Ocean Life

Diversity, Distribution, Abundance

NATIONAL GEOGRAPHIC IN PARTNERSHIP WITH CENSUS OF MARINE LIFE

ARCTIC JELLY
A *Crossota norvegica* jellyfish observed 2,600 meters below sea level in the Arctic's Canada Basin. Researchers have noted recent northward expansions of invertebrate species into Arctic waters.

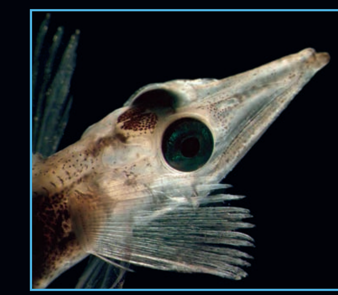
KEVIN RASKOFF

SQUIDWORM
Using a remotely operated vehicle exploring the Celebes Sea in the southern Philippines, scientists discovered this extraordinarily shaped worm, considered a new genus and species.

LARRY MADIN

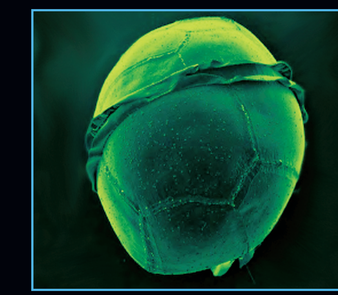
DEEP-OCEAN SEA CUCUMBER
Enypniastes holothurian, a sea cucumber photographed in the Celebes Sea. This animal has been observed at depths to 2,700 meters, sweeping food-rich sediment into its mouth.

LARRY MADIN



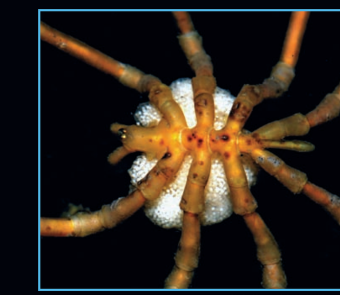
ICE FISH
A juvenile *Chionodraco hamatus*, from the oceans that surround Antarctica, withstands temperatures that would freeze the blood of other fishes inhabiting seawater below zero degrees Celsius.

RUSS HOPCROFT



DINOFLAGELLATE
Microbes constitute up to 90 percent of all ocean biomass. Most types remained hidden until technological methods, especially fast extraction and sequencing of DNA, revealed their diversity.

STEPHANIE VALENTIN, D.J. PATTERSON



SEA SPIDER
A male sea spider carries eggs on specially adapted appendages under its body. This specimen is a possible new species from the Antarctic where sea spiders grow to the size of dinner plates, much larger than relatives in temperate waters.

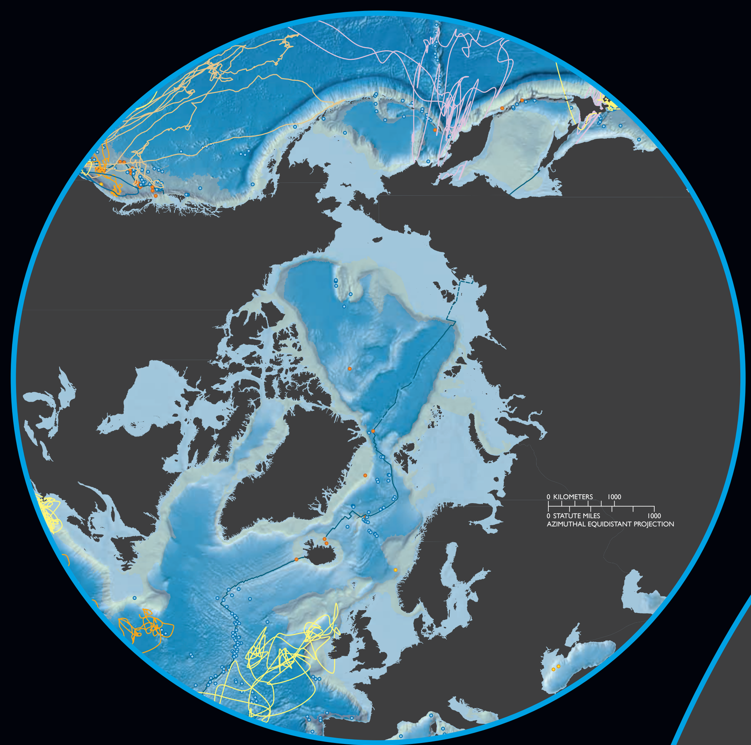
PABLO J. LOPEZ-GONZALEZ

YETI CRAB
On a vent near Easter Island, Chile, Census explorers discovered the yeti crab, *Kiwa hirsuta*, which is not only a hairy new species, but also a new genus and a new family.

A. FIFIS, IFREMER

Discovery and Fascination

Life evolves new dimensions of complexity and beauty beneath the sea. Our understanding of the diversity of marine life is still expanding as hundreds of new species are discovered every year. Explorers use new sampling and photographic techniques to obtain images of these creatures in their natural habitats.

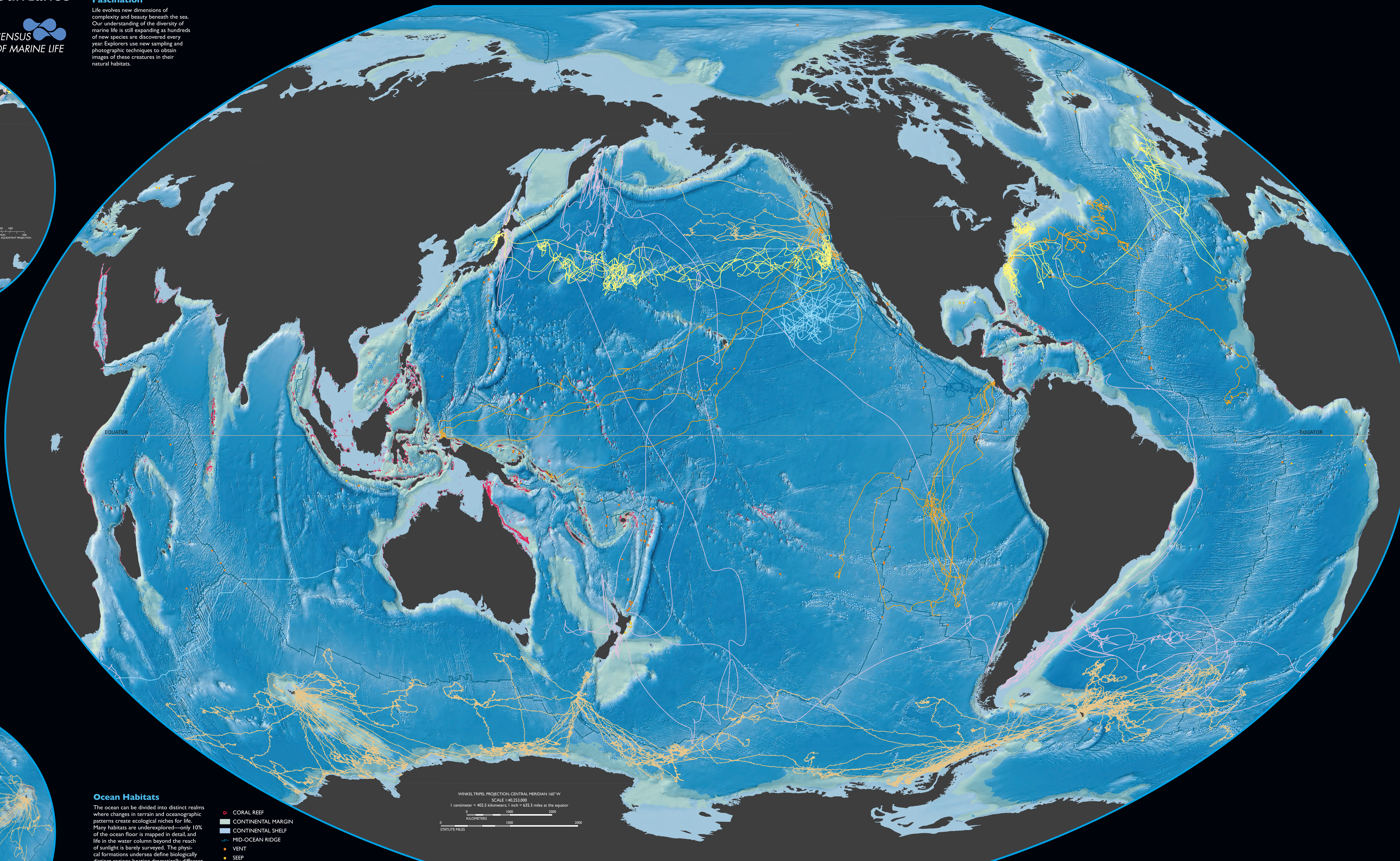


For millennia, the ocean has enchanted human imagination with the lure of treasure, monsters, and mystery, all hidden beneath a seemingly endless surface. Centuries of exploration have revealed wonders beneath the waves, but much more remains to be discovered. Facets of oceanography and marine biology remain only partially understood; including questions about the diversity, distribution, and abundance of the life that dwells in the ocean.

A collaboration of scientists working with unprecedented scope has provided a push to answer many of these questions. In the year 2000, the first Census of Marine Life began a 10-year effort to reveal the state of life in the ocean. Enrolling some 2,700 researchers from more than 80 countries, it employed divers, nets, and submersible vehicles, genetic identification, sonars, electronic and acoustic tagging, listening posts, and communicating satellites. The Census spanned all oceanic realms, from coasts, down slopes, to the abyss, from the North Pole across tropics to the shores of Antarctica. It systematically compiled information from new discoveries and historic archives and made it freely accessible. Census explorers found life wherever they looked—a riot of species.

The last decade has improved our understanding of the very small, the very large, and very remote creatures that call the ocean home. Marine life continues to bring forth surprises. In the Caribbean, explorers encountered a clam that thrived 200—65 million years ago, thought to have been extinct since the early 1800s. Off Mauritania, they found cold-water corals extending over 400 kilometers in waters 500 meters deep—one of the world's longest reefs. Near Chile, they found giant microbial mats covering an area of seafloor the size of Greece. Long-term tracking revealed migratory highways. Combining all this information has created a deeper understanding of new habitats and ecosystems, and also of habitats that have a long history of human contact.

This map highlights discoveries of ocean life—its variety, extent, and habitat. It offers a glimpse into the discoveries of a decade's investigation into life in all ocean realms from microbes to whales.



Polar Regions

More than geographic opposites, the Arctic is an ocean surrounded by continents and Antarctica is a continent surrounded by ocean. Yet the polar regions both face uncertainties as climate changes. The Antarctic is the only region where waters of all the great oceans mingle, a crossroads for the spread of marine species. The Arctic may serve a similar role if the polar ice cap recedes. The prospect of an open Northwest Passage and an ice-free Arctic summer would enable a mixing of life previously confined to separate ocean basins.

Ocean Habitats

The ocean can be divided into distinct realms where changes in terrain and oceanographic patterns create ecological niches for life. Many habitats are underexplored—only 10% of the ocean floor is mapped in detail, and life in the water column beyond the reach of sunlight is barely surveyed. The physical formations undersea define biologically distinct regions hosting dramatically different life forms.

HABITAT BOUNDARIES PROVIDED BY: CENSEAM, CHESS, COMARGE, UNEP WCMC

- CORAL REEF
- CONTINENTAL MARGIN
- CONTINENTAL SHELF
- MID-OCEAN RIDGE
- VENT
- SEEP
- SEAMOUNT

1 NEAR SHORE
Coastal areas, where land and sea intersect, are among the best known marine environments. They are also the most impacted by humans.

KATRIN IKEN

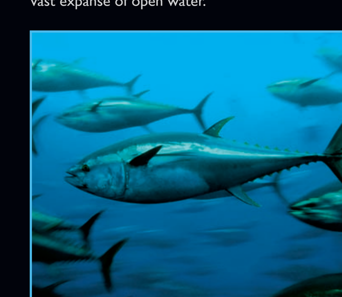
2 CORAL REEFS
Reefs are considered to be the most biologically diverse ecosystems. Individual reef systems likely host tens of thousands of species, most of which have yet to be sampled by scientists.

HUMBERTO BAHENA

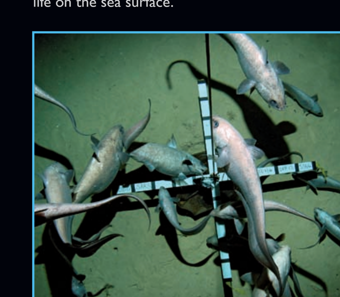
3 CONTINENTAL SHELVES
The shelves gently slope toward deeper ocean basins, sitting mainly within national waters of individual countries and holding the majority of known marine biodiversity. They support many of the world's fisheries.

4 CONTINENTAL MARGINS
Margins, or slopes, are ribbons of seafloor that plunge steeply from the shelf to abyssal depths. They have only recently been recognized as complex and diverse habitats.

5 OPEN OCEAN
The largest animals in the ocean roam the upper layers of the open sea, far from land. While humans have long pursued them as prey, recent technology has illuminated their paths across the vast expanse of open water.

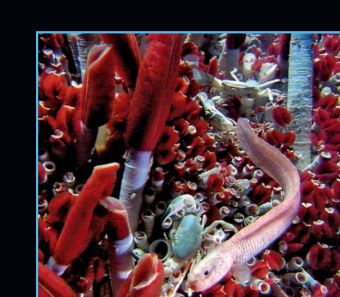


6 MID-OCEAN RIDGES
Underwater mountain ranges formed where continental plates rise and spread, ridges constitute a continuous ocean feature circumnavigating the globe. The deep ocean habitat of ridges influences life on the sea surface.



NICOLA JANE KING

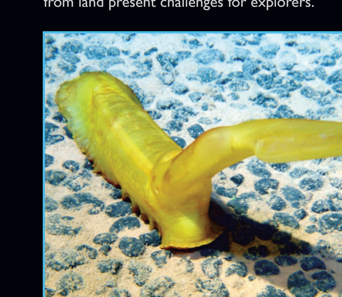
7 VENTS AND SEEPS
Hydrothermal vents, akin to geysers on land, and hydrocarbon-emitting cold seeps create unique environments that do not rely on photosynthesis as a source of energy for life.



RICHARD A. LUTZ

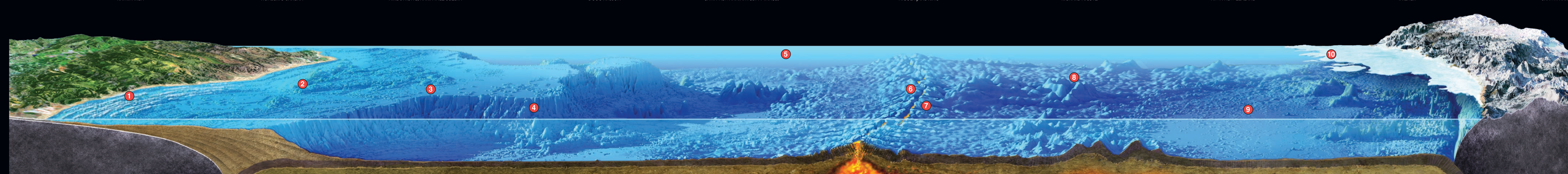
8 SEAMOUNTS
Globally, there may be over 100,000 undersea mountains that do not break the surface as islands. Hot spots that attract many species, seamounts are not only ecologically important, but also a target of commercial fishing.

9 ABYSSAL PLAINS
The abyssal plains are flatter and more uniform than other habitats. Less impacted by humans, abyssal plains are thus more pristine than other environments. Vast extent, depth, and distance from land present challenges for explorers.



IFREMER

10 ICE OCEANS
Extreme conditions occur at the poles where ice meets the oceans, and life spreads outward into cold, deep water below. There is less biodiversity near the poles, but populations are abundant.



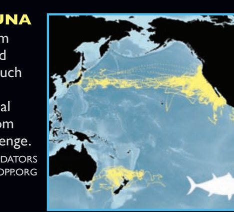
Long-distance Ocean Travels

The central map shows the complexity and richness of undersea geography, and highlights a sample of long-distance ocean travelers only now becoming visible to humans. As modern tracking technology follows animals over ever-longer distances and durations, the last decade has revealed the largest daily migration and the longest seasonal migration yet observed. The eventual goal is to define migratory corridors of the oceans: the "blue highways."

The map insets below depict multiple animal tracks for each species, whereas the main map depicts the track of a single or a small number of individuals from each species.

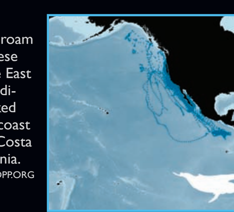
PACIFIC BLUEFIN TUNA
Pacific bluefin tuna can swim from California to Japan and back in six months. With much of their migration corridor occurring outside of national waters, protecting them from overfishing presents a challenge.

TAGGING OF PACIFIC PREDATORS
LEAD: BLOCK, WWW.TOPP.ORG



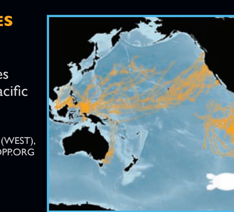
PACIFIC WHALES
Blue and humpback whales roam the global ocean, though these tagged animals stayed in the East Pacific. On the main map, individual blue whales are tracked along the North American coast to their summer range off Costa Rica and the Gulf of California.

LEAD: MATE, WWW.TOPP.ORG



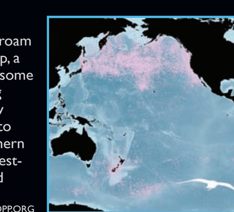
PACIFIC SEA TURTLES
These large reptiles can be found across the middle latitudes. Leatherback turtles nest on both sides of the Pacific and can traverse the entire Pacific Basin.

LEAD: SHILLINGER (EAST), BENSON (WEST), WWW.TOPP.ORG



PACIFIC SEABIRDS
Albatross and shearwaters roam the Pacific. On the main map, a sooty shearwater journeys some 64,000 kilometers following summer weather from New Zealand to Japan to Alaska to Chile and back to the Southern Ocean, tracing out the longest-ever electronically recorded migration.

LEAD: SHAFFER, WWW.TOPP.ORG



PACIFIC SHARKS
While long-term tracking of great white sharks found them in the expected range, it also revealed great whites assembling in an area midway between California and Hawai'i, dubbed the "White Shark Café." The area seems to provide little food, yet the sharks linger for months for reasons not yet understood.

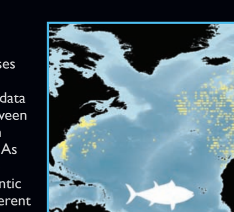
LEAD: BLOCK, WWW.TOPP.ORG

PACIFIC PINNIPEDS
Seals and sea lions thrive in colder temperate and polar waters, finding most of their prey along coastlines, but still venturing into the open ocean waters. Elephant seals spend little time at the surface, regularly swimming below 600 meters, which has made interpreting tracking data difficult until recently.

LEAD: COSTA, WWW.TOPP.ORG

ATLANTIC BLUEFIN TUNA
A single bluefin tuna traverses the north Atlantic over the course of two years. These data show extensive mixing between eastern and western bluefin populations in the Atlantic. As they mature, tuna are more likely to make this transatlantic voyage, passing through different management areas.

BLOCK ET AL. (2005), WWW.TAGAGIANT.ORG



ATLANTIC SEA TURTLES
Loggerhead sea turtles travel from the east coast of the United States, circumnavigating the North Atlantic to Africa and then west to the Caribbean following the circular North-Atlantic gyre.

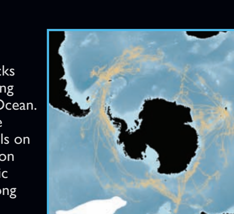
MCCLELLAN (2007), GODLEY (2004), MACHADO (2010) AGGREGATED AT WWW.SEAMAP.ENV.DUKE.EDU

ATLANTIC SEABIRDS
Cousins of the long-traveling sooty shearwater, greater shearwaters also migrate vast distances in the Atlantic, traveling the length of the Americas and crossing to southern Africa.

MARTIN ET AL (2010), WWW.SEAMAP.ENV.DUKE.EDU

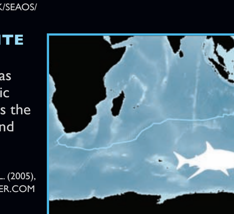
SOUTHERN OCEAN PINNIPEDS
Southern elephant seal tracks gathered from several tagging locations in the Southern Ocean. Over several seasons, these animals provided new details on seal behavior and distribution and collected oceanographic conditions encountered along their voyages.

BIUW ET AL. (2007), WWW.BIOLOGY.ST-ANDREWS.AC.UK/SEAOS/

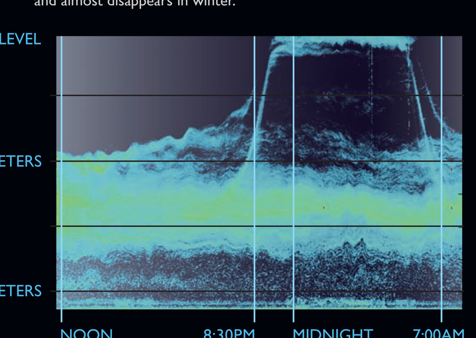


INDIAN OCEAN WHITE SHARKS
A white shark was tracked as it traversed from the Atlantic Coast of South Africa across the entire Indian Ocean basin and arrived on the west coast of Australia.

BONFIL ET AL. (2005), WWW.SHARK-TRACKER.COM



VERTICAL MOVEMENT
At dusk above the Mid-Atlantic Ridge, a nightly migration is revealed by new technology—upward looking sonars that provide a full-depth profile of the ocean. Fish and zooplankton that spend the day where sunlight barely penetrates the water begin to move upward at nightfall. Rising more than the height of the Eiffel Tower, they feed at the surface until early morning. Spectacular during the summer, the upward commute shrinks during autumn and almost disappears in winter.



LEAD: BERGSTAD, WWW.MAR-ECO.NO, GODØ AND PATEL (2009)

www.coml.org

The first Census of Marine Life, completed in 2010, brought together 2,700 scientists from more than 80 nations to establish a baseline of the diversity, distribution, and abundance of life in the global ocean against which future change can be measured.

MAP DESIGN AND DEVELOPMENT: CENSUS OF MARINE LIFE MAPPING & VISUALIZATION TEAM: PATRICK HALPIN, JESSE CLEARY AND BEN DONNELLY; NATIONAL GEOGRAPHIC MAPS: ALLEN CARROLL, FRANK BIASI AND RICHARD BULLINGTON. PHOTO AND CONTENT DEVELOPMENT: CENSUS OF MARINE LIFE EDUCATION & OUTREACH TEAM; SARA HICKOX, DARLENE CRIST AND FRANK BAKER. TOPP VISUALIZATION: AUTUMN-LYNN HARRISON

SUPPLEMENTAL INFORMATION AND FULL SCIENTIFIC CITATIONS FOR CONTRIBUTED CONTENT LOCATED AT HTTP://MGEL.ENV.DUKE.EDU/COMLMAPS

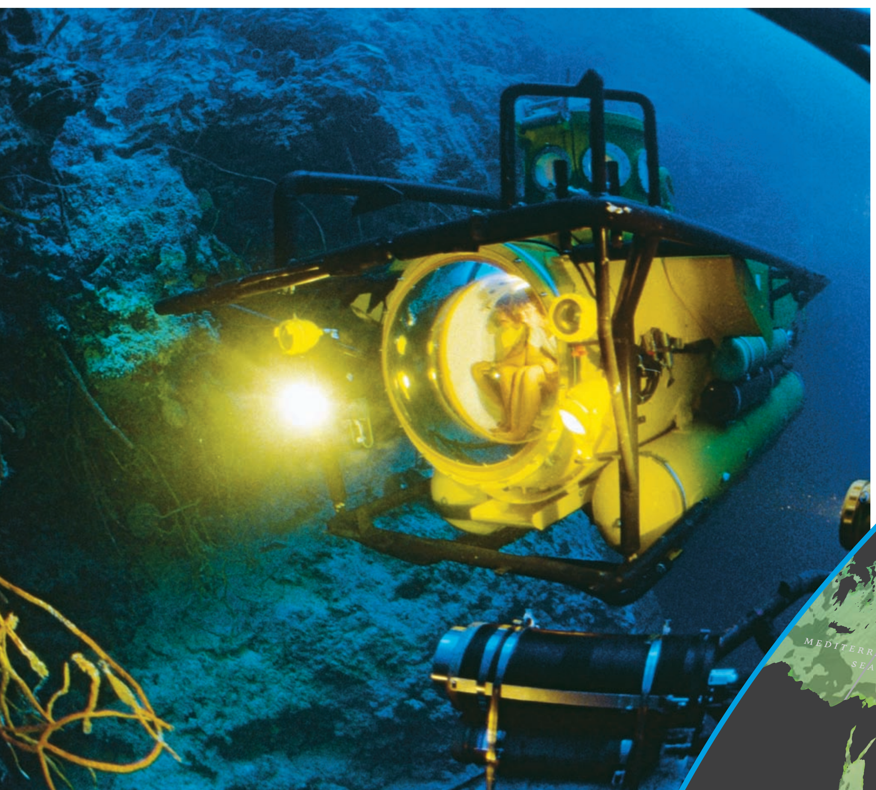
PRODUCED BY NATIONAL GEOGRAPHIC MAPS FOR THE CENSUS OF MARINE LIFE.

COPYRIGHT © 2010 NATIONAL GEOGRAPHIC SOCIETY, WASHINGTON, D.C.

Ocean Life

Past, Present, and Future

NATIONAL GEOGRAPHIC IN PARTNERSHIP WITH CENSUS OF MARINE LIFE

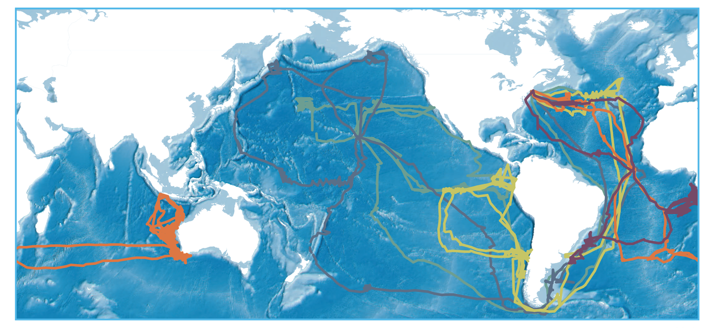


ANDRZEJ ANTCZAK

EARLY IMPACTS
Between the years 1200 and 1500, more than five million conchs were harvested, leaving this pre-Hispanic megamidden, or shell mound, of queen conch (*Strombus gigas*) on La Pelona Island, Los Roques Archipelago, Venezuela. Many traditional marine mollusk fisheries around the world have disappeared, while others are dwindling.

LIBRARY OF CONGRESS

EARLY WHALING
An 1859 print by Utagawa Hiroshige II looks back at traditional whaling techniques from previous centuries. Harpoons were traded for nets in the 1600s. By the time this woodcut was made, the whale population was already showing signs of stress as whaling became an international industry.



LUND ET AL. (2010)

SPANNING THE GLOBE
European whaling began before the year 1000, and the effects of a millennium of hunting have been substantial. The right whale was the first species to be commercially hunted, beginning in the 1100s. Severely depleted by the late 1600s, the Atlantic right whale remains endangered today. These map tracks show the reach of American vessels in the mid-1800s. Departing from New England, voyages of three to four years spanned the globe.

GLENN A. JONES

FANTASTIC FLATFISH
A 120 kilogram halibut caught near Provincetown, Massachusetts, U.S., in 1910. Such giants were common in the past, but are no longer found in coastal waters. Fishing fleets now routinely operate beyond continental shelves and national jurisdictions.

GLENN A. JONES

TASTE OUTSTRIPS SUPPLY
Discarded abalone shells near San Francisco, U.S. San Francisco menus began to feature the slow-growing abalone in the 1920s. Menus indicate a sharp rise in prices linked with over-harvesting in the 1930s and 1950s. Since the 1950s, the price has risen seven to ten times faster than inflation. The state of California banned commercial abalone fishing in 1997.

H. BLEGVAD, FISKERET I DANMARK

BUBBLES BURST
Northern bluefin tuna, for sale in the fish auction hall at Skagen, Denmark, ca. 1946. Before World War I, bluefin tuna were rarely captured in northern Europe and coastal sightings were exciting events. After the war, improving technology enabled European fishers to fill the floors of markets halls. This exploitation of the northern bluefin tuna population occured in a relative blink of time. The species virtually disappeared from the North Atlantic in the early 1960s and remains rare.

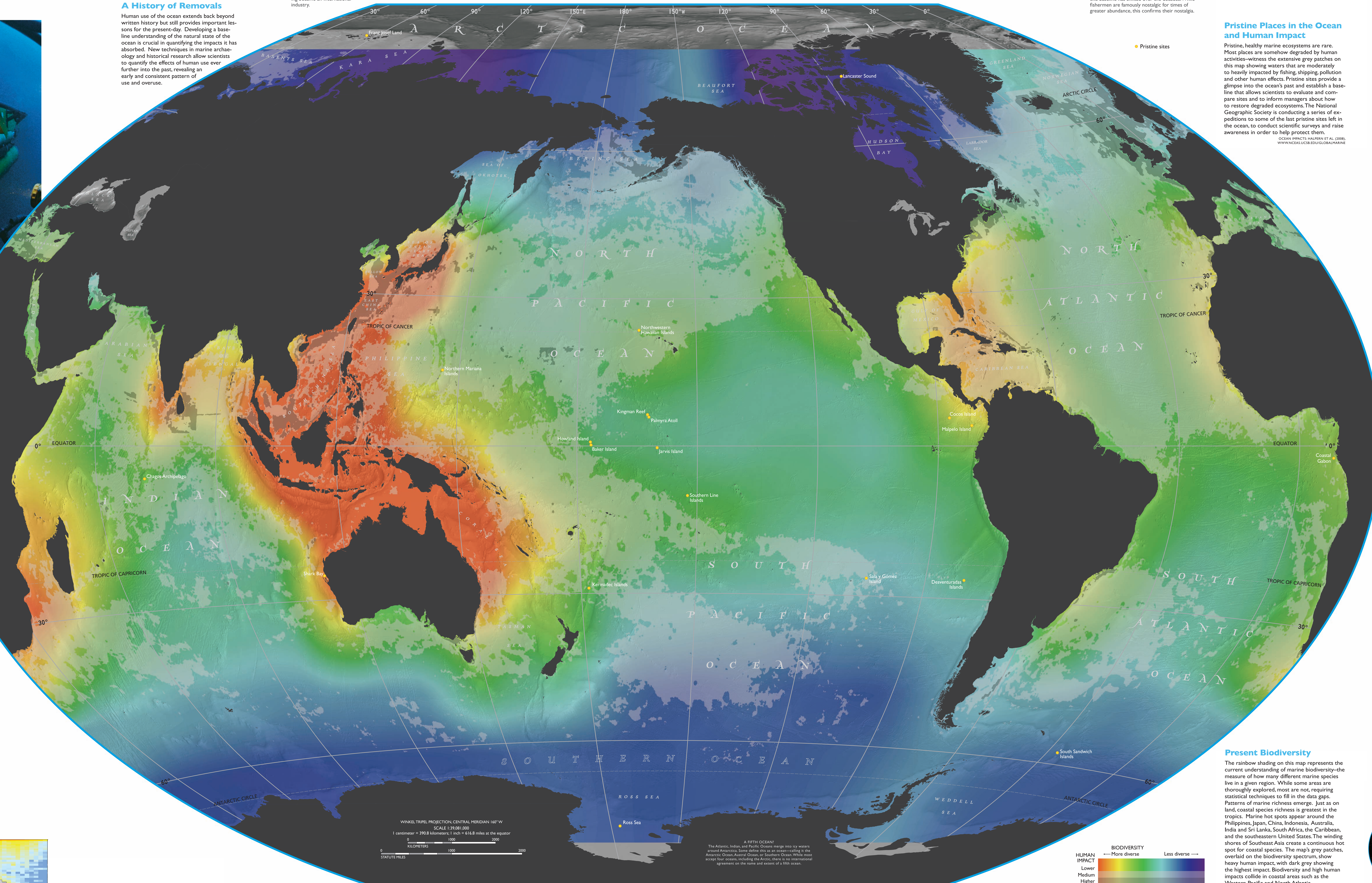
©1960 WIL-ART STUDIO COURTESY OF MONROE COUNTY LIBRARY

2007 JOHN WYLEY & SONS LTD.

NOSTALGIA FOR FISH TALES PAST
Recreational fishers often seek large "trophy" fish and take photographs when they catch them. Research compiling photos of 865 individual fish caught in reefs around Key West, Florida, U.S., between 1956 and 2007 allows for comparison of what has qualified as an impressive catch over the last half-century. The average length of individual trophy fish declined from 91.7 cm to 42.4 cm. Like many notions of what is normal for marine life, this baseline has shifted over the decades. While fishermen are famously nostalgic for times of greater abundance, this confirms their nostalgia.

A History of Removals

Human use of the ocean extends back beyond written history but still provides important lessons for the present-day. Developing a baseline understanding of the natural state of the ocean is crucial in quantifying the impacts it has absorbed. New techniques in marine archaeology and historical research allow scientists to quantify the effects of human use ever further into the past, revealing an early and consistent pattern of use and overuse.



What lived in the oceans? What lives in the oceans today? What will live in the oceans of tomorrow? As we uncover the changes of oceans past, we can better interpret the forces that shape these ecosystems today, and project what changes the future might hold.

To gain insight into what has lived in the oceans, Census of Marine Life researchers reconstructed the history of marine animal populations since human predation became significant – tracing major impacts to more than 500 years ago. Teams of fisheries scientists, historians, and economists collaborated on case studies to create the first reliable picture of marine life before large-scale fishing. They found that declines in the abundance of marine life began much earlier than was thought and are far broader than imagined. This baseline of marine animal populations will help distinguish natural fluctuations from the effects of human activity.

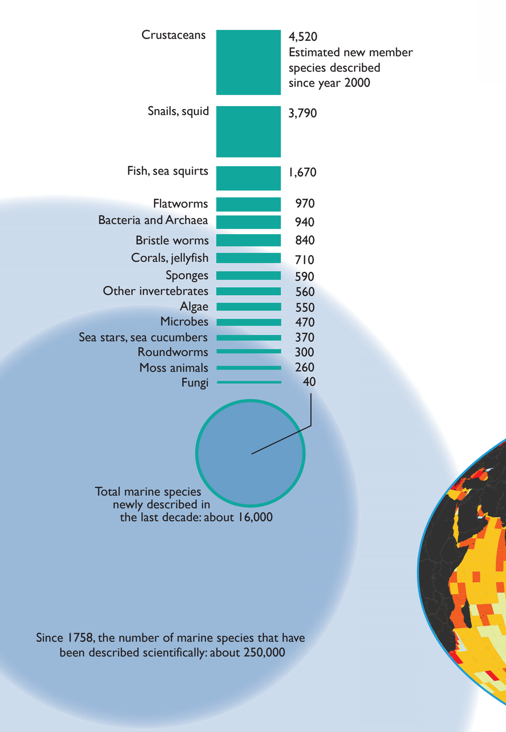
The largest component of the Census delved into our present-day ocean through field projects. Fourteen international groups each explored a distinct marine feature, from shorelines to mid-ocean ridges, recording what species exist and describing new species they encountered. These and future observations flow into a central database, creating an unprecedented listing of over 100,000 species, some 1,300 of them discovered and described by Census scientists, with another 5,000 awaiting taxonomic description. This aggregation enabled a new global map of present marine biodiversity and revealed new distributions for many species. Many gaps have been filled, but much remains to be done.

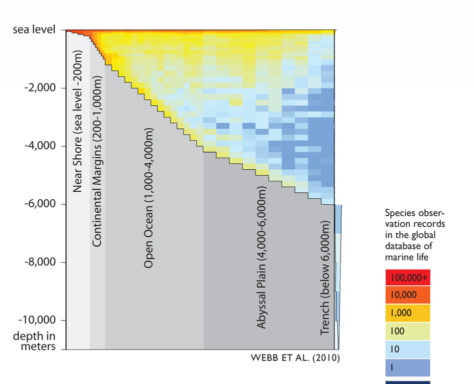
To speak about what will live in the oceans involves integrating data from these historic and modern sources to create new analytical tools. Models predict what we might find in the gaps, and what animal populations might be like in the future. Future modeling and existing trends reveal pressures upon habitats and offer warnings that can inform policy for sustainable use of the oceans.

Together, this three-pronged approach integrating the past, present, and future has provided a baseline against which coming change can be measured. It also has helped better define what may be unknown now but can be known, and what remains unknowable.

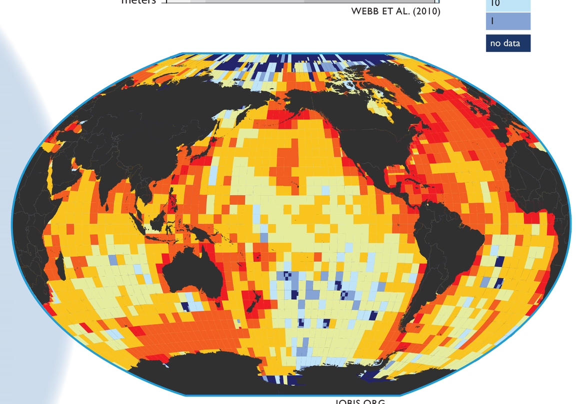
Marine Biodiversity: Known, Unknown, Unknowable

A decade of effort assessing the scope of marine life has revealed thousands of new species. Yet perhaps only 20 percent of the total number of species have been described. Plotting the observations of the global database of marine life shows the most data near the coastlines of industrial nations, with major gaps in the southern hemisphere. A cross section grouping of the same data show that most observation has been close to land, close to the ocean's surface, or along the bottom. The mid-water column in the open ocean is the largest habitat on Earth, yet data are sparse. Here, new species are discovered on virtually every expedition. Placing discoveries in the taxonomic tree of life takes time, even as new DNA barcoding techniques can help clarify if a species is genuinely new. During the last decade over 16,000 new species have been described. Thousands more await. The age of discovery in the ocean is far from over.





WEBB ET AL. (2010)

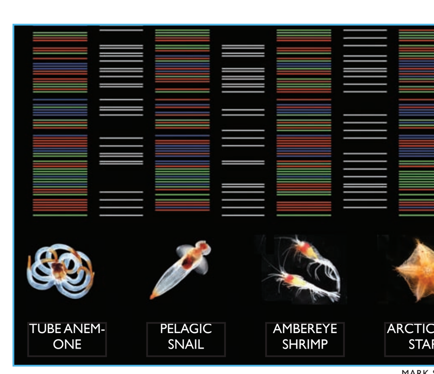


IOBIS.ORG

ANIMALS AS OBSERVERS
Tagged elephant seals are providing oceanographic data about the Southern Ocean in ways never before possible. The image depicts a male elephant seal being fitted with a satellite tracking system on his head. The satellite tag allows researchers to track the animal, while a smaller radio transmitter allows the instrument to be recovered when the animal is on the beach.

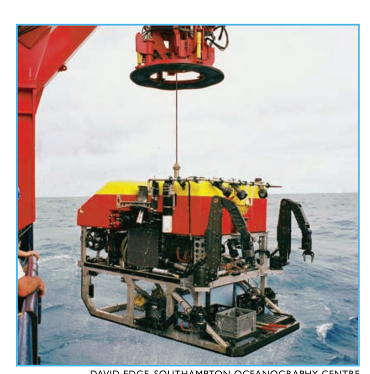
DAN COSTA

BARCODING GENES
The genetic sequences from fish and starfish can be pared down to snippets like supermarket barcodes. Each of the four colors represents one of four nucleotides in a DNA sequence. Differences in barcode regions sometimes reveal specimens that have mistakenly been identified as separate species. More often, analysis expands the number of known species.



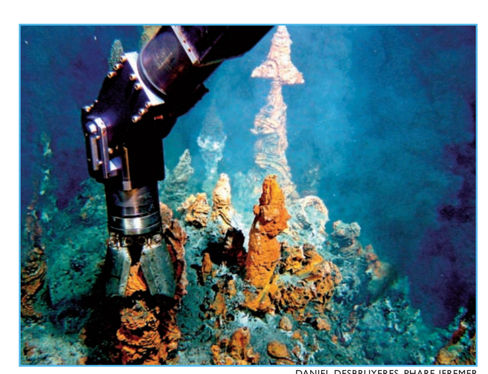
MARK STOECKLE

UNMANNED DEPTHS
The remotely operated vehicle *ISIS* (ROV) can dive to depths of 6,500 meters. In 2007, it explored the seabed and deep marine life of Marguerite Bay, Antarctica. ROV technology continues to improve, expanding the knowledge of the ocean's most remote depths.



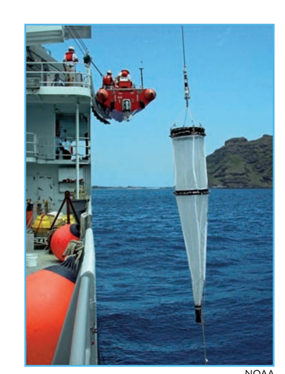
DAVID EDGE, SOUTHAMPTON OCEANOGRAPHY CENTRE

EXPLORING EXTREMES
A mechanical arm from the French submersible *Nautile* taking a sample from a hydrothermal vent. Vent systems are difficult to explore because of their depth and scalding temperatures, but support some of the most unique ecosystems on the planet.



DANIEL DESBRUYERES, PHARE-IFREMER

THE BIG MIDDLE
A ring net is readied for towing behind a research vessel. Plankton nets catch different sizes of drifting animal life by changing the mesh size of the net. The picture of life in much of the mid-water column is less complete than the ocean floor.



NOAA

UNDER THE ICE
By drilling holes through the ice to collect water samples, Arctic biodiversity researchers measure the growth of photosynthetic organisms. When the drill breaks through the bottom of the ice, water floods the hole. A pipe encloses the aquatic life, and is lowered to the original depth, maintaining conditions for several hours of observation.

BODIL BLUHM

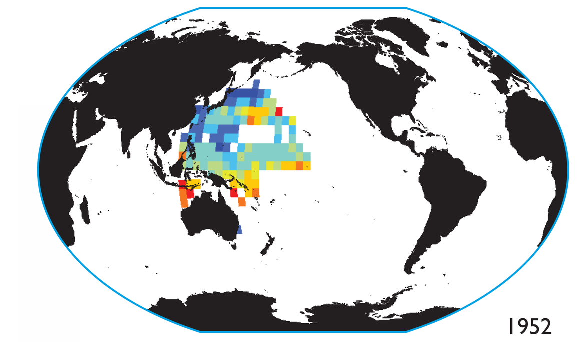
REPEATABLE REEF RESEARCH
A researcher studies coral reef specimens in a lighted aquarium on the Australian Great Barrier Reef. To learn what new creatures colonize coral reefs, scientists developed Autonomous Reef Monitoring Structures (ARMS). Built of layered plastic, ARMS resemble empty dollhouses and mimic the "nooks and crannies" of a natural reef. Species drawn into the nooks can be compared to those found in other reefs.

GARY CRANITCH

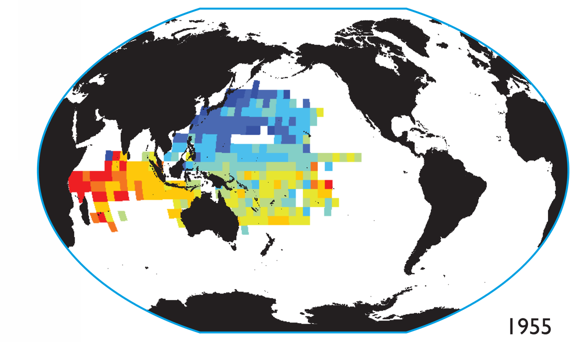
Going Farther, Catching Less

Beginning with high yields in the southwest Pacific, a longline fishing fleet rapidly expands its reach during the second half of the 20th century. The amount of fish caught is normalized by effort, with red areas highlighting high yields. Blue shows areas where the fleet's path hauls in fewer fish. By 1968, the fleet is fishing world wide, but finding the highest takes ever farther afield and seeking species that are more difficult to harvest. By the 1990s, the fleet needs to work much harder to sustain it's catch levels.

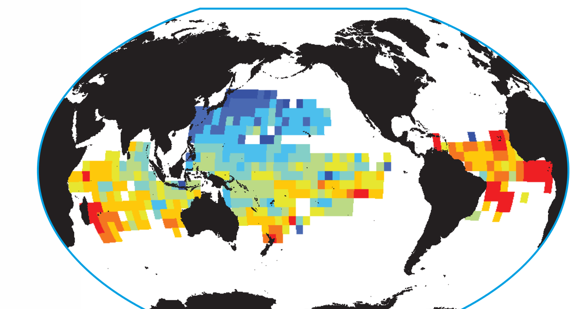
MYERS AND WORM (2003), WWW.FMAP.CA



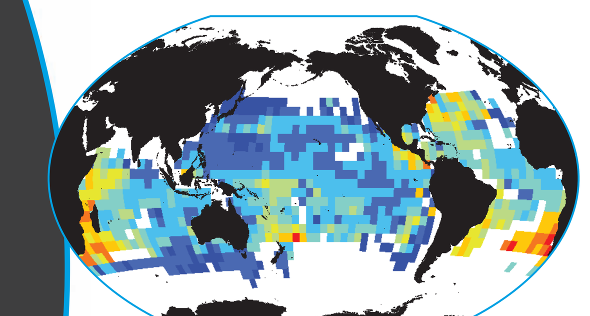
1952



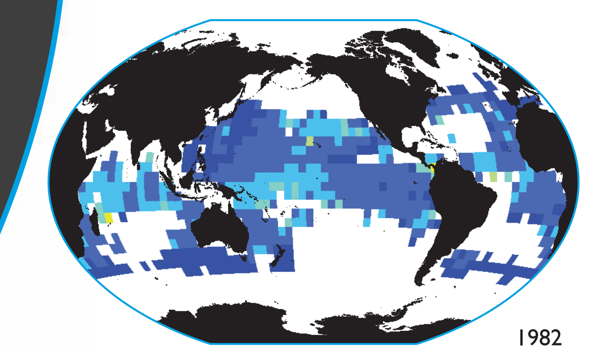
1955



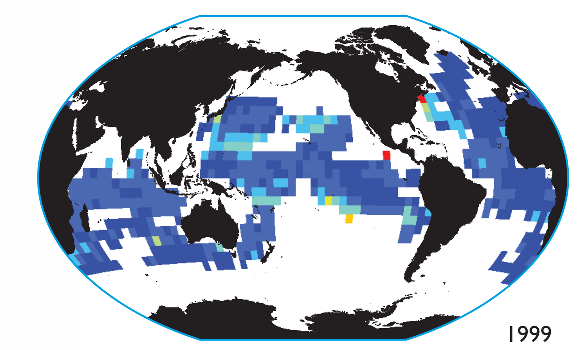
1959



1968



1982



1999

Pristine Places in the Ocean and Human Impact

Pristine, healthy marine ecosystems are rare. Most places are somehow degraded by human activities–witness the extensive grey patches on this map showing waters that are moderately to heavily impacted by fishing, shipping, pollution and other human effects. Pristine sites provide a glimpse into the ocean's past and establish a baseline that allows scientists to evaluate and compare sites and to inform managers about how to restore degraded ecosystems. The National Geographic Society is conducting a series of expeditions to some of the last pristine sites left in the ocean, to conduct scientific surveys and raise awareness in order to help protect them.

OCEAN IMPACTS: HALPERN ET AL. (2008), WWW.NCEAS.UCSB.EDU/GLOBALMARINE

● Pristine sites

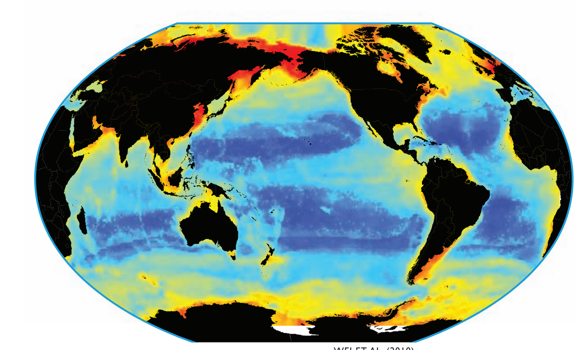
Present Biodiversity

The rainbow shading on this map represents the current understanding of marine biodiversity–the measure of how many different marine species live in a given region. While some areas are thoroughly explored, most are not, requiring statistical techniques to fill in the data gaps. Patterns of marine richness emerge. Just as on land, coastal species richness is greatest in the tropics. Marine hot spots appear around the Philippines, Japan, China, Indonesia, Australia, India and Sri Lanka, South Africa, the Caribbean, and the southeastern United States. The winding shores of Southeast Asia create a continuous hot spot for coastal species. The map's grey patches, overlaid on the biodiversity spectrum, show heavy human impact, with dark grey showing the highest impact. Biodiversity and high human impacts collide in coastal areas such as the Western Pacific and North Atlantic.

BIODIVERSITY: TITTENSOR ET AL. (2010), WWW.FMAP.CA

HUMAN IMPACT	BIODIVERSITY ←More diverse … Less diverse→
Lower	
Medium	
Higher	

● Pristine sites



WEI ET AL. (2010)

Where is Life Abundant?

Biomass measures the quantity of life in a region, regardless of the variety of species and the complexity of the ecosystem. This global estimate of seafloor biomass shows life teeming in polar regions, where the number of species is limited compared to the middle latitudes.

WWW.IFREMER.FR/COMARGE/EN/INDEX.HTML

Technologies of Discovery

Technologies combine to take the pulse of the planet. An integrated ocean observing system is emerging from an array of data gathering tools, from satellites to submersibles to deep-sea microphones. As data are aggregated and analyzed, the sum is greater than any one sampling effort.

www.coml.org
The first Census of Marine Life, completed in 2010, brought together 2,700 scientists from more than 80 nations to establish a baseline of the diversity, distribution, and abundance of life in the global ocean against which future change can be measured.

MAP DESIGN AND DEVELOPMENT: CENSUS OF MARINE LIFE MAPPING & VISUALIZATION TEAM: PATRICK HALPIN, JESSE CLEARY AND BEN DONNELLY; NATIONAL GEOGRAPHIC MAPS: ALLEN CARROLL, FRANK BIASI AND RICHARD BULLINGTON. PHOTO AND CONTENT DEVELOPMENT: CENSUS OF MARINE LIFE EDUCATION & OUTREACH TEAM; SARA HICKOX, DARLENE CRIST AND FRANK BAKER.

SUPPLEMENTAL INFORMATION AND FULL SCIENTIFIC CITATIONS FOR CONTRIBUTED CONTENT LOCATED AT HTTP://MGEL.ENV.DUKE.EDU/COMLMAPS

PRODUCED BY NATIONAL GEOGRAPHIC MAPS FOR THE CENSUS OF MARINE LIFE.

COPYRIGHT © 2010 NATIONAL GEOGRAPHIC SOCIETY, WASHINGTON, D.C.