

**Marine Biodiversity in the Present:
The Known, Unknown and Unknowable
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**Conference Report, February 2003
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This interim report covers the recent activities of the Center for Marine Biodiversity and Conservation (CMBC) since the inception of funding in October 2002 by the Alfred P. Sloan Foundation KUU Program. Our shared goal is to explore what is known, unknown and unknowable about marine biodiversity – and the research and policy implications thereof – in a series of three conferences. In particular, we are interested in exploring strategies for addressing the limits to knowledge in the context of the Census of Marine Life (CoML) and other Sloan sponsored programs. Here, we report on the first of these three conferences as well as other activities of the CMBC, with comments on our progress.

Marine Biodiversity in the Present – KUU 2002

The first KUU conference, *Marine Biodiversity in the Present: the Known, Unknown and Unknowable*, was held 6-9 December 2002 at Scripps Institution of Oceanography. The goal of the conference was to explore the structure of knowledge about marine systems -- what we know, what we do not know, and why we do not know. A major contributor to the success of the conference was the diversity of over 200 participants, who represented a wide international mix of producers and users of knowledge (please see attached list of participants). Seventy percent of the participants were social, physical and biological scientists and 30% were professionals from government and non-governmental organizations, industry, media, education, legal and funding organizations.

The agenda featured five plenary addresses, which were open to the public, followed by a smaller gathering of invited participants who engaged in five half-day panel discussions focused on a series of questions (please see attached agenda). Our goal was to encourage dialog and generate discussion; we encouraged all speakers to be provocative and challenging. The questions posed to the panels were: (1) how much biodiversity exists in the oceans and what are the limits to knowledge? (2) How does marine ecosystem function change as biodiversity changes and how do the tools of science influence what is known and unknown? (3) What is the value of biodiversity and knowledge about biodiversity and what is the cost of not knowing? (4) What is the best approach for arresting and reversing biodiversity decline in light of what is known, unknown and unknowable? (5) The final panel considered these and other issues in the context of the Census of Marine Life. (The last of these provided a good introduction for the first meeting of the National Committee on the Census of Marine Life, which was hosted by CMBC immediately following the KUU meeting.) An additional session on

the evening of the second day, produced by filmmaker Randy Olson, considered: how can we communicate science in light of the known, unknown and unknowable? All panels included a moderator and three rapporteurs; one a panelist and the other two Scripps graduate students. The closing session (synthesis and wrap-up) included summary presentations by the graduate rapporteurs and closing remarks by Nancy Knowlton. The opening session and closing sessions were aired live on the CMBC website.

Several themes emerged from the conference. First, we do not know and may never know how much biodiversity exists in the oceans, nor are traditional methods of measuring biodiversity sufficient. The need to combine intensive data collection and catalogues with entirely new types of models was raised, as well as the possibility of using genomic methods of cataloging diversity. Second, there is an urgent need for “green accounting” (economic theory which integrates knowledge about natural dynamics and includes the economic value of dynamical stability), and data to support such accounting, which is largely lacking. The point was made that ecologists need to become involved with economists. Third, communicating the urgency of marine biodiversity issues to politicians was discussed as a general weakness of the marine conservation community. How to get the message out generated animated discussion in response to filmmaker Randy Olson’s video presentation on shifting baselines. Pros and cons ranged widely in discussion on the value of using entertainment media and of scientists becoming advocates. Fourth, several participants pointed out the lack of a clear message or action plan from the marine conservation community. In response, Nancy Knowlton suggested instituting a series of marine plots distributed around the world to conduct multidimensional geographically co-located studies of biodiversity (based on a terrestrial model of 50-hectare plots implemented by the Smithsonian Institution). Lastly, reiterations of the known, unknown and unknowable theme ranged from suggesting the “controlled and uncontrollable” as a more accurate reflection of the problem (Roughgarden); observing that the unknown leads to inertia (Miles); and pointing out that we currently know enough to act (Safina). Several stressed the importance of what “should we know” while others (mainly academics) emphasized that our explorations of the unknown and unknowable have and will lead to important discoveries and cannot be dismissed.

Several points were raised in reference to the Census of Marine Life. The importance of thinking globally, and acting globally, something that can be accomplished by federations of people acting locally, was emphasized in several presentations. The need to integrate these projects spanning wide spatial and temporal scales, across the whole food web and contemporaneous with oceanographic data was emphasized in discussion. Shirayama noted that the NaGISA members agreed to sample for 50-years which raised a collective “wow” from the audience. There was concern expressed over the veracity, accessibility and long-term viability of the data collected. Additional concerns were raised over voucher specimens, collection space and curation, and the need for young taxonomists. The speakers demonstrated that we have the minds and computing power to be able to tackle some of the most pressing problems of marine biodiversity and its decline. A marine counterpart to the National Center for Ecological Analysis and Synthesis (NCEAS) was suggested as a means of making the best use of the data collected.

Feedback from conference attendees was very positive, with comments such as: *Great job! You should feel proud to have assembled such an exciting group* (Stuart Pimm, Duke University)... *It was a great experience for me as a student--not only to hear what people had to say, but to see a whole host of different careers and the possibilities of what I can do once I leave the nest of SIO* (Lisa Munger, Scripps graduate student). We are especially pleased by the links that we heard were established between conference participants, since forging such links between people with different perspectives who do not ordinarily meet was a primary goal of the conference. John Gray (University of Oslo, Norway), for example, wrote: *Kerstin Johannesson* (Tjärnö Marine Biological Laboratory, Sweden) *and I are planning to promote a Skagerrak Centre for Marine Biodiversity between our respective institutions with the aim to provide the most comprehensive map of the biodiversity of anywhere in the world, from microorganisms to the landscape level ... the idea started from the inspiration from the meeting.* Bill Fox (NOAA-Fisheries) wrote *I arranged with Rainer Froese* (University of Kiel, Germany) *a project to make our fish stock survey data available as part of FishBase/OBIS. It is going forward as a pilot project with our Northeast Fisheries Science Center.* Links made among conference participants were both academic and applied. For example, Peter Halmay, a San Diego based fisherman linked up with Peggy Turk Boyer from the Intercultural Center for the Study of Deserts and Oceans (CEDO) in Puerto Peñasco, Sonora, Mexico and agreed to work with the local fishing community on techniques and marketing strategies.

We took special efforts to integrate graduate students in the conference. Nearly 40 graduate students from Scripps, UC San Diego, San Diego State, Boalt School of Law, University of Washington School of Law, and the Universidad Autónoma de Baja California attended the conference. All student costs were covered. We hosted a student poster session on Sunday and, on Monday, coordinated affiliation tables for graduate students and invited speakers on various subjects. Without a doubt, the graduate rapporteur presentations were one of the conference highlights. The students were synthetic, insightful and charged with energy. It is our hope that their ability to move easily between the social and natural sciences and to communicate these links is reflective of the intelligence and activism of a new generation of scientists.

In retrospect, it was more challenging than we anticipated addressing broad philosophical questions to such a diverse audience in a workshop setting. In particular, the tension between those wanting to acquire new knowledge and those wanting to use what we have made it impossible to come up with a clear outcome or action plan, which frustrated some participants. Also, most participants were unused to thinking about the unknown and especially the unknowable, and more creative ideas about new approaches (as exemplified by Barbara Block's plenary) would have been useful. In hindsight, the conference would likely have benefited from defining more focused questions, working with the moderators to keep the discussion centered on a single idea before moving on, and having fewer panelists with more time to speak. We plan to implement these changes in KUU 2003. This year, we were saddened that a plan to bring wildlife managers from developing nations fell through (due to budget difficulties at World Wildlife Fund) yet we plan to pursue this avenue for funding in the future. We also felt our use of the web for communicating the conference and proceedings fell short. In part, this was due to our newness to the medium and what airing live entails (such as staying on schedule). Next year,

we will work more closely with media services and the Scripps webmaster to advertise and have the conference available online in a user-friendly format. Lastly, we are currently working on a follow-up report to all conference participants and a short questionnaire: what did you like; what did you dislike; and what are you doing or thinking of differently after attending KUU 2002?

Products of the Conferences

We are pursuing three means of disseminating information about the conference: the CMBC website, the mass media and a peer-reviewed journal. The PowerPoint panel presentations are available on our website (<http://cmbc.ucsd.edu>). The opening and closing sessions are currently being edited for video archive. Natasha Loder has already discussed the microbial biodiversity issues raised by Farooq Azam in his plenary for *The Economist*, with other articles drawing on the conference expected; Antonio Solé-Cava, an invited participant from the Universidade Federal do Rio de Janeiro, submitted a piece for the Brazilian paper, *Jornal do Brasil*; and a local writer, Judith Garfield, has published an article entitled "Are our oceans worth saving?" in two local San Diego papers (the *La Jolla Village News* and the *Golden Triangle News*). In addition, Nancy Knowlton has written an eloquent thought piece on the conference and we are working with Nancy Baron of Seaweb on possible avenues for its publication (please see attached). Now that the dust has settled a bit, we will turn our efforts toward publishing in a peer-reviewed journal; currently we are considering a submission to the Perspectives section of Trends in Ecology and Evolution.

Marine Biodiversity in the (primarily recent) Past: KUU 2003

Plans are already underway for KUU 2003. Jeremy Jackson, Enric Sala and Sarah Mesnick will take the lead on planning the conference. We have chosen 14-17 November 2003 as the dates and we have tentative panel topics in hand. We will integrate the comments raised above regarding the structure of the panel sessions and will use our graduate students (who were widely praised in KUU 2002) throughout, including a panel seat where appropriate. We intend to enhance the session on communication and to engage more participation from the media (in collaboration with Nancy Baron). We also plan to involve more social scientists and historians of science in the panels. We are considering having one or more panels focus on the use of historic data in a single management problem (e.g., the use of historic whaling data by the International Whaling Commission or the archeological work by Jim Estes on the dynamics among sea otters and killer whales in the management of Stellar sea lions in Alaska). We anticipate KUU 2003 being about half the size of KUU 2002 due to the more limited number of scientists involved in marine history.

Other activities of the CMBC

CMBC is entering the New Year with several education initiatives planned or underway. We have been asked by the NSF to submit a full proposal to the Integrative Graduate Education and Research Traineeship (IGERT) Program following review of our preproposal submitted last fall. Lisa Shaffer has just finished a proposal for the establishment of a new program leading to a Master of Advanced Studies in Marine Biodiversity and Conservation (MAS-MBC) in cooperation with the

Division of Extended Studies and Public Programs at the University of California, San Diego. The second quarter of Lisa Shaffer's, *Marine Science, Law and Policy* course will be taught this winter. Sarah Mesnick will focus on formalizing the plan for Scripps CMBC students. We continue to struggle with the challenge of integrating the more interdisciplinary goals of CMBC with the high course load of the established Scripps curriculum and with how to support an applied component of graduate research within the Scripps educational system (for both students and faculty advisors).

CMBC is committed to communicating science and to facilitating the exchange of knowledge between scientists and the general public through workshops and our website. CMBC hosted two science-media workshops during the past three months: *Scientists are from Venus, Journalists are from Mars* in collaboration with Nancy Baron of Seaweb and *Marine Protected Areas: Fact, Fiction, Myths and Misconceptions* in collaboration with Ocean Wilderness Network, California SeaGrant, and COMPASS. We are also committed to strengthening our web presence during the next six months, before intensive 2003 conference preparation sets in.

CMBC is using its networking skills to host think tanks on topics related to marine biodiversity and conservation. CMBC teamed with Southwest Fisheries Science Center, NOAA-Fisheries and the International Whaling Commission to host the workshop, *Testing of Spatial Structure Models* (TOSSM) in January, and later in the year, we will be hosting a workshop on environmentally responsible whale watching in collaboration with the Oceans Blue Foundation.

**Biodiversity, Knowledge, and the Fate of the Oceans –
Passing the Baton**

Nancy Knowlton

Scientists rarely distinguish between the unknown and unknowable because the pursuit of either creates new knowledge, and possibilities are more inspirational than limitations. Yet more than a decade after the Rio Biodiversity Convention, marine biodiversity scientists who gathered recently to discuss what is known, unknown and unknowable¹ acknowledged that they will never be able to catalogue all of its species, just as nations cannot catalogue all of their citizens. The goal of attaining a complete understanding the roles and interactions of these species, both in terms of the natural and human economies of the planet, is even further out of reach. But we could (and should) know much more than we do.

Some of the limits have been technical – we have sensors that can measure temperature, salinity, currents and depth but automated biological sensors are largely limited to measuring chlorophyll. These limitations are disappearing, as the tools of genomics are applied in the ocean and the tools of informatics are developed to analyze complex assemblages of data. Some habitats, like the deep sea and open ocean, are simply difficult and thus expensive to reach. And the complexity of the webs of ocean life make prediction far more difficult than is commonly realized – predicting the weather is a far less daunting task.

Others obstacles have more to do with the sociology of science than the science itself. High tech routinely trumps basic natural history, and people who know how to identify and classify organisms are almost as endangered as many of the creatures they study. Surely, this must be the reason why our catalogue of stars in the universe is more complete than our catalogue of species on planet Earth (or more accurately, planet Ocean).

Unfortunately, the fate of life on our planet depends far more on what we know and do with that knowledge than does the fate of the stars. We have been slow to appreciate this for ocean life. Turtles hover on the brink of extinction, yet we only now are beginning to know where they go once they leave the beach. Coral reefs have declined dramatically over the last two decades worldwide, but our only estimates for the total number of species on reefs vary between one and ten million and are based on extrapolations from the numbers of insects in tropical rainforests and from counts from a tropical aquarium in Baltimore! Ongoing attempts to create a database for all of the oceans (e.g. the Census for Marine Life) will play an essential role in filling the knowledge gaps that plague our ability to document and cope with the threats to ocean life, but they are just beginning.

¹Marine Biodiversity in the Present: The Known, Unknown & Unknowable
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“A stitch in time saves nine” vs. “I’ll cross that bridge when I come to it”: why do we apply the precautionary principle when considering the structural viability of designs for bridges, but fail to do so when the viability of ecosystems is at stake? Underlying our tendency to gamble on nature’s resiliency is our fundamental ignorance not only about the biology, but also about the economic costs and benefits of taking vs. postponing action. When contemplating setting aside a marine protected area, we rapidly calculate the short-term costs to fishers affected by the action, but often lack information to fill in the

other parts of the equation, such as the long-term benefits that healthy oceans provide. We want our accountants to be “clean”, but still care little if they are “green”.

When faced with a problem of enormous complexity and scope, people’s reactions range from apathy to activism. Most activists are born young, but many generations have passed since major social movements completely captured the passions of the young. As marine scientists who have personally seen the massive changes that have occurred in the oceans, we are partly to blame. Fisheries and with them entire ecosystems are collapsing worldwide, yet the public continues to believe that oil pollution is the greatest threat to life in the oceans. To most policy-makers, biodiversity, if it means anything at all, is about tropical rainforests, not their ocean equivalent, the coral reefs, which are equally threatened. We are also partially to blame as educators, living within the ivory tower and disparaging the efforts of students to work on real-world problems. Potential Gandhi’s and Martin Luther King’s of the ocean are all around us - we need to answer your emails, give you the tools needed to solve problems, and reward you for doing what we have failed to do ourselves.