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Census of Marine Life Discoveries and Highlights 2005:

**“Fish with Chips”
Reporting Around, Across the Pacific
Top Highlights at Census Mid-Point**

*Coastal Fish Tracking, Using Implanted Chips, Becoming Continental Project;
1,800+ Sharks, Turtles, Other Species Call in Via Satellite from Mid-Ocean*

*Carnivorous Sponges among New Species in Southern Ocean Abyss;
Eerie Underwater Dead Zone Found at 2004 Tsunami Epicenter;
Explorers Record Life at Smoking Seafloor Vents, 1st S. of Equator in Atlantic;*

Giant Inventory of Marine Life Grows to 8.4 Million Records, 40,000+ Species

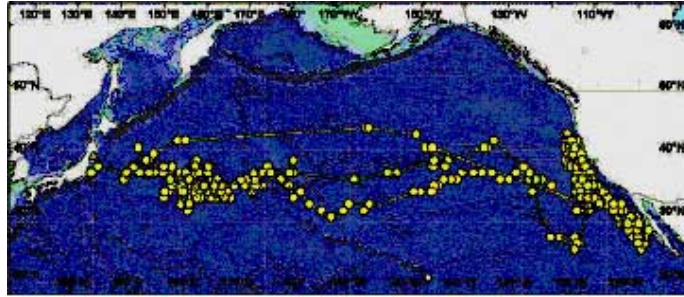
Revelations by high-tech tracking devices about the coastal migrations of endangered fish and of large animals in the open Pacific Ocean top the highlights from the growing ranks of researchers conducting the global Census of Marine Life at its 2005 mid-point.

A Census project tagging thousands of endangered salmon to chart their individual travels, with profound implications for protection of threatened stocks, will expand its arrays of underwater monitors from British Columbia north along the continental shelf to Alaska and south to California. The system could spread worldwide to monitor traffic and tribulations of the many species that migrate along the shallow coastal highways.

Meanwhile, Census scientists increased by more than 50% from 2004 the number of reporting devices on the large animals that typically venture from the shallow shelves

into the deep Pacific Ocean. Some 1,800 open ocean animals of 21 species, including sharks, turtles, seals, sea lions, and seabirds carried Census tags during 2005. Some of the tags, resembling cellphones, call information into scientists via satellite each time the animal surfaces. A website (www.toppcensus.org) allows the public to follow some of these creatures in near real-time.

Tags show tuna are the marine jet set. A tagged bluefin tuna recorded its stunning trans-Pacific migration – three crossings in 600 days, a distance of 40,000 km, greater than Earth’s circumference.



1st Census of Marine Life at Mid-Point: Exploring the Unknown, Assembling the Known, Defining the Unknowable

Drawing comparisons to the Domesday Book that comprehensively surveyed England in 1066, the Census has enrolled leading global experts in a 10-year scientific partnership, unprecedented in scale, to assess and explain the diversity, distribution and abundance of life in all oceans, a baseline against which future change may be measured.

They are assembling in one place for the first time most of what we know about marine life, and marking what is unknown and may yet be unknowable. They are reconstructing the history of ocean life since fishing became important, censusing the present state, and using the past and present to forecast future marine life. They are satisfying basic human curiosity about what lives beneath the waves as well as generating insights useful for better managing and preserving ocean resources.

Starting the 10-year project in 2000 with about 250 collaborators, an almost seven-fold increase has taken place in five years. Some 1,700 experts from 73 nations are today working to produce the 1st Census by 2010. In November 2005, some 150 leaders of all components of the Census met in Frankfurt to review progress and harmonize their efforts to cover all habitats and species by 2010.

The Census reached maturation in project breadth in 2005 with 17 initiatives, four of them new this year¹. Expeditions to previously unexplored regions rose from 8 in 2004 to 14 in 2005, with many more planned through 2010. The years 2006-8 will see the most intense field work; the results will be analysed and integrated in 2009-10.

The research spans species from microbes to whales, from near-shore to mid-ocean, from the world’s deepest mud in the abyssal plains to the foamy and sparkling surface, from

¹ Censuses of Marine Life in: the Antarctic (CAML), Continental Margin Ecosystems (COMARGE), Coral Reefs (CReefs), and Seamounts (CenSeam)

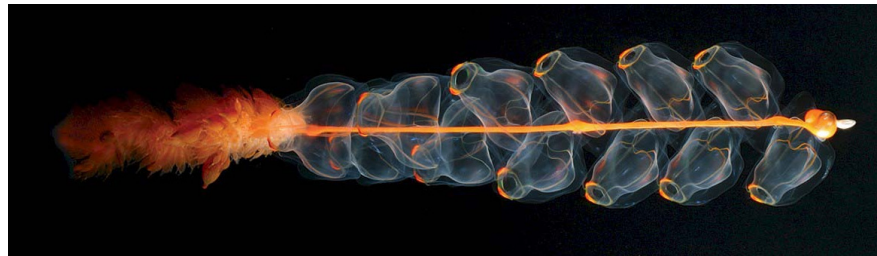
hot seafloor vents to the ice oceans at both poles. Areas of exploration include the submerged edges of continents, seamounts dotting the ocean's floor, and coral reefs.

Using new approaches and technologies, including supersensitive visual and acoustic devices, Census researchers can sample life in all ocean realms and identify specimens quickly through genetic science and digital image libraries.

“Immense scale challenges the Census,” says Dr. Victor A. Gallardo of Chile, Vice-Chair of the Census Scientific Steering Committee and a professor at the Universidad de Concepcion in Chile, “The deep-sea floor is an area of 300 million square kilometers, of which the area sampled to date is equal to a few football fields. The number of seamounts” (underwater mountains rising at least 1,000 meters from the ocean floor, often extinct volcanoes that failed to grow tall enough to become islands) “is estimated at between 30,000 and 100,000, of which a few hundred have been biologically sampled, less than 50 of them sampled well. Representative sampling on a global scale is the key for an effective census.”

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*Physonect
siphonophore,
Marrus sp., found
at 1,500 meters
deep,*



*photographed
during NOAA's*

Arctic "Hidden Ocean" expedition in support of the Census of Marine Life. A feeding adult can reach almost 3 meters. ©2005, Kevin Raskoff. [Download](http://www.coml.org/) full version (zip file) at <http://www.coml.org/>

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Discoveries and highlights, 2005: Fish with Chips

Marine animals carrying computer chips that report their locations show that fish and many other species use well-defined ocean zones.

The POST (Pacific Ocean Shelf Tracking: www.postcoml.org) project has revealed the Pacific migration routes of young wild salmon from US and Canadian rivers. Because many salmon die in the ocean, knowing their usual travels along marine highways has far-reaching implications worldwide for authorities who determine when fisheries should be open or closed to conserve endangered stocks.

The salmon are implanted with almond-sized electronic tags scanned by devices on the ocean floor when they pass over, like an electronic tag on a car passing through a highway tollbooth (see animation at http://www.postcoml.org/videos/how_it_works.htm). The data reveal the movement and survival of each tagged fish as it migrates within the system and the distribution of all the tagged fish.



The current array stretches more than 1,550 km, from Washington State, through British Columbia to north of the Alaskan panhandle. By 2010, the CoML team aims to cover the entire western North America coast, with a goal to replicate the network on continental shelves worldwide. Continental shelves average about 80 km (50 mi) wide, and the edge of the shelf occurs at an average depth of about 200 m (660 ft), where it falls steeply into the deep sea. Salmon and many other marine animals travel extensively along shelves.

The number of fish tagged almost tripled in 2005 – some 2,700 salmon from 19 US and Canadian stocks in 16 river systems, up from 1,050 fish tagged from 14 stocks in 8 river systems in 2004. The array performed nearly flawlessly, revealing substantial differences in the paths, speed, distribution and survival of species and stocks within species, both wild and from hatcheries.

Among other benefits, the work will provide clues how fish behaviour would change should ocean waters warm.

Says POST lead scientist, David Welch: “New developments in the technology mean that we will be able to monitor individual fish with tags that will last 10-20 years. For salmon, this means we will also be able to monitor the return migration of adults, providing information that could help better protect endangered stocks.”

Science Suggests Smart Fishing

"The dream of abundant and sustainable stocks of commercial fish is now one step closer, thanks to this Census of Marine Life program. The new data reveal for the first time those zones of the ocean where we have the highest leverage for conservation and thus smarter fishing," said D. James Baker, President of the Academy of Natural Sciences of Philadelphia and former long-time chief of the US National Oceanic and Atmospheric Administration, responsible for management of marine fisheries.

Why did the Fish Cross the Ocean?

The TOPP (Tagging of Pacific Pelagics) project, meanwhile, found many salmon sharks (*Lamna ditropis*) from Alaska share with humans an attraction to warmer winter destinations and frequently migrate to destinations like Hawaii. Growing to more than 300 kilograms (660 pounds), the salmon sharks can attain speeds of more than 50 kilometers (30 miles) per hour. The project's shark team also recorded an unprecedented 305-day track of a white shark that completed a full migratory cycle from coastal waters to off-shore and back again.

TOPP's state-of-the-art tags have also allowed marine turtle researchers to determine how much energy a leatherback sea turtle burns at sea. Says TOPP researcher and post-doctoral Research Associate at Duke University Bryan Wallace, "Imagine that the turtles are cars. These measurements allow us to know their ratings for miles per gallon on the road, not just idling in traffic. And with the help of habitat data the turtles are collecting, TOPP research may just help make traveling a bit safer for this highly endangered species."

Discoveries and highlights, 2005: Diversity

- **Carnivorous Sponges and other New Species in Southern Oceans:**

Unexpected biodiversity greeted scientists on two expeditions to the abyssal plains and basins of the South Atlantic and Southern Oceans. Although those seas are low in biomass, they are rich in variety, and scientists say 50% to 90% of specimens collected from the two expeditions are new to science. The southern deep abyss may hold reservoirs of genetic diversity and evolutionary novelties. Among the most intriguing creatures were tiny carnivorous sponges, about 5 mm (0.2 inches) in diameter, which engulf other organisms with their "mouths" (sponges typically feed by

filtering small particles from the water) Three of four carnivorous sponge species found in the Southern Ocean abyss had never been seen before. Sponges with calcium skeletons living much deeper than expected also created surprise. Also found: minute unicellular animals (called "xenophyophore") using sediment grains to construct delicate shells that resemble soccer balls.



Sponge Bob Carnivore: *Asbestopluma*, a never-before-known species of carnivorous sponge, about 5 mm in diameter, engulfs other organisms with its "mouth," one of four such species, three of them new to science, found in the Southern Ocean abyss, 2005. Photo credits: Dorte Janussen, Senckenberg Museum, Frankfurt

- **Novelties Still in North Atlantic:** Exploring the northern Mid-Atlantic Ridge, beneath the most-traveled ocean surface on Earth, researchers documented several new and rare species, including strange varieties of deep-sea fish, two possibly new species of squid and, at the ocean floor, at least four new species of sea cucumbers. They also found almost one-quarter of demersal (deep swimming) fish species identified were new to the study area, reflecting how much there is yet to learn about the distribution and abundance of species known already.
- **DNA Identifiers for 800 Fish:** DNA barcodes, a standardized segment of the genome, can rapidly and accurately identify species. The Census now has a library of barcodes for almost 800 fish species, and another 1,000 species will be added by mid-2006. Researcher Bronwyn Innes (Tasmania, Australia) barcoded eight tuna species and used the barcodes to identify tuna carcasses on longliners in the Indian Ocean. Some misidentifications were revealed, including instances of endangered Southern Bluefin being misidentified as yellowfin or bigeye tuna.
- **Microbe Database:** Marine microbes are the tiniest of ocean species but constitute 90% of the ocean's biomass and cycle 98% of the carbon and nitrogen. To census microbes, CoML in 2005 launched an array of online resources that allows researchers to exploit molecular, environmental, geospatial, and taxonomic information, "MicroBIS". MicroBIS allows researchers to cross-check the identity of collected microbes against known species.

Discoveries and highlights, 2005: Distribution

- **Unexpected Presences in Arctic:** Census explorers in the Arctic Ocean's frigid Canada Basin discovered many creatures never seen there before, including several species of squid and the area's first known octopus.
- **First Atlantic Hydrothermal Vent South of Equator:** An international team of researchers, towing remotely operated vehicles to explore the southern Mid-Atlantic Ridge, found the first known hydrothermal vents south of the equator in the Atlantic. They sampled animals adapted to life in these extreme vent environments, where water super-heated to 350° C in Earth's crust flows from "black smokers" on the deep ocean floor. Comparison of the specimens collected with those found on hydrothermal vents previously discovered north of the Equator provides clues to the mysterious deep currents that may disperse them.
- **Whales Follow Undersea Ridges:** Tagging of baleen whales show they use the mid-ocean ridge as a feeding area and north-south migration route in the North Atlantic.

- **Expansion of Near-shore Coverage:** In a cooperative effort to catalog biodiversity in the near-shore environment, scientists and volunteers are now working at 80 official Census sites around the world, encompassing more than three-quarters of the world's coastlines.

Discoveries and highlights, 2005: Abundance

- **Dead Zone around Tsunami Epicenter:** On the first scientific expedition to the epicenter of the December 2004 tsunami, deadliest in recorded history, Census biologists found little or no effect on deep-sea fauna except at one site off Sumatra roughly 4000 m (2.5 miles) deep, where five months after the disaster there was no evidence of large animals during an 11 hour dive. The absence of biological life at the site was “unprecedented in 25 years of deep-sea sampling.”
- **Gulf of Maine Fluctuations:** A joint operation of scientists coordinating data from surface ships from small airplanes documented in 2005 major fluctuations in the abundance of feeding whales, pelagic fish, and plankton in the Gulf of Maine.
- **Reconstruction of North Sea Marine Life back to Middle Ages:** Creatively mining historical data from such sources as salt tax records, Census researchers have revealed drastic declines in populations of whales, seals, birds, large fish, and oysters during the past 500 years in the Wadden Sea, part of the North Sea bordering Denmark, Germany, and the Netherlands. The area once teeming with large animals would be unrecognizable to the early civilizations that lived there, characterized today by quiet mud flats. Ocean historians also documented that recent conservation efforts such as hunting bans and habitat protection have benefited seals as well as some birds.
- **Global Demography of Tuna and Billfish since 1950:** Using records of fish hooked on longlines in open oceans, researchers found the abundance and species diversity of large pelagic fish declined rapidly over the past 50 years. Global concentrations of such key predators such as tuna, marlin, and swordfish decreased dramatically worldwide. The research also uncovered four regions where high diversity persists – off the east coasts of the US, Australia, and Sri Lanka; south of Hawaii; and in the South-Eastern Pacific.

Discoveries and highlights, 2005: Synthesis

- **North Pacific Pilot Inventory:** To test the feasibility of the global Census, a team of CoML experts in the North Pacific Science Organization (a.k.a. PICES: www.pices.int/publications/special_publications/CoML/toc_sp_publ_2.as) prepared the pilot Census “Marine Life in the North Pacific: The Known, Unknown, and Unknowable.” The report surveys bacterio-plankton, phytoplankton, zooplankton, unexploited fishes and invertebrates, commercially important fishes and invertebrates, seabirds, marine mammals, and turtles. While everything cannot be known in detail because of the vastness of the system and rapid fluctuations of some populations, the North Pacific report encouragingly points the way toward the 2010 Census.

OBIS Inventory Grows

Perhaps the foremost legacy of the inaugural Census will be the geographical information system it is creating for all data about marine life where the species of the specimen and the place it was observed are reliably recorded.

A \$9.5 million meta-database, the Ocean Biogeographical Information System (OBIS), now links 60 databases containing 8.4 million taxonomic records (species, date, latitude, longitude, and depth found), an increase of 62% from 5.2 million records last year.

OBIS today contains more than 40,000 of an estimated 230,000 marine species described in science literature so far (which may only represent only one-tenth of all marine species in existence).

Of the 40,000 species of all types inventoried, 78 are marine fish newly added in the first 11 months of 2005, an average of 6.5 species added monthly. The total number of marine fish species in the database is now 15,717.

OBIS (www.iobis.org) is intended to become the world’s primary source of species distribution data – essential to knowing if a species is rare or common, where an alien invasive species originated, and if certain ocean areas are species hotspots that merit special protection. Ten regional nodes were established in 2005 to make it easier for users around the world both to deposit and access data.

Best represented species: some 80% of known fish and other marine vertebrates, as well as anemones and corals, are now included in the OBIS catalogue of life.

Census of Marine Life sponsors:

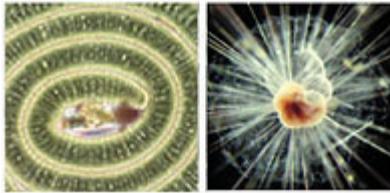
Support for the Census of Marine Life comes from government agencies concerned with science, environment, and fisheries in a growing list of nations as well as from private foundations and companies. The Census is associated or affiliated with several intergovernmental international organizations including 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.

2005 Census of Marine Life Highlights: New Images

The appended images and others in high resolution are available for media download at <http://www.coml.org/>



A physonect siphonophore, *Marrus* sp., photographed during NOAA's Arctic "Hidden Ocean" expedition in support of the Census of Marine Life. ©2005, Kevin Raskoff..



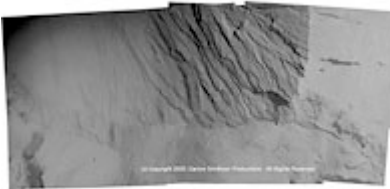
These two microbes (*Lyngbya* sp. on the left and *Hastigerina pelagica*) are examples of thousands of microbes being studied in the world's oceans. ©2000, D. Paterson and 1995, L. Amaral Zettler.



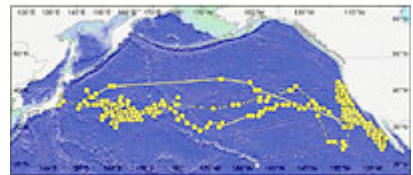
This red peniagone sea cucumber is one of four new species of sea cucumbers discovered by Census scientists along the Mid-Atlantic Ridge. ©2004, Andrey Gebruk..



This bucket contains organisms from the Southern Ocean from a depth of more than 1,000 meters in. ©2005, Brigitte Hilbig..



Census scientists participated in an expedition to the epicenter of the deadly December 26, 2004 Indonesian earthquake. Seafloor ruptures were photographed at a depth of 4,500 meters. ©2005, Darlow Smithson Productions..



The yellow dots represent the journey of a tagged bluefin tuna, *Thunnus orientalis*, which made a remarkable trans-Pacific migration three times in 600 days and traveled a distance of 40,000 kilometers. Map courtesy of S. Benson, 2005..



A new species of comb jelly, a cydippid ctenophore, was discovered by Census scientists during a month-long expedition to the Arctic Ocean. ©2005, Kevin Raskoff.



This polychaete worm of the genus *Macrochaeta* is one of many potentially new worm species found by Census scientists on the floor of the Arctic Ocean. ©2005, Bodil Bluhm..



Census researchers documented biological hotspots in the Gulf of Maine. Here, two humpback whales feed on red krill. ©2005, P. Stevick..

Census of Marine Life Projects
www.coml.org

Information System: OBIS
Ocean Biogeographic Information System
www.iobis.org

Near Shore: NaGISA
Natural Geography in Shore Areas
www.nagisa.coml.org

Coral Reefs: CReefs
Census of Coral Reefs*

Regional Ecosystems: GoMA
Gulf of Maine Area Program
www.usm.maine.edu/gulfofmaine-census

Continental Shelves: POST
Pacific Ocean Shelf Tracking Project
www.postcoml.org

Continental Margins: COMARGE
Continental Margin Ecosystems on a Worldwide Scale*

Abyssal Plains: CeDAMar
Census of the Diversity of Abyssal Marine Life
www.cedamar.org

Mid-Ocean Ridges: MAR-ECO
Patterns and Process of the Ecosystems of the Northern Mid-Atlantic
www.mar-eco.no

Seamounts: CenSeam
Census of Marine Life on Seamounts*

Vents and Seeps: ChEss
Biogeography of Deep-water Chemosynthetic Ecosystems
www.noc.soton.ac.uk/chess

Arctic Ocean: ArcOD
Arctic Ocean Diversity www.sfos.uaf.edu/research/arcdiv/index.html

Antarctic Ocean: CAML
Census of Antarctic Marine Life
www.caml.aq

Top Predators: TOPP
Tagging of Pacific Pelagics
www.toppcensus.org

Zooplankton: CmarZ
Census of Marine Zooplankton
www.cmarz.org

Microbes: ICoMM
International Census of Marine Microbes
<http://icomm.mbl.edu>

Oceans Past: HMAP
History of Marine Animal Populations
www.hmapcoml.org

Oceans Future: FMAP
Future of Marine Animal Populations
<http://as01.ucis.dal.ca/fmap>

*website under development