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www.coml.org

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CoML scientists are available for advance interviews Mon-Tues, Nov. 22-23. Please call 416-538-8712 or email terrycollins@rogers.com to schedule a time. ***They will also take part in a media conference call Tuesday. Nov. 23, 12 noon EST. To join the call, dial 800-531-3250 (+1-303-928-2693 from outside North America), conference ID 2203989****. High-resolution images are available for download at: http://www.coml.org/embargo/embargo4.htm*

Making Ocean Life Count

Burgeoning marine life database tops 5 million records, 38,000 species
Scientists add over 4 million new records, 13,000 species in 2004;
Exponential growth of "information seaway" tops Census highlights

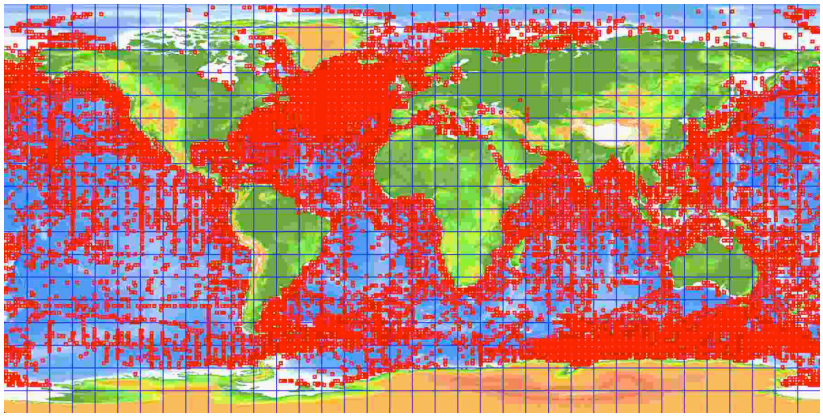
Even in Europe and the best studied seas, the rapid ongoing discovery of new marine species shows no end in sight, according to the world's first Census of Marine Life, a massive collaboration to catalog and map marine species worldwide involving hundreds of scientists in more than 70 countries.

The Census database has assembled more than 5.2 million records mapping the distribution of 38,000 marine species, an exponential increase from 1.1 million records and 25,000 species at this time last year. The progress, which tops a list of Census highlights in 2004, will be announced at a meeting of experts in Hamburg, Germany Nov. 29, along with news of a network of regional organizations[1] being formed to advance the world's "information seaway." A meeting of the CoML International Scientific Steering Committee will follow in Paris [2], Dec. 1 to 3.

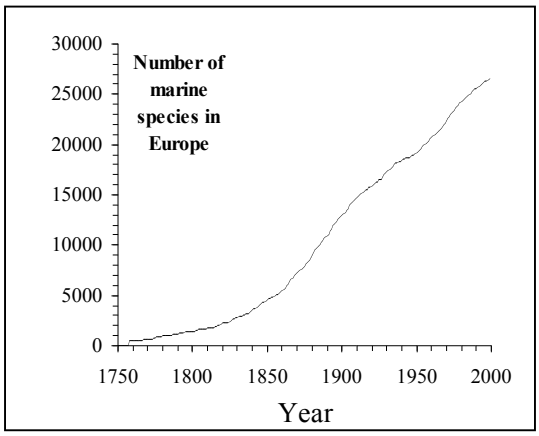
Though still under construction, the $9.5 million Ocean Biographic Information System (OBIS) database already shows for the first time that near-surface records account for 95

[1] From Australia, Canada, China, Europe, India, Japan, New Zealand, South America and Sub-Saharan Africa. For partner details, see appendix.
[2] See appendix for details

percent of all existing observations of ocean life; less than 0.1 percent are from the bottom half of the water column. A specimen collected below 2000 m (6,000 ft) is about 50 times more likely to be new to science than one found at 50 m.



An unprecedented map has been produced from the 5.2 million records. Red dots represent the locations of marine species found in, on and above the seabed, from microscopic plankton to whales, recorded over the past few hundred years. Also included in the database are the date and depth for each record. Large patches of blue show where no samples at any depth have been recorded.



From the European Register of Marine Species (www.marbef.org/data/erms.php)

A graph of marine species discovered in Europe reveals a trend line with no end in sight. And the researchers say such rates are higher in southern and Pacific oceans where research has been less intensive.

"We have barely skimmed the surface," says Dr. J. Frederick Grassle of Rutgers University, who directs the OBIS Secretariat and chairs the Census' International Scientific Steering Committee.

"Humans have explored less than five percent of the world's oceans, and even where we have explored, life may have been too small to see. Thus, opportunities abound to discover species and increase our knowledge of abundance and distribution."

About 230,000 marine species have been described by scientists and there is great debate about how many more exist, but it will be several times this number, perhaps ten times. As part of the Census, the undersea race is on to discover these unknown species using old and new technologies in all the world's oceans. OBIS captures and freely communicates this data to the world online at www.iobis.org, complete with tools for

making maps and relating the presence of animals to currents, temperature, and other ocean conditions.

Some 106 new species of marine fish were added to the database so far in 2004, an average well over two new species per week, bringing the total of marine fish species to 15,482. CoML experts expect the final count to total roughly 20,000.

Amblyeleotris katherine. Credit John E. Randall. A new-to-science species of the goby fish discovered in Guam and described in 2004 lives in partnership with a snapping shrimp. The shrimp digs a burrow while the goby serves as sentinel and uses the burrow for refuge.

CMarZ: Zooplankton of the genus *Tomopteris*. Photo: R. Hoparoft/NOAA

The database includes more than 6,800 species of zooplankton, animals that drift with the currents. They expect to discover, identify, and add at least as many zooplankton species to the database over the next six years.

Microbes, the smallest organisms, astonishingly form more than 90 percent of biomass in the ocean. The Census is building a cyber-infrastructure to organize what is known about this huge micro-world and preparing for countless new arrivals.

ICoMM: Single-celled eukaryotic microbe (~2mm in diameter). Photo: L. Amaral Zettler

Advances in technology have lifted limits for discovery of life that is small, deep, or rare, says Dr. Grassle. Census scientists are innovating, refining, and integrating techniques to assess and monitor marine life. For example, newly field tested equipment and techniques reveal hundreds of new microbial life forms quickly and inexpensively through sophisticated filtration and gene sequencing. And newly developed protocols for the inventory of near-shore coastal biodiversity enable comparative worldwide surveys for the first time.

Census grows to 13 projects

Creating a census of many trillions of moving organisms belonging to millions of diverse species in the three-dimensional oceans of the world is a scientific challenge seldom equaled. Launched in 2000 and running through 2010, the US $1 billion Census embraces researchers and institutions from more than 70 countries, pooling skills and tools to assess the diversity, distribution, and abundance of ocean life over time. In 2004,

the Census grew from 10 to 13 projects (acronyms below in parentheses), detailed online at *www.coml.org*.

Census researchers organize their work in two ways, according to kinds of life and geography. Scientists are studying everything from large ocean predators to the tiniest microbes in ocean realms ranging from shallow coastal waters to the deep sea. Field projects track migrations to map distributions, for example, of salmon and sturgeon along North America's west coast (POST) and of turtles and tuna transiting the Pacific (TOPP). Data on the genes of microbes (ICoMM) and zooplankton (CMarZ) support a complementary project, creation of universal standards to aid quick, accurate identification of species.

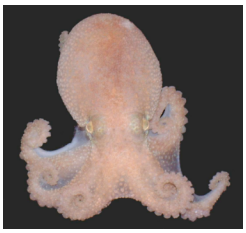
Census researchers study biodiversity along near-shore areas from equatorial to polar water (NaGISA) and around a vast seafloor mountain range, the Mid-Atlantic Ridge (MAR-ECO). Using sophisticated underwater vehicles and cameras, investigations plunge to depths of 6000 m along the abyssal plains of the sea floor (CeDAMar) and near vents and seeps (ChEss) where chemical energy, rather than sunlight, sustains life. Teams survey the sea life and habitats of a classic, exploited regional ecosystem, the Gulf of Maine (GoMA), to refine ecosystem-based ocean management, and visit the unexplored Arctic (ArcCoML) to assemble baseline data that might later show changes associated with global warming. To achieve the goal of sampling all major forms of marine life and ocean realms, the Census field program will soon expand to seamounts, coral reefs, and continental margins, as well as the Antarctic and Southern Ocean.

To complement ongoing fieldwork, Census researchers are compiling data on marine animal populations from the past 500 or so years (HMAP) and developing models to help foresee life in the world's oceans of tomorrow (FMAP).

Discoveries 2004

Modern technologies helped produce many 2004 Census highlights. Researchers used a redesigned device, for example, the epibenthic sledge, to collect specimens down to 6000 m below the surface in the delicate habitats of Africa's Angola Basin, and explored the benthos of the deep Southern Ocean, one of Earth's least-known marine areas. The samples reveal surprising patterns of deep-sea species and endemism markedly different from one animal group to another.

CeDAMar: ANDEEP. Photo: W. Brueheland



Previous research shows many fauna of the Antarctic shelf are highly endemic. For example, about 85 percent of deep-sea crustaceans found there are unique to that region. However, scientists discovered the deep Southern Ocean harbors many single-cell species known from the North Atlantic and elsewhere. The deep Southern Ocean also yielded a surprisingly large collection of octopods—four species in two genera, including one genus new to science.

NaGISA: Rhodoliths, coralline algae, resemble toy jacks. Photo: K. Iken

Meanwhile, discovery of a colony of rhodoliths, coral-like marine algae, surprised biologists studying Prince William Sound, Alaska. Hard, red, resembling toy jacks, the plants roll like tumbleweed in beds used as nurseries by scallops, shrimp, and other invertebrates, prompting plans to study the plants' contribution to the ecosystem.

Additions to the book of life from hydrothermal vents and seeps

ChEss: A rich variety of fauna lie near a hydrothermal vent in the Indian Ocean. Photo: A. Warren

Using manned and remotely-operated vehicles that withstand crushing pressures and extreme temperatures, investigators collected samples with robotic arms to reveal the unique geology, geochemistry, and biology of deep-sea hydrothermal vents and cold seeps. A suspected new species of clam that draws life from methane hydrates was documented off the coast of Chile, while a new species of minute mollusk was discovered in vents in the Indian Ocean.

Seeing the Ocean as Its Inhabitants Do

Fifty scientists from eight countries tagging 22 large open-ocean species in the North Pacific are allying with the animals to create the first-ever map of marine life highways and hot spots.

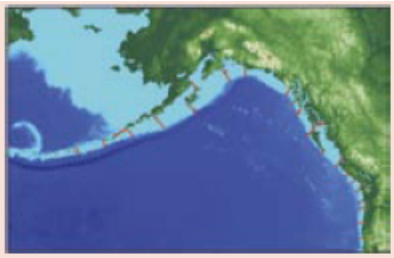
More than 1500 "animal observers" have now been recruited, carrying compact electronic tags, some recording data for future retrieval, others revealing animal movements across the Pacific in near real time. Scientists have observed the transoceanic journeys of tuna from Mexico to Japan, followed salmon sharks on two-year migrations from Alaska to Hawaii, and tracked endangered leatherback sea turtles as they fanned out from their nesting beaches in Costa Rica. The animals provide valuable insights along the way into their behavior (depth preferences, for example) and about ocean conditions.

Movements of the ocean's top predators identify critical habitats and migratory corridors, crucial knowledge for wise resources management.

Scientists find lost tribe of green sturgeon

POST: A salmon is fitted with an acoustic tag. Photo: D. Welch

Acoustic tags in young salmon allow listening lines on the floor of the Pacific Ocean to record their location from Washington State along the coast of British Columbia to southeast Alaska.



POST: An acoustic array on the Pacific Ocean sea floor is shown in red.

The tracking array's listening lines also unexpectedly picked up tagged green sturgeon from northern California, rarest of the 26 sturgeon species, having traveled 1,000 km north to Canada's Brook's Peninsula. The finding may prompt new protection strategies for this endangered fish, known to spawn only in a few western U.S. rivers.

Comparing Past and Present Populations

HMAP: This mid-19th century illustration depicts fishermen using single hand lines from inside the rail, as was the practice during the colonial era.

HMAP: Tub trawling from dories replaced handlining in the latter half of the 19th century.

By studying historical fisheries records, Census researchers can compare present populations and use this information to predict population trends. Among discoveries in 2004:

As fishing technology changed in the 19th century, the size of landed cod decreased significantly. Large cod caught in the 1600s could weigh as much as 80 pounds. New England fishermen employed one or two hand lines over the rail of small vessels until the 1850s, still occasionally catching very large fish. In the 1860s, the new technique of tub trawling replaced hand lining, increasing by hundreds the number of hooks each man could fish. More fish were caught, but fishing was less selective; cod weighed, on average, 30 percent less.

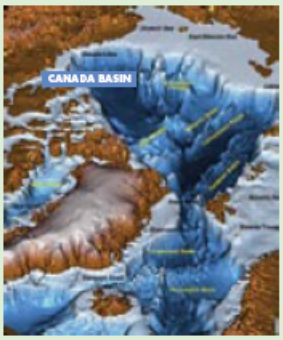
Comparison of historical and current data showed that the population of oceanic whitetip sharks in the Gulf of Mexico has dropped 99 percent since the mid-1950s. The loss of these sharks and other predators caused an explosion of corresponding magnitude in the population of pelagic stingrays. A recent decline of sharks in the Northwest Atlantic also was measured, ranging from 40 percent among makos to almost 90 percent for hammerheads.

80,000 specimens collected from the Mid-Atlantic Ridge

Crossed largely without notice by countless vessels for the past 1000 years, the Mid-Atlantic Ridge is a submerged mountain range dividing the North American and Eurasian plates. It may prove a popular way-station for trans-Atlantic submarine animal travelers, and home for species that surface sailors never see.

After two months aboard Norway's state-of-the-art vessel *G.O. Sars,* 60 scientists from 13 countries returned with unprecedented quantity and quality of video footage captured by remotely operated submersibles, sonar data showing deep donuts of plankton ten km wide, and photographs of many probable new species among 80,000 specimens collected.

Arctic Ocean



ArcCoML: Canada Basin, NOAA, Ocean Exploration

Work began using modern sonar detection, remotely operated vehicles, and traditional techniques to catalog Arctic Ocean species, some isolated for tens of millions of years. One area under investigation is the Arctic's Canada Basin, an ice-lidded bowl containing some of the oldest water in the world. "In this virtually unexplored ocean realm, we know many unusual creatures await discovery," says Dr. Ron O'Dor, Chief Census Scientist, based in Washington DC.

Integrating Data, Creating Information

A new super-portal is serving as a model for ecosystem-based marine management worldwide. Layers of biological, physical, chemical, and geologic data from the Gulf of Maine are merged online in unprecedented ways. Through a partnership among ocean observers of many kinds, the super-portal permits, for example, combining trends in ground fisheries with records on the presence of prey, temperature, currents, and sea floor topography, improving understanding of species behavior and suggesting better ecosystem-based management policies.

Communicating about the Census

Finally, to make the findings of Census scientists more accessible and to share the excitement of the technology that makes the dream of a Census a reality, CoML team members launched the educational website *Investigating Marine Life* at www.coml.org, accompanied by the launch of a television public service commercial.

Appendix: Census of Marine Life meetings in Hamburg and Paris

The week of Nov. 27 to Dec. 3 spans key meetings in Europe for the Census of Marine Life.

Some 200 experts will convene Nov. 29 to Dec. 1 in Hamburg, Germany for the International Conference on Marine Biodiversity Data Management, of which CoML is a lead sponsor. Prior to the Hamburg Conference the International Committee which steers development of the OBIS database will meet to review progress and policies.

On Wednesday Dec. 1, the Museum National d'Histoire Naturelle in Paris hosts a symposium highlighting contributions to the CoML by French researchers.

On Dec. 2-3, the Intergovernmental Oceanographic Commission in Paris will host meetings involving roughly 50 people from 18 countries, including the CoML International Scientific Steering Committee, heads of all the Regional and National Implementation Committees, leading European officials and researchers, and experts in education and outreach including filmmakers and writers. Among the key issues: plans for the CoML Progress Reports in 2005 and 2007 and the final Census in 2010.

Global Network of Regional Organization Formed to Support OBIS

The Alfred P. Sloan Foundation has given a $1.5 million grant to establish a global network of organizations to support development of OBIS (www.iobis.org) with regional nodes in Australia, Canada, China, Europe, India, Japan, New Zealand, South America, and Sub-Saharan Africa.

The network's establishment will be announced at the Ocean Biodiversity Informatics conference, Hamburg, Germany, Nov. 29 (www.vliz.be/obi). It will feature a secretariat at Rutgers University (USA), with an executive office at the University of Auckland (New Zealand). Dr. Richard Chinman has been appointed OBIS Program Manager and will be based at Rutgers University.

The OBIS International Committee is chaired by Dr. Mark Costello (University of Auckland, New Zealand). The OBIS Secretariat is directed by Dr. Fred Grassle and the portal is managed by Dr. Yunqing Zhang. Recent appointments include Dr. Pat Halpin (Duke University, USA), Chair, OBIS Technical Committee, Bob Branton (Bedford

Institute of Oceanography, Canada), Chair, OBIS Management Committee, and managers of each regional node:

Australia National Oceans Office & CSIRO	Dr. Kim Finney
Canada Centre of Marine Biodiversity & Bedford Institute of Oceanography	Mr. Bob Branton
China Institute of Oceanology, Qingdao	Dr. Song Sun
Europe Vlaams Instituut voor de Zee (VLIZ)	Dr. Edward Vanden Berghe
India National Chemical Laboratory & National Institute of Oceanography, India	Dr. Vishwas Chavan
Japan National Institute for Environmental Studies	Dr. Junko Shimura
New Zealand National Institute of Water & Atmospheric Research	Dr. Don Robertson
South America University of Sao Paulo	Dr. Fabio Lang da Silveira
Sub-Saharan Africa Southern African Data Centre for Oceanography (SADCO)	Dr. Marten Grundlingh

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Census of Marine Life sponsors:

Support for the Census of Marine Life comes from government agencies concerned with science, environment, and fisheries in a growing list of nations as well as from private foundations and companies. The Census is associated or affiliated with several intergovernmental international organizations including the Intergovernmental Oceanographic Commission of the UN, the Food and Agriculture Organization of the UN, the UN Environment Programme and its World Conservation Monitoring Centre, the Global Biodiversity Information Facility, the International Council for the Exploration of the Seas, and the North Pacific Marine Science Organization. It is also affiliated with international nongovernmental organizations including the Scientific Committee on Oceanic Research and the International Association of Biological Oceanography of the International Council for Science. The Census is led by an independently constituted international Scientific Steering Committee whose members serve in their individual capacities and a growing set of national and regional implementation committees.