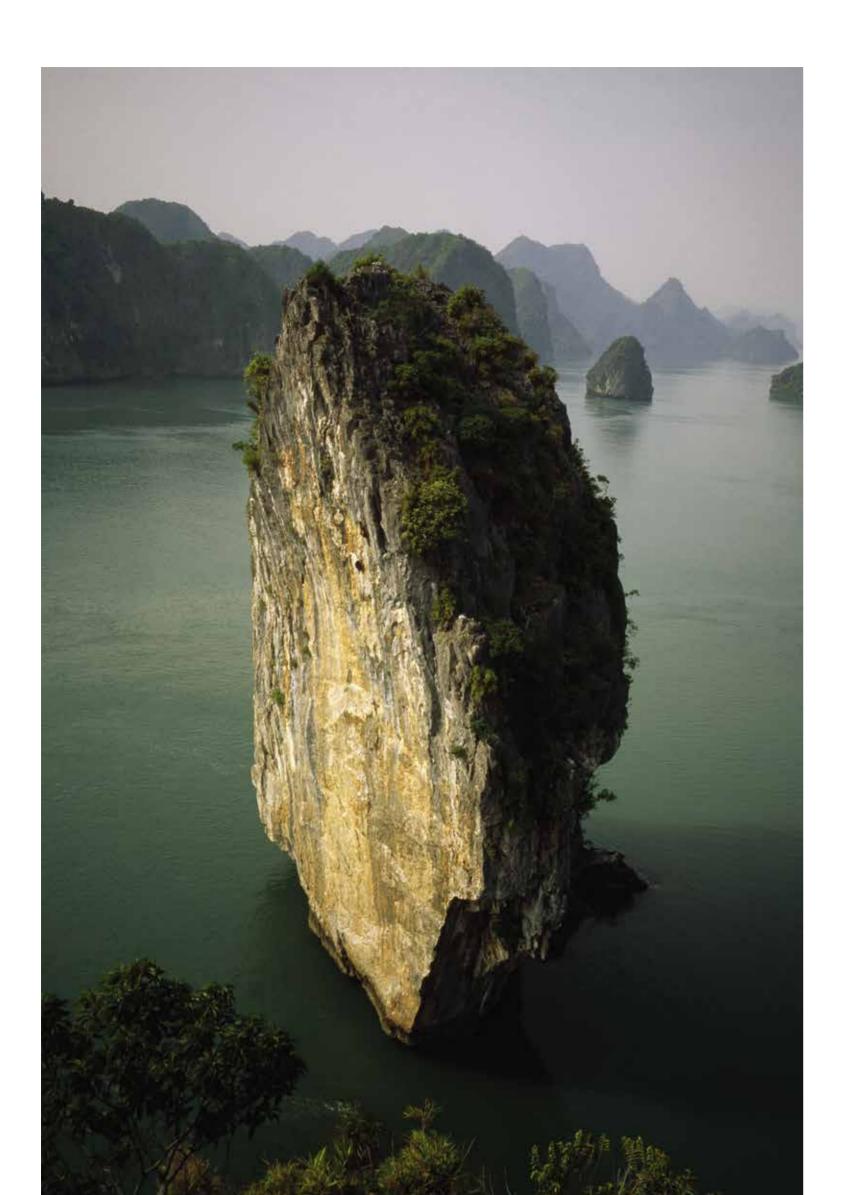






LEFT Just like many fish have colors that allow them to hide from predators, these have also adopted a similar strategy to harass their prey. Amongst the organisms that are the champions of camouflage are the octopus, as they are able to change color and form their skin in surprising patterns similar to the rock strata and marine reflections. (AM/NPL)

ABOVE The Australian sea snakes is another group of land animals that settled in the waters, and this allowed them to benefit from the food available in the South Pacific tropical seas. The sea snake with black head is able to withstand the salinity of the sea and take up to eight hours under the water looking for food. (FB/SP)



LEFT The Pacific Ocean border on the west with China shores. This country has the most populated city in the world, but is also number three in biological diversity in the world. The China Seas are characterized by being highly rich in species given the exchange of organisms between the Indian Ocean and the Pacific Ocean. (BH/NGC)

BELOW The Island of Borneo, the third biggest island in the planet, has the oldest rain forest in the world and is considered to be one of the most diverse sites. In this island 6000 species of plants and at least 100 species of vertebrates that only live here have been registered in this island. (MS/LSM)







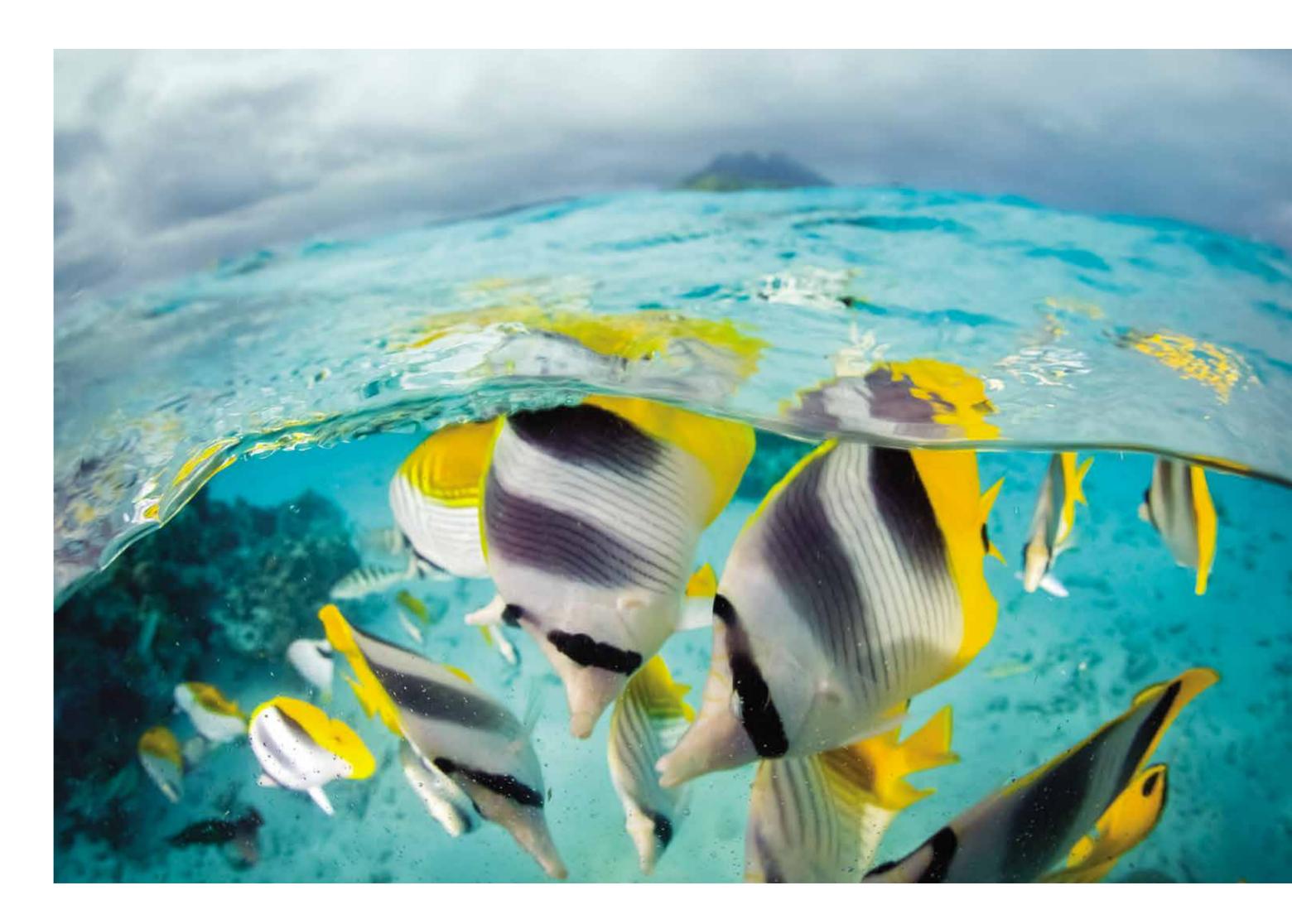


LEFT The Coral Triangle has the highest reef fish diversity in the world. Amongst them one can find extravagant species of forms that allow them to hide and be confused with corals. The harlequin ghost fish has a body that is equipped with the ideal camouflage to be undetected by the most keen observing predators. (HH/SP)

ABOVE In the seas between Indonesia, Philippines and Papua New Guinea, there is a channel that connects the Pacific Ocean waters with the Indian Ocean and that fosters an exchange between them. This coral, fish and invertebrate mix favored an extraordinary morphologic variation promoted by the new sea interactions and conditions. (above BJS/NGC; below DRS/SP)

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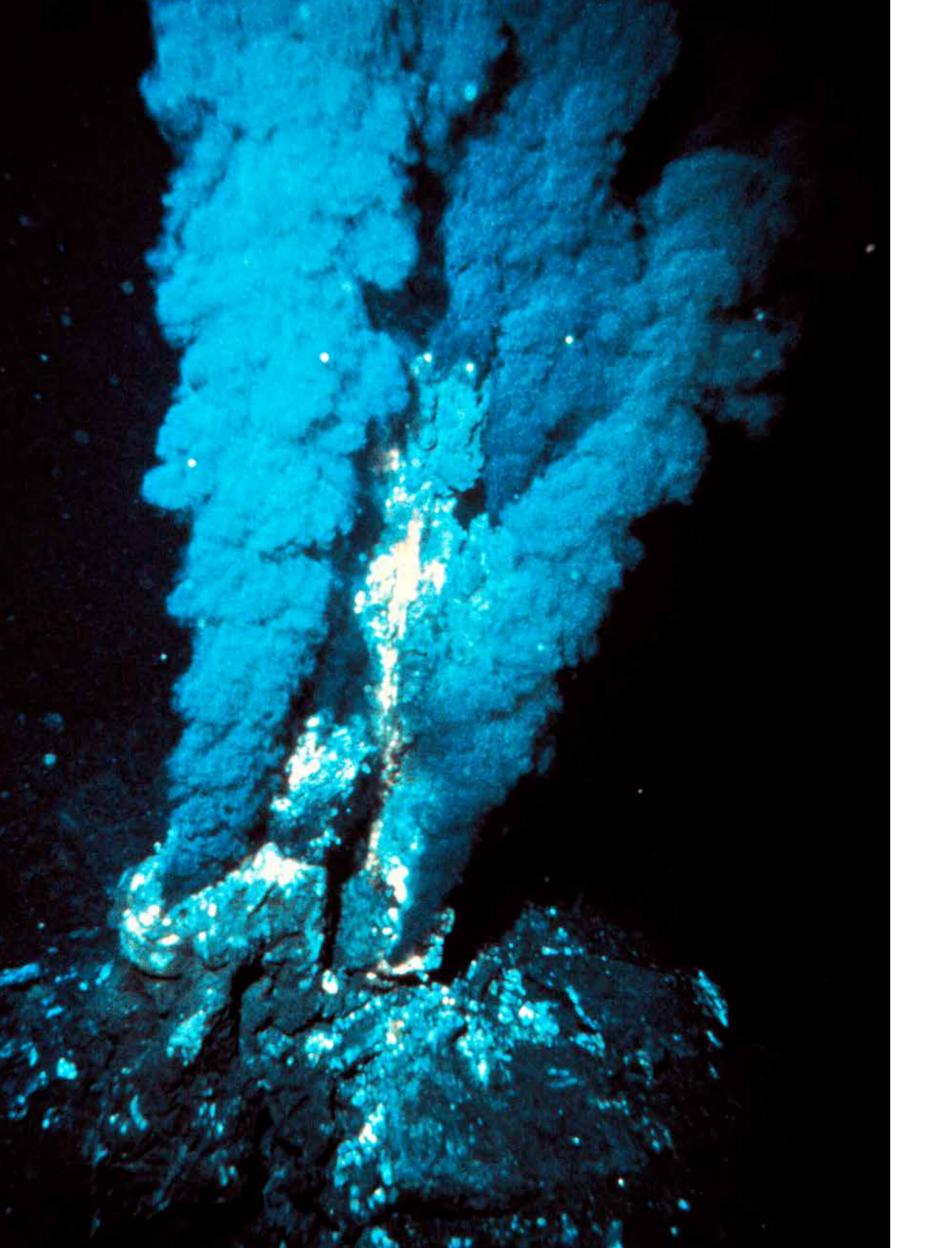


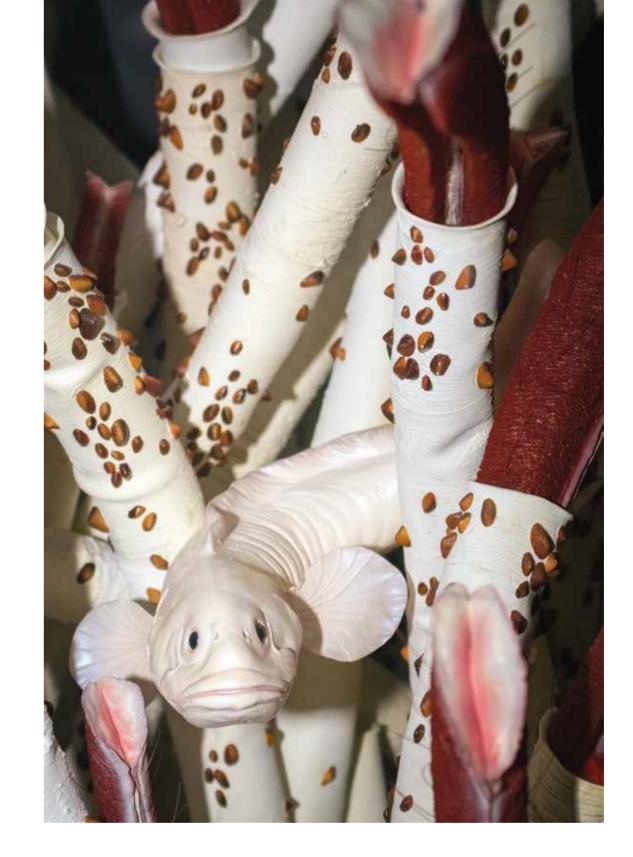
PAGE 224 The intense tectonic activity in the Pacific gave rise to volcanoes that in shallow waters gradually emerged, until they stopped their activity. As centuries went by they became islands, while coral reefs were formed in the parts submerged. The Bora Bora Island, in the French Polynesia in the South Pacific, is one of the hundreds of islands that characterize this region of the planet. (FL/NGC)

Estimates are that the Pacific reefs generate millions of tourism and fishing dollars and benefit millions of persons that trade or consume these products of the sea. Decades of research, international collaborations and work with coastal communities have led to the design and implementation of sustainable practices in the tourism and fishing sector, to allow a balance between the use and the conservation of the marine resources. (ED/SP)

PAGE 228 The American Samoa National Park was established in 1988 to protect a representative portion of the marine Pacific Ocean southern ecosystems. Alongside this ocean, protected natural areas have been created to safeguard places that have a high biological diversity, but also to guarantee the production of food, which entirely depends on the good health of this marine area. (FB/NPL)







Close to the Pacific Ocean submarine cracks and volcanoes, hydrothermal vents are created. These appear when the underground water warms up because it is close to magma currents, and this generates a considerable temperature increase and its expulsion by pressure through tubular vents that have been formed in thousands of years. (PR/SLP)

Despite the fact that the temperature around the hydrothermal vents may reach 400 °C, forms of life able to bloom have appeared under these extreme conditions. Communities of bacteria can be developed here, that are able to transform the chemical compounds generated by the vent into energy and that are the basis of the food chain of the oceans' dark depth where there is no sunlight and where there are no photosynthetic organisms. (SD/SP)



Lourdes Martínez and Donald A. Croll

CONSERVATION OF THE SEAS

The existence of human beings is intimately related to the ocean and not only due to the millions of tons of fish we extract each year or because the coasts are a favorite tourist destination. At global scale, sea water produces approximately 70% of the oxygen that we breathe thanks to the photosynthesis carried out by the phytoplankton, microorganisms invisible to the naked eye that are dispersed on the surface of the sea and that produce their own food through the energy of the sun. As photosynthetic organisms they are the first link in the food webs of the ocean and through oxygen release, they are the precursors of the existence of life throughout the planet. Oceans are also the biggest warehouse of carbon dioxide. This gas is released into the atmosphere through human activities such as the burning of fossil fuels and it is one of the global warming precursors. Without the ocean and the forests that capture it, the temperature of the planet would be even higher, threatening our capacity to survive as well as of many other species.

Oceans are invaluable. These huge masses of saltwater that we have not yet explored completely, provide free benefits to human communities throughout the planet. This year the World Wildlife Fund for Nature estimated that the services and goods offered by the oceans basically through fisheries, tourism, commercial trade, transportation of goods, and coastline protection —mainly



PAGE 232 Whales are the biggest animals that currently live on the planet. In past centuries many of them were persecuted because of the high value of their meat and fat. Fortunately the implementation of temporary and total closed seasons and also the design of conservation plans, have allowed many endangered species to recover. (JF/NPL)

The Atlantic northern coasts are also the home of a large variety of birds. The Atlantic puffins spend autumn and winter on the high seas, and in the spring they return to the rugged coastal rocks where they form colonies to nest hundreds of animals. (IV/LSM)

through to the mangroves and corals— worth at least 24 billion dollars! This would make the ocean the seventh world economy after the United States, China, Japan, Germany, France and the United Kingdom

Unfortunately the large variety of benefits provided by the ocean at global, regional and local scales, are seriously threatened as a result of centuries of overexploitation and neglect. The huge extension covered by the oceans, as well as the perception that they are an inexhaustible source of resources, have made their protection difficult and now we are facing the collapse of many ecosystems and their species around the world.

The main threats

Nowadays oceans are subject to human pressures like never before. The largest one is the extraction of species. The current abundance of species in the oceans is probably a small sample of what once were oceans teeming with life. The disappearance of the largest marine species such as sharks, whales and tuna fish is the biggest proof of this. Jeremy Jackson, recognized marine ecologist and his collaborators, documented the sizes reduction of the fish captured between 1956 and 2007 as sport fishing trophies in Key West, Florida. In 50 years the average size of groupers decreased from 135 to 37 cm and the size of sharks from 195 to 90 cm; besides, these species ceased to be abundant ad therefore less frequent as trophies.

This is the trend in several latitudes of the world due to the development of fishing arts and more efficient boats but at a very high cost. Every year close to 38 million sharks are extracted to meet the shark fin demand in Asia and according to the Food and Agriculture Organization of the United Nations, in 2012 the fishing of tuna and horse mackerel reached the highest levels ever with more than 7 million tons extracted. To deny that the abundance of marine animals has changed, it is probably a defense mechanism to not recognize that we are devastating the seas. The loss of populations and the extinction of species are modifying the function and structure of the marine ecosystems and, in turn, decreasing their capacity to provide environmental services that are fundamental for our well-being.

The impact of our consumption habits is harder to detect in the oceans than in terrestrial ecosystems. However, in recent years migratory species have become sentinels of the current situation under the water surface. In 2010 a grey whale stranded on a beach in Seattle and it revealed one of the most catastrophic impacts of our presence on the planet. This majestic animal of more than 30 ton died from a bowel obstruction caused by twenty plastic bags, a pair of surgeon gloves, a golf ball and numerous plastic objects in its

stomach. Oceans have become the rubbish dump of our waste that every year causes the death of more than a million birds and 100 000 marine mammals. But plastic is only one of the diverse set of wastes that we dump into the seas; industrial waste, solvents, urban discharges, fertilizers and pesticides are our constant contribution to the sea.

We destroy marine ecosystems in several ways. The Great Barrier Reef in Australia is the largest coral reef ecosystem in the world; it comprises more than 340 000 km² and it shelters approximately 400 species of corals and a great diversity of fish and invertebrate animals. Corals are sessile animals, that is, they are permanently attached to the ground; they have a skeleton composed of calcium carbonate and they live associated to a microscopic alga commonly called zooxanthellae who gives the wonderful range of colors that characterize them. Coral reefs are the equivalent of rainforests and they have been considered one of the most diverse ecosystems on Earth. Sea temperature rise and the constant absorption of carbon dioxide by sea water lower its pH in a phenomenon known as acidification of the ocean. The most heinous consequence of this phenomenon is the whitening of the corals due to the expulsion of the zooxanthellae, which in turn increases their vulnerability and ability to survive throughout their entire distribution. Warm temperatures and the acidification of the ocean represent a challenge for the existence of numerous species, especially those whose body is formed partially or entirely by calcium carbonate as is the case not only of corals but also of numerous species of snails and clams.

Protection of the oceans

Three years ago I was sailing the Gulf of California waters in a small panga, says Lourdes. I was in the Grandes Islas region as part of a marine conservation course organized by Duke University. This region includes an archipelago located in the north of the gulf formed by 45 islands and islets and two of the biggest islands in the country: Tiburón and Ángel de la Guarda. The deep blue sea was calm. The panga maintained a constant speed and I was immersed in my thoughts. Shortly after, we saw a large seabird concentration far away in the sky and this could only mean one thing: a group of sardines under the surface and, with them, many dolphins that join the birds in the feast. As we came closer the group of birds became a mix of cormorants, sea gulls, pelicans and frigate birds, and when I looked closer at the sea,a group of more than one hundred common dolphins were coming closer. They were everywhere, wherever you turned your eyes you saw them coming out of the water and with the same speed they dove again into it. Their bodies have a perfect hydrodynamic design, that is the result of millions of years of evolution, and a smooth and

thick skin that generates little resistance in the water to make them reach high average speeds of 30 kilometers per hour.

Upon arrival, you only need to gaze at the feeding frenzy and the very interesting dynamic displayed by birds and dolphins. In such an event, dolphins surround the sardines and force them to come up to the surface where it is easier to eat them; the birds then drop in free fall to the sea to catch a sardine with the beak. When I thought that nothing could improve such sight, a hungry humpback whale appeared a few meters away from the panga opening its mouth and taking hundreds of sardines in a single bite. This scene lasted only a few minutes, this is why it is a frenzy moment loaded with excitement and lots of activity, until the school of sardines was consumed and only a few of them were left scattered and baffled. After that the birds and dolphins dispersed and the sea seamed to regain its peace. Undoubtedly, this has been one of the greatest expressions of the interaction between species and the value of each one to maintain the ecosystem functioning that I have ever seen. It is impossible not to think in the amount of sardines there must be in this gulf to feed millions of birds and thousands of marine mammals. I cannot imagine the tremendous amount of life in the years prior to the overexploitation of the seas.

Monterey Bay in California has one of the most classical stories of overexploitation of resources. In the early years of the 20th century the growth of the fishing industry in the region originated the cannery industry that flourished in the street called Cannery Row, on the seafront. The exports of canned sardines boomed during the First World War years because this was a non perishable and nutritious food for soldiers; in those years the production increased from 75 000 cans in 1915 to 1400 000 in 1918. In subsequent years the demand was more or less constant and it flourished again during the Second World War when Monterey became the main sardine exporter city in the world. What no one thought was that although Monterey is a highly privileged area in terms of fishing productivity — due to the flourishing of cold nutrient rich waters from the bottom of the Pacific Ocean which are channeled to the surface through a great submarine canyon in the bay — the capture of sardines would experience an imminent collapse since the species was not recovering from the massive extraction. The collapse of sardine fishing and therefore of the cannery industry happened after the war with the subsequent economic and social conflicts and the closure of the last factory in 1973.

During the 50's and the 60's fisheries increased their extraction levels throughout the world and this set a precedent for what later was known as the conservation of the oceans. Towards 1958, The Law of the Sea was the first effort to regulate the governability of the countries over the oceans. Subsequently, four conventions were adopted at international level: the Convention on the Continental Shelf, the Convention on the High

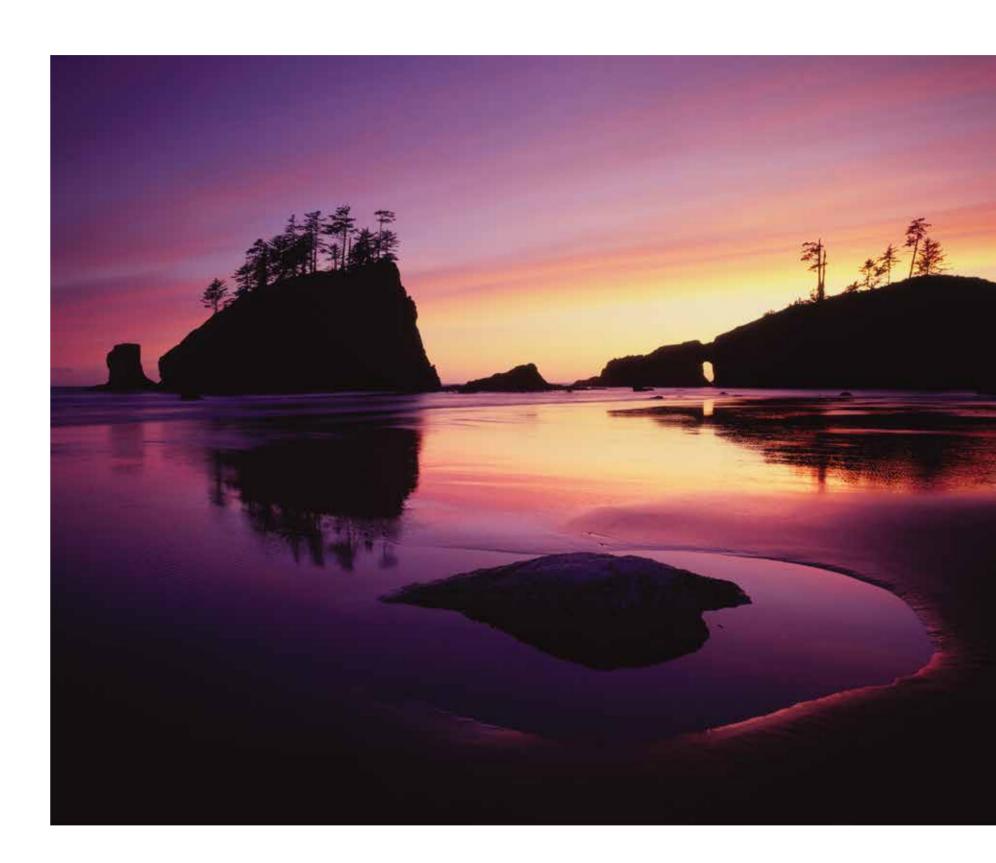
Seas, the Convention on the Territorial Sea and the Contiguous Zone, and the Convention on Fishing and Conservation of the Living Resources of the High Seas. Spatial planning emerged as a response to the global concern regarding the overexploitation of the marine ecosystems and the loss of biodiversity. The first conference on marine protected areas was in 1975 and the need to establish a network of protected areas representative of the marine ecosystems of the entire world was declared.

Since then, marine protected areas have been established to regulate human activities in areas that are important for the maintenance of the species and populations critically endangered, to preserve the critical habitats for the survival of species including those that are of economic importance, to prevent activities that may risk the marine area per se, to maintain the genetic feasibility of populations and species, and to protect historical and cultural important sites.

To date, more than 10 000 marine protected areas cover 7.9% of the waters in zones with national jurisdiction and 2.3% of the total surface of the ocean. This effort is being assumed by the 193 countries that participated in the Convention on Biological Diversity held in 2010 in Nagoya, Japan, in which the Strategic Plan for Biodiversity 2011-2020 and the commitment to protect 10% of the marine systems by the year 2020 were approved.

Oceans' conservation has been a major challenge due to management difficulties, lack of enforcement, and the complex monitoring of protected areas, especially those that cover vast areas or that are established in the open ocean. In response to the difficulties other strategies have been developed to protect the oceans at different levels and scales; the locally-managed protected areas and the networks or corridors of protected areas — spatially separated but oceanographically connected— are some examples. Oceans are dynamic environments where the wind and ocean currents move surface water long distances. Therefore the availability of resources, the species distribution and the presence of human coastal communities also change. In addition, our impact on the global climate change modifies even more the dynamic nature of these vast masses of salt water. Recently, the scientific community of universities such as Stanford and Duke in the United States of America are focusing their efforts in the dynamic management of resources in accordance with the global changing conditions and the specific features of each region.

This new approach is coupled with the use of better technologies to study and understand the oceans' dynamics. The use of devices, attached to individuals, that send satellite signals about their geographic location allow to record the species' movements, its habitat use and its interactions with other populations and species in order to have a better understanding of its life history and to identify the key sites to protect it along its distribution area. For instance, in Papua, New Guinea a broader program to mark the



The scenic beauty coasts around the world offer us is another environmental service provided by the marine ecosystems. It is the responsibility of the current generations to take care of these places so that they can be equally enjoyed by future generations. (JD/NPL)

tuna fish in the Pacific is carried out and to date more than 300 000 individuals have been marked. The program is keen to achieve a sustainable use of this species and also to identify those areas with illegal fishing activities; this is done by reading the information that each individual carries on a microchip inserted under the skin.

Last hope for the sea marine vaquita

Less than 60 years ago the *vaquita* was described, a porpoise of meter and a half long that lives on the upper Gulf of California in an area of approximately 4000 km² long. Today, it is the most threatened marine mammal, facing a serious risk of extinction. Its main threat are the fishing nets. In recent years the fishing of the Totoaba has been identified as one of the factors that has caused more damage to this species. The Totoaba is a fish endemic to the Gulf and that is also critically endangered due to fishing. The illegal trade of the swim bladder of this fish with China generates the demand in Mexico and its price range between 3 000 to 9 000 dollars per kilogram.

Numerous efforts and resources have been made invested to protect the *vaquita*. Among them, the establishment of the protected area Alto Golfo de California y Delta del Río Colorado, its inclusion in the IUCN Red List of endangered species, the creation of the International Committee for the Recovery of the *Vaquita* (CIRVA), the action program for the conservation of the species (PACE), the Totoaba fishing ban and the prohibition of fishing nets within the area, as well as the work with local fishing communities. However, the species has not been able to recover. In the last 17 years the *vaquita* population has decreased from 567 individuals to less than 100, which represents more than 18% annual rate. This means that by 2018 the *vaquita* will be the second extinct marine mammal in the last 50 years, due to human beings, after the baiji or the river dolphin that was considered extinct in China in 2006.

In April this year the government of Mexico adopted a clear position that could be the last hope to protect this species. The President announced the temporary suspension of commercial fishing in the upper Gulf of California. This decision is accompanied by a compensation to local fishermen and the presence of the Navy in the area, as the highest authority to survey and enforce the new provisions. This is one of the greatest environmental challenges Mexico is facing today but if the Navy does the job that was entrusted to for, we would feel more confident that this time we are taking a major step in the conservation of this enigmatic species, a survivor in the Gulf of California.



The vaquita is one of the 100 most threatened mammals in the world. Its population has been severey affected by unregulated and illegal fishing over decades, including the overexploitation of shrimp, shark and totoaba. On this species it is focused one of the most intense conservaiton efforts of the country, and involves the federal government, local fishermen and dozens of national and international organizations, and has resulted in the decree of refuge zones such as the Biosphere Reserve Alto Golfo de California y Delta del Río Colorado and the Wildlife Refuge for the Protection of the Vaquita Marina. (TAJ; Image captured with the authorization (Oficio DR/488/08) from the Comisión Nacional de Áreas Naturales Protegidas / Secretaría de Medio Ambiente y Recursos Naturales, in a special management natural area. We thank the colaboration of the Coordinador de Investigación y Conservación de Mamíferos Marinos, Instituto Nacional de Ecología)



The future of the marine diversity will depend on how willing human societies are to replace the industrial fishing methods, which have overexploited most of the fisheries of the world, with alternative methods that respect the natural cycles of the species and allow their recovery and reproduction of those that are on the brink of extinction. (AL/BP)

Coda

More than 50 years have passed since Rachel Carson, a renowned marine biologist, wrote the following phrase in her book *Sea Around Us*: "It is a curious situation that the sea, from which life first arose, should now be threatened by the activities of one form of that life. But the sea, though changed in a sinister way, will continue to exist: the threat is rather to life itself". And her words still apply today. It is the time to reduce the pressure that we exert on oceans, to stop seeing them as an endless storage of food and to give a respite to the species that live therein. Not doing so is undermining our own existence.





The Antarctic Ocean surrounds the Antarctic landmass.

For some authors it is not an ocean of its own right but the southernmost waters of the other oceans. However, it is also distinct from its neighboring oceans by being surrounded by an upwelling in which deep waters of the south meet waters from the north, and it acts as a barrier that has isolated many of the species that live therein.

Here, the ice covers 18 million km² at the end of winter and it is reduced to approximately 3 million towards the end of summer; a significant difference with the Arctic Ocean.

Despite these changes on the surface covered by ice, water temperature variation is low throughout the year (from -2°C to 3°C), and therefore marine species that live here have more stable conditions than those living in other oceans of the planet. Penguins are perhaps the most distinctive animals of this ocean. Emperor penguins are the only vertebrates that spend part of the winter on the sea ice.





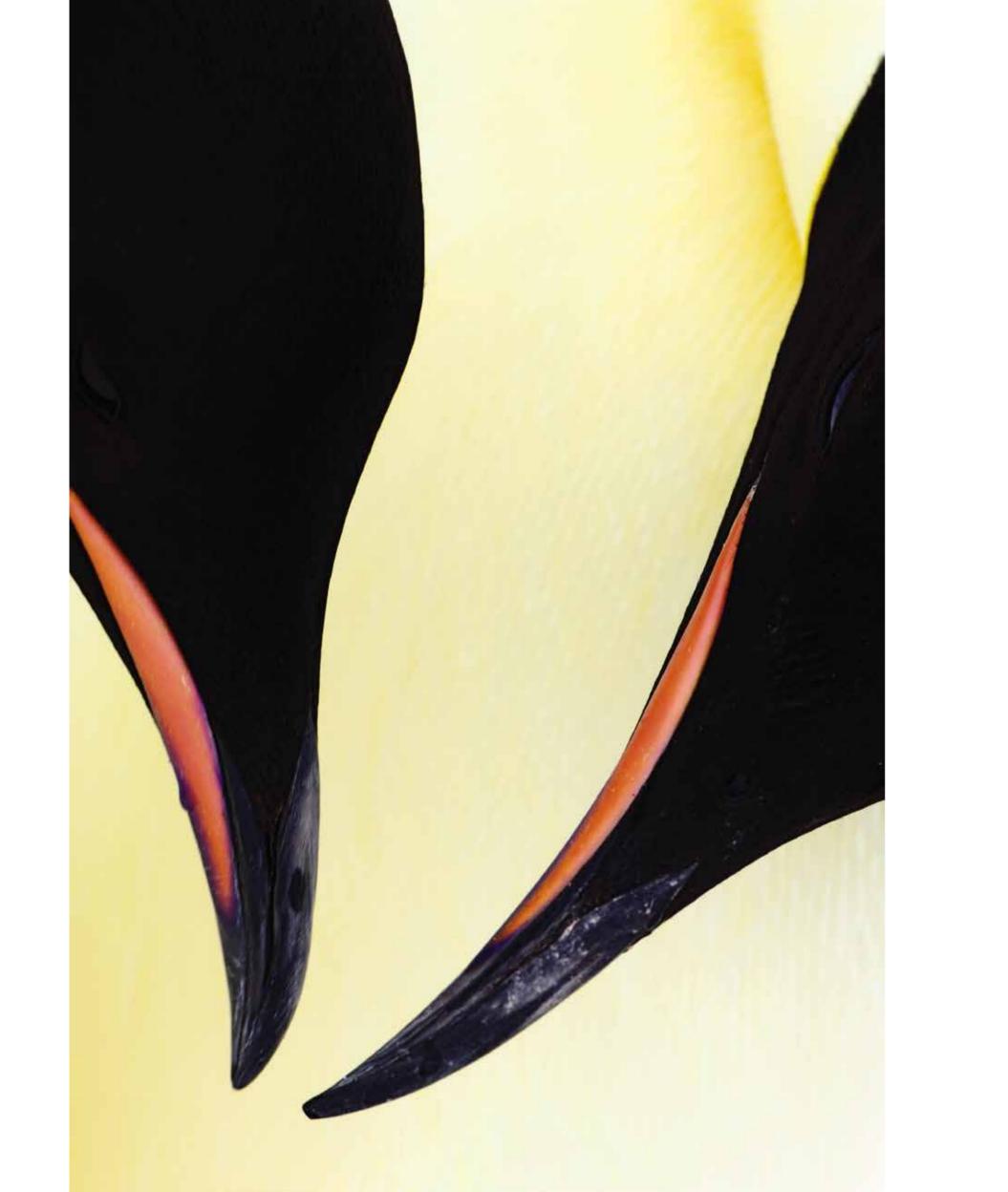
PAGE 244 In the winter a thick layer of ice covers half the Antarctic Ocean and huge blocks of ice that float adrift. Despite the fact that the surface temperature drops to -50 °C, the temperature of the sea stays between 0 and -2 °C. Life is not common on the surface but, as incredible as it may seem, under the water there are hundreds of forms and colors.

(YM&JE/LSM)

PAGE 246 Despite the fact that the Antarctic has 90% of the fresh water of the planet, it is at the same time the driest place in the world. Humidity, in the form of ice, is dragged by strong blizzards. Although the temperatures may drop to -70 °C and the winds exceed 100 km/h, life has found extraordinary ways to survive in these inhospitable landscapes. (FP/SP)

PAGE 249 The Antarctic is the place that has the strongest winds that together with the Antarctic circumpolar current that surrounds the South Pole, generate the biggest sea current of the planet, dragging with it millions of litters of water. Gigantic waves and the unseaworthy currents have kept these seas as some of the wildest and at the same time more productive of the world. (FL/NGC)

Weeks before the southern winter begins, thousands of penguins gather and migrate up to 100 km into the Antarctic continent. When they find the ideal place, that will shortly after become the coldest place in the planet, they form their nesting colonies. (JS/NGC)









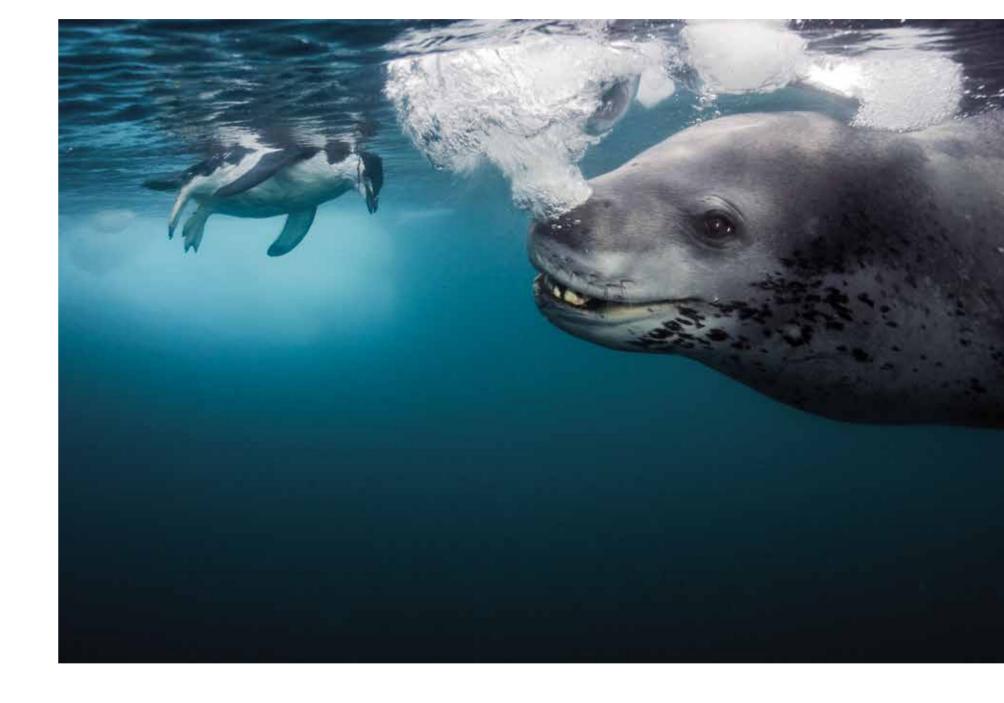
PAGE 252 The Antarctic is the penguins empire. The emperor penguin, the biggest of this group of birds, weighs up to 30 kilos and can be up to 1 meter high. Nature has provided penguins with feathers capable of withholding the little heat generated by their body to withstand the low temperatures. (IV/LSM)

PAGE 253 At the end of a harsh winter and when it seemed impossible for life to develop under extreme cold conditions, small penguins, just out of the egg, that the father cared between its feet so much, peek their peaks and little by little learn the art of survival in conditions under which no human being would be able to survive. (FL/BP)

LEFT Under the water penguins are extremely fast; this bird did not adapt to fly but to swim, and moves with the same speed and accuracy as its relatives when they fly. During immersions the penguins reduce their cardiac rhythm from an average of 200 beats per minute to 20 beats per minute, and this allows them to reduce as much as possible their consumption of oxygen and spend more time under water feeding. (PN/NGC)

ABOVE The extraordinary skill of penguins to swim allows them to spend half of their lives under the water eating krill, fish and small crustaceans. On land these birds are not as skilled as under water, but this does not represent a serious problem for them, since there are no natural predators that threaten their life. (PN/NGC)





ABOVE Leopard seals, agile and quick swimmers are by far the predators of penguins. In a single day one seal alone can eat up to ten penguins. Apparently this is a large quantity but it also allows the population of penguins to stay strong and healthy since those that are caught by the seals are normally the weakest or oldest ones. (PN/NGC)

PAGE 260 Despite the fact that the Antarctic Ocean temperatures are the coldest in the planet, these are some of the most productive waters. There is an explosion of krills, small crustaceans that despite the fact that they are only a few millimeters long, they form concentrations that together represent thousands of tons from which many animals feed. (FN/LSM)

PAGE 261 The color at the bottom of the sea of the Antarctic Ocean is a contrast with the pale colors of its surface. Nothing is wasted in the sea; any waste or blooming of organic matter is quickly taken up by other species, and this maintains the cycle of active nutrients and healthy and productive polar waters. (NW/LSM)

The huge concentrations of penguins on the South Georgias Island provide food to the sea elephants that in turn form the largest reproduction colonies of the world. The sea elephants are able to survive in the most extreme conditions in the Antarctic thanks to a thick layer of fat under the skin that they develop during their first years of life. (YM&JE/LSM)



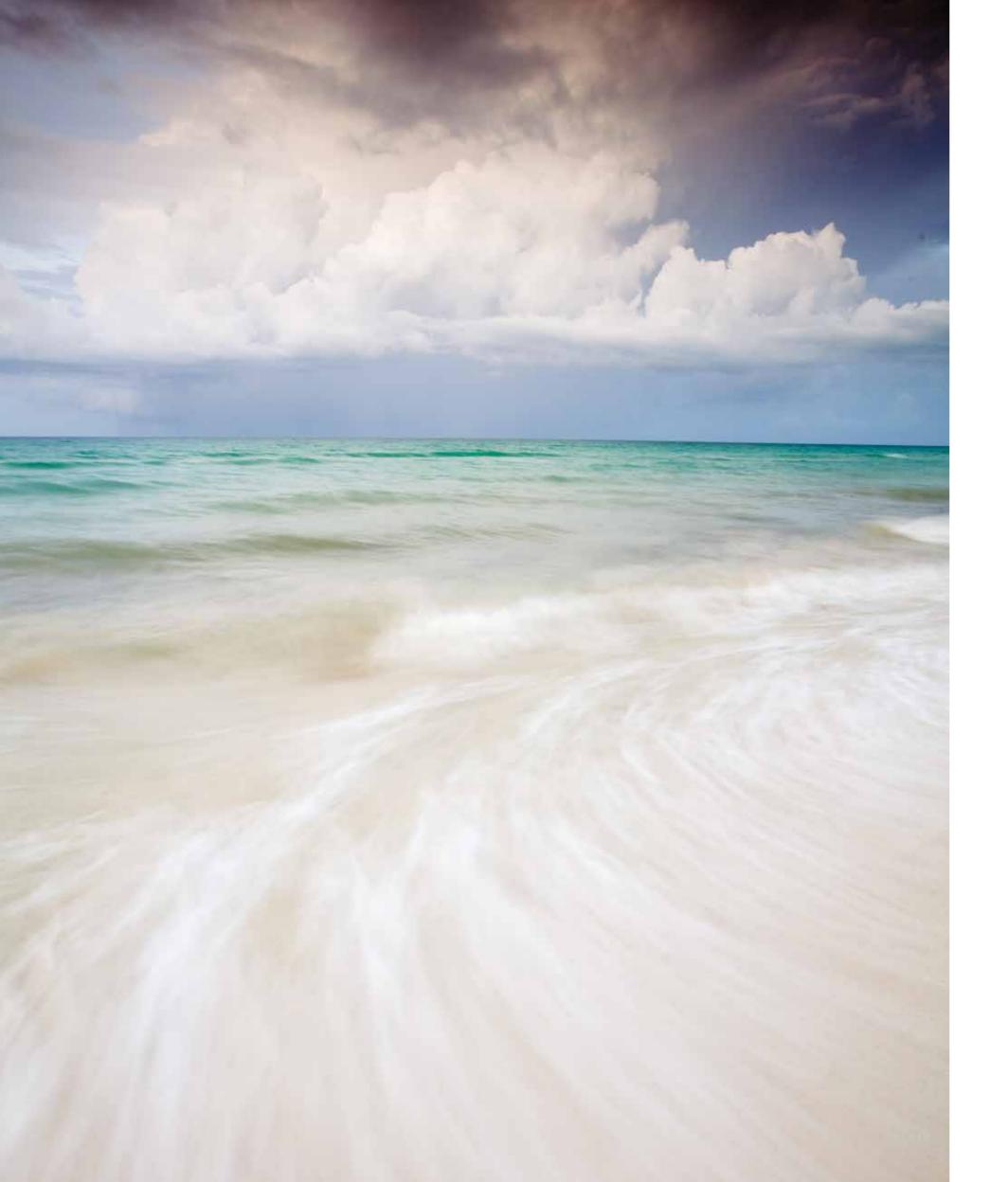


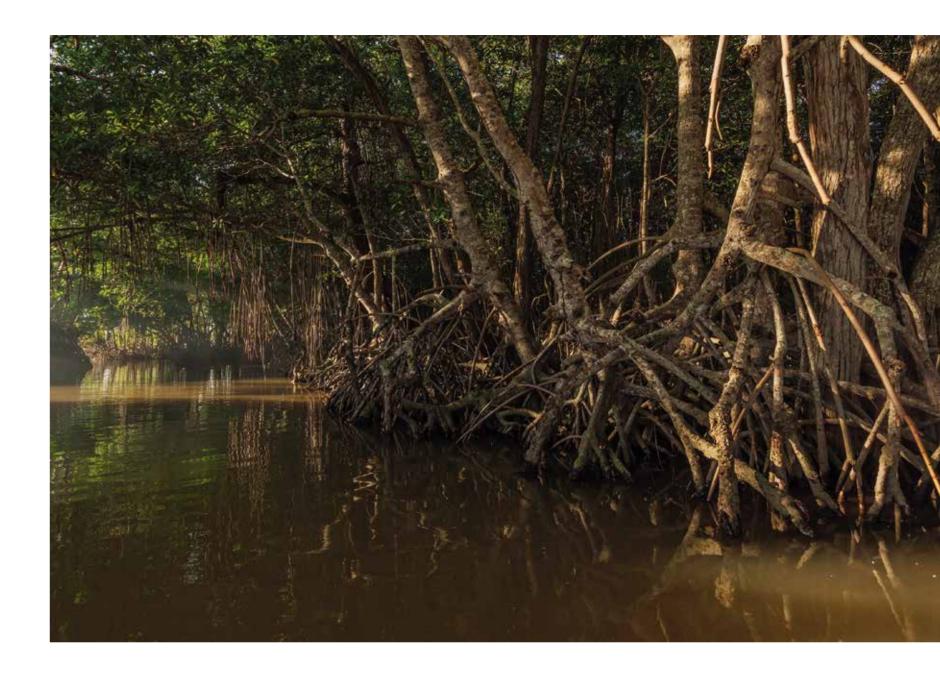




Western Mexico is directly bathed by the Pacific Ocean and also by the Sea of Cortez or the Gulf of California, defined by the Baja California Peninsula and where there is a great diversity of marine species, many of which are endemic of this sea.

To the east, the warm waters of the Gulf of Mexico foster the formation of storms and hurricanes that affect the climate of a significant portion of North and Central America. The Gulf of Mexico was an important fishing region, but its wealth is being lost due to pollution and overfishing. The crystalline waters of the Caribbean Sea surround the eastern portion of the Yucatan Peninsula and harbor the northern part of the Mesoamerican Reef, the second largest reef barrier of the planet which is close to one thousand kilometers long. The presence of the coral reef and numerous mangroves allows an extraordinary diversity of marine species in this region.





PAGINA 262 Surrounded by the Pacific and Atlantic Oceans and also by the waters of the Gulf of California and the Caribbean sea, Mexico has more than 200 islands and islets distributed in its territorial waters. Their separation from the continent –by the distance or by sea currents– allows Mexican islands to be a national biological diversity reservoir, for the enjoyment of present and future generations. (CCK)

PAGE 264 Mexico has the second biggest reef barrier of the world, and it is more than 1000 km long and runs in front of the coasts of Quintana Roo, Guatemala, Belize and Honduras. Besides its spectacular biological diversity it represents the basis of the economy of numerous fishing and tourism services communities that depend on the good health of this magnificent ecosystem. (CCK)

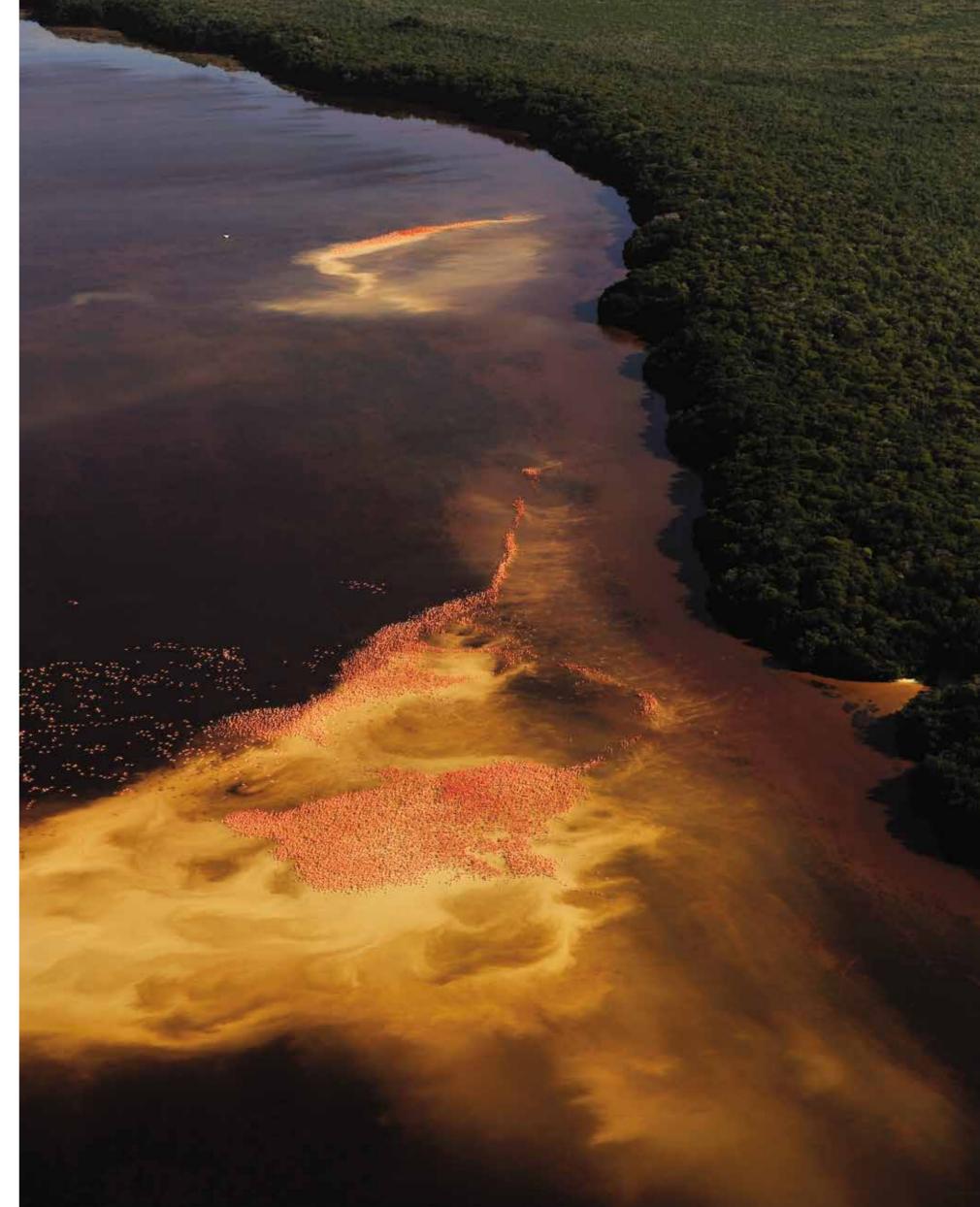
LEFT In the tropical zone of the Atlantic ocean and the Caribbean sea the cold air currents join the hot air masses from the north. The hottest masses are then lifted and create an ascending current that takes with it the sea steam to higher parts of the atmosphere. The clouds thus formed move thousands of kilometers and release the water in different regions throughout their route, including the valleys and the tropical mountains of the Mexican southeast. (CCK)

ABOVE Mangroves such as this one, located on the Tabasco coasts in the Gulf of Mexico, besides being very important for the fisheries and biodiversity, are important ecosystems for the storage of carbon. Its soils have big amounts of organic matter with low decomposition levels, and this makes their conservation and recovery a global importance issue. (DGT)



ABOVE The Caribbean flamingo lives in lagoons and hyper saline estuaries alongside the Gulf of Mexico's coastline. During their reproduction season, thousands of flamingos gather and form extensive nesting colonies. (CCK)

RIGHT The flamingo colonies, formed occasionally by up to 25 000 individuals, dye pink the Ría Celestún Biosphere coasts. This site hosts one of the largest populations of Caribbean flamingos in North America. (KN/NGC)



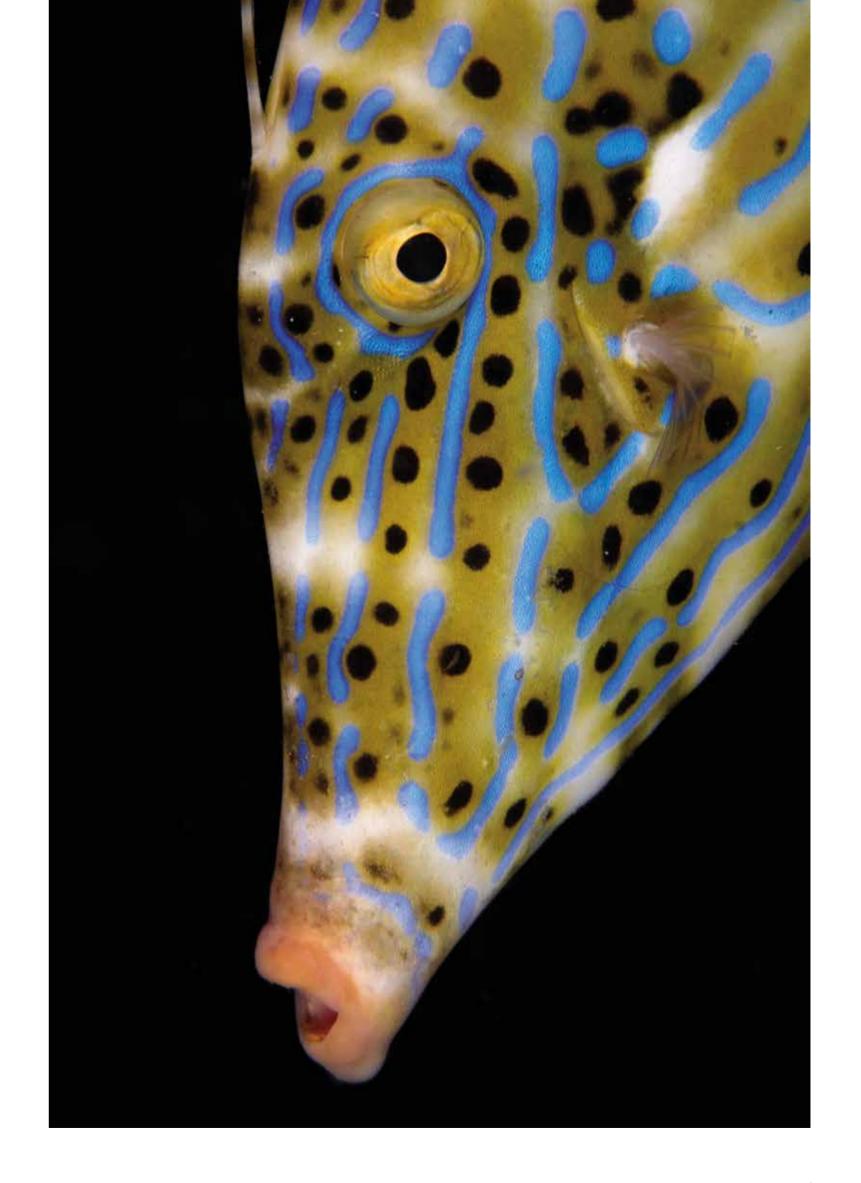


The Mexican Caribbean waters are highly nutrient rich due to the confluence of the cold currents from the Atlantic Ocean and the Caribbean warm tropical waters. These rich waters and the emerging soil, such as the Contoy Island, feed millions of birds and turtles that year in year out nest in the Mexican tropical zones. (CCK)



ABOVE The Mexican Caribbean hot and rather shallow waters have allowed the development of diverse and complex communities of sponges and corals. For thousands of years the coral reefs have formed slowly, because the new generations grow on the remains of prior generations, forming spectacular structures covered with life. Numerous economically important species live and are protected at some stage of their development by the reef, and therefore their protection is fundamental to maintain the productivity of the fisheries of our country. (CCK)

RIGHT The colors and forms of some of the marine animals seem to come from fantastic stories that happen in other planets. Despite the fact that the seas represent a large part of the biosphere, the seas are some of the least explored areas. We know very little of their inhabitants that day in and day out continue to discover forms of species and surprising colors. (LJS)





In the Mexican southeast the Atlantic Ocean cold waters mix with the warm Caribbean waters creating optimum conditions for a large diversity of organisms to prosper and intertwine in a delicate life network. Here, all the organisms benefit from the richness of the waters, from microscopic crustacean and shellfish –which are the basis of the food chain– to the gigantic shark whale and the majestic manta rays. (CCK)

PAGE 276 In the north of the country the conditions are very different to those in the Caribbean. The deep Pacific Ocean waters with rough sea currents and polar winds, have sculpted an impressive landscape that shows the resistance of the land, but also the slow erosion of the huge cliffs formed on their coastlines. These currents are the ones that keep the water and marine life moving. (CCK)

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In the rough waters of the Pacific Ocean algae and animals live with strong currents and establish close associations. The kelp forests on the Baja California coastline represent huge groups of algae where each corner is the home of some kind of life. These forests are a shelter for many species that are economically significant for the fishermen who co-exist with the sea. (OA)

The kelp forests develop in the lukewarm waters of the North America western coasts. These sites provide many environmental services that benefit millions of persons close and far away from the coastline. Amongst the services they provide is the protection of a large amount of commercial species that spend the first stages of their life in these dense algae forests. It is fundamental to take care of these places if we want to continue extracting food from the seas. (CCK)

PAGE 280 For millions of years the rocky coastlines of Baja California have supported the attack of the waves driven by strong sea current and the numerous hurricanes that form every year in the Mexican Pacific. These natural forces have sculpted extravagant shapes on the rocks that attract thousands of persons that admire the beauty of the Mexican seas. (RLH/NGC)









The productivity of oceans not only benefits the species that live in the water. On the surface millions of birds, such as sea swallows also live thanks to the food the sea provides. These birds use every square meter of the islands, islets and rocks in the middle of the water to live and reproduce. Fortunately, many islands are still paradises for seabirds, because there are no dogs, cats or rats there that devour their eggs, normally deposited on the ground. (CCK)

The Sea of Cortes is one of the Mexican waters most diverse and nutritious. The proliferation of millions of microscopic crustaceans lures the whales to this place who year in year out come here to give birth to their offspring. The whale calfs born in these calm and rich waters have to be guided by the Pacific sea currents to go throughout the world in the next 30 years. (MC/SP)

PAGE 284 Mexico's land diversity forms incredible contrasts when it meets with the sea. When the lukewarm sea meets the warm desert of the Baja California Peninsula and Sonora, cactus and palm trees get the humidity they need from the sea, forming islands of land vegetation isolated by the desert conditions that surround them. (CCK)

The Sea of Cortes

is the aquarium

of the world

JACQUES-YVES COUSTEAU



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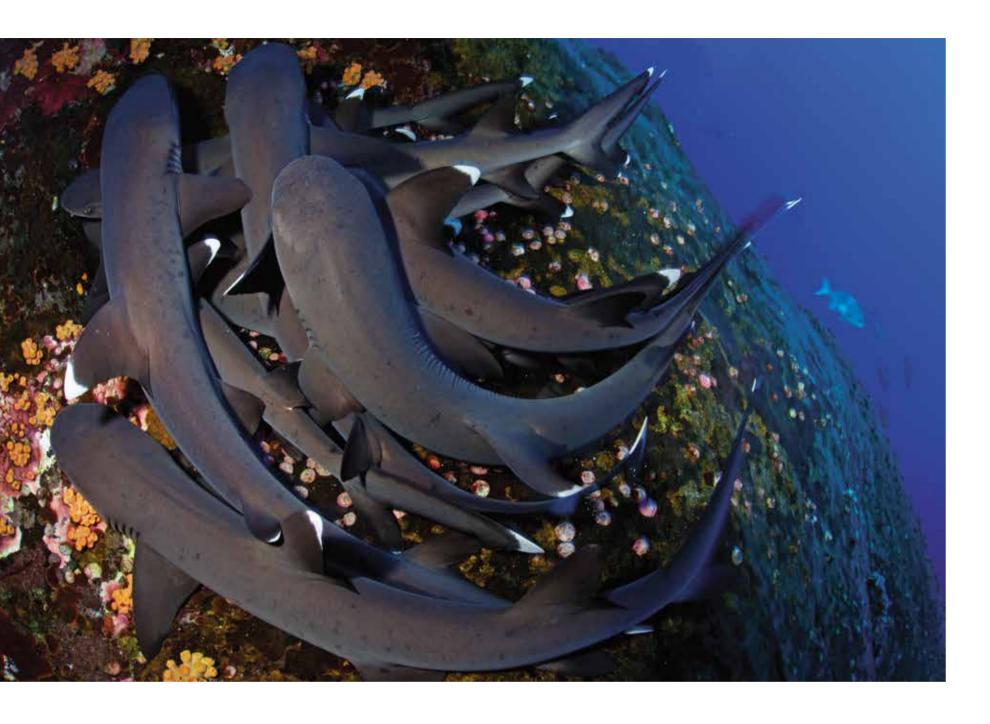


Productivity and diversity of the Baja California seas have surprised millions of visitors to the so called "aquarium of the world". Just like in all ecosystems their species are closely intertwined by the food chain where prey and the great predators co-exist maintaining a fine equilibrium in the life cycle. (OA)

RIGHT The rocky forms that can be seen on the surface are only a small sample of the rock masses seen on the surface which are but a small sample of the rock masses submerged. While the rocks emerged are important sites for the survival of birds, the submerged mountain ranges are ideal places for the development of numerous fish and invertebrates, many of them are important as food for human populations. (CCK)



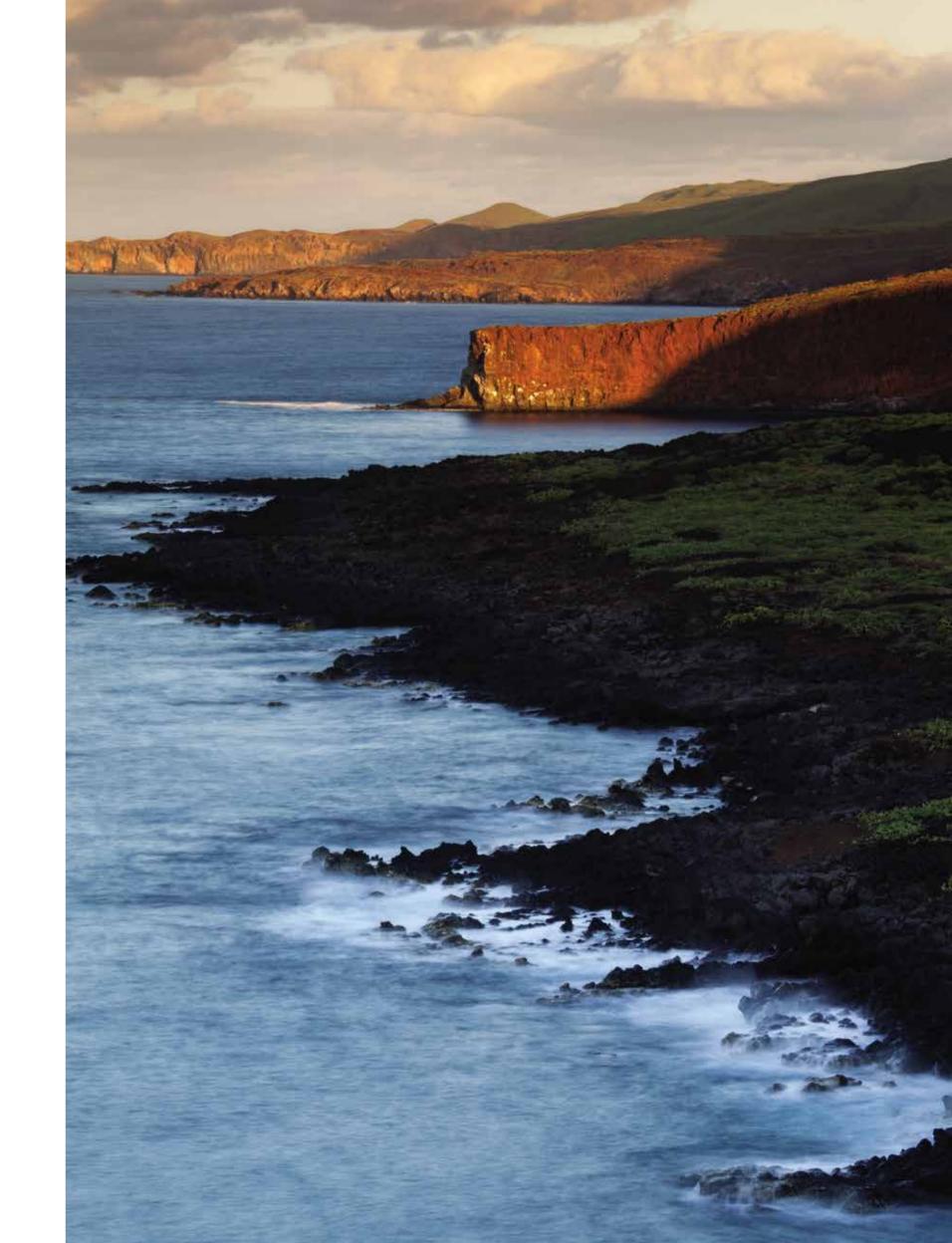




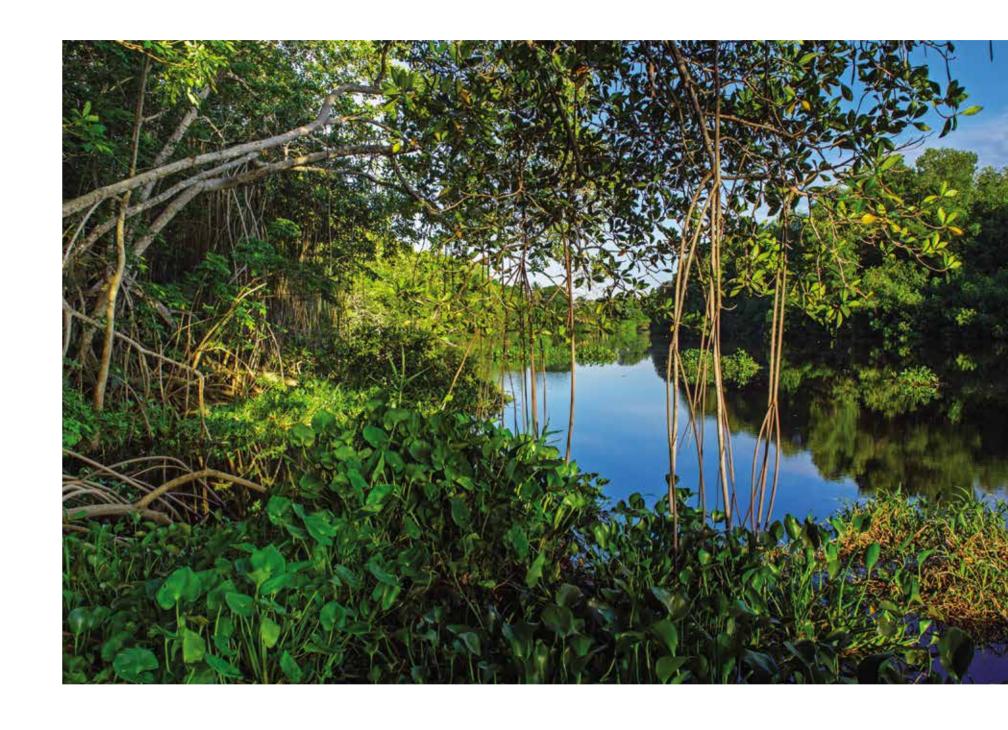
PAGE 288 When the Revillagigedo Islands emerged in front of the Colima coast, only the birds that could fly long trips over the sea were able to establish. In these sites, full of food and free from human presence and other predators, birds like the boobies have taken hold of every corner available to build their nests and incubate future generations of birds that will fly over the Pacific Ocean. (CCK)

ABOVE Sharks are emblematic species of all the seas and oceans of the world. Despite the bad reputation humans have about them, they are fundamental to maintain the balance and productivity of the marine communities, from the sandy beds of the sea to the coral reefs. (CCK)

RIGHT During the long history of the seas, thousands of submarine volcanoes have erupted forming, throughout hundreds of years of volcanic activity, monumental islands. These new emerged spaces have been gradually inhabited by birds and plants that continue their life cycle there. (CCK)







The shallowness of the Huatulco Bays has allowed the establishment or coral reefs. Although the species composition is different from that of the North Pacific of the Mexican Caribbean reefs, they share the diversity of forms and colors that differentiates these ecosystems. (CCK)

In the southeastern Mexican coasts the land is connected with the sea through rivers, coastal lagoons and estuaries, and this originates vegetal communities capable of living both in fresh water as well as in brackish waters. Amongst the types of vegetation are the mangroves, which are essential for the local fisheries since many fish species spend their first stages of their lives in this intricate maze of roots and canals. (OA)



Sea turtles represent the incredible transition between sea and land. Mexico has numerous sandy beaches where thousands of turtles of different species deposit their eggs. This is one of the most renowned events for Mexicans and each year thousands of tourists and volunteers go to the beaches to promote the conservation of these emblematic animals. (CCK)

PAGE 296 Dolphins form groups of hundreds to thousands of individuals, who, fed by the rich waters of the gulf of California, represent a special attraction for tourists who enjoy these gatherings. Dolphins are very intelligent mammals. With their friendly closeness it sometimes seems like they are trying to communicate with humans to ask for help due to the poorly regulated fisheries. (CS/BP)

PAGE 298 The biological richness of Mexican seas is a heritage we should feel very proud of. With the same force waves hit the cliffs, it is necessary that we Mexicans promote forceful protection campaigns of our seas and oceans. The path has been rough, but thanks to a couple of dedicated businessmen who have sailed these turbulent waters, part of our coasts and waters are now protected, assuring the future of numerous species of plants and animals. (CCK)

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EPILOGUE

Many pages have recently been written on the oceans and seas of the world in scientific and popular literature. Most of them are bad news: threats to the coral reefs, overexploitation of the fisheries, extinction of species and populations, among others. For example, it has been written that less than 2% of the oceans are protected and that 64% is not under national jurisdiction. That today the protected marine waters cover less than 1% of the open ocean, despite the fact that it is responsible for 50% of the total productivity of the oceans. That almost 87% of the fisheries of the world are overexploited, exploited at their maximum capacity or have already been depleted. And despite it all the governments allocate 30 billion dollars in fishing subsidies every year (70% of these subsidies is contributed by developed countries basically Japan, China, the United States of America and the European Union), of which 60% promote non sustainable practices which are responsible for the over exploitation. A vicious circle. But there is more. Almost 80% of marine pollution comes from land; the inefficient use of nitrogenous fertilizers have created more than 500 hypoxic zones (dead) in the oceans of the planet and 13 000 pieces of plastic garbage float on average in each km² of ocean. The acidification of the oceans caused by greenhouse gas effect that we issue to the atmosphere has increased 26% since the beginning of the industrial revolution and if it is not stopped, the world economy could lose billions of dollars. The alteration of the coastal zones due to tourism and poorly planned coastal development has destroyed 20% of the mangroves, 19% of the coral reefs and 29% of the sea grasses of the planet.

On top of it all, it is clear that we have not sufficiently valued the services that the oceans provide for the well-being of humanity. Oceans represent 75% of the planet's surface and they have 97% (1.3 billion km³) of the available water, they absorb 90% of the heat caused by greenhouse gas emissions, capture and store 30% of the carbon dioxide that humans produce (the value of this storage amounts to 148 billion dollars a year) and the phytoplankton produces 50% of the oxygen that we breathe.

One out of every eight persons in the world is malnourished. The challenge increases because by the year 2050 we will be almost 10 billion human beings. That is why we are

surprised that little or nothing is written or heard about the immense value of the oceans as a source of protein and jobs, over the crucial role for the global food security, human health, social justice and eradication of poverty. Let's see some examples. Today more than 3 billion people depend upon the marine or coastal resources to subsist. 4.3 billion obtain from the sea 15% of the animal protein consumption (which is fundamental for brain development and raising of children) and since 1999 the number of patents of genetic materials from marine species has increased 12% per year. The employment and environmental services opportunities (including cultural services) provided by the oceans contribute with 3 to 6 trillion dollars a year to the global economy. There are more than 350 million jobs related to the oceans. Women are a majority in secondary employment (such as processing and marketing) related to fisheries and mariculture. Almost 97% of the fishermen live in developing countries. The employment opportunities allow young men and women to stay in their communities instead of emigrating. Half the international tourists visit coastal areas, while in some countries, especially in the small island States, tourism represents 25% of the gross domestic product.

This is the time to act. It is the hour of the oceans, when we should all turn to look at the sea. In September 2015, during the celebration of the 70th anniversary of the United Nations Organization, world leaders shall meet in New York to define the development agenda post 2015. What we expect from the inhabitants of this blue planet is that our leaders use this opportunity to commit to a sustainable development goal that recognizes the importance of the oceans as pillars of a fairer and more prosperous world. And that this goal is not left only in words but also strategically guides investments in new and greater resources of the countries, the development banks, the international organizations, the private sector, the foundations and the individuals.

As was recently mentioned by The World Ocean Commission: "There is no Planet B. The only planet that we have needs healthy oceans to survive. Save the oceans of the world is a task that no government, institution or individual may achieve alone."

To have been born in Colombia and to have become a citizen of Mexico where I have lived half of my life —two nations nature has blessed with coasts on two oceans— has made the sea a source of personal inspiration. I know that it has also been and is for many others. I am convinced that by preserving the oceans we shall be contributing to global peace and to the prosperity of our people and of all the planet.

OMAR VIDAL
General Director
World Wildlife Fund (wwf) – México



REALIDAD AUMENTADA

In this book of the editorial series of TELMEX, presents once again the Increased Reality infinitum. This technology is experiencing major expansion and offers the reader access and additional information besides that presented in a video, audio or 3D Model.

Upon agreeing to the content of Increased Reality it is necessary to have a smart phone or a tablet and download the **RA** infinitum Application, which is available cost-free in Play Store and App Store. Simply download the application, open it, aim at the photograph and enjoy the content.

In this book the images in which you can enjoy Increased Reality infinitum are identified by the symbol **RA** in the following pages:

- Cover
- Page 36
- Pages 106-107
- Page 281
- Pages 282-283



Nombres comunes y científicos

Abalone • Haliotis spp. African Penguin • Spheniscus demersus American Crocodile • Crocodylus acutus American Herring Gull • Larus smithsonianus Anchovy • Engraulis ringens Angel Island Mouse • Peromyscus guardia Atlantic Puffin • Fratercula arctica Atlantic Sailfish • Istiophorus albicans autilus • Argonauta nodosa Baiji dolphin • Lipotes vexillifer Bearded Seal • Erignathus barbatus Beaver • Castor canadensis Beluga • Delphinapterus leucas Blue Whale • Balaenoptera musculus Blue-faced Parrot • Scarus prasiognathos Brown Booby • Sula leucogaste Brown Fur Seal • Arctocephalus pusillus Brown Trout • Salmo trutta Bryde Whale • Balgenontera edeni Bull Shark • Carcharhinus leucas Cardinalfish • Apogon imberbis Caribeean Reef shark • Carcharhinus perezi Chuckwalla • Sauromalus spp. Coconut Palm • Cocos nucifera Cod • Gadus spp. Common Dolphin • Delphinus delphis Common lionfish • Pterois sp. Cormorant • Phalacrocorax carbo Dragonfish • Idiacanthus sp. Flegant Stern • Sterna elegans Emperor Penguin • Aptenodytes forsteri

European Squid • Loligo vulgaris Flamingo • Phoenicopterus ruber Giant Kelp • Macrocystis pyrifera Green Sea Turtle • Chelonia mydas Greenland Seal • Pagophilus groenlandicus Grey Seal • Halichoerus grypus Grey Whale • Eschrichtius robustus Grouper • Epinephelus spp. Guadalupe Palm • Brahea edulis Guadeloupe Cypress • Cupressus guadalupensis Guanaco • Lama guanicoe Handfish • Brachionichthys sp. Hispaniolan Hutia • Plagiodontia aedium Horseshoe Crab • Limulus polyphemus Humpback Whale • Megaptera novaeangliae Killer Whale • Orcinus orca Komodo Dragon • Varanus komodoensis Leafy Sea Dragon • Phycodurus eques Leatherback Turtle • Dermochelys coriácea Leopard Seal • Hydrurga leptonyx Lion's Mane Jellyfish • Cyanea capillata Mackerel • Scomberomorus cavalla Magellanic Penguin • Spheniscus magellanicus Magnificent Frigatebird • Fregata magnificens Manta Eagle • Aetobatus narinari Manta Ray • Manta birostris Marine Iguana • Amblyrhynchus cristatus Marine Vaquita • Phocoena sinus Marlin • Thunnus spp. Maud Island Frog • Leiopelma pakeka Mediterranean Moray • Muraena helena

Narwhal • Monodon monoceros Painted Comber • Serranus scriba Polar Bear • Ursus maritimus Read Sea Clownfish • Amphiprion bicinctus Reindeer • Rangifer tarandus Sardine • Sardinox sagax Shy Hamlet • Hynonlectrus guttavarius Silver Trout • Oncorhynchus mykiss Slender-necked Sea Snake • Hydrophis melanocephalus Snails • Trivia sp. Socorro Dove • Zenaida graysoni Southamerican Sea Lion • Otaria flavescens Southern Elephant Seal • Mirounga leonina Southern Right Whale • Eubalaena australis Southern Rockhopper Penguin • Eudyptes chrysocome Speckled Skink • Oligosoma infrapunctatum Sperm Whale • Physeter macrocephalus Steller Sea Cow • Hydrodamalis gigas Steller's Sea Eagle • Haliaeetus pelagicus Stephens Island Gecko • Hoplodactylus Stephensi Sutton Flyingfish • Cheilopogon suttoni Swordfish • Xiphias gladius Totoaba • Totoaba macdonaldi Tuatara • Sphenodon spp. Walrus • Odobenus rosmarus Whale Shark • Rhincodon typus White Pelican • Pelecanus erythrorhynchos White Shark • Carcharodon carcharias Yellow Nosed Albatross • Thalassarche chlororhynchos

Monaco Shrimp • Lysmata seticaudata

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First pages photographs

- PAGE 2 A Sutton flying fish starts to fly over the Adaman Sea, in the southeastern part of the Bay of Bengal. Approximately 70 species of flying fish are found in practically all the World tropical oceans and seas. (DF/NPL)
- PAGE 4 The Arctic Ocean, in the northern end of our planet, is surrounded by North American and Eurasia. It is covered by huge masses of ice especially in the winter. When summer comes, the temperature increase melts most of this ice that breaks off in the form of huge blocks that drop into the sea and melt little by little while drifting away. (IM/NGC)
- PAGE 6 Waves are ripples produced when the wind currents through friction stir the surface of seas and oceans. These ripples may measure only a few centimeters or form big waves like the ones off the Hawaiian coast. (BB/LSM)
- PAGE 8 The Coconut Island National Park is in the Pacific Ocean, 532 km away from the coast in Costa Rican waters and has an extension of more than a million hectares. This area is vitally important for sharks and tuna fish, species severely overexploited by the fisheries around the world. (MC/SP)
- PAGE 10 The calm water beaches combined with vibrant blue shades are characteristic of the Caribbean sea. Here, a beach inside the Sian Ka'an Biosphere Reserve, in the Mexican state of Quintana Roo. (CCK)
- PAGE 14 The reefs are one of the most diverse systems in our planet; only equaled in number of species and complexity of biological interactions by the humid rainforests. This spectacular reef is within the Coral Triangle. (ED/SP)

- PAGE 16 The prohibition to hunt whales, has allowed the recovery of species, such as the Bryde whale, many of which were about to disappear. Here, in this sample you can see a shoal of sardines in the South Africa east coast. (DP/SP)
- PAGE 18 The Hawaiian islands are a referral to biodiversity and health of the marine ecosystems. In this image, a green turtle is cleaned by a team of color fish that include surgeonfishes and wrasses, some endemic of this Archipelago. (MU/SP)
- PAGE 20 The Red Sea is between Africa and India and is part of the Indian Ocean. Although the land that surrounds it is basically arid and semiarid, the coral reefs prosper in those waters to their depth and the appropriate circulation. Characteristic species of this sea include the magnificent anemone and the Red Sea clown fish. (DB/LSM)
- PAGE 26 In the Pacific Ocean it is normal to find volcanic islands with spectacular landscapes. The Socorro Island has a maximum altitude of 1050 meters. Due to its isolation from the continental mass, most of its flora and fauna is endemic. (CCK)
- PAGE 28 The spotted eagle ray is a cartilaginous fish distributed in our planet. It practically lives in all the tropical seas and oceans, preferring coastal or semi pelagic waters. (MU/SP)
- PAGE 32 The beluga or white whale lives in the Arctic ocean and in the more northern Atlantic ridges. A large part of the year the waters are covered by a thick layer of ice and the temperature varies between 1 and 3 °C. Some of the characteristics that have allowed these animals to survive in this environment are in the presence of a thick layer of fat under the skin, and efficient echolocation system and the white color that makes them less visible to the predators' eyes. (FN/LSM)

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Atardecer en la costa de California. (GC)

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DP/SP	Doug Perrine / SeaPics.com		Creative		Picture Library
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