Coordinating workshop for "DNA Barcoding for CoML"

Workshop Venue
Royal Netherlands Academy of Arts and Sciences
Het Trippenhuis, Kloveniersburgwal 29
1011 JV Amsterdam, the Netherlands
Tel +31 (0)20-5510700; Fax +31 (0)20-6204941

Workshop Dates
15 – 17 May 2006

Workshop Local Host
Annelies Pierrot – Bults
Institute for Biodiversity and Ecosystems Dynamics
Zoological Museum, University of Amsterdam
P.O. Box 94766, 1090 GT Amsterdam
The Netherlands
Tel.. +31 (20) 525 7194; Fax +31 (20) 525 5402
Email: pierrot@science.uva.nl

Workshop Organizers

Ann Bucklin
Professor and Head, Department of Marine Sciences
Director, Marine Sciences and Technology Center
Tel. 860-405-9208; Fax 860-405-9153
Email: ann.bucklin@uconn.edu

Paul D.N. Hebert
Department of Integrative Biology
University of Guelph
Guelph, Ontario, Canada N1G 2W1
Phone: 519 824-4120, ext. 56668; Fax: 519 767-1656
E-mail : phebert@uoguelph.ca

Robert D. Ward
CSIRO Marine and Atmospheric Research
GPO Box 1538 (Castray Esplanade)
Hobart, Tasmania 7001, Australia
Tel: +61 3 6232 5370; Fax: +61 3 6232 5000
Email: Bob.Ward@csiro.au

Introduction

DNA barcodes are short regions of DNA sequence from a standard region of the genome that can be used to discover, characterize, and distinguish species. Launched in 2004, the Consortium for the Barcode of Life (CBOL, see http://barcoding.si.edu/) is an international initiative devoted to promoting the development of DNA barcodes as accurate and reliable tools for scientific research on the taxonomy of plant and animal species; practical, cost-effective tools for assigning unidentified specimens to their correct species; and a system for expanding interest and activity in taxonomy. CBOL has recently begun two major initiatives: All Birds Barcoding Initiative (ABBI, see http://barcoding.si.edu/AllBirds.htm) and the Fish Barcode of Life (FISH-BOL, see http://www.fishbol.org/). DNA barcodes can be used for accurate estimation of species diversity across many animal groups. DNA sequence data can also be used to assess microbial diversity, although the lack of a species concept, as such, changes the nature of the questions that may be addressed.

Usefulness of DNA Barcoding for CoML

DNA barcoding of marine species will help address the second grand challenge of the Census of Marine Life (CoML), "What lives in the ocean now?" DNA barcoding of CoML specimens will provide immediately useful results and will have long-term applications for CoML investigators and the general scientific community. CoML has estimated that as many as 5,000 fish species may be undiscovered, and CoML discoveries include a new cetacean and gigantic cephalopod species. However, most of the new discoveries are likely to come at the other end of the size spectrum. DNA barcoding may be particularly useful for assessing diversity of small animals and microbes in the ocean, for which diagnostic morphological characters may be subtle or lacking. In turn, the phylogenetic diversity of marine life – including microbial and animal life – will allow examination of the broad applicability and validity of DNA barcoding for biodiversity studies.

All of the ten reasons (see http://barcoding.si.edu/) given by CBOL organizers for DNA barcoding apply to CoML:

1. DNA barcodes can identify species from bits and pieces;
2. DNA barcodes can identify species in any of its life stages;

3. Barcodes can distinguish among species that have no diagnostic morphological characters, enabling a more accurate view of biodiversity;
4. A library of digital barcodes will provide an unambiguous reference to facilitate identifying species;
5. DNA barcodes can speed identification of known organisms and facilitate rapid recognition of new species;
6. A standardized library of barcodes will empower many more people to call by name the species around them;
7. DNA barcodes will lead to development of portable devices for field identification of species;
8. DNA barcodes can help indicate the taxonomic affiliations of newly discovered species;
9. DNA barcodes will demonstrate the value of museum collections and archives; and
10. DNA barcodes will enhance public access to biological knowledge.

A CoML DNA barcoding protocol (including guidelines for specimen preservation and labeling, DNA isolation, gene targets, and databasing results) was prepared some time ago (see http://www.coreocean.org/Dev2Go.web?id=255158). The goal at that time was to encourage CoML investigators to determine DNA barcodes of collected specimens. Now, more strenuous efforts toward standardization and coordination of data collection are needed to speed progress in DNA barcoding of marine species, in order to be consistent with CoML program goals for 2007 and 2010.

Preliminary assessment of the likely relevance of DNA barcoding for CoML field projects suggests that many, if not all, would benefit from this initiative (Table 1). In addition, we would seek direct participation from OBIS (Ocean Biogeographical Information System), to ensure integration of all information, including DNA sequence data, relating to CoML specimens and collections.

Goals and Objectives of the Workshop

The primary objectives of the "DNA Barcoding for CoML" workshop are: 1) to coordinate and standardize DNA barcoding efforts that are ongoing as part of CoML projects, and 2) to produce a set of documents that describe plans, policies, and protocols for DNA

barcoding by all relevant CoML projects and programs. The ultimate goal of the CoML barcoding initiative will be to establish a public archive of DNA barcodes linked to voucher specimens (or voucher DNA) for the species of marine life that are being identified or newly described, counted, and analyzed as part of the global CoML effort.

Table 1. CoML field projects, project leaders, and likely relevance for DNA barcoding.

CoML Field Project	**Project Leaders**	**Relevance of DNA Barcoding**	**Participation in DNA Barcoding Workshop**
ArcOD	R. Gradinger, R. Hopcroft, B. Bluhm	High	Agreed to participate
CAML	M. Stoddart, C. Summerhayes	High	Agreed to participate
CeDAMAR	P. Martínez Arbizu, C.R. Smith	High	Org. Comm. Member
ChEss	P.A. Tyler, C.R. German	High	Agreed to participate
CenSeam	M. Clark, A. Rowden, K. Stocks	High	
CMarZ	A. Bucklin, S. Nishida, S. Schiel	High	Org. Comm. Member
CoMargE	M. Sibuet, L. Levin, et al.	Medium	
CReefs	N. Knowlton, J. Caley, R.E. Brainard	High	Org. Comm. Member
GoMA	E. Richert, L. Incze	High	Agreed to participate
IcoMM	M.L. Sogin, J.W. de Leeuw	High	Org. Comm. Member
MAR-ECO	O.A. Bergstad	High	Org. Comm. Member
NaGISA	Y. Shirayama, B. Konar	Medium	Agreed to participate
POST	D. Welch	Uncertain	
TOPP	B. Block, D. Costa, R.E. Kochevar	Uncertain	

Workshop Organization and Duration

The "DNA Barcoding for CoML" workshop will be modeled on the successful FISH-BOL conference, held in June 2005 and co-chaired by Paul Hebert and Bob Ward. Similar to the FISH-BOL conference, this CoML workshop will be 3 days long, and will include public presentations, plenary discussions sessions, and meetings of special-focus groups for detailed planning (see draft agenda, Appendix I). Should funding be available, we will seek to invite graduate students to participate as observers in the workshop, and will include special student poster and discussion sessions during the workshop. The public presentations will be designed for an audience of ~200 people; the workshop itself will involve about 50 participants.

The public symposium will be held during the first day. Presentations will be targeted for a general scientific audience and topics will include a broad overview of the goals of DNA barcoding and descriptions of progress to date in several areas, including e.g., microbes, corals, zooplankton, fish, mammals, and/or particular marine habitats. The presentations will be designed to stimulate interest and participation by the marine ecological and systematic communities, but will also be understandable for teachers, students, science writers, etc.

There will be two non-overlapping sets of small group discussions: one organized by taxonomic groups and one organized by issues. For the taxon-specific sessions, we will cover bacteria to marine vertebrates, with special sessions for prokaryotes, protists, meiofauna, and macrofauna. The discussions will consider how to design or adapt protocols and procedures of DNA barcoding to the different organisms, being careful to include so-called "minor" groups of protists and invertebrates, which may not have economic or social importance, but are important components of marine biodiversity.

For the discussion groups focused on issues, we will seek to address a variety of topics, including approaches to specimen collection, use of museum specimens, meeting the need for expert taxonomic identification, selection of genes for barcodes, required data and information for DNA databases, quality control, etc.

The final sessions of the workshop will include plenary discussions to address practical issues for DNA barcoding for CoML: description of realistic goals, timelines, resources available, additional resources needed, etc.

Workshop Participants

The public symposium will be advertised and announced to research institutions and universities in the surrounding area and to the international CoML community. Audience size can be 200 – 250. Talks are to be targeted to the educated, interested non-specialist. Symposium presentation will include up to 5 of among the following:

1. DNA Barcoding in Broad View
2. CBOL perspective
3. CoML field projects
4. Technology / techniques from outside CoML / CBOL communities
5. Partner organizations
6. Capacity development in developing countries
7. Potential customers or end-users: Large Marine Ecosystem; Invasive Species detection.

The number of workshop invited participants (~50) is designed to be large enough to include programmatic, taxonomic, and technical expertise from diverse regions of the world needed to meet the workshop goals, but also to be small enough to produce tangible results in terms of an implementation plan with useful information and detailed protocols. Representatives from all CoML ocean realm field projects, CoML core activities (HMAP, FMAP, OBIS), the CoML Scientific Steering Committee, and CoML secretariat will be invited and encouraged to participate. Additional members will be added as needed to ensure diversity in terms of geography, knowledge, and expertise. Thus, we will seek participants from the CoML community with expertise in population genetics, molecular systematics, morphological taxonomy, bioinformatics, database management, archiving of museum collections, etc.

Participants will also be invited who can represent international programs and projects with missions and goals in common with CoML. The Organizing Committee will discuss strategic approaches to the selection of potential partners. Possible programs include DIVERSITAS, the IGBP/SCOR program IMBER (Integrated Marine Biogeochemistry and Ecosystem Research), and others. Possible organizations include IOC (Intergovernmental Oceanographic Commission), IAPSO (International Association for the Physical Sciences of the Ocean), and IABO (International Association for Biological Oceanography).

Workshop Venue

The workshop will be held at the Royal Netherlands Academy of Arts and Sciences, Amsterdam, the Netherlands (see http://www.knaw.nl). Annelies Pierrot-Bults (University of Amsterdam and a CMarZ Steering Group member) will serve as the local host. This venue will provide an auditorium for 200 people, meeting room for 50 people, and break-out rooms as desired.

Workshop Dates

The workshop will take place during May 15 – 17, 2005. The meeting will begin at 1:00 pm on the first day (May 15th) with a public symposium. The Organizing Committee will remain an extra day to finalize the workshop report and other documents.

Workshop Products

The primary product of the workshop will be an implementation plan, which will describe in practical terms how to coordinate DNA barcoding of the marine animals and microbes that are the focus of on-going CoML activities, including especially the ocean realm field projects. Questions to be addressed include: 1) what is the scope of the effort of DNA barcoding for CoML projects in terms of numbers of species and DNA sequences; 2) to what extent are specimens available for DNA barcoding (i.e., identified and properly archived); 3) what groups will be 'missed' by CoML field projects; 4) do CoML projects in aggregate currently have sufficient technical expertise and facilities to carry out DNA barcoding; 5) what additional resources (e.g., time and money) and other types of resources (e.g., taxonomic experts for species identifications) will be needed for the CoML DNA barcoding effort?

The implementation plan will include a detailed set of field, laboratory, and computer protocols to be used as a guidebook for the standardization of DNA barcoding by CoML projects. The guidelines will be entirely consistent with CBOL policies, procedures, and protocols, including: collection, preservation, and vouchering of specimens; molecular analysis and DNA sequencing; selection of genes for DNA barcoding; quality control of data; and database management. Database management issues will specifically address integration with OBIS (Ocean Biogeographic Information System) and the new DNA barcoding section of GenBank.

An important contribution of the implementation plan will be to provide a summary of existing DNA barcode data for marine species, available in GenBank or BOLD (the Barcode of Life Database). This 'baseline' summary may suggest ways to filter or re-organize BOLD as a resource for the CoML DNA barcoding effort.

The implementation plan will describe realistic, quantifiable goals for DNA barcoding of marine species (in terms of numbers of marine groups, species, and specimens barcoded) by 2007 and 2010, the critical dates for the CoML program as a whole. Careful consideration will be given to how DNA barcoding can best contribute toward the overall CoML program goals, as well as any other new information and understanding which may be result from analysis of the CoML DNA barcode data.

The implementation plan will also provide a basis for proposals for additional funding to agencies and foundations to secure additional financial and programmatic support the CoML barcoding effort.

An additional workshop product will be a publishable paper or report, written for the broader marine biology and biological oceanography community, explaining the scientific rationale for DNA barcoding and the likely contributions for understanding global patterns of marine biodiversity. The publication would be designed to draw additional practitioners into the effort, to speed to acquisition of the DNA barcode data.

During the workshop, a DNA barcoding for CoML coordinating committee will be named, whose members will be responsible for finalizing the workshop report, implementation plan, and scientific publication. The coordinating committee will be the driving force behind implementation of the project as defined by these documents.

Sources of Funding

Following the workshop, we will distribute the "DNA Barcoding for CoML" implementation plan to program managers for private, national, and regional funding agencies. We will prepare targeted proposals as appropriate. We will seek to partner with organizations with related or synergistic mission areas. For example, we will approach SCOR for partnership opportunities with the SCOR Panel on New Technologies for Observing Marine Life and other SCOR working groups. Funding from national funding agencies (including the US NSF) will be requested to support student travel.

Planning Timeline

A planning meeting was held prior to the CoML All-Program meeting, on November 2nd, 2005 in Frankfurt, Germany. The planning meeting generate a final draft of the workshop agenda, definitive plans for workshop dates and venue, a selection of possible speakers for the public symposium, and a list of people to be invited to the workshop. The workshop venuw has been reserved for the dates indicated. Invitations to workshop participants will be sent via email during November and December. The workshop organizing committee will meet again as opportunity allows (e.g., at the AGU/ASLO Ocean Sciences meeting) at the participants' expense, but additional planning will be done largely by email and telephone.

Appendix I. Draft Workshop Agenda

Day 1 / May 10. Public symposium (35 minute talks + 10 minutes questions)

1:00 pm	Welcome by CoML and CBOL representatives, local official
1:30 pm	Talk #1
2:15 pm	Talk #2
3:00 pm	Talk #3
3:45 pm	Coffee Break
4:15 pm	Talk #4
5:00 pm	Talk #5
5:45 pm	Summary
6:00 pm	Adjourn
6:15 pm	Reception

Day 2 / May 11

9:00 am	Plenary discussion session (Moderator TBN) - Needs and opportunities - Scope of effort (time and money)
12:00 noon	Lunch
1:00 pm	Working Groups on Taxonomic Groups (Chairs and Rapporteurs TBN) - 1. Viruses, microbes, and protists - 2. Meiofauna (infaunal) - 3. Mesofauna (invertebrates) - 4. Megafauna (vertebrates)
3:00 pm	Coffee break
3:30 pm	Plenary session (Moderator TBN) - Working group reports - General discussion on taxon-specific issues - Collection, preservation, vouchering, which gene, etc
5:30 pm	Adjourn

Day 3 / May 12

9:00 am	Plenary discussion session (Moderator TBN)
10:00 am	Working Groups on Major Issues (select only 4) - 1. Database and data management needs - 2. Specimen and materials handling - 3. Capacity development: training workshops, student exchanges - 4. Molecular protocols - 5. Use of museum specimens; formalin preservation - 6. Implementation: sequencing centers, at-sea sequencing
12:00 noon	Lunch

Draft Workshop agenda (Continued)

Day 3 / May 12

1:00 pm Panel discussion by DNA barcode customers (Moderator TBN)
- Invasive species/ports/ballast water inspectors
- Fisheries managers, bycatch detection
- Seafood labeling for enforcement, endangered species
- Mining / environmental impact (e.g., Internat. Seabed Authority)
- Human health, pathogen detection
  (e.g., Centers for Oceans and Humans Health, NIH/NSF)

3:00 pm Coffee Break

3:30 pm Plenary discussion (Moderator TBN)
- Working Group reports
- Funding strategies
- Next steps

5:00 pm Adjourn