

Intergovernmental Oceanographic Commission

Workshop Report No.

IOC Workshop on

The Census of Marine Life in South East Asia

Phuket, Thailand

10-12 October 2001

This workshop was co-sponsored by the Census of Marine Life

UNESCO

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ABSTRACT

This report describes the outcome of a workshop held in Phuket, Thailand, 10-12 October 2002, with the purpose of introducing the Census of Marine Life to scientists of Southeast Asia. The Census of Marine Life is an emerging international program for research to assess and explain the diversity, distribution, and abundance of marine organisms throughout the world's oceans. The specific objectives of the workshop were (i) to brief regional experts on the goals, objectives and activities of the CoML; (ii) to review the status of marine biodiversity data collection, analysis, communication and use in Southeast Asia; and (iii) to explore needs and opportunities for additional linkages and mechanisms, including pilot projects, by which to gather, communicate and use information on marine biodiversity in Southeast Asia and the role CoML can play in that process. The workshop produced a consensus statement on the future elaboration of two possible follow-up projects. those being: (i) a History of Marine Animal Populations (HMAP) project to explore historic populations in the region., and (ii) a field research project to characterize the coral reef and seagrass communities in the region and improve the regional knowledge and information base to enhance the effectiveness of assessments of national marine biodiversity and genetic resources.

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PREFACE

The Census of Marine Life is an emerging international program for research to assess and explain the diversity, distribution, and abundance of marine organisms throughout the world's oceans. The IOC and the Census of Marine Life (CoML hereafter) have joined hands to expand the activities of the CoML to the Southeast Asian region, and to this end, jointly organized a workshop with the participation of both regional as well as overseas experts.

The IOC-Census of Marine Life Workshop on Marine Biodiversity in Southeast Asia was held 10-12 October 2001 in Phuket, Thailand. The workshop was convened and sponsored by the Intergovernmental Oceanographic Commission (IOC) and hosted by the Phuket Marine Biological Centre. Mr. Maarten Kuijper (IOC), Dr. Ned Cyr (IOC/NOAA), and Dr. Cynthia Decker, (Consortium for Ocean Research and Education) jointly chaired the meeting.

The workshop included 46 participants from 13 different countries. The participants from the countries in the Southeast Asian region and Australia were invited to prepare background papers that illustrated the status of marine biodiversity data collection and research in their respective countries (these papers are included in the CD-Rom enclosed in the back cover or alternatively available upon request from the IOC/WESTPAC Secretariat). A number of additional resource persons were invited who provided introductions to specific topics. The presenters of these papers also served as facilitators during the workshop in the formulation of specific project ideas.

The objectives of the workshop were:

1. to brief regional experts on the goals, objectives and activities of the CoML.
2. to review the status of marine biodiversity data collection, analysis, communication and use in Southeast Asia.
3. to explore needs and opportunities for additional linkages and mechanisms, including pilot projects, by which to gather, communicate and use information on marine biodiversity in Southeast Asia and the role CoML can play in that process.

The workshop was organized in three parts.

1. Opening and Introductory presentations
2. National presentations on Marine Biodiversity Data Collection and Research
3. Working group discussions and plenary on possible Southeast Asian CoML pilot project in three fields: (i) History of Marine Animal Populations; (ii) Use of new technologies; and (iii) Marine Biodiversity Survey

The workshop produced a consensus statement on the future elaboration of two possible follow-up projects.

1. OPENING OF THE MEETING

On behalf of the Executive Secretary of the IOC, Dr. Patricio Bernal, Mr. Maarten Kuijper, welcomed all participants and thanked them for their contributions to date. He also thanked the local organizer for the excellent arrangements and expressed his hope that the ambience of the Phuket Marine Biological Center would prove conducive to a successful meeting. The IOC has set itself an ambitious mission: the development of a knowledge and information base for the sustainable use of the oceans. This is particularly challenging in the field of marine biodiversity in Southeast Asia, where one finds not only the highest diversity but also some of the greatest pressures. In this respect, the Census of Marine Life initiative, in which the IOC participates as member of the Steering Committee, offers an unique opportunity under which to develop a multi-year program that will enhance the region's capability in assessing and explaining the rich marine biodiversity. In the present workshop, the participants are invited to explore the possibilities of establishing a joint research program in Southeast Asia with due attention to the region's needs and current capabilities.

Mr. Praween Limpsaichol, Director of the Phuket Marine Biological Center welcomed all the participants to his center. He briefly introduced the scope of work carried out at the center, which acts as one of the principal research facilities for the Thai Department of Fisheries. The center has a special department devoted to marine biodiversity research and further harbors the country's reference collection for marine species. He concluded the welcoming address by wishing all the participants a pleasant stay in Phuket.

Mr. Niran Kalayanamit, Vice Governor of Phuket Province gave the final welcoming address and emphasized the importance of the marine and coastal biodiversity to the province's tourism industry. He further invited all the participants to savor the beauty of the island during their stay.

2. INTRODUCTORY PRESENTATIONS

2.1. INTRODUCTION TO THE CENSUS OF MARINE LIFE (COML)

Dr. Cynthia J. Decker, Consortium for Oceanographic Research and Education, Washington, DC

Biological organisms are incredibly diverse and abundant throughout the oceans but much less is known about these communities than almost any other part of the planet. For this reason, we cannot hope to understand the impact that humans have on the global oceans without knowing what organisms live where and how they interact on a species level. The United Nations Convention on Biological Diversity demonstrates that many nations have come to understand the importance of conserving the variety of life in the world. Large efforts are underway globally to manage failing fisheries and many nations are trying to preserve their ocean habitats by establishing marine protected areas. At the same time, the impacts of pollution and human alteration of the environment are being evaluated, including the increasing occurrence of harmful algal blooms and invasive species.

As these new questions emerge about ecosystems and human impacts on the ocean, new technologies are being developed that allow many areas of the ocean to be observed or sampled in ways that they never have been before. These new systems range from electronic systems for managing huge volumes of digital data to new acoustic and optical sensors to remotely-operated platforms such as satellites and autonomous underwater vehicles. In this new era of concern for the oceans and improved technology to sample the environment and analyze the data, scientists in many nations have come to recognize that now is the time for a new initiative to examine species in the oceans.

The Census of Marine Life (CoML) is an exciting new international research program that will assess and explain the diversity, distribution, and abundance of organisms throughout the world's oceans (<http://www.coml.org>). Over the next ten years, this program will develop collaborative research projects around the world to study marine species in many habitats, both coastal and deep-water. The CoML will be a program of new field projects that also expects to work closely with existing marine research programs such as BIOMARE, a European biodiversity initiative, and GLOBEC, a worldwide program to examine the effects of climate change on ecosystems.

CoML seeks to understand the role of diversity not only in the oceans of today but also in the past, through retrospective analyses, and in the future, through conceptual and numerical ecosystem models. The CoML program is proceeding rapidly in these areas. The program is developing a Scientific Strategy that will guide and focus the entire research program. This Strategy will be ready for review by the scientific community and others at the end of 2001.

At the same time, the program has catalyzed financial support for the development of the Ocean Biogeographical Information System (OBIS), a distributed database system that will allow researchers to use many different datasets to create visualizations of the distribution and abundance of organisms together with physical and chemical parameters in three dimensions.

CoML is also supporting a historical component, the History of Marine Animal Populations (HMAP). This program is comprised of research collaborations between marine biologists and environmental historians to study marine communities 500-1000 years in the past, at a time when humans became significant predators in the

ocean.

To facilitate the development of a full suite of research projects, the CoML is starting six initial field projects that will demonstrate the use of innovative techniques or technologies that can be applied to future studies. One such project is a coastal survey of selected taxa in the western Pacific from the northern to southern boreal regions using low-cost sampling methods. This project is sponsored under the Diversitas in the Western Pacific Area (DIWPA) program and will involve the establishment of reference sites in nearshore areas from Russia through Japan, Korea, China, the Philippines, Indonesia, Malaysia, Thailand, and Australia.

Other pilots involve the electronic tagging of large predators and salmon in the Pacific, a series of studies in the mesopelagic and epibenthic zones along the mid-Atlantic Ridge, a study of the different habitats in the Gulf of Maine, NW Atlantic to explore the diversity of that presumably well-studied area using some innovative acoustic and other sampling methods, and a biogeographical exploration of hydrothermal vent and cold seep habitats in the Atlantic and Arctic Oceans.

The Census of Marine Life has become involved in a number of activities to foster support of the program in existing organization. Some examples of these are the North Pacific Marine Science Association (PICES) and the Food and Agricultural Organization of the United Nations.

CoML also convened a workshop in November 2000 that brought together scientists from natural history museums and marine laboratory networks from around the world to better define how CoML can work with these institutions to develop the best research plan. Although it was expected that these individuals would have many common research interests, it soon became clear that they actually represent two different kinds of science. Museums were represented primarily by systematists and evolutionary biologists, whose primary interests are in understanding the complete range of life in any environment such that they focus as much on the rare as the well-known species. The interests of marine lab scientists tend to be ecological, seeking to understand the functioning of an environment such that they focus on fewer species, those that are dominant numerically or in biomass. These fundamental differences often result in very few true collaborative research projects between the two kinds of scientists.

At this workshop, groups of people from both institutions convened to design projects of interest to both. Two of the three groups designed projects to be carried out in the Indonesia/ Malaysia/ Philippines triangle because of the high diversity of both species and habitats and the lack of understanding of these systems. Thus, it became clear that the Census of Marine Life must focus some of its efforts on developing projects in this region of the world. The results of this effort with museums and marine labs was the beginning of an idea to hold a workshop in Southeast Asia (Southwest Pacific) and try to bring together scientists working this region to design projects of interest to the Census of Marine Life, the governments in this region, and other organizations.

The existence of the DIWPA project in this region as part of the CoML that could be expanded into other areas of the Pacific was the other significant factor that caused the Census of Marine Life to consider a specific effort in this region of the world. When the Intergovernmental Oceanographic Commission of UNESCO showed interest in organizing a workshop to address this, the Census of Marine Life agreed to sponsor the workshop. It is the hope of the CoML program that this workshop will mark the beginning of a significant research program over the next ten years on marine biodiversity in Southeast Asia and the southwest Pacific.

2.2 HISTORY OF MARINE ANIMAL POPULATIONS (HMAP)

Dr. Andrew Rosenberg, University of New Hampshire, Dean of Life Sciences

The History of Marine Animal Populations (HMAP) is part of the Census of Marine Life. HMAP is a new interdisciplinary research program that combines classic historical research with marine ecological and environmental archives to examine the history of marine communities. HMAP is founded on the concept that contemporary scientists can better understand present-day population dynamics if they have a satisfactory understanding of historical populations. HMAP aims to improve our understanding of long-term marine ecosystem change, and especially of the human role in affecting such change through activities such as

commercial fishing.

Seven initial case studies, encompassing fisheries and ecosystems that are rich in historical documentation, have been identified for pilot projects in an initial two-year period. Involving both scientists and historians in numerous institutions around the world, the teams responsible for each study will assemble time series, test ecological hypotheses, and establish a framework to train specialists in the emerging disciplines of marine environmental history and historical ecology. The output of these studies will enable fisheries managers to understand more about natural fluctuations in marine populations and how human activities interact with this through harvesting and pollution.

The case studies are:

1. Northwest Atlantic (Gulf of Maine, Newfoundland-Grand Banks, Greenland)
2. Southwest Pacific (Southeast Australian Shelf and Slope)
3. White and Barents Sea (Russian and Norwegian herring, salmon and cod fisheries)
4. Norwegian, North and Baltic Seas (multinational cod, herring and plaice fisheries)
5. Southwest African Shelf (Benguela current system)
6. Worldwide Whaling (all the world's oceans)
7. California Current (continental boundary current system)

These cases studies were chosen because they represent exploited ecosystems where sufficient historical data exists and current ecological understanding is sufficient to detect changes in ecosystem structure and function. These proposals can be found at: www.cmrh.dk/hmapindx.html.

The HMAP steering committee includes:

Paul Holm, Southern Denmark University
Tim Smith, U.S. National Marine Fisheries Service
David J. Starkey, University of Hull
Robert C Francis, University of Washington
Andy Rosenberg, University of New Hampshire

2.3 COASTAL SURVEY OF THE WESTERN PACIFIC

Dr. Yoshihisa Shirayama, Seto Marine Biological Laboratory, Kyoto University, Japan

Dr. Cynthia Decker already briefly alluded to the DIWPA project as one of the field projects under the CoML. The aim of this study is to determine and compare the diversity of macrophyte assemblages along a latitudinal transect in the Western Pacific ranging from 50°N and 50°S. The idea for the study stems from an effort to determine the diversity of forests along a similar gradient in forest ecosystems.

Core sites will be identified in each of the participating countries that will meet certain criteria: (i) be relatively pristine (according to the definition adopted by MARS); (ii) be protected by law; (iii) possess 'homogenous' macroalgae-hard and/or seagrass-soft substratum habitats with a shoreline extent of 20-200m; (iv) be proximal to laboratory facilities; and (v) have previously been studied to the extent that background environmental information is available for compilation. At each study site a stratified random sampling strategy will be employed, with samples taken both by non-destructive and destructive methods, targeting animals and macrophytes of above 2 cm and 1 mm in size respectively. Meiofauna larger than 63 micron shall also be retained in the latter methods. It is envisaged that core sites will be annually monitored for a long period of time. The sampling programme at each study site should take place at least once a year, during the period of expected highest diversity, and commence by the end of 2002.

Another objective of the project is to train people in various aspects of sampling using the established protocols. The project, which is supported by the Japan Society for the Promotion of Science (JSPS) will provide training, workshops, scientist exchange programs. The project builds on a 10-year bilateral exchanging program under which many samples were collected and that resulted in a number of published field guides.

It is further foreseen that a caravan of postdoctoral researchers visit each participating laboratory in order to assist in the classification and storage of species and to ensure consistency in the methods applied. Many samples will be generated and for that purpose the project will provide storage place and assist in type collection and sample management. All data will be added to the OBIS database that is separately developed under the Census of Marine Life. The results of the study shall moreover be disseminated in the form of websites, articles in scientific journals, and an encyclopedia of marine life in the Western Pacific. The project is currently in the process of identifying project sites and collaborators. The participating countries are: Russia, Korea, China, Japan, Indonesia, Malaysia, Vietnam, Philippines, Thailand, Australia, New Zealand, Taiwan, and the USA. Additional countries to be invited are: Fiji, New Guinea and New Caledonia.

3. REGIONAL OVERVIEW AND NATIONAL PRESENTATIONS

3.1 REGIONAL OVERVIEW: IN AND AROUND THE CENTER OF MARINE BIODIVERSITY IN SOUTH EAST ASIA

Dr. Bert W. Hoeksema, National Museum of Natural History, Leiden, The Netherlands

Most tropical benthic animal species occur on coral reefs in the Indo-Malayan Triangle, which includes Malaysia, Indonesia, the Philippines and Papua New Guinea. Many taxa show an Indo-West Pacific range from the western Indian Ocean and the Red Sea toward the central Pacific, while others occur predominantly in the Indo-Pacific convergence. Cumulatively, these ranges form a center of maximum marine biodiversity, which is located within the East Indies triangle. The boundaries of this triangle do not appear to have any biogeographic significance themselves. Depending on the taxa and material studied, various triangles have been distinguished in the past. Consequently, we do not know precisely where exactly the real center of diversity is located.

Species distributions presented in systematic revisions are usually incomplete. Nevertheless, well-defined boundaries are important for explaining the center of diversity, since they may relate to the area's climatic and geological past or to dispersal by currents and to ecological barriers. The fossil record and data on molecular variation between and within species may also help herein. Taxonomists should design sampling programs that focus on model taxa, which would enable them not only to look for occurrence data but also to obtain reliable information on species absence. Such data sets should be collected predominantly in Southeast Asia and the Western Pacific from within and outside the hypothetically most probable diverse centers. Eventually, the species richness patterns of many marine benthic taxa need to be compared in order to find the most accurate center of marine biodiversity.

3.2 COUNTRY PRESENTATIONS

3.2.1 Australia

Dr. J.N.A. Hooper, Queensland Museum

Status of knowledge: taxa. The Australian EEZ consists of 16 million square km of ocean, containing a described fauna of approx. 33,000 marine species (in 28 phyla), representing only about 30% of the estimated total number of species living in the EEZ (including continental Australia, islands and external territories). The current Australian taxonomic capability consists of some 175 marine taxonomic experts (from around 27 institutions) - a number that is gradually decreasing - of which some 50 marine experts are based in museums (i.e., with the ability to discriminate species-level taxa), and the others based in universities, other state and federal government agencies. The decline in national taxonomic capability (the so-called 'taxonomic impediment') is reflected in the decline of taxonomic research and expertise in the university sector, and their capabilities to teach the fundamental biodiversity sciences to new generations.

Status of knowledge: environments. Several habitats are relatively well studied (intertidal and shallow waters in proximity to urban areas) whereas others are virtually unstudied (seamounts, deep sea). Coral reefs of the Great Barrier Reef are relatively well-known for taxa such as corals, fishes, molluscs, only moderately well-known for

macrobenthic sponges and ascidians, and poorly known when it comes to symbiotic, parasitic, cryptic, sciaphilic and meiofaunas.. Inter-reef faunas are poorly studied, as are most of the island and external territory faunas. The tropical North and Northwest coasts moderately well sampled for pelagic and some demersal faunas, but collections remain largely unworked. Several processes are in place for regular reporting of measurable environmental 'milestones', such as large (beta, gamma) scale assessments of environmental and ecological health, threats and human impacts for each major bioregion / state jurisdiction, as are processes that use marine data for large scale bioregional planning, management, conservation and resource assessment. Conversely, fundamental species and genetic-level biodiversity knowledge, based on comprehensive site (alpha-scale) inventories, is poor and remains a challenge in terms of our ability to 'ground-truth' these larger scale (e.g., life-form) biodiversity assessments.

Australian marine biogeographic provinces. Models based on biological data and surrogate approaches to biogeography have been developed in response to the lack of adequate biological data to define marine ecosystems, and the urgent need for such data to plan and manage marine EEZ resources (such as in the IMCRA process), but few comprehensive biological datasets have yet been applied to surrogate models to assess their validity in bioregional planning and assessment.

On-going collection of marine data. Australia has several tiers of government and other agencies undertaking marine biodiversity data collection, consisting of: state-funded museums and herbaria (there is no national museum of natural history); other state agencies (fisheries etc.); federal government agencies (AIMS, CMR); other federal agencies (e.g., GBRMPA, EA); universities; and corporate and NGO agencies (e.g., CRCs), together representing a comprehensive national marine biodiversity capability. Each tier has a distinctive focus, differing in their scales of biodiversity assessment (genes, species and the ecosystems they form), spatial scales (alpha (site), beta (inter-community), gamma (landscape scales)), and basic, strategic or applied research strategies. The country report highlights the strengths, challenges and examples of projects undertaken by each tier are outlined, and URLs to agency and project web sites are provided.

Communication strategies. The country report also presents effective tools to communicate marine biodiversity data to the public, the research community, planners, managers, bureaucrats and politicians, including examples of: national and international symposia, workshops, meetings; biodiversity publications; building national and international biodiversity databases and metadatabases; and marine biodiversity training and education.

Capacity building. Current challenges, threats, and new initiatives to strengthen data acquisition and communication are outlined in the reports for the Australian marine biodiversity effort, and the status of marine biodiversity collections is summarized.

3.2.2. People's Republic of China

Dr. Zhou Qiulin, Third Institute of Oceanography, State Oceanic Administration

The identification of marine biological species in China dates back several hundred to thousands of years ago, while the comprehensive and systematic study was initiated in 1930. The past efforts by five national institutions of marine sciences and some universities have successfully identified 20,279 marine species, with distributions from tropical to cold zones, that are highlighted by the National Coastal Zone Survey in the 1950s and the National Integrated Survey of Coastal Zone and Intertidal Resources (1980-1986). In 1995, the State Oceanic Administration formulated the China Marine Biodiversity Conservation Action Plan. In the China Ocean Agenda 21, both Integrated Coastal Zone Management and Marine Ecological Protection and Conservation are listed as major program areas.

All marine species data in China is collected in accordance with a national protocol for marine biological surveys. However, there is no specific protocol for marine biodiversity surveys available. The identification of species is highly literature-based. Marine biodiversity data are filed in National Marine Data and Information Center and exchanged in meetings, and through publications and reports.

Capacity building is badly needed in differentiating biological surveys from biodiversity surveys, to coordinate the development of a protocol for biodiversity survey, indices for assessing biodiversity and bridging the national protocol, which has been used for decades, and any regional protocols that are to be developed in the Southeast Asia. Regional cooperation is needed and the taxonomic resource gap requires more attention in China and other regional countries.

3.2.3 Cambodia

Kathe R. Jensen, Asian Institute of Technology, Thailand

This summary only covers the research project carried out as collaboration between the Department of Fisheries of Cambodia and ITCZM program (DANIDA-funded) at the Asian Institute of Technology in Bangkok, Thailand. Danida provided a small personal research grant to its seconded faculty at AIT, which was subsequently used for this project, entitled 'Survey of coastal marine living resources in Cambodia'. The time frame is July 2000 to February 2002, and the budget amounts up to over 20,000 US\$. The primary objective was to create a pictorial database of the coastal marine living resources in the Sihanoukville area. The secondary goals were to produce posters of some of these resources, and to document our findings by placing preserved specimens in the newly established (very small) reference collection in Sihanoukville. However, after presenting a preprint of the first poster at a national workshop on coastal zone management, priorities were changed, because the poster was very popular and the idea of an electronic database was not really interesting to the local stakeholders. In the future the project will focus on the publication of more posters and pictorial guidebooks, with Khmer and English text, rather than the production of a database. At the present time two posters have been published (crabs and bivalves) and two more are ready to be printed (fishes and gastropods).

The results in terms of number of species recorded are very preliminary, and for some groups it is known that many more species were recorded previously in the northern Gulf of Thailand. Specimens were collected from trawling with local fishermen, from fish landing sites and markets, and from mangroves, sandy shores, and rocky shores.

Historical information is available on shell collecting by French colonialists from the 1880s to about 1970. The Department of Fisheries also has annual statistics, published in Khmer, but these are not reliable for all periods. The Tropical Marine Mollusc Programme (TMMP) has published some information, and also organized a training course in November 1999. There are a number of other biodiversity related activities in Cambodia, but due to the short time of preparation, the list presented is probably not inclusive. Some of the data published previously in government reports and fisheries statistics have been made available in a number of international publications authored by Mr. Touch Seang Tana. There is a GEF-funded Biodiversity Enabling Activity anchored in a local FAO project, but this has no or very little marine component. Plans are underway to organize a training seminar on marine biodiversity from 15-16 November 2001. The Department of Fisheries and CITES are collaborating on a sea turtle conservation project, and WCS is supporting a project on cetaceans. Besides some NGOs have biodiversity related activities. The Cambodian government is in the process of decentralization and formation of Village Development Committees. The project ties into this by creating public awareness, which will help local stakeholders in decision-making concerning conservation and sustainable use of marine natural resources.

3.2.4 Indonesia

Dr. Jan Sopaheluwakan, Indonesian Institute for Science

In order to understand how the 'Wallacea' area, the epicenter of the world's marine biodiversity was formed, the country report starts with a brief review of the physical oceanographic setting of Indonesia and its palaeo-oceanographic evolution on a geological time scale.

Some basic features of the archipelago were presented including the fact that some 8,377 marine biota have been recorded so far. The present status of the knowledge is illustrated among others by the statistics of marine biodiversity, including mollusks (2500 species), crustaceans (1512 species), sponges (850 species), Echinoderms

(745 species), fishes (2334 species), marine mammals (30 species), marine reptiles (38 species), hard corals (Scleractinians 362 species), and sea turtles (6 species).

Statistics on the status of endangered coral reefs were also presented, ranging from damaged, heavily damaged, good and the rate of annual destruction. This is reflected in the objectives of the national marine biodiversity management program, which are as follows:

- (i) to unravel the marine biodiversity of the Indonesian waters in a greater details,
- (ii) to develop an extensive management system to protect the marine biodiversity resources, and
- (iii) to conserve the marine biodiversity for further sustainable use.

The presentation continued with listing the target taxa, collection methods, analytical methods, inventory methods, research outputs and communication efforts. It highlighted the large volumes of reference collections, publications, field guidebooks, maps and databases. Important communication includes public education campaigns to stakeholders and websites.

Future tasks were outlined, with particular emphasis on the COREMAP Phase II as a continuation of the soon completed COREMAP Phase I. In view of the large number of stakeholders involved in marine resource management in the country (from national to local levels), it is unclear what the impact will be of the new Law on Decentralization, and this will pose a major future challenge.

The presentation ended with a quick look at the existing capacity in the country, underlining LIPI as the lead Marine Scientific Institution with a capacity in developing and maintaining the reference collections and related databases. Two possible future projects in Lombok and Bitung were also highlighted.

Future capacity building needs were outlined, ranging from establishing the national policy on specimen collection, developing a data and specimen exchange scheme, regional training and education for professional curators on taxonomy and systematics, and the improvement of public awareness.

3.2.5 The Philippines

Porifio M. Aliño, Miguel D. Fortes and Antonette Juinio-Menez, Marine Science Institute, University of the Philippines

The Philippines being strategically located in what is known as the coral triangle, is part of the Indo-West Pacific region (together with Indonesia-Papua New Guinea and Borneo, Malaysia), the marine world's highest area of diversity. Around 5000 species were cited by the Department of Environment and Natural Resources as recorded in the Philippines. By far the most diverse habitats are the coral reefs that harbor 90 percent of the recorded species, the seagrass and the mangrove habitats share around 5 and 4 percent, respectively while other habitats share the remaining records.

An overview of the efforts on marine biodiversity research and conservation in the Philippines was made: (i) to describe the main thrusts and themes including some historical highlights, (ii) to discuss the changing approaches in their historical context; and (iii) to identify the gaps surmised from the synopsis. Early works in the start of the 1900s that were associated with the main colonial powers especially during the American colonial period (1898 – 1940s) showed a wellspring in taxonomic efforts in the country. One of the notable works in this field is that of Herre (first quarter of the twentieth century) which showed the Philippines to be the highest in marine fish diversity during this period. The brief hiatus seen during World War II was followed by a resurgence of efforts until the 1960s. These mainly concentrated on marine invertebrates like echinoderms, corals and crustaceans and were mainly undertaken by scientists from the universities (like the University of the Philippines). Marine plant taxonomy (especially on marine algae) also saw an increase in interest in the late 1960s until the present. The Gregorio Velasquez Herbarium is perhaps the most extensive phycology collection in the Association of South East Asian Nations (ASEAN) and is housed in the University of the Philippines Marine Science Institute (UPMSI). Much of the taxonomic work has not only expanded in areas and institutions (e.g. the University of San Carlos, in Cebu and the Silliman University in Dumaguete City, Negros Oriental and the Philippine National Museum) but marine biodiversity has started to take new meaning in marine resources management. Despite the

great headway in the field of marine resources management, a considerable gap exists in the degree of understanding the basis for the patterns and processes of marine biodiversity in the Philippines.

The work of Nemenzo on scleractinian coral taxonomy has found new adherents in overall coral reef ecosystem research in the universities and in collaboration with the various government institutions. Despite what may seem to have been the academic emphasis of marine scientific research in the country, government funding was tightly linked to how the information was perceived as relevant to the country's needs in food production and the sustained well being of these ecosystems. Thus the Philippines through the works of Gomez and Alcala and their co-workers were known for the first countrywide surveys in the world. These surveys not only highlighted the dire conditions of the country's coral reefs but also provided the stimulus for much of the resource management efforts in the country. In the late 1970s the work of Alcala and later Alcala and Russ highlighted the importance of marine reserves and their linkage to marine biodiversity conservation and sustainable fisheries utilization. The urgent need for greater marine conservation action and management ushered in the 1980s an expanded collaborative effort like those under the ASEAN-Australia Living Coastal Resources Program. These collaborative programs were a welcome boost not only to marine biodiversity research but also to a broadening recognition of other problems and opportunities in the coastal zone. Efforts in capacity building mainly focused in the marine ecological realms and indirectly relegated marine systematics to the sidelines, in the 1980s to mid-1990s. The broadened realization of the importance of marine biodiversity in the country (e.g. marine natural products, ecotourism and marine protected areas) facilitated a renewed interest in discriminating the mechanisms for the evolutionary and ecological basis for the resilience of the marine ecosystems. Understanding the basis of the resilience of the Philippines' marine biodiversity that have been recognized as one of the highest (together with Indonesia) in the world is perhaps one of the emerging challenges for generation next to come.

Marine biodiversity efforts have been emancipated through interdisciplinary studies undertaken at various hierarchical scales. On the other hand researches have also come full circle, in the sense in that there has been a relearning that enhancement of effectiveness in marine resources management requires a deep understanding of the linkage between the scientific information and management action. Indeed various information networks on marine biodiversity have been initiated and sustained in the last 5 years. Various national biodiversity action strategies have now been cognizant of the link between the natural history museums and the ecologists. These efforts also saw an effort to integrate these efforts in a recently held national biodiversity priority setting workshop which provided a venue for the taxonomists, ecologists, government organizations and Non-Government Organizations (NGOs) biodiversity practitioners to come out with a joint priority action agenda. The Association of South East Asian Nations (ASEAN) Regional Center for Biodiversity Conservation (ARCBC) based in the Philippines unfortunately has relegated marine biodiversity concerns to the sidelines. Despite the resurgence in interest and growing awareness of the significance of Philippine marine biodiversity studies and management, there is still a big gap to be overcome. Sustained efforts are needed to save the dwindling marine systematists and their institutional capabilities in the country. The expanded and interdisciplinary role of the marine scientists and resource managers in complementary and cooperative efforts can be promising avenues for the future.

Some of the emergent issues that have been derived from the insights of work in the applications of scientific and management work related to marine biodiversity has shown that enriched taxonomic depth offers value-added benefits to the management applications of ecological studies. These insights are increasingly realized in the interrelated studies that look at the functional diversity of reef trophic dynamics as affected by fisheries overexploitation (e.g., the high variability in the species specificity of nano- and pico-plankton and their role in maintaining productivity; and deriving source and sink connectivity of populations and communities through population genetics studies). Aside from the direct applications, our understanding of the variable responses of marine organisms to natural and human induced stresses (e.g., the El Nino Southern Oscillation links to the recovery and maintenance of coral reefs vis-à-vis coral bleaching) is emerging as an important knowledge base on how local communities, governments and humanity will cope with the more strategic concerns of the future. Learning from the wanderings of the larvae and its reproductive strategies, we see many challenges ahead and our survival can be derived from the strength in the cross fertilization of our combined scientific experiences. Surely, there are great opportunities to be successful if we seize the day and work more effectively together.

3.2.5 Vietnam

Dr. Vo Si Tuan and, Nguyen Xuan Hoa, Institute of Oceanography and Dr. Do Cong Thung, Haiphong Institute of Oceanology, Vietnam

The collection of marine living creatures in Vietnam waters has a long history. Some early surveys by foreign scientists data back to the 17th and 18th centuries (on molluscs in 1784, on invertebrates in 1857, 1861). Since 1922, coinciding with the establishment of the Institute of Oceanography at Nha Trang, the surveys on marine biodiversity have been implemented in all areas including both coastal waters and offshore (Paracel and Spratly Islands). The history of biodiversity data collection In Vietnam can be divided into different periods: 1922-1954, 1955-1975, 1976-1990 and 1991 to present corresponding to respectively the colonial era, a period of large international expeditions, national survey programs and most recently surveys in support of conservation and management in near-shore areas.

From a review of the studies, the following number of species recorded can be inferred: Phytoplankton: 537; Zooplankton: 657; Seaweeds: 600; Sea grasses: 15; Sponges: 150; Coelenterata: 650; Polychaeta: 700; Crustaceans: 1,500; Molluscs: 2,500; Echinoderms: 350; Fish: 1,600; Mangroves: 35. These lists need to be revised because of the long period of time that has passed since the collection and identification, and updated nomenclature. However, an inventory of species and their distribution does allow us to address some issues. Many scientists support the idea of Cape Varella (latitude 12°N) as a biogeography boundary between the Japan-China and Malay-India subregions. The survey on hermatypic corals showed 5 diversity areas with the highest diversity recorded in the south central area.

Recently, the Institute of Oceanography has two specimen collections: at Nha Trang (since 1922) and Hai Phong (since 1959) and some at other institutions and Universities. The Museum at Nha Trang developed a database to manage the specimen collection. The results of biodiversity surveys have been published in the 'Journal of Biology' and 'Collection of Marine Research Works'. Some checklists on marine fish, economic shrimp, copepods, and Echinoderms were printed. Vietnam also initiated an effort to compile a Fauna and Flora of Vietnam. Capacity building needs concern training with formal and informal courses, equipment for field trip and laboratories, database and information exchange, support for publications, new technology in biodiversity surveys and information exchange. The cooperation among the countries in the region and international organizations will help Vietnam to solve some urgent activities such as surveys on endangered species, biodiversity assessment and monitoring, establishment of a Marine Biodiversity Center for Education and Training and regional information exchange.

3.2.6 Thailand

Mr. Somchai Bussarawit, Phuket Marine Biological Center, Thailand

Thailand has a long coastline intersected by many river estuaries. Many biologically rich habitats along this coast, e.g. mangroves, beaches, coral reefs, seagrass beds, estuaries and swamps are becoming increasingly disturbed and modified by man. Thailand's biodiversity is rich, but the flora and fauna are incompletely known. The 'Marine Fauna of Thailand' project has thus far enumerated only 20-30 % of the species and will most likely require another 100 years before completion at the present rate of financial support and manpower.

The marine resources are of tremendous importance to the rural economy, and provide the basis for future social and economic development of the country. Marine natural products are now receiving major research emphasis at several universities. Marine fauna is the key to new development in fisheries, biotechnology and tourism. They are the key to future economic sustainability and stability, and more equitable distribution of wealth.

The biodiversity of Thailand is rapidly eroding due to forest degradation, wetland alteration, drainage, pollution and coastal development. Although efforts to conserve and manage the rich biodiversity of the country must proceed with haste, neither conservation nor management can be effectively implemented and sustained without concurrent research efforts. Research is vital in order to:

- save rare and endangered species, with emphasis on the study of present distribution and population size of these species.
- establish what and how many species of marine animals occur in Thailand, with emphasis on important groups such as fish, crustaceans, mollusks, coral etc. with special consideration given to economically and biomedically important invertebrate groups such as crustaceans, mollusks, echinoderms, sponges and tunicates.
- inventory the ecosystems and important species groups in all regions, to determine their distribution, extent of fragmentation and effects of human disturbance.
- understand processes that will inevitably contribute to extinction.
- understand the ways in which coastal fishermen exploit coastal marine resources, the socioeconomic and legal factors which lead to overexploitation and environmental degradation and the strategies to promote sustainable utilization of marine fauna and flora.

The most critical limiting factor for understanding the biodiversity of Thailand is the shortage of trained manpower in ecology, systematics and environmental biology. Programs and funds must be obtained to increase the number of persons who can properly identify and do research on the ecology and systematics of flora and fauna of the country, including training at the technician level to scientists at the PhD level. This problem has already reached the crisis stage in invertebrate taxonomy where a shortage of taxonomic expertise is hampering research on natural chemicals and other products. For many other important groups of organisms there are no local taxonomic experts at all, and no adequate museum collections.

Centers related to biodiversity research already exist at several institutions. These require increased support and research staff. Coastal and mangrove ecosystems require more attention as there are few institutions with research group concerned with the basic ecology. Moreover, it is necessary to consider projects that foster interdisciplinary work and better inter-institutional collaboration, including with foreign institutions as well as the development of long-term field research sites for a critical inventory of species and ecosystem studies.

3.2.7. Malaysia

Dr. Ross bin Haji Othman, University Kebangsaan Malaysia

The sea area surrounding Malaysia is one of the largest continental shelf areas of the world. This shelf area is very productive as well as diverse in its habitats. Although there have been some studies on marine biodiversity in this area dated as far back to the mid 1930's, the information is rather limited and far from satisfactory. The status of marine biodiversity studies around Malaysian waters is examined, and research efforts by the scientists and the availability of funds to do research is explored.

3.2.8. Singapore

Peter K. L. Ng, National University of Singapore
Beverly P. L. Goh, National Institute of Education

The marine biodiversity program in Singapore is relatively healthy, with strong institutional support primarily in the form of its two universities, as well as its large, historically significant and well-maintained zoological and botanical collections in the Raffles Museum and Botanic Gardens. It has a very active research program, many (especially systematic studies) being regional or Indo-West Pacific in orientation. The scientific programs and outputs are targeted at specific groups of organisms, ecosystems and processes. Within Singapore, the research activities are oriented towards helping and supporting government and non-governmental conservation organizations, as well as implementing numerous outreach and public education programs.

4. REGIONAL PRIORITIES FOR COML IMPLEMENTATION IN SOUTHEAST ASIA

4.1. SYNTHESIS OF THE PREVIOUS SESSION

This session began with a brief presentation by Dr. Yoshihisa Shirayama, followed by his presiding over the subsequent roundtable discussion. Dr. Shirayama highlighted the main activities of CoML (e.g., HMAP, OBIS) and the primary regional CoML project, DIWPA. The capacity requirements for the region were outlined, particularly libraries, sample and data storage, training of specialists, and greater funding for coastal management and genetic resource studies. Given the amount of discussion already devoted to the need for adequately trained taxonomists in Southeast Asia, Dr. Shirayama suggested that any large-scale ecological proposals for marine research in Southeast Asia include taxonomic components that are properly factored into the proposal's budget.

In closing, Dr. Shirayama broadly outlined several criteria that should be considered for new projects or activities in the region. Foremost, should be the establishment of a regional steering committee that would oversee a new multinational research project. Other associated activities would include the organization of a regional network of laboratories; creation of training courses; establishment of a regional, core research center; and finding a funding sources for a CoML project in the region. Dr. Shirayama remarked that a Marine Biodiversity Center of Excellence in this region might prove to be too ambitious but that a multinational project would be far more successful in soliciting research and assessment funding than would individual national programs.

4.2. ROUND TABLE DISCUSSION AMONG EXPERTS

The task before the plenary session was to address how such a steering committee would be organized, who would be the members, and what activities might it oversee. It was immediately noted that 'in organizing a regional steering committee, it is important to have something to steer'. That is, the steering committee should develop a multinational research program, rather than simply monitor national programs. There was agreement that there is a large amount of biodiversity data within the region but that it is not statistically coherent, data sets are often disparate and cannot be cross-referenced.

Given the adequate computing capabilities within Southeast Asia, it was suggested that one way to proceed would be to create a geographic information system (GIS) of maps of marine taxonomic data from all participating countries. This atlas of species could then serve as a baseline or frame of reference for future studies. Once this baseline is established, field transect surveys across those mapped regions would then provide legitimate ground-truthing for the GIS maps. The results would improve the baseline maps, feed into OBIS, and set the stage for future quantitative studies.

Another opportunity and benefit of such a strategy would be the organization of joint research cruises across national boundaries. It was envisioned that joint data work-up and publication would lead to 'intellectual camaraderie' among Southeast Asian countries.

A counterpoint was raised that suggested that such a strategy might be too ambitious. Rather than assemble a compendium of regional biodiversity information, which may be incomplete or contain questionable data, it may be best to have IOC publish the credible data already presented in the country report presentations (at this workshop) and then proceed with identifying weaknesses within those data sets.

A third alternative was raised that suggested a network of museums and universities would provide a considerably lower cost mechanism for training young Asian scientists who could begin anew with scientifically-defensible, peer-reviewed marine science studies.

Another participant, supportive of the GIS map strategy, suggested that it would be far more useful to establish GIS maps now, even though they may be incomplete, than to wait for several years until regional scientists can present a more comprehensive picture.

Regarding the actual organization and management of a steering committee, it was suggested that several smaller subcommittees could more narrowly focus on specific research areas and create new mechanisms for collaborative studies. Naturally, these subcommittees would be formed with the intent of supporting the larger goal of comprehensive natural history studies within the region.

The discussion shifted towards what research areas the steering committee would emphasize. The majority of

participants agreed that there are significantly fewer taxonomic studies than large-scale ecological studies within Southeast Asia. Moreover, there is a critical need for trained taxonomists in the region. It was suggested that a concerted effort must be made within Southeast Asian universities to encourage graduate students to examine phylogenetic problems within larger-scale ecological studies. Recognizing that some groups of organisms are, indeed, difficult to identify, it was suggested that it is better to plod forward with the best identification techniques available and then return later if mistakes have been made.

This comment then turned the discussion towards quality control of systematic work. Participants suggested several quality control mechanisms including an annual international meeting to review systematic names, and establishment of virtual, regional committees of experts (e.g., nematods, corals, etc.) that could be called upon to periodically review the strengths and weaknesses of large data sets, including the associated metadata.

In closing, it was noted by two participants that the region is losing habitat and dependent species at an alarming rate. The reality is that the region has a wealth of data - granted, some of questionable quality - but the point is that it is a data management issue. Despite an unknown degree of imprecision, the best quality control mechanism is to review the data comprehensively, build a picture of biodiversity (i.e., via GIS maps), and then chart an agenda for future studies within the context of the scientific agenda of the CoML.

4.3. ADVANCED TECHNOLOGY IN MARINE BIODIVERSITY RESEARCH

Dr. Elgar Desa, National Institute of Oceanography

Dr. Elgar Desa attended the workshop as a member of the SCOR working group and made a presentation on Advanced (or Emerging) Technologies for Species Identification. The primary objective of this advanced technology working group is to identify the potential benefits of emerging technologies for observing marine life and then disseminating their findings to the international community.

The main features of the presentation dwelt upon:

Overview of the science of biodiversity

- Exploration and Collection - habitat with high biodiversity
- Identification - real-time recording and identification methods
- Monitoring - platforms for real-time monitoring efforts
- Experimental approaches - e.g., mesocosm studies
- Public Education - aquariums, Internet, visualization software

Emerging Technologies

- Airborne Optical LIDAR
- Optical Plankton Recorder - used as a towed vehicle
- Optical imaging of microplankton - counts, measures, and images plankton, see www.cytobuoy.com
- Broadband plankton sonar - ability to distinguish between copepods and euphausiids
- Holographic cameras - species identification, spatial distributions, species interactions
- Autonomous Underwater Vehicles (AUV) - video of coral reefs, hydrothermal vents, etc.
- Satellite remote sensing - basin-scale maps of biodiversity (ocean color), SST

In closing, Dr. Desa reminded the participants that advanced technologies are promising quicker, more accurate means to explore, identify, and monitor marine habitats and their associated species. Advanced technologies, however, are but a single tool to achieve these objectives within the context of the CoML. He postulated that public education, bioinformatics, improved prediction models, and broad capacity building are all required to further the goals of the CoML within Southeast Asia.

5. WORKING GROUP REPORTS

The introductory briefings on the Census of Marine Life, the DIWPA program, the HMAP program, a regional overview of biogeography in the region and the country reports set the stage for the subsequent discussion in three different working groups focusing on:

- History of Marine Animal Populations (HMAP)
- New Technologies
- Survey of biodiversity in SE Asia

Within each of these working groups, the participants were asked to discuss possible projects that could be set up and that could contribute to a better understanding of the biodiversity in the region. The discussions ultimately led to two proposed research programs / pilot projects, one on HMAP and another one amalgamating the use of new but proven and regionally feasible methodologies (videography, molecular genetics, OBIS Data Management) in a comprehensive biodiversity assessment.

5.1. HISTORY OF MARINE ANIMAL POPULATIONS REPORT

Malcolm Tull and John Butcher jointly chaired the working group on the History of Marine Animal Populations. Malcolm Tull began the session by reminding the group of the HMAP methodology, namely:

1. Define candidate ecosystems/fisheries
2. Identify state of ecological knowledge
3. Identify historical and palaeo-ecological archives
4. Identify ecological hypotheses that might be tested
5. Identify historical/ecological expertise

Given the fact that many in the working group were completely new to HMAP, a considerable part of the discussion was devoted to clarifying what makes a good HMAP project. Two points became clearer during the meeting:

First, HMAP is not just about fisheries or other human activities, nor is it sufficient to trace change in an ecosystem. Instead, the goal is to study the interaction of human activities and ecosystems and preferably to do so over a long period of time.

Second, if the focus is on particular animals (sea cucumbers, tuna, and so forth), then the goal should be to use this as a way of gaining insight into changes in the ecosystems of which they are a part. In other words, changes in those particular species should be used as an indicator of changes in the larger ecosystem. As an example, Zulfigar Yasin argued that because giant clams can only survive in a particular environment their disappearance from a particular place might well indicate environmental change as well as, of course, extraction.

During the working group session, the group tried to identify whether there is any research that has already done what HMAP is setting out to do. The work that has been done on the Gulf of Thailand seems to come closest to doing this. There is a great deal written in English-based literature on the results of trawl surveys conducted (by FRV Pramong II) since trawling began in the early 1960s. Anuwat Nateewathana and Kanchana Jirapunpipat moreover assured the group that there is an abundance of material in Thai language on the fisheries of the Gulf of Thailand. It is unclear how much has been done that looks at the ecosystem of the Gulf as a whole rather than, say, the demersal fish species and how much has been written on the period before 1960. It was also noted that there a lot has been written on the trade in sea cucumbers (by Pak Larrisa, Heather Sutherland, and others), which also might serve as a starting point for an HMAP project.

Various types of possible sources of information as used by the historians in the group were:

- Fisheries reports
- Production/trade data

- Archives
- Trawl surveys (starting with the 'Gier' in 1907, the results of which are readily available in the former Dutch-colonial publication *Mededeelingen van het Visscherij-Station te Batavia*)
- Japanese fisheries reports (starting well before the Pacific War) - although Japanese historians have written about the variety of Japanese fisheries activities before the war it is not clear whether any of them have used these reports to trace ecological changes.

Others sources of information that were identified by the group and possibly underexploited by historians in the working group were:

- Records of expeditions conducted by European countries and Japan since the 1700s—Kathe Jensen mentioned the observations of a Danish expedition about 1900.
- Specimens found in museums, provided that it is certain where they were found. The starting point is to ask whether the species is still found in the same place.
- Shell middens, found at Merbok in Kedah (according to Zulfigar Yasin), South Sulawesi (Farnis Boneka), and in areas frequented by sea nomads ('Bajo' according to Maarten Kuijper). Archeological work (similar to that reported in Jeremy B.C. Jackson et al., "Historical overfishing and the recent collapse of coastal ecosystems", *Science*, 293 (27 July 2001), 629-38) could show changes in consumption over time and relate this to overexploitation of particular species or environmental changes or both.
- Coral core sampling. Zulfigar Yasin highlighted the idea of 'layers of information' and suggested how coral core sampling might be used to trace environmental change over a long period.
- Church facades in the Philippines. Miguel Fortes noted during the meeting that one could examine the shells in many facades and see whether these species still exist in the same localities.
- Documents generated by territorial disputes before the World Court, especially the dispute over Pulau Sipadan, for which the Malaysian and Indonesian governments have produced many historical documents.
- Interviews, especially of the now rather old generation involved in the great expansion of fisheries after World War II.

Possible HMAP projects were of three types:

(i) Historical studies of particular species:

- Sea horses
- Tripang (sea cucumbers)
- Sharks (Malcolm Tull suggested focusing on the area off the north coast of Australia)
- Giant clams

What is striking here is that all of these animals have long been in great demand in the China market, sometimes for centuries. Because of this, there are many records in Chinese as well as European and Southeast Asian languages about these species, but just how extensive these records are and what their potential is remain to be explored.

(ii) Focusing on a particular area. Two were suggested:

- The Gulf of Thailand because of the great body of literature that already exists
- The Java Sea. According to Jan Sopaheluwakan, a group of Indonesian scholars including fisheries experts, hydrologists, pollution experts, historians, etc. associated with LIPI are beginning a project of this type though concentrating on the area near Jakarta.

(iii). Building up a database which could be used for various HMAP projects:

- A record of European and Japanese expeditions with an overview of the contents of the expedition

reports and how they might be used. The 'Atlas of Marine Policy in Southeast Asia – Morgan and Valenia (Eds), 1983' has a map showing where various expeditions explored.

- Other archives
- Data generated by boundary disputes before the International Court of Justice (notably Pulau Sipadan).

Possible collaborators were identified as follows:

- Sea horses: Miguel Fortes, Amanda Vincent, P. Sanchaing
- Tripang (sea cucumber): Zulfigar Yasin, Farnis Boneka, Somchai Bussarawit, Heather Sutherland, Mohammad Raduan bin Mohd. Ariff
- Sharks: Andy Rosenberg, Malcolm Tull, Anuwat Nateewathana, Kanchana Jirapunpipat, Farnis Boneka, T. Tam, P. Naiyentr, Jim Warren
- Giant clams: Zulfigar Yasin, Kongkiat, Patzolt, John Benzie, Gunarto Latama (S. Sulawesi), Ed Gomez
- Gulf of Thailand: S. Chullasorn, V. Hongsakul, Trep Mensavate, Mansur
- Java Sea: Masyhuri, Pujo Semedi
- Archival database: Kathe Jensen, Andy Rosenberg, Akihiko Matsukumo, John Butcher

Other possible projects, primarily focusing on animals, considered were:

- Flying fish: Miguel Fortes mentioned that they are now captured (only?) off northern Luzon, not in the Visayas as they once were.
- Tuna, for which the records are relatively good (see for example Ardill, Atlas of Indian Ocean Tuna Fisheries).
- Coconut crab: Farnis Boneka mentioned how the range in which they live has shrunk greatly over the years. They are dependent on forests along the shore.
- Turtles, the shells of which were once in great demand, particularly in China.
- Pearl oysters, the target of skin divers in the Andaman Islands, Aru Islands, and Sulu Archipelago in late 1800s and early 1900s.

The group further discussed some of the challenges that HMAP scholars will face, in particular the fact that more work is needed to identify people who might want to contribute to HMAP's work. It is important to have historians as well as biologists and to include as many experts within the region as possible. It was further emphasized that work is needed towards formulating questions and hypotheses if the research is to have direction and purpose. The work done by Jackson et al. (2001) provides a model in this regard.

A future activity identified by the HMAP group related to the organization of a workshop devoted to the history of marine animal populations in the region, possibly to be sponsored by HMAP. [Post-workshop note: Tentative location and date: Singapore in late 2002/early 2003. Professor Peter Reeves (University of Singapore) is willing to be involved. Professor James Warren (Murdoch University) will also be at the University of Singapore from mid-2002]

This would lead to ideas for projects, which could then be presented to the HMAP steering group for consideration. The steering group's deliberations would then lead to particular projects/histories. Funding opportunities would of course have to be carefully explored.

5.2. NEW TECHNOLOGY WORKING GROUP REPORT

- (i) To what extent are advanced sampling/identification technologies known and being used in Southeast Asia?

The availability of advanced technology for marine sampling and species identification is well known across the region, particularly among younger researchers. A number of new or advanced technologies are in use across the region. These include:

- video recorders for shallow-water biodiversity surveys

- satellite ocean color
- molecular markers
- data buoys for environmental information
- acoustics (primarily as a fish location tool)
- information technology
- ROVs (used formerly in Malaysia)
- geographic information systems (GIS)
- electronic keys for taxonomists
- digital cameras and microscopes

The application of these technologies, however, is not widespread compared to traditional sampling and identification methods. This is particularly true for research and monitoring activities in shallow coastal waters that are the areas of highest biodiversity and the focus of most surveys. Most countries do not conduct extensive blue-water oceanographic research, and hence the need for, and application of sampling technology in these areas is not significant.

Acoustics are frequently used by the fishing industry but considerably less in the research communities. Under the auspices of the SEAFDEC Program, Myanmar, Malaysia, Vietnam, Philippines, and Thailand conduct trawl surveys, along with sediment grabs, and CTD casts. Acoustics is occasionally incorporated into the same cruises. Very often, however, there is little effort towards data dissemination. SEAFDEC surveys are a possible platform for more extensive surveys and assessments throughout the region.

(ii) What are the major needs and challenges for new technology in Southeast Asia?

For most sampling and species identification needs throughout the region, existing technology is sufficient. Many of the new technologies discussed, such as acoustics, LIDAR, and high-resolution ocean color are not applicable to coastal systems that are the focus of biodiversity studies in the region.

Many participants also felt that technologies that are still in the research and development phase may not be sufficiently robust, reliable and cost-effective for sustainable application in the region. Reliable, basic technologies such as still photography and scuba for shallow-water biodiversity survey sampling will continue to be used extensively. However, new technologies, which are operational, should be considered and applied as appropriate. Toward this end, there should be an effort to raise awareness among the scientific community with regard to these operational advanced survey/identification technologies. Awareness of advanced technologies is not necessarily the rate-limiting factor, but application is often inhibited simply due to unfamiliarity.

One significant need that was highlighted is additional training, particularly in taxonomy, as well as basic oceanographic / biological survey techniques. In many cases, the utility of advanced sampling / identification technologies may only be appreciated when practitioners have the basic training to understand how they can be applied.

Participants agreed that the Ocean Biogeographical Information System (OBIS) could be a very useful tool for researchers in this region. OBIS is a query system that searches out databases on worldwide servers, and a GIS system to conduct data visualizations. Participation in OBIS may be inevitable in the region, as the CoML requires that all funded projects make their data accessible through OBIS. The application of OBIS may be facilitated by an existing agreement among some governments in the region to develop common databases and exchange data. This regional effort was started several years ago, but has stalled at the point of entering existing datasets into a common format. Regional CoML/IOC projects may be able to assist by supporting the further processing of these regional data sets that can then be fed into OBIS.

A few specific needs were highlighted:

- Optical systems for hard bottom (corals) surveys are needed. Not only better optics to increase resolution and coverage but also image analysis systems to help processing greater quantities of data. Digital cameras (still

and video) are inexpensive and should be incorporated into surveys where appropriate.

- Molecular genetics could be a very useful tool for enhanced biodiversity studies. The Philippines in particular is already working with genetic markers, and is prepared to help expand this technique throughout the region.

Finally, participants highlighted the challenge of access to government-collected oceanographic / physical data. These data are often considered sensitive and are not frequently shared externally. This could hamper the ability to participate in systems like OBIS where free and open access to data is a prerequisite.

- (iii) Propose projects that could be undertaken to advance the application of new technologies within the context of the Census of Marine Life Program.

Three projects are recommended for development:

- Image collection and processing to surveys of shallow-water biota
- Information technologies (OBIS)
- DNA markers/molecular techniques

5.3. BIODIVERSITY WORKING GROUP REPORT

From the outset, the biodiversity working group focused the discussion on a large multi-year and multi-country effort which would incorporate elements of new technologies as discussed in the previous section. In this respect, it was realized that such an effort would bear a high cost, commensurate to or above the cost of the DIWPA study and the DANIDA funded Tropical Marine Mollusc Program, with price tags of 10 and 3-4 millions of dollars respectively. The Global Environmental Facility was seen as a possible funding source for the study.

In order to appeal to funding agencies, it was also considered important to consider the relevance of the project to the governments in question and society in general. Many governments in the region are in the process of or in need of a marine biodiversity action plan that lays out the government's policy for the conservation and use of marine biota. A concerted research effort could provide necessary information to support this planning process. Similarly it was recognized that current efforts toward the establishment of a representative network of marine national parks in Southeast Asia and emerging commercial interest in the use of marine biota for medicinal products warrant a targeted research effort on the implications of gene flow and genetic uniqueness across the region.

These considerations led the group to propose the following preliminary project:

- (i) Project title

Improving the regional knowledge and information base to enhance the effectiveness of assessments of national marine biodiversity and genetic resources.

- (ii) Objectives

A biogeographical study of the abundance and distribution of marine key species/taxonomic groups in the Southeast Asian region over a 5 year time frame, to possibly identify regional differences in biodiversity (species richness/functional diversity hotspots, regional endemism and unique genetic resources.

- Regional assessment of existing knowledge within each country
- Merging of national lists of taxonomic groups and target species with detailed information on past/present nomenclature
- Field surveys of status of marine biodiversity

Selected habitats: corals and sea grass beds

Selected target group/species: mollusks, corals, fish, invertebrates, seagrasses (focus on taxa that represent functional groups and that are relatively well-studied / understood).

(iii) Outputs

- National marine biodiversity and genetic resources assessed in regional context
- Guidelines for sustaining biodiversity (functional/species) and genetic resources
- Building national marine biodiversity collections and expertise
- Improved access to historical reference collections
- Linking ecological and taxonomic information
- Capacity building, network of trained experts
- Effective mechanism for dissemination and exchange of information (OBIS, websites, training material)
-

(iv) Cost and duration

Pre-planning phase: 2 years, national budgets

Planning/proposal preparation, 2 years (GEF block B, 250 000 USD)

Implementation, phase 1: 5 years, 10-18 M USD total from GEF

Research/field surveys	5 M
Capacity building (institutional strengthening)	5 M
Awareness building	3 M
Planning, coordination	5 M
Total	18 M

(v) Participating countries:

Participating countries: Indonesia, Vietnam, Cambodia, Thailand, China, Malaysia, Singapore, Australia

Candidate countries: Japan, India, Hong Kong, Brunei, Solomon Islands, Palau

Overseas institutions: Taiwan, UK, Netherlands, Denmark, Sweden, Germany, Finland, USA, Norway, and Canada (in particular museums with strategically important collections and universities with specific expertise)

5.4. GENERAL CONCLUSION OF WORKSHOP

The Census of Marine Life (CoML) is a basic research program that will facilitate the implementation of regional projects to assess the distribution, abundance, and diversity of marine species in Southeast Asia, both in terms of past and existing populations.

5.4.1. Specific Workshop Recommendations

- (i) Form a Southeast Asian Regional Coordinating Group for CoML to oversee the following projects and other efforts of interest in the region.
- (ii) Two projects to be developed in the region:
 1. A History of Marine Animal Populations (HMAP) project to explore historic populations in the region.

This HMAP proposal would investigate the possibility of conducting research on the use, trade and changes in certain marine resources (sharks, sea horses, trepang (sea cucumbers) for which records could possibly exist in old Chinese, Thai or Japanese records, and the exploitation over time of clams and oysters (through analysis of

shell middens or even building facades). Another option considered was the history of overfishing and its impact on fish communities in the Java Sea and/or the Gulf of Thailand where records would predate the advent of industrial fishing (1960s).

The meeting agreed to assess the feasibility of undertaking such kind of research in the region. Dr. Malcolm Tull of Murdoch University in Perth agreed to coordinate the initial phase of identifying additional co-workers in the region (particularly historians as in the present workshop the audience primarily consisted of biologists) and narrowing down the scope of the proposed project pending the further analysis of available materials and interest. It was further planned to organize another planning meeting on HMAP in the region in June 2001. Cynthia Decker of the Census of Marine Life Secretariat promised to look into the possibility of having the Sloan Foundation come up with the necessary funding.

2. A field research project to characterize the coral reef and seagrass communities in the region - OR - Improve the regional knowledge and information base to enhance the effectiveness of assessments of national marine biodiversity and genetic resources.

Recognizing the moderate resources available in each of the countries, the lack of adequate regional taxonomic expertise, and the reality that much of the research currently conducted in the region follows a piecemeal approach, there is little chance that a significant contribution to a further understanding of marine biodiversity in the region can be made. What is needed is a concerted effort to broaden the region's understanding of the regional marine biodiversity and unique genetic resources and the importance thereof to society. To this end, it was proposed to prepare a proposal to the Global Environmental Facility focusing on marine biodiversity research and its role in national marine biodiversity action planning. This would differ from existing GEF funded initiatives in the region in that it would focus more on explaining species and genetic diversity as a prerequisite to ecosystem-based management whereas other projects are much more oriented towards either habitat conservation (e.g., guidelines on how to manage marine protected areas, guidelines for state of the environment reporting) or environmental management (e.g. reduction of waste loads).

The proposed project would target seagrass and coral reef communities in view of the fact that these are more resilient to changes over time as opposed to soft-bottom communities. The proposed project would complement and reinforce the DIWPA project that looks at macrophyte and seagrass communities along a latitudinal gradient, by adding multiple seagrass sampling locations throughout the tropical Southeast Asian region and Western Pacific in addition to coral reef habitats.

The knowledge generated under the presently proposed project would directly address many management questions (e.g., location and size of marine parks, impact of climate change, impact of anthropogenic influences, introduction of exotic species, habitat destruction, sedimentation, pollution, fishing) to which there are currently insufficient answers. An important aspect of the research project would be to link it to the ecological understanding of the ecosystems, not just an inventory of species, but an understanding of why and how different functional groups of one and the same ecosystem are represented over a large biogeographical area and along various gradients of human perturbation and (past and present) climate change. Given the presently insufficient taxonomic knowledge of many species groups, it is recommended to look at keystone species or taxa that correspond to functional groups within the ecosystem under consideration (i.e., reef builders, reef eroders, parasites, symbionts, primary producers, etc.).

The project will require a coordinated effort of biodiversity research on a scale not seen before. There will be no duplication with existing efforts; neither will there be a contention with respect to the geopolitically sensitive areas of the South China Sea (only undisputed reefs and seagrasses within a logistically practical distance of well-established labs will and can be considered).

The IOC as an agency pursuing the development of a knowledge and information base for the sustainable use of the oceans is well positioned to take on the role of implementing agency.

5.4.2. Next Steps

- Finalize workshop report and submit to CoML / IOC by April 2002.
- Establish a Southeast Asian Regional Steering Committee (SEA RSC) to oversee the development of CoML in the region.

The principle charge to the SEA RSC will be to identify concrete questions on species / genetic patterns and processes that the study intends to answer with corresponding hypotheses to be tested and draw up appropriate research methodologies for the research envisioned under the above-mentioned proposals.

The SEA RSC will also have to consider possible partners from overseas institutions and research groups that can contribute to the study in one way or another.

It was agreed that the IOC/WESTPAC Secretariat would provide SEA RSC preliminary Terms of Reference and oversee the nominating process. Two scientists per participating country would comprise SEA RSC. NGOs, overseas institutions, and museums would be eligible for associate membership or serve as consultants.

The IOC/WESTPAC Secretariat shall also assist in the identification of funds for necessary pre-planning meetings. SEA RSC will be responsible for identifying subsequent external funding and national funding.

- Organize two workshops to further the two identified projects by June 2002.

The present workshop merely started the project formulation process. The participants expressed the wish to conduct consecutive meetings to further elaborate the project ideas. It was also realized that any future HMAP workshop would benefit from having more historians present who have access to and can identify relevant historic documents in each of the Southeast Asian countries.

June 2002 was proposed as a tentative date for the next workshops in each of these subjects.

6. CLOSURE

On behalf of the sponsors, Mr. Maarten Kuijper and Dr. Cynthia Decker thanked the participants for their hard work in the preparation of very informative country reports, as well as for their contributions to the stimulating discussion. The invited speakers and facilitators were also thanked for their contributions. It was noted that a good start has been made and that the proposed projects would clearly merit both the region as a whole and the individual countries. Special thanks went to the Director of the Phuket Marine Biological Center and the local organizing committee. The workshop finished at 17:00h on Friday 12 October 2001.

ANNEX I

WORKSHOP AGENDA

IOC-Census of Marine Life Workshop on Marine Biodiversity in SE Asia, Phuket, Thailand, 10-12 October 2001

Venue: Phuket Marine Biological Center

Wednesday, 10 October

TIME	TOPIC	PRESENTER
0900-0930	Registration	
0930	Introductions/Overview Chair: M. Kuijper	
	Welcome	P. Limpsaichol
	Introductions and Objectives	M. Kuijper/C. Decker
	Introduction to CoML	C. Decker
1030-1100	Coffee break	
	History of Marine Animal Population	A. Rosenberg
	Coastal Survey of the Western Pacific	Y. Shirayama
	Discussion	
1200	LUNCH	
1300	Regional perspectives on status of marine biodiversity data collection, analysis, communication and use in Southeast Asia Chair: N. Cyr	
	Regional overview	B. Hoeksema
	Australia	J. Hooper
	China	Q. Zhou
	Cambodia	K. Jensen
	Indonesia	J. Sopaheluwakan
1500-1530	Coffee break	
	Philippines	P. Alino
	Vietnam	V. S Tuan
	Thailand	S. Bussarawarit
	Singapore	P. Ng
	Malaysia	R. Othman
1800	ADJOURN	
1830	RECEPTION	

Thursday, 11 October

TIME	TOPIC	PRESENTER
0900	Regional Priorities for CoML Implementation in SE Asia - Round table discussion Chair: Y. Shirayama	
1200	LUNCH	
1300	Potential Regional Initiatives/Pilot Projects – Concurrent Working Groups Chair: C. Decker	
	History of Marine Animal Populations	Leaders: J. Butcher/M. Tull
	Biodiversity of shallow hard-bottom communities	Leaders: Y. Shirayama/V.S. Tuan
	Advanced species identification technology applications	Leaders: E. Desa/N. Cyr
1700	Working Group Reports	Working Group leaders
1800	ADJOURN	

Friday, 12 October

TIME	TOPIC	LEADER
0900	Potential Pilot Projects – Concurrent Working Groups (continued)	
1100	Working Group Final Reports	Working Group leaders
1200-1300	LUNCH	
	Next Steps Chair: M. Kuijper/C. Decker	
	Workshop Conclusions and Recommendations	
	Follow-up requirements	
1700	ADJOURN	

ANNEX II

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ANNEX III

LIST OF ACRONYMS

AIMS	Australian Institute of Marine Science
AIT	Asian Institute of Technology
ARCBC	ASEAN Regional Center for Biodiversity Conservation
ASEAN	Association of South East Asian Nations
AUV	Autonomous Underwater Vehicle
BIOMARE	Implementation and Networking of large scale, longterm Marine Biodiversity Research in Europe
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMR	CSIRO Marine Research (Australia)
CoML	Census of Marine Life
CRC	Cooperative Research Center (Australia)
CTD	Conductivity, Temperature, Depth probe (instrument)
DANIDA	Danish Agency for Development Assistance
DIWPA	Diversitas in the Western Pacific Area
EA	Environment Australia
EEZ	Exclusive Economic Zone
FAO	Food and Agricultural Organization of the United Nations
FRV	Fisheries Research Vessel
GBRMPA	Great Barrier Reef Marine Park Authority
GEF	Global Environmental Facility
GIS	Geographic Information System
GLOBEC	Global Ocean Ecosystems Dynamics Research
HMAP	History of Marine Animal Populations
IMCRA	Interim Marine and Coastal Regionalisation for Australia
IOC	Intergovernmental Oceanographic Commission
IOC/WESTPAC	IOC Sub-Commission for the Western Pacific
ITCZM	Integrated Tropical Coastal Zone Management
JSPS	Japan Society for the Promotion of Science
LIDAR	Light Detection and Ranging (instrument)
LIPI	Indonesian Institute of Sciences
MARS	Network of European Marine Research Stations
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration (USA)
OBIS	Ocean Biogeographical Information System
PICES	North Pacific Marine Science Association
ROVs	Remotely Operated Vehicles
SCOR	Scientific Committee on Oceanic Research
SEAFDEC	Southeast Asian Fisheries Development Center
SEA-RSC	Southeast Asian Regional Steering Committee
SST	Sea Surface Temperature
TMMP	Tropical Marine Mollusc Programme
UPMSI	University of the Philippines Marine Science Institute
WCS	Wildlife Conservation Society