Scientists Report Major Steps Towards 1st Census of Marine Life

Meeting in Spain, global crew shares progress towards historic Census in 2010;

Among revelations in fourth interim global highlights report:

Antarctic ancestry of many octopus species,

Behemoth bacteria, colossal sea stars, mammoth mollusks, more

The 2,000-strong community of Census of Marine Life scientists from 82 nations today announced astonishing examples of recent new finds from the world's ocean depths.

As more than 700 delegates gather for the World Conference on Marine Biodiversity (Valencia, Spain Nov. 11-15), organized by the Census's European affiliate program on Marine Biodiversity and Ecosystem Functioning, the report details major progress towards the first ever marine life census, for release in October, 2010. In Spain, renowned marine scientists will announce more new and surprising results daily throughout the event, to be opened with a news conference in Valencia Tues. Nov. 11.

In the fourth highlights report issued since the global collaboration began in the year 2000, Census scientists say their work is:

- Compiling an unprecedented number of "firsts" for ocean biodiversity;
- Advancing technology for discovery;
- Organizing knowledge about marine life and making it accessible;
- Measuring effects of human activities on ocean life;
- Providing the foundation for scientifically-based policies;

According to Ian Poiner, chair of the Census's International Scientific Steering Committee and Chief Executive Officer of the Australian Institute of Marine Science:

"The release of the first Census in 2010 will be a milestone in science. After 10 years of new global research and information assembly by thousands of experts the world over, it will synthesize what humankind knows about the oceans, what we don't know, and what we may never know – a scientific achievement of historic proportions."

“Dedication and cooperation are enabling the largest, most complex program ever undertaken in marine biology to meet its schedule and reach its goals. When the program began, such progress seemed improbable to many observers.”

In 2010, the first global Census will relate:

- *Distribution* of animals in the ocean and their changing ranges;
- *Diversity* as the total number of species in the ocean (known and unknown);
- *Abundance* of major species groups and how they have changed over time;

With regard to *distribution*, the Census will offer:

- Range maps for known marine species;
- Major global traffic patterns of top marine species;
- Global maps of species richness, showing hotspots and the extent of biodiversity in the oceans

With regard to *diversity*, the Census will offer:

- A complete list of named marine species, likely to range between 230,000-250,000, as well as fresh estimates of species yet to be discovered;
- Web pages for the great majority of the named species, compiled in cooperation with the Encyclopedia of Life;
- DNA identifiers (“barcodes”) for many species

With regard to *abundance*, the Census will offer:

- New estimates of biomass at various levels in the food chain and for selected species;
- Estimates of changes in the relative frequency of small versus large animals;
- Estimates of abundance that has been or might be lost soon.

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Top highlights, fourth progress report of the Census of Marine Life:

Antarctic ancestry of many deep-sea octopuses worldwide
Within their mandate "to assess and explain the diversity, distribution, and abundance of marine life in the oceans – past, present, and future,” Census of Antarctic Marine Life scientists report the first molecular evidence that a large proportion of deep sea octopus species worldwide evolved from common ancestor species that still exist in the Southern Ocean.

Octopuses started migrating to new ocean basins more than 30 million years ago when, as Antarctica cooled and a large icesheet grew, nature created a “thermohaline expressway,” a northbound flow of tasty frigid water with high salt and oxygen content.

Isolated in new habitat conditions, many different species evolved; some octopuses, for example, losing their defensive ink sacs – pointless at perpetually dark depths.

This revelation into the global distribution and diversity of deep sea fauna, to be reported Nov. 11 in the journal Cladistics, was made possible by intensive sampling during Census International Polar Year expeditions.

Highlights on offer include as well:

Distribution:

- Scientists discover both a "White Shark Café" and a "sturgeon playground" in the Pacific, as others explore life on a "new continent" in the mid-Atlantic, in oceanic canyons, around Earth's deepest hot vents, and in the world's coldest, saltiest seawater;

Diversity:

- Deep sea explorers discover new forms of life, including behemoth bacteria, colossal sea stars, astonishing Antarctic amphipods and a mammoth mollusk, and find familiar species in many new places. Experts also estimate that, beyond the 16,000 marine fish species already known to science, another 4,000 await discovery, many of them in the tropics.

Abundance:

- Researchers find a sea floor carpet of bugs and a city of brittle stars, and document bluefin tuna abundance in the early 1900s by scouring fishery reports, fishing magazines and other records.

Meanwhile, the Ocean Biogeographic Information System has grown to include more than 120,000 species. And a rapidly-expanding reference library of DNA barcodes of marine species recently helped reveal inaccurate labeling of sushi in New York City and elsewhere.

As well, the national and regional networks expediting much of the Census work expanded from 10 to 12 since 2006. They and the field projects of the Census established precedent-setting ethical standards for marine research.

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Appendix 1: Quotable quotes from senior Census officials.

Appendix 2: All 58 highlights, clustered in seven categories:

- Exploring the unexplored;

- Discovering new forms of life;
- Finding the unexpected;
- Advancing technology;
- Building global partnerships;
- Informing decisions;
- Sharing knowledge.

Appendix 3: Partners and sponsors

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Appendix 1: **Quotable quotes**

Deep sea biologist **Paul Snelgrove** (Canada), leader of the team integrating findings from all 17 Census projects: "We expect to have much-improved tools for predicting the presence or absence of various species based on what we know about a particular environment," he says. "In fact, the Census may offer a new map, a new biogeography, of all ocean life."

Mollusk expert **Patricia Miloslavich** (Venezuela), Census co-senior scientist: "We are beginning to pull together a picture and clarify the complicated and interconnected global drivers of marine biodiversity patterns and changes, and we are starting to see the conservation-related implications and benefits, from the small coves of the near-shore to the vast abyss."

Squid expert **Ron O'Dor** (Canada), Census co-senior scientist: "Not only do we have a better picture of the distribution of the animals that stay in place, we are approaching a global picture of the movements of animals, whether swirling in eddies the size of Ireland, or commuting 8,000 kilometers across ocean basins. And understanding how behavior and the environment combine to determine the movement of many animals is within reach."

Deep-sea explorer **Myriam Sibuet** (France), vice-chair of the Census: "The impressive number of landmark findings over the past two years reveals the richness of what remains to be discovered. The vastness of the ocean and our new research tools keep marine biology forever young."

Biological oceanographer and marine microbiologist **Victor Gallardo** (Chile), vice-chair of the Census: "Census leadership of the Arctic and Antarctic biodiversity research for the International Polar Year reflects the significance of recent activity. In 2007 and 2008 alone, Census scientists participated in more than 30 research expeditions."

Coastal ecologist **Carlo Heip** (Netherlands), Valencia Conference Chair and member, Census Scientific Steering Committee: "As a European, I am pleased that European Union support for the MarBEF program laid the foundation for this World Conference on Marine Biodiversity. I am especially pleased that the location is Spain, home of many

dynamic contributors to MarBEF and the Census, including Eva Ramirez Llodra and Carlos Duarte."

Dr. **Ian Poiner** (Australia), Chair, Census of Marine Life Scientific Steering Committee and Chief Executive Officer, Australian Institute of Marine Science: "We are thrilled with the quality of our collaborations, for example, with the French film company, Galatee, whose spectacular Oceans film will debut in about a year. And with new sponsors, including many government agencies and also organizations such as the Nippon Foundation, and companies, including Total, Chevron, Petrobras, and BHP Billiton, which have joined this bold venture. Ten years ago many expressed skepticism about a Census of Marine Life but now we know that, with many working together, it can – and must urgently – be done."

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Appendix 2: Fourth Highlights Report, Census of Marine Life

The 17 Census projects have acronym nicknames such as MAR-ECO. For the projects' full names and missions, Internet links are provided below in the first reference.

EXPLORING THE UNEXPLORED

1) Exploring a "new continent" in mid-Atlantic

MAR-ECO (www.coml.org/descrip/mareco.htm) scientists describe their work as "surveying a new continent half way between America and Europe." Sampling along the Mid-Atlantic Ridge at depths down to 2,500 meters, they find many hundreds of species rare or unknown elsewhere in the world and collect environmental data to help explain their distribution and abundance.

2) World's deepest known active hot vent

ChEss (www.coml.org/descrip/chess.htm) scientists in the Mid-Atlantic Ridge explore the world's deepest known active hot vent, field named Ashadze, over 4,100 meters deep, dominated by anemones, polychaete worms and shrimp. They also discover marine environments with little or no oxygen harboring more life than expected.

3) Bacterial mats in Black Sea

ChEss scientists also find reefs deep in the Black Sea made of bacterial mats using methane (natural gas) as an energy source, the bacteria forming spectacular chimneys up to four meters high. Such reefs could contribute key insights into mechanisms controlling emissions of methane, an important greenhouse gas, from the ocean to the atmosphere.

4) Brittle Star City

Exploring off the coast of New Zealand, CenSeam (www.coml.org/descrip/censeam.htm) researchers capture images of a novel "Brittle Star City," whose inhabitants colonize the peak of a seamount – an underwater summit taller than the world's tallest building. In a swirling circumpolar current flowing at roughly four kilometers per hour, tens of millions of brittle stars live arm tip to arm tip. The current kept away would-be predators while delivering an ample supply of food that residents of Brittle Star City collected simply by raising their arms.

5) Surprisingly different twins

NaGISA (www.coml.org/descrip/nagisa.htm) nearshore scientists in the Alaskan Arctic find a site with a rocky seafloor, rare along the normally soft and silty Arctic coastline. The hard substrate hosts a highly diverse community compared to surrounding soft bottom habitat. Comparison of this new site to a similar site surveyed by Census researchers in 2002 shows surprisingly different communities. Census nearshore scientists collaborating with local agencies also discover new species in the Aleutian archipelago, including a kelp, sea anemones, chitons, snails, and sea stars.

6) Pacific hotspots

TOPP (www.coml.org/descrip/topp.htm) researchers discover eddies of warm water in the Pacific may meld, forming hotspots in the open sea that support elevated levels of tiny phytoplankton that form the base of the marine food web. These green meadows in the vast Pacific in turn concentrate species from all tiers of the food web – from shrimp to large predators like tuna, seabirds, and whales.

7) Seep mega-sites

COMARGE (www.coml.org/descrip/c-margins.htm) and ChEss scientists discover more lively communities flourishing off cold gases such as methane seeping out of the sea floor. Around New Zealand, they map the "Builder's Pencil" site covering about 180,000 square meters, among Earth's largest known seep sites. Sensitive to human activities despite their depth, the communities keep revealing unique features. Finding both potential new species and scars from deep-water trawls by fishing vessels on the scientific surveys suggests the urgency for further conservation of these fragile habitats.

8) Philippine firsts

In the first deep-sea work in the area, COMARGE researchers sample to a depth of 2,300 meters, collecting about 300 fish and 400 mollusc species for barcoding. Some 320 decapod crustaceans are photographed, displaying their beauty and aiding future identification of many unique and subtly distinct specimens.

In 2008, COMARGE investigators return to explore the Philippine margin of the South China Sea, between 100 and 2,200 meters depth. Discoveries include the first Philippine record of the deep-water stony coral *Lophelia pertusa*, the first living specimen of *Acharax bartschi* (a large bivalve living in symbiosis with bacteria), rare deep-water snails living on a dog's skull that had washed out to sea, and a likely new species of shrimp belonging to a group only known from hydrothermal vents. The trawl also collected many plastic shopping bags.

9) Potential new marine protected area, Africa

While largely unexplored, the rich Western Indian Ocean, including the Mozambique channel, suffers destructive fishing practices, such as use of dynamite. Census-affiliated explorers with the Sub-Sahara African Committee chart a proposed marine protected area off Tanga, Tanzania. Using SCUBA and remotely operated vehicles, Tanzanian scientists and students join international researchers to survey life along transects that could be periodically revisited, collecting samples for identification and barcoding.

10) Life in coldest, saltiest seawater

ArcOD (www.coml.org/descrip/aobio.htm) researchers studying life in the Arctic find temperatures of –25°C in sea ice channels where brine is more than six times saltier than regular sea water. Representing the coldest conditions in the global ocean, researchers find sea ice algae, such as diatoms, and flagellates thriving in concentrations of thousands of individuals per liter.

DISCOVERING NEW FORMS OF LIFE

11) 100 new species and records near Hawaii

CReefs (www.coml.org/descrip/c-reefs.htm) experts census biodiversity in the French Frigate Shoals, the world's largest, fully protected marine area in the Northwestern Hawaiian Islands. Using a variety of new and proven methods over a diverse range of habitats, the team logs more than 100 species and new records.

12) Carpet of bugs

COMARGE researchers describe a new species of amphipod, *Ampelisca mississippiana*, inhabiting the head of the Mississippi Canyon about 460 meters deep in the Gulf of Mexico. These small crustaceans (less than 6 millimeters in length) and living in tubes, carpet the seabed in densities up to 12,000 individuals per square meter. Based on its abundance and the stabilizing effects this "carpet of bugs" has on sediments, researchers believe this amphipod may have great ecological importance.

13) Deepest comb jelly

CMarZ (www.coml.org/descrip/cmarz.htm) explorers find a potential new species of comb jelly, or ctenophore, at the record depth of 7,217meters in the Ryukyu Trench near Japan – the deepest ever recorded siting of this unique species, that flies like a kite on the end of two long "strings" attached to the bottom. The discovery raises questions about the availability of food resources at such depths, which had not been thought capable of supporting predators like this one.

14) Evolutionary mollusk

In the Southern Ocean, CAML (www.coml.org/descrip/caml.htm) researchers find many potential new species including sea cucumbers, sponges and komokiaceans – little known protozoa living in the depths of the ocean resemble the organisms that form chalk.

They also collect a rare mollusk, named *Laevipilina antarctica*, believed to play a role in how segmentation evolved in marine invertebrates.

15) Arctic jellies galore

In the Canada Basin of the Arctic Ocean, ArcOD researchers find several new species and more than 50 taxonomic categories of gelatinous zooplankton. Almost two-thirds are medusae, one-fifth siphonophores, and one-tenth larvaceans. The first new species formally described from the expedition was named *Sigambra healyae*, in honor of the research vessel, the U.S. Coast Guard Cutter Healy.

16) 85 new zooplankton species

CMarZ scientists discover at least 85 new species of zooplankton, small drifting and swimming marine animals. Four genera and one family were officially deemed new to science, with many more expected to follow. In the Atlantic Ocean from Germany to South Africa, scientists collect zooplankton in a range from the surface to below 5,000 meters. Taxonomic experts and geneticists identify and barcode the DNA from hundreds of species. As expected, several new species of small crustaceans called ostracods or seed shrimp and other groups are found.

17) Antarctica's big amphipod

CAML scientists exploring a 10,000 kilometer portion of the Antarctic Weddell Sea made suddenly accessible by the collapse of the Larsen A and B ice shelves sample an estimated 1,000 species. Of these, four presumed new species of cnidarians (organisms related to coral, jelly fish and sea anemones) are found, as well as 15 potentially new amphipod (shrimp-like) species, including one of Antarctica's biggest-ever amphipod crustaceans, nearly 10 centimeters long.

18) Spectacular species in Celebes Sea

Zooplankton researchers with CMarZ travel to a biodiversity hot spot in the Celebes Sea in the southern Philippines, uncovering unexpected richness and diversity of marine life from the surface to the almost totally unexplored deep waters. Divers collect a remarkable variety of fragile and beautiful gelatinous species, while video cameras and collect images and organisms from depths beyond the divers' reach.

19) Surprising species richness

Recent advances in technology are opening up remote frontiers – deep-sea canyons. COMARGE researchers aboard the RRS James Cook off Portugal find that species richness was almost double in the more active Nazaré Canyon than in Lisbon Canyon. This is despite Lisbon Canyon receiving a substantial supply of river-borne organic matter that would foster large populations of filter-feeding organisms.

20) 11,130 known species in South African waters

Experts with the Census' Sub-Sahara African Committee estimate 6,000 more species, primarily smaller marine animals, are yet to be discovered in South African waters, which are already known to feature some 11,130 species. A new shrimp

(Hippolyte) and the first record of the enigmatic group Myzostomida from the region are discovered in False Bay, the most sampled site on the African coast.

21) 870+ squat lobster species

COMARGE scientists list 870 known species of squat lobsters and create an electronic library of relevant literature. Squat lobsters are colorful decapod crustaceans found in all oceans, at all depths, and in all marine habitats, but are especially abundant on continental margins.

FINDING THE UNEXPECTED

22) Antarctic Expressway

In the Southern Ocean, Census CAML explorers find evidence that deep sea octopuses ride the "Antarctic thermohaline expressway." The northbound expressway is a mass of sea water with a high salt density caused by the ice that forms at the surface around the Antarctic, the water cascading like cream.

They find as well that sea birds feed on Antarctic zooplankton when the tiny organisms aggregate at a thermal front.

23) Animals in new places

ArcOD explorers make the first record of many marine animals in many areas of the Canada Basin. These include abundant and diverse ctenophore (comb jellies) under Arctic pack ice and a dense bed of sea cucumbers in what might be a pockmark. They also record more squid than ever before in the Arctic deep sea, and document the importance of sea ice ridges for marine life in the region.

24) White Shark Café

Satellite tagging by TOPP reveals a previously unknown behavior of white sharks (www.eol.org/taxa/17143484), travelling long distances each winter to concentrate in the Pacific for up to six months. During these months, both males and females make frequent, repetitive dives to depths of 300 meters, which researchers theorize may be significant in either feeding or reproduction.

25) Migration pathway

MAR-ECO researchers suggest the Mid-Atlantic Ridge may serve as an important pathway in colonization of North Atlantic continental slopes. Before their expeditions, scientists thought skates and rays, for example, migrated through the Mid-Atlantic Ridge, rather than taking up residence there.

26) New species in familiar waters

Systematically exploring two islands on the Great Barrier Reef and a reef off northwestern Australia, CReefs researchers find hundreds of new kinds of animals in

waters were long familiar to divers. They also conduct the first scientific inventory of spectacular soft corals, named octocorals for the eight tentacles that fringe each polyp.

27) Australian expedition: One species in three new to science

The first results from the COMARGE "Voyages of Discovery" expeditions to the deep continental shelf and slope in Australia's southwest region show 524 species of Decapoda—crabs, shrimps, prawns, lobsters, and the like. Some 33 percent of all species encountered are suspected to be new species, and 25 percent are new records in the region, eight percent are new records for Australia.

28) Sponge garden

COMARGE and ChEss researchers examining cold seeps in the Mediterranean Sea using remotely operated vehicles find surprisingly abundant marine life, including a garden of sponges around a brine lake. The sponge itself, likely *Rhizaxinella pyrifera*, harbours a multitude of small worms.

29) Behemoth bacteria

A diverse set of giant, filamentous, multi-cellular marine bacteria is discovered by ICOMM (www.coml.org/descrip/icomm.htm) researchers in the eastern South Pacific. These bacteria may be "living fossils" that developed in the earliest ocean when oxygen was either absent or much diminished, living on the toxic gas hydrogen sulfide. Scientists hypothesize that communities of bacteria may hold potential for bioremediation of organically polluted bottoms and, because of their ability to survive in anoxic conditions, may be an important clue in the search for extraterrestrial life.

30) Colossal sea stars

CAML expeditions to the Southern Ocean find frequent examples of gigantism common in Antarctic waters. The researchers collect huge scaly worms, giant crustaceans, starfish and sea spiders as big as dinner plates.

31) Largest mollusk in class

A giant aplacophoran mollusk, *Chaetoderma felderi*, is collected in deep waters off Louisiana by GoMex, a Census-affiliated project working in the Gulf of Mexico. Measuring over 407 mm in length and 10 mm in diameter, about the size of a AAA battery, it is more than twice the length and three times the diameter of the next largest known mollusk in the subclass.

32) Gigantic oysters

With the assistance of a remotely operated vehicle, COMARGE explorers find dense communities of giant oysters 20 cm (eight inches) long at a depth of 700 m on the La Chapelle continental slope. Genetic studies will confirm if this is a new species.

ADVANCING TECHNOLOGY

33) Barcoding zooplankton

An international CMarZ team from 25 cooperating projects is analyzing data from roughly 6,000 historical samples to help create a catalog of described species diversity and distribution. DNA barcodes will identify approximately 7,000 known species of zooplankton in 15 phyla. This growing database will help scientists identify specimens, describe their geographic distributions, and recognize when a species is in fact new. Scientists envision a day soon when quick, automated sample barcoding analysis will be a reality.

34) Following fishers to find vents

Stymied in their search for active methane seeps in the Chilean margin, COMARGE scientists take a novel approach: follow the fishers. They launch their search in known fishing grounds of the Patagonian toothfish (*Dissostichus eleginoides*), suspecting that these fish congregate near methane seeps. Their hunch proves correct: Most fishing grounds were associated with hard grounds, with some made of carbonates associated with methane seepages.

35) Coral reef colonization

To learn what new creatures colonize coral reefs, CReefs scientists develop and test Autonomous Reef Monitoring Structures (ARMS), to be colonized by fish and other creatures that inhabit coral reefs. The structures mimic the "nooks and crannies" of a natural reef. With this information, marine scientists can better understand the health of reefs and policy makers can develop scientifically-based management strategies.

36) Mapping microbes

To identify marine microbes and survey their distribution around the globe, ICoMM launches 40 separate projects using the same DNA sequencing technology, "454 tag-pyrosequencing." The efficient identification by a standardized method allows scientists to inventory areas as diverse as polar biodiversity hotspots, coastal microbial mats, and sediments in tropical coral reefs. They can then create unprecedented global maps of the tiniest life in the ocean.

37) Arctic robots

Two new underwater robots give ChEss scientists a bird's eye view of what lives on Gakkel Ridge in the Arctic Ocean. These exploration vehicles carry cameras and sophisticated arrays of instruments used by scientists to discover a new underwater volcanic chain covered by extensive microbial mats. Because the deep Arctic ridges are isolated from other ocean basins, the investigation of Gakkel Ridge provides clues about the evolution of fauna around underwater vents in isolated habitats.

BUILDING GLOBAL PARTNERSHIPS

38) Nearshore research expands worldwide

NaGISA expands nearshore research within the Caribbean, South America, and around the Indian Ocean through regional workshops aimed at standardizing protocols.

Scientists use these protocols in monitoring and educational program to assess environmental impacts and to engage local communities in the process.

39) A highly detailed look at biodiversity in a well-documented bay

A unique collaboration of U.S. and Canadian GoMA (www.coml.org/descrip/gom.htm) researchers enhances knowledge of changing marine eco-systems by studying the nearshore zone of Cobscook Bay, Maine, from both historical and present-day perspectives. One of the most diverse coastal ecosystem on the North American east coast north of the tropics, this estuary features many different habitats, a tidal range of over eight meters, two centuries of historical records dating back to 1842, and more than 800 species identified to date.

40) Engaging the public

NaGISA scientists studying the nearshore environment of the world ocean are present on six continents. Science education programs and training workshops aim to incorporate research protocols, which makes data gathered in the coastal environment comparable from place to place. The nearshore investigations engage the public in ocean and coastal issues and inspire the next generation of marine scientists.

41) International study of plankton bloom

In the Southern Ocean, collaborating CeDAMar (www.coml.org/descrip/cedamar.htm) researchers follow a plankton bloom from its onset until it changes to marine snow and finally sinks to the deep-sea floor. The scientists then examine the influence of the snow of fallen plankton on marine life on the floor itself. It is the first such collaboration undertaken since the Galathea expedition in the early 1950's. In spite of bad weather and complicated logistics, the collaboration produces a trove of data.

42) Leading research for International Polar Year

Census projects play a key role in the International Polar Year 2007-2009. In the Arctic, the Census leads the marine biodiversity cluster of 13 projects from eight countries on more than 20 expeditions. They observe how mammals use diverse polar habitats, inventory life in a fjord, and explore seeps, pockmarks, and mud volcanoes on remote ocean floors. In the Southern Ocean, the Census coordinates the science on 10 major expeditions by vessels from nine different countries, the results reported live via the Internet. The Census also initiates a collaborative program focusing on Antarctic marine life in seven South American countries.

INFORMING DECISIONS

43) Race to protect sea turtles

The Great Turtle Race, an international race developed by TOPP to save a 100-million-year-old species from extinction moved to China in 2008. A Mandarin language version of an interactive webpage tracks the migration of endangered leatherback turtles, bringing the race to approximately 100 million Chinese citizens. Donations go to protection of leatherback turtle nesting areas in Indonesia, and raise awareness of the turtles plight.

44) Leatherback conservation

For more than 12,095 satellite-tracking days over three years, TOPP scientists track leatherback turtles and compile the largest, multi-year migration record ever. The data reveals that ocean currents shaped the migration corridor and turtle dispersal in the South Pacific.

45) Hydrothermal vents and seabed mining

ChEss scientists orchestrate a joint scientific and policy meeting for the spring of 2009 to discuss protection of the vent sites from the potential growth of deep sea mining. The meeting's goal: set priorities for future research and balance the conservation of critical vent sites versus the value of ores.

46) Focusing fishery management

MAR-ECO research along the Mid-Atlantic Ridge strives to fill information gaps about the distribution and abundance of certain species of grenadier (www.eol.org/taxa/17063155), distant relatives of codfish in the North Atlantic. Amid the uncertainty, regional managers take precautionary measures to protect grenadier stocks and their habitats.

47) CSI in the sea: DNA barcoding shark fins

Demand for their fins and other organs impact global shark populations. The frequently inaccurate identification of sharks and rays confuses what fishermen are catching, what fins and organs markets are selling, and how populations are changing. Accordingly, researchers with the Marine Barcode of Life project (www.marinebarcoding.org/publications) develop DNA barcoding to identify species of sharks and their products, such as dried fins, essential to knowing how many sharks are being caught and to enforce prohibitions. (See also http://phe.rockefeller.edu/docs/pacificfishingsept2008.pdf)

48) Managing underwater mountains

CenSeam expeditions in the Southern Ocean and Antarctica expand knowledge of life on seamounts, providing a foundation for sustainable management of these ecosystems. Census researchers deliver a report to the United Nations General Assembly on the vulnerability of seamount corals to fishing and help develop guidelines for deep-sea fisheries.

49) Learning from the past: Rise and fall of tuna

Scouring fishery reports, fishing magazines, and other records, HMAP (www.coml.org/descrip/hmap.htm) researchers document the presence of bluefin tuna (www.eol.org/taxa/17050078) in northern European waters several decades before the onset of major fisheries in the early 1900s. After fishing increased and techniques became more powerful, the fishery collapsed in the mid-1960s. Documentation of the historical abundance of this especially popular seafood species, and its subsequent collapse, will be used to inform future decisions.

50) Assessing human impact

HMAP brings together a worldwide network of experts from multiple disciplines to figure out why populations of mollusc have declined. They report their work in a book, Early Human Impact on Megamolluscs (Oxford: Archaeopress).

51) High mortality for young salmon

Using acoustic tagging, POST (www.coml.org/descrip/post.htm) researchers track the progress of young Chinook salmon (www.eol.org/taxa/17154704) as they move from freshwater rivers in the Canadian and US northwest out to the ocean and eventually to the Alaska coast. The observations suggest that in just a few weeks, 40 percent of the tracked salmon perished in the ocean.

52) Sturgeon playground

POST researchers discover green sturgeon congregate at a "playground" off Vancouver Island before moving on to Alaska for the winter, contrary to scientists' expectations. The reason for their layover is unknown, but it makes them susceptible to potential over-exploitation.

53) Conserving life in open ocean

MAR-ECO documentation of the quantity and patterns of diversity on the mid-Atlantic Ridge summit at 3,500 meters helps international management organizations protect habitats and assure sustainable resource use. Continued work by Census scientists and a variety of partners creates a better basis for conservation of marine life in the immense areas of the oceans that lie beyond national jurisdiction.

54) Tuna and Billfish distribution

FMAP (www.coml.org/descrip/fmap.htm) researchers investigate the global distribution patterns of two highly migratory predators, tuna and billfish, and relate the information to the temperature tolerances of these species, work that may help anticipate the effects of ocean warming on biodiversity.

SHARING KNOWLEDGE

55) OBIS reaches 16 million records

Census experts creating the Ocean Biogeographic Information System (www.coml.org/descrip/obis.htm), log 16 million biological records, with 17 million expected by year's end, received from nodes around the world. Collaboration with the Encyclopedia of Life, among others, expedites information sharing, creating an integrated system containing geographical, biographical, evolutionary, and genetic information, as well as images.

56) Counting all creatures in the Gulf

Scientists complete a comprehensive inventory of all marine life in the Gulf of Mexico. Published in a 79-chapter book written by 140 authors from 15 countries, the inventory shows 15,625 species from 40 different phyla in the Gulf. A second phase of

the project currently underway will make the information available in a searchable online database.

57) Listing all species, eliminating aliases

The list of known marine species surpasses 120,000, placing the Census halfway toward its goal of cataloging the estimated 230,000 known species by 2010. The Census-affiliated World Register of Marine Species (WoRMS) identifies more than 56,000 aliases for ocean species, with one species, the "breadcrumb sponge," alone having 56 scientific names.

58) 4,000 Marine Fish May Await Discovery

Employing a novel approach to count quantify global fish species, FMAP researchers estimate that almost 16,000 species of marine fish are recorded in publicly accessible databases. They suggest another 4,000 fish species await discovery and description, many of them in the tropics.

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Appendix 3: Partners and Sponsors

The Census is made possible by support from a broad range of private sources and government agencies in nations ranging from Germany, Netherlands, Norway, and Portugal to Argentina, Brazil, China, India, Indonesia, and South Africa. An inclusive list of supporters is available at www.comlsecretariat.org/Dev2Go.web?id=302846&rnd=27348.
Some recent partners and sponsors include:

- Alfred P. Sloan Foundation, USA
- Australian Antarctic Division, Government of Australia
- Australian Institute of Marine Science
- BHP Billiton
- Bonneville Power Administration, USA
- Bureau of Fisheries and Aquatic Resources, Philippines
- Chevron
- Consejo Superior de Investigaciones Científicas, Spain
- Commonwealth Scientific and Industrial Research Organisation, Australia
- David and Lucile Packard Foundation, USA
- Department of Oceanography and Center for Oceanographic Research in the Eastern South Pacific (University of Concepción, Chile)
- European Union (including HERMES, MARBEF and other programs)
- Fisheries and Oceans Canada
- Fisheries Research and Development Corporation, Australia
- Flanders Marine Institute (VLIZ) (host, World Register of Marine Species and EurOBIS), Belgium
- Gordon and Betty Moore Foundation, USA
- Government of Chile (Ministry of Foreign Affairs, Chilean Antarctic Institute, and

Ministry of Defence - Air Force)
- Group on Earth Observations (GEO)
- Ifremer, France
- Museum Victoria, Australia
- Natural Environment Research Council, UK
- National Institute of Water and Atmospheric Research, New Zealand
- National Oceanic and Atmospheric Administration, Office of Ocean Exploration, USA
- National Oceanography Centre, UK
- National Science Foundation, USA
- Natural Sciences and Engineering Research Council, Canada
- New Zealand Foundation for Research, Science and Technology
- Nippon Foundation, Japan
- Petrobras
- Richard Lounsbery Foundation, USA
- Russian Academy of Sciences
- Russian Foundation for Fundamental Research, Russia
- Stavros Niarchos Foundation, Greece
- Total Foundation for the Biodiversity and the Sea, France
- University of Ghent, Belgium
- Universidad Catolica del Norte and Centro de Investigacion, Chile
- World Bank