



The Census of Marine Life: Progress and Prospects Pacific Pelagics Pilot Project Workshop

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Good morning. Thanks to Julie Packard and the marvelous Monterey Bay Aquarium for hosting this workshop. Thanks to Barbara Block, George Boehlert, and Dan Costa for conceiving and organizing the meeting. And thanks to all of you for participating. In fact, the Census of Marine Life is you. I will return to this fact before closing.

First, let me introduce myself. I am a program director for the Alfred P. Sloan Foundation, a private philanthropic foundation located in New York City. The Sloan Foundation works with different parts of the scientific community to try to bring to fruition important scientific programs. About three years ago, several leading oceanographers approached the Foundation. They wanted to begin a new international scientific program to assess and to explain the diversity, distribution, and abundance of marine life. In brief, they want to organize a worldwide Census of Marine Life (CoML). I speak to you on behalf of the distinguished international Scientific Steering Committee (SSC) that is now planning the program.

Three main reasons motivate the Census of Marine Life (CoML). The first is simply the chance for exciting discoveries about the world in which we live. Much remains to be discovered about life in the oceans. For example, ichthyologists have so far identified about 15,000 species of marine fishes. They also believe about 5,000 species of marine fishes remain to be discovered. The Age of Discovery in the oceans is not over.

The second reason for a Census is improved management of marine resources. Big opportunities exist to improve management of fisheries and other human uses of the oceans. These are so well-known to you that I will not repeat them.

The third compelling reason for the CoML is the International Convention on Biodiversity. For this Convention to become useful, good baseline information on ecology is required. The present baseline information on marine ecosystems for most of the world's oceans is weak. The CoML can help greatly to create the needed baseline information.

A continuing series of international workshops, about 15 so far, have defined the challenges for the Census and the ways they can be addressed. One of the planning workshops were held at the Monterey Bay Aquarium Research Institute and another at the Aquarium itself. The prior meeting at the Monterey Bay Aquarium settled definitively the Grand Challenges that the Census should address. These are 1) What did live in the oceans? 2) What does live in the oceans? 3) What will live in the oceans? The International Scientific Steering Committee is now working hard to integrate the most valuable, feasible ideas into a 10-year strategy and plan for the Census to answer these questions. The draft strategy will soon be circulated to the various potential

stakeholders in the Census for review and comment. Let me share with the likely main components of the program.

The historical component of the Census, addressing the history of marine animal populations (HMAP), will try to create a picture of what lived in the oceans before fishing became important, say 500 years ago, and how these populations have changed. HMAP will try to create and make accessible time series on marine animal populations. It will try to rescue and put in electronic form historical data that could otherwise be lost. The Danish environmental historian and Steering Committee member, Poul Holm, who chaired an exciting workshop on HMAP in February 2000, has taken the lead in organizing the network of researchers and institutions that will conduct this part of the Census.

The history of marine animal populations is a blind spot in environmental history that the combined efforts of historians, paleo-ecologists, and ecosystem modelers can surely fill. We expect that the HMAP research during the next 5-10 years will lead not only to compilations of statistics but to the creation of beautiful visualizations of the marine environment in earlier historical times. Imagine the visual re-creation of marine life as it may have existed centuries ago in the Bay of Naples or in Tokyo Bay. As an American, I would love to have a picture of the life in Massachusetts Bay around the year 1620 when the English settlers came. Exhibits about the history of marine animal populations could be inspiring and influential, for example, in considering goals for Marine Protected Areas. I find the reconstruction of the oceans before fishing, or what we might call the primal ocean, one of the most exciting parts of the Census.

The present component of the program, addressing what now lives in the oceans, involves new field programs. The Steering Committee believes that about half a dozen pilot programs are needed to demonstrate that new technologies can make synoptic and synchronous measures of large ocean areas. These pilot programs need to address diverse marine environments. Pilot programs now under development address

a) the Gulf of Maine & Georges Bank (<http://www.whoi.edu/marinecensus/>). This area is of course one of the world's most historic fisheries. Much surveying has been done in this region. Remarkably, we really do not know if we have the numbers right, so the region provides an excellent chance for the demonstration and calibration and integration of new technologies, including sonars of various kinds as well as new optical devices.

b) the Mid-Atlantic Ridge and overlying deep water. These areas exemplify the vast largely unexplored areas of the open ocean, and the technological challenges to see deep and far.

c) vent and seep communities on the bottom of the North Atlantic. Studies to date have examined only a few such communities and tended to focus on a tiny area, say, a few square meters. Big questions pertain to the numbers and distribution and diversity of these communities.

d) Pacific populations of large pelagic species, including tunas, whales, seals, and sharks. We are here in Monterey to explore a tremendously exciting opportunity to describe what must live in the ocean at several trophic levels based on obtaining a much more reliable and complete view of life at the top of the food chain.

e) North Pacific and Gulf of Alaska salmon populations. Remarkably, it is still largely unknown where salmon go when they leave their rivers. This pilot project is a cousin of the study of pelagics in the open ocean of the Pacific, and like it will rely heavily on tagging technologies, and the revolutions in miniaturization and data storage that microchips have brought.

f) diversity of near shore populations in the Western Pacific. A classic yet unanswered question is how marine biological diversity changes with latitudinal gradient. Steering Committee member Yoshihisa Shirayama is leading an effort to answer this question with strict survey protocols that would describe populations from the Bering Sea to New Zealand.

Eventually, there may be 30-40 field programs in diverse parts of the world oceans, which, taken together, will form the Census and vastly improve our knowledge of the diversity, distribution, and abundance of present marine life. The selection of the field programs must rely on an improved biogeography or stratification of the oceans on which scientists are now also working. Obviously, the gaining of commitments, financial and political, to conduct the field programs is the biggest step to make the Census a reality.

The prospective portion of the program, addressing what will live in the oceans, requires improved models of ecosystems dynamics, attentive both to trophic levels and questions at the species level. It is important to note that such models can, in principle, work both backward and forward in time. With appropriate data, they can help fill in the picture of what did live in the oceans as well as what will live in the oceans.

A requirement for the CoML is an improved system for absorbing, integrating, and accessing data about life in the oceans. Already we are working to create an Ocean Biogeographical Information System (OBIS). The idea of OBIS is that anyone anywhere at a computer can click on an area on a map of the oceans and bring up information on what has been reported to live there. The CoML may be said to have begun in a formal sense with the announcement in May 2000 of eight grants totaling about 4 million US\$ to create the OBIS, as reported in *Science* magazine, 2 June.

The grants, made by the Sloan Foundation in partnership with the US National Science Foundation, Office of Naval Research (ONR), and other organizations belonging to the US National Ocean Partnership Program involve researchers in more than 60 institutions in 15 countries. The idea is to evolve OBIS cooperatively, worldwide. OBIS will be a distributed system, a system of systems, also integrating and linking to geo-referenced databases for ocean optics and other physical, chemical, and geological parameters. The initial OBIS grants address overall system architecture as well as 5 species groups: fishes, cephalopods, gelatinous zooplankton, mollusks, and corals and anemones. OBIS aims to include all species groups. A September 2000 conference brought together all the initial grantees as well as other interested parties to share information and plans and to agree on how to manage development of the system.

A potentially important partner in the Census is the Global Biodiversity Information Facility (GBIF). The GBIF was in June 1999 in Paris by 29 ministers of science or similar governmental leaders meeting in the Global Science Forum affiliated with Organization for Economic

Cooperation and Development. The GBIF is expected to begin its operations early in 2001. Most preparatory activities for GBIF concerned terrestrial ecosystems. The CoML can form the major marine component of the GBIF. In the US, the Census has already been invited to be the marine part of the US affiliate of GBIF, the US National Biological Information Infrastructure.

The Steering Committee estimates the Census as a whole will require 10 years and a total of about \$1 billion US\$. In an international scientific program of this type, about half of this amount would typically come from US sources, public and private. The main cost of the program will be the field projects, which are likely to cost about \$5-\$25 million each. While Sloan and other private funders can catalyze the Census, most of the support will need to come from government agencies concerned with science, with fisheries, and with environment, as well as organizations such as the World Bank dedicated to capacity building in developing countries as well as with implementation of agreements such as the Convention on Biodiversity.

Planning and development for the Census will require about two more years. Pilot field projects should take place in 2002-2004. The main field projects should occur in 2005-2007. Analysis and integration of information should culminate in 2008-2010.

The direct goals of CoML are to create the historical data base on marine animal populations and a much more complete present picture. However, a census is most valuable when it is repeated. In this regard, we are paying careful attention to the relation of the CoML to the proposed Global Ocean Observing System (GOOS), that sponsors hope will become operational over the next 1-2 decades. The CoML can help bring the living marine resources component of GOOS into existence. The Census can help determine the design specifications for parts of GOOS and demonstrate its value.

Management of the CoML is centered on the International Scientific Steering Committee chaired by Frederick Grassle, director of the Institute of Marine and Coastal Sciences at Rutgers University. Dr. Grassle was the first biologist to explore the hydrothermal vents off the Galapagos Islands. The Census Secretariat, led by Dr. Cynthia Decker, is housed at the Consortium for Oceanographic Research and Education in Washington DC. The Steering Committee has met 5 times since its formation in June of 1999. The CoML website <http://www.coml.org> describes the program and also, by the way, contains a job advertisement for a distinguished senior scientist to join the program in a leading capacity. The job should be one of the most exciting in marine science in the coming decade.

Both individuals and institutions are critical for the success of the Census. I do want to note that the CoML does not require the creation of *new* institutions. In contrast, the success of the CoML depends on continuing, strong partnerships with organizations such as the International Council for the Exploration of the Seas (ICES), the Pacific International Council for the Exploration of the Seas (PICES), DIVERSITAS, the fisheries branch of the Food and Agriculture Organization of the UN, and the Intergovernmental Oceanographic Commission. PICES has formed a working group on the Census, as has the Scientific Committee on Oceanographic Research (SCOR). The SCOR working group, chaired by Canadian acoustician and Steering Committee member David Farmer, focuses on new technologies for the observation of marine life and their transition into

practice. Such technologies, and the Census in general, require close partnership between national fisheries agencies and oceanographic research institutions.

The Census also requires the contributions of marine laboratories and museums of natural history, repositories of much of our knowledge of marine biodiversity. At the instigation of Annelies Pierrot-Bults of the Zoological Museum of Amsterdam, more than a dozen such institutions participated in a meeting 15-17 November at the Institute of Marine Biology of Crete to explore their roles in the Census, and their goals for it.

What about the roles of aquariums, where we now meet. Aquariums can do much for the Census. An early role for aquariums can be to make the plans and goals of the Census known to their many visitors and thus to help build the public support that will assure continuing broad political and financial support for the Census. A second role, later, can be to help share the discoveries and findings of the Census. A third role is direct participation in the design and conduct of the field research.

This meeting is a crucial step in developing the Census. Your skills and resources can make the Census of Marine Life become one of the great scientific and educational adventures of the next decade. I know Barbara Block, George Boehlert, Dan Costa, and others among you are prepared to do the hard work to make the Pacific Pelagic pilot project happen. If you do not do it, no one else will.

One of my favorite movies is Taxi Driver, starring Robert de Niro. At one point, de Niro, alone, is staring in the mirror and says "You talkin' to me? There ain't no one else here." If the world wanted to conduct the Census of Marine Life, it could not import experts from Neptune to do it. Nor is it possible to train quickly a whole new cohort of people with the needed skills. If the Census happens, it will happen because the present and emerging leaders of ocean science and technology come together creatively and choose to do it. The Census is you.

Thank you very much.