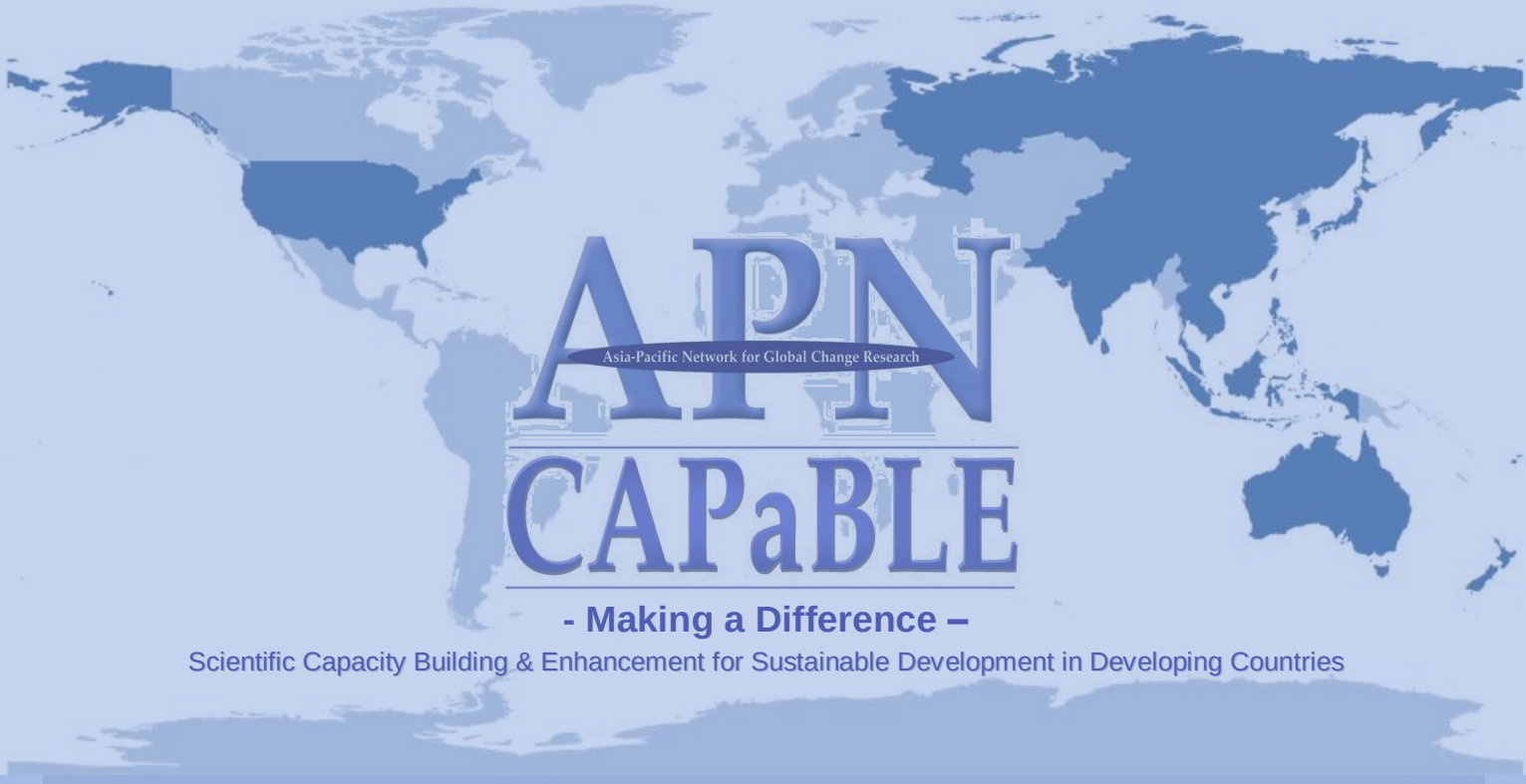
FINAL REPORT for APN PROJECT

Project Reference Number: CBA2012-06NSY-Zhang

International workshop: Needs assessment for capacity development for integrated marine biogeochemistry and ecosystem research in the Asia-Pacific



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IMBER EAST CHINA NORMAL UNIVERSITY SKLEC

International workshop: Needs assessment for capacity development for integrated marine biogeochemistry and ecosystem research in the Asia-Pacific region

Project Reference Number: CBA2012-06NSY-Zhang
Final Report submitted to APN

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OVERVIEW OF PROJECT WORK AND OUTCOMES

Non-technical summary

The Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project is a multi-disciplinary, international project that seeks to identify the mechanisms by which global change and anthropogenic forcing influence marine biogeochemical cycles and marine food webs and how these, in turn, influence marine ecosystems and human society. In order to enhance IMBER research in the Asia-Pacific region, an international workshop was held to assess needs for capacity development for IMBER research. The workshop evaluated current capacity building efforts and attempted to identify critical issues of capacity building, within the integrated ocean science programmes in the Asia-Pacific region, where additional development is required to ensure that the member countries are able to make appropriate contributions, both for regional and international success. This workshop was closely aligned to the APN's (Asia-Pacific Network for Global Change Research) goal of "improving the scientific and technical capabilities of nations in the region" and was a good fit with the APN's Scientific Capacity Building/Enhancement for Sustainable Development in Developing Countries (CAPaBLE) Programme. The output of this meeting will provide a unique and important contribution to the capacity building efforts of Scientific Committee on Oceanic Research (SCOR) Capacity Building Committee, the IMBER Capacity Building Task Team and UNESCO Intergovernmental Oceanographic Commission Western Pacific Sub-commission (IOC/WESTPAC)). All these groups contributed to the success of this meeting and are dedicated to improving capacity and keen to have the Asia-Pacific countries involved as stakeholders.

Keywords

capacity building, needs assessment, IMBER, APN, Asia-Pacific region, marine science

Objectives

The main objectives of the project were:

1. To synthesize current capacity building efforts, analyze successes and lessons learned, and identify whether they meet the requirements for IMBER-related research in the Asia-Pacific region
2. To provide suggestions for improved capacity building within the IMBER community, particularly in the Asia-Pacific region

Amount received and number years supported

The Grant awarded to this project was:
US$ 27,275 for Year 1: 2012/2013

Activity undertaken

The main activities of this project included a background study on local/regional capacity building activities from all participants and one international workshop held on 31 July 31–4 August 2012 in Shanghai, China. The workshop brought together about twenty marine scientists and capacity building (CB) experts from 14 countries (11 were APN countries), to discuss CB experiences and case studies, assess CB needs, and consider potential collaboration for future capacity development. The international organizations involved in this effort included IMBER, APN, SCOR, IOC/WESTPAC (IOC

Sub-commission for the Western Pacific), and the Partnership for Observation of the Global Oceans (POGO). Following up the 2012 capacity building assessment workshop, a small group meeting was held on 25-27 March 2013 in Shanghai, China to finalize the 2012 capacity building workshop report (a strategic paper to be submitted to a peer-reviewed journal) and to explore future actions of capacity building for marine research in the Asia-Pacific region. Seven people participated the second meeting.

Results

1. Mapping ongoing CB activities
2. Identification of CB problems and challenges
3. Identification of CB needs for IMBER relevant research
4. Global/regional networking information
5. Strategy to CB enhancement

Relevance to the APN Goals, Science Agenda and to Policy Processes

The international workshop in 31 July – 4 August 2012 analyzed the needs and mechanisms for capacity building within the integrated marine biogeochemistry and ecosystem research community in the Asia-Pacific region. This will assist Asia-Pacific countries to make appropriate contributions to regional and international IMBER science. This aim is closely aligned with the APN's goal of "improving the scientific and technical capabilities of nations in the region". It also fits well with the main objectives of APN's CAPaBLE programme, that is, enhancement of capacity in developing countries for generation and sharing of knowledge concerning climate change impacts, vulnerabilities, adaptation and mitigation, as well as of informed decision-making through dissemination of the outcomes to policy-makers and other stakeholders, particularly in the Asia-Pacific region.

Self evaluation

In general, this project was very successful. Marine scientists and CB experts from 14 countries were involved in this project. The proposed objectives of this project have been fully achieved. The workshop held on 31 July – 4 August 2012 in Shanghai was productive. Marine capacity building needs and challenges, particularly for the Asia-Pacific region, were assessed. Existing regional/international CB resources were explored. Potential collaboration and dedicated financial resources for CB activities targeting the regional needs were discussed.

Potential for further work

1. IMBER was invited to help build a regional CB platform targeting regional research priorities in collaboration with relevant CB resource actors (e.g., SCOR, IOC/WESTPAC, and POGO)
2. Creating an IMBER-related mentoring program and alumni network for early-career researchers
3. In order to follow up the 2012 Shanghai CB workshop and enhance IMBER related research capacity in the Asia-Pacific region, IMBER is considering having its 2014 Summer School in China.
4. Designing and promoting training and technical assistance on targeted research domains

Publications (please write the complete citation)

1. Liuming Hu, Bernard Avril, & Jing Zhang. 2013. Capacity Building for Sustainable Marine Research in the Asia-Pacific Region. Eos. 94 (2): 21.
2. IMBER CBTT, IMBER RPO. 2012. Needs assessment for capacity development for integrated marine biogeochemistry and ecosystem research in the Asia-Pacific region. IMBER Newsletter No.21.
3. IMBER RPO, IMBER CBTT. 2012. Needs assessment for capacity development for integrated marine biogeochemistry and ecosystem research in the Asia-Pacific region. APN Newsletter Vol. 18, No. 4: 28-30.
4. R. John Morrison, etc. Developing Human Capital for Success in International Marine Research Projects (under preparation for publication in a peer-reviewed international journal).
5. APN final report

Acknowledgments

This project was co-supported by the APN, IMBER, and East China Normal University.

TECHNICAL REPORT

Preface

Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) requires expensive research platforms, e.g., research ship, sophisticated measuring instruments, satellite observation, and multiple disciplines such as chemical, biological and physical or fisheries oceanography experts which many developing countries are unable to afford. There is consequently a great need for collaboration, technology sharing and capacity building in regional and global basis utilizing rapidly developing and inexpensive information technology. Several mechanisms are used to enhance research capabilities globally, especially in less developed countries. However, no comprehensive analyses of the successes or lessons learned have been undertaken to evaluate the capacity building efforts in the research in the Asia-Pacific region. This activity will provide a cost-effective and efficient opportunity to synthesize current capacity building efforts, analyze whether they meet the requirements for IMBER-related research, and to suggest improvements.

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1.0 Introduction

1.1 Background information

IMBER (the Integrated Marine Biogeochemistry and Ecosystem Research project) was established in 2004 by the International Geosphere-Biosphere Programme (IGBP) and SCOR, to identify the mechanisms by which marine life influences marine biogeochemistry and how these, in turn, influence ecosystems in the ocean. In March 2010, IMBER and its sister project GLOBEC (Global Ocean Ecosystem Dynamics) merged, leaving IMBER as the only remaining marine core project of IGBP. One of the priorities of the *IMBER Science Plan and Implementation Strategy* is to promote research capacity along with integrated studies of biogeochemistry and end-to–end food webs. The IMBER Capacity Building Task Team (CBTT) was formed during the early stages of IMBER's Implementation. The Terms of Reference of the CBTT are:

- To enhance research capabilities in less developed countries especially those geographically close to regions of interesting biogeochemical/ecosystem provinces for optimal implementation of the IMBER science plan.
- To enhance research capabilities globally in those IMBER activities which have few practitioners but are crucial for optimal implementation of the IMBER science plan.
- To strengthen graduate education in ocean sciences.

Through capacity building efforts, IMBER encourages the development of new research initiatives and aims to establish or improve the infrastructure needed for IMBER-related research in less developed and other coastal countries. This is the most important, but also the most difficult challenge facing the CBTT, because marine research requires expensive infrastructure, especially the seagoing facilities, which many less developed countries cannot afford on their own. Scientists from these countries are hampered by a lack of access to equipment, recent literature, and research funding, which often isolates them from the global scientific community. Networking, both regionally and on a global scale, is essential to overcome these constraints. Networking will facilitate the development of enabling environments to promote capacity building measures within the scope of IMBER. Regional networking should target:

- Those countries that already have some financial and/or human resources and where modest help can yield quick and substantial returns (e.g., countries in the Middle East, Southeast Asia, Northeast and Southwest Africa, South America)
- Geographical areas of special interest to IMBER that are geographically far from the developed world.

Capacity building networking can be achieved through several different mechanisms, such as information exchange, specific training workshops and Web-based training, collaborative cruises and scientific exchange programmes. Regional networking should use existing regional programmes and establish new programmes, led by the more developed countries in the region. Some already established networks and ongoing programmes that could be used are those of POGO, SCOR, GOOS (Global Ocean Observing System), START (Global Change System for Analysis, Research, and Training), LOICZ (Land-Ocean Interaction in the Coastal Zone), CLIVAR (Climate Variability and Predictability project), MARBEF (Marine Biodiversity and Ecosystem Functioning), UNESCO Floating University, and NATO (North Atlantic Treaty Organization), ASI (Advanced Study Institute),and ARW (Advanced Research Workshop).

Information exchange within the network should be achieved through a dedicated IMBER Web portal comprising, amongst other topics, information about capacity building measures. The Web portal of the European network of excellence MARBEF (www.marbef.org) provides is a good example of such a system. Smooth information flow on capacity building initiatives that fall within the scope of IMBER must be ensured. It is recommended that all capacity building activities undertaken by IMBER, including all participants, be documented, to ensure that any future analysis of such activities can be done efficiently and collaboratively.

1.2 Scientific significance and objectives of this activity

Marine research requires expensive infrastructure and training, which many developing countries cannot afford. Consequently, collaboration, technology sharing and capacity building are needed. Several mechanisms have been used in an attempt to enhance research capabilities globally.

In order to enhance IMBER science in the Asia-Pacific region, an international workshop was convened to assess capacity building activities for the implementation of IMBER science. The main objective of this workshop was to provide IMBER, relevant agencies, and decision makers with a scientific basis for developing a capacity building strategy to enhance integrated marine biogeochemistry and ecosystem research in the Asia-Pacific region and to assess the efficacy of previous capacity building activities. This is a cost-effective way of evaluating important lessons that have been learned from capacity building efforts that have already been implemented by international projects in the region, and identifying the gaps and critical development issues that still need to be addressed. Practical suggestions resulting from this workshop will be published and distributed widely to enable the relevant agencies and projects to develop appropriate capacity building strategies. It will improve the situation for scientists from many developing countries in the region and ensure that they are able to contribute to the global effort to understand, predict and mitigate the impacts of global change. It will also contribute to the global effort of capacity development for marine research.

2.0 Methodology

The main activity was a workshop/meeting involving participants from counties in the region with interests in marine research, together with representatives of IMBER and international agencies with expertise and experience in capacity building for marine research. Regional participants were selected on the basis of their actual or potential involvement in marine research and knowledge of relevant capacity building in the Asia-Pacific region. These participants covered a geographic area from the Pacific Islands to East Africa. Prior to the workshop, participants were involved in planning the agenda and meeting format through a questionnaire developed and circulated by the workshop secretariat. The meeting opened with discussion of the goals and activities of IMBER, a review of its objectives, and an overview of capacity building concepts and processes. This was followed by a series of presentations from all participants, including reports on current activities, limitations and opportunities in the various countries represented, IMBER operations and activities relevant to the region, ongoing or planned capacity building, and mechanisms for capacity building. These presentations were aimed at providing information required for an evaluation of recent activities and an analysis of capacity needs.

Capacity building needs assessment workshop participants (30 July-4 Aug, 2012, ECNU, Shanghai, China)

Professor Jing Zhang (left), chair of IMBER capacity Building Task Team, convened the workshop and Professor Yunxuan Zhou (right) director of SKLEC, ECNU gave a welcome speech (31 July, 2012)

The presentations were followed by a roundtable (plenary) discussion of the issues raised. It was recognized that a wide diversity of issues required attention and development and prioritization of future capacity building needed attention from different perspectives. As a result, it was decided that the development of proposals for future action should be developed in two complementary working groups – the first group involving the regional country representatives, 7 participants from 7 countries of the region (China, Cambodia, Korea, Thailand, The Philippines, Pakistan, Russia), in

addition to representation from small island countries of the Pacific, who would consider the recognized needs and try to produce an integrated and prioritized listing – and the second group involving participants from IMBER and related international programs who would consider the presented information in the light of perceived international program activities and needs. The regional group developed a set of tables that summarized recent regional capacity building activities in marine science, defined priority needs in terms of social and economic priorities in relation to marine science research, and a listing of preliminary capacity building needs relating to aspects of the IMBER prospectus. The international group reviewed global capacity building problems and challenges of marine science, listed existing international resources for capacity building, and provided suggestions particularly to IMBER on how to enhance capacity for marine research.

Following the discussions within the two groups, the participants met in a plenary session to consider outcomes and develop an agreed integrated set of future actions. The participants then prepared this written report summarizing their individual contributions along with the summary outputs of both the group and plenary discussions.

Group discussion on 1-4 August 2012 in Shanghai

Small group meeting on 25-27 May 2013 in Shanghai

3.0 Results & Discussion

3.1 Summary of presentations (International organizations)

3.1.1 IMBER capacity building to date

Julie Hall

An overview of the IMBER Themes, Issues and Key Questions was presented to ensure that all participants were familiar with the scientific focus of the IMBER project. A review of IMBER capacity building activities to date was then presented. These included both capacity building activities that have been embedded into wider IMBER activities and those that have had a specific capacity building focus. The embedded activities have primarily been associated with the IMBER IMBIZO (a Zulu word for gathering) series of conferences. At each conference, both young scientists and developing country scientists have been supported to attend and participate. For each of these conferences approximately 15% to 20% of the participants have been either young and/or developing country scientists. At each of the IMBIZOs there have also been data management workshops to provide training for all levels of scientists in data management requirements, particularly for ship-board activities. The specific capacity building activities that have been conducted to date have been focused on summer schools involving students and young scientists from both developed and developing countries. There have been 4 IMBER summer schools since 2008:

- ClimECO I: Climate Driving of Ecosystem Change (April 2008, Brest, France)
- E2E Ecomodel: Analysis of End to End Food Webs and Biogeochemical Cycles (11-16 August 2008, Ankara, Turkey)
- ClimECO 2: Oceans, Marine Ecosystems, and Society Facing Climate Change: A Multidisciplinary Approach (23-27 August 2010, Brest, France)
- ClimECO 3: A View Towards Integrated Earth System Models: Human-Nature Interactions in the Marine World (23-28 July 2012, Ankara, Turkey)

Together, these summer schools have trained 194 young scientists, which 56 of them were from developing countries.

3.1.2 Capacity building for marine sciences: new challenges and new opportunities

Bernard Avril

The presentation provided general background information about definitions of CB used by many practitioners in the field, about what CB is in the context of marine research and education, and what and whom CB is intended to target. Some considerations were introduced about why CB is needed for marine research initiatives and organisations, especially for addressing specific challenges related to “Human” (with individual and team-building aspects), “Organisation” (with research infrastructure and support) and “Institutional” (with relevance to governance). It was recommended that the current CB practices, achievements, and needs for marine research and education should be examined and evaluated regionally and globally. Some suggestions were offered about how CB could be used, and about how it could be improved, especially in marine sciences, using a few examples, such as those associated with marine protected areas. Possible improvements of the CB activities and their impacts within the IMBER project were suggested, for instance by considering that CB is a key priority to help address issues associated to the “human

condition in a changing marine environment"; by promoting links to practitioners at the local and regional levels and to private companies and foundations for securing additional support; by monitoring the CB impacts and 'value for money' with respect to the IMBER scientific goals; and by establishing a long-term CB strategy with clear goals, incentives, genuine engagement of actors and stakeholders, and "good practice" guidelines. Finally, it was suggested that CB activities in IMBER should be also considered, when needed, within the emerging research framework linked to the "Future Earth" initiative and the Belmont Forum activities.

3.1.3 APN and its role in capacity building

Xiaojun Deng

The Asia-Pacific Network for Global Change Research (APN) is an inter-governmental network established in 1996 to promote global change research in the region, increase developing country involvement in that research, and strengthen interactions between the science community and policy-makers. The strategic goals of the APN are to 1) support regional cooperation in global change research on issues particularly relevant to the region; 2) strengthen appropriate interactions among scientists and policymakers, and provide scientific input to policy decision-making and scientific knowledge to the public; 3) improve the scientific and technical capabilities of nations in the region, including the transfer of know-how and technology; and 4) cooperate with other global change networks and organizations within and outside of the region.

Since its inception, capacity development and enhancement have been an important part of APN's strategic goals. In 2003, the APN initiated CAPaBLE, a stand-alone programme on capacity building in response to the Johannesburg Plan of Implementation of the World Summit on Sustainable Development in 2002, which has since become a major pillar of APN's activities. The scope of activity under the CAPaBLE programme spans across the full spectrum of global change research, and covers scientific capacity development, science-policy interfacing, awareness raising and knowledge/information dissemination, among others. Regarding research on the marine domain, the APN has established partnerships with many research institutions and initiatives, including IOC/WESTPAC, UNEP/NOWPAP (United Nations Environment Programme Northwest Pacific Action Plan), IMBER, LOICZ, etc., to support and foster cross-border collaborations in investigating, understanding and predicting changes in the marine domain in the Asia-Pacific region, of which capacity building is an important component. A data base of past and ongoing APN research and capacity building activities can be accessed through the APN website at http://www.apn-gcr.org/resources/.

3.1.4 How can international research projects stimulate regional capacity building?

Ed Urban

Why should temporary international research projects be involved in capacity building (regional or global)? Capacity building requires scarce project resources (staff time and project money), so there needs to be good project-relevant justification for project capacity-building activities. The major goal of project-oriented capacity building should be that it will help the project meet its research goals by developing the human resources needed for the project to succeed. An implication of this view is that the capacity-building activities of a project will probably vary over time, with perhaps more emphasis on basic training in project science at the beginning (e.g., through summer schools and

ship-board training) and more emphasis on capacity-building activities that assist in project synthesis in the middle to late phases of the project. Capacity-building activities can be designed so that they benefit early-career scientists from all countries and help scientists from developing and developed countries learn and work together.

How can international projects help regional ocean science communities?

1. Create global capacity-building activities that benefit all regions to some extent.
2. Identify activities that would benefit specific regions that are most important to the scientific goals of the project. Did the project science plan identify any special research regions? Any cruises or process studies in developing regions?
3. Use opportunities that arise because of resources in developing regions that can be accessed by science steering committee members or other participants in the project.
4. Access resources of developed country scientists involved in the project to provide capacity building that does not require money or time from project staff.
5. Access resources of other organizations that specialize in capacity building, for example, SCOR, POGO, IOC, APN, IAI (Inter-American Institute for Global Change Research), START, etc.

What can be done to advance the capacity for ocean science in a specific region?

- Assess needs: What areas of ocean science capacity need to be built in the region? It is important to identify needs shared by several countries.
- What capacity-building activities are already being carried out by national, regional, and international organizations in the region?
- How can the existing approaches be combined on a regional level?
- What new approaches need to be developed where existing approaches are not adequate?
- The SCOR concept of regional graduate networks for oceanography (see http://www.scor-int.org/RGSO_Design_Principles.pdf) offers ideas for how national institutions might share resources in virtual networks.

3.1.5 POGO capacity building

Francis Gerry Plumley

A central element of the POGO agenda is capacity building and training. POGO has developed an extensive array of training and education activities, targeted primarily at scientists from developing countries and those with economies in transition.

- **Visiting Fellowship Programme on Oceanographic Observations:** In partnership with SCOR, POGO runs a program that permits young professionals from developing countries to spend up to three months training in their specialty at a major oceanographic institution. This programme has been very successful in providing training for scientists and students from developing countries as well as in developing collaborations between institutes.
- **Visiting Professorship Programme** under which marine scientists of international standing teach at marine institutions in the developing world for periods of up to three months. This exposes young scientists, particularly from developing countries, to the best oceanographers world wide and facilitates the formation of professional contacts, invaluable in the development of their scientific careers.
- **Centre of Excellence in Ocean Observations (CofEOO):** In collaboration with the Nippon

Foundation, POGO established the CofEOO at the Bermuda Institute of Ocean Sciences. This is an intensive training course for young professionals at the doctoral level, ten months in duration, with training of 10 individuals per year.

- **A Regional Training Programme in a Developing Country** is offered as one component of the CofEOO. This programme is modeled after the Visiting Professor Programme in goals and strategies.
- **Visiting Fellowship Programme** for on-board training on Atlantic Meridional Transect (AMT) cruises is also offered. This provides the opportunity for a scientist from a developing country to participate in cruise preparation and planning, to help make hydrological, biological and ecological observations on board the ship, and to analyse and statistically interpret the results after the cruise.
- **Austral Summer Institutes (ASI)**: POGO contributes to ASI, which takes place at the University of Concepcion in Chile around December-January every year, for training of students from countries from South America and beyond.
- **Postgraduate Bursary for study at the University of Cape Town**: POGO has supported one student from Africa every year to study for a Master degree in Applied Marine Science at the University of Cape Town since 2009.
- **Phytoplankton identification**: Since 2012, POGO has offered a grant for a young scientist to work with the Sir Alistar Hardy Foundation for Ocean Science (SAHFOS) to learn phytoplankton identification.
- **Nippon Foundation – POGO Alumni Network for Oceans (NANO)**. NF-POGO has trained more than 200 students since 2005; a major goal of both NF and POGO has been networking. NF-POGO alumni are the future leaders in their field and collectively, they can tackle the issues facing oceans and society today and in the future.

  The goals of the network are:
  - to maximize the benefits to the alumni from the training received
  - to facilitate active contacts among alumni and with the faculty
  - to promote joint research activities that will build on the training

In total, POGO offers many capacity building programmes that may serve as useful models for IMBER and/or in which IMBER may which to partner.

(Region/countries)

3.1.6 Empowering countries in the Western Pacific sustainably develop their marine and coastal resources---WESTPAC's capacity building efforts in marine sciences

Wenxi Zhu

The Western Pacific region is of vast social and economic importance, with more than 70% of its population living in coastal areas and relying economically on coasts and oceans, and more than half of the world's annual merchant tonnage traversing the area. Meanwhile, the ocean in the region is among the richest and most productive in the world as a home to some 70% of the world's coral species, and is universally recognized as a major influence on the global climate system.

Any additional delay in building relevant capacity in marine management and research will result in greater risk of destruction from ocean hazards, irreversible damage to ocean resources, and loss of resources of wealth for future generations. IOC/WESTPAC has been making remarkable efforts to build the scientific capacity of countries in the region to address their priority concerns, through a series of training activities, on harmful algal blooms, toxic marine organisms and marine invasive species, WESTPAC International Scientific Symposia (Young Scientists Travel Support and Best Young Scientist Award), Summer School on Monsoon Onset and its Social & Ecosystem Impacts (MOMSEI Summer School), Training Through Research, Training at Sea, IOC Regional Network of Training and Research Centers on Marine Science, Regional concerns include climate change and variability, natural hazards, and health of marine ecosystems, among others.

Details were also given on the methodology employed by WESTPAC to build capacity, with focus on early-career scientists in the region. The triennial WESTPAC International Scientific Symposia (since 1989) and the newly initiated "IOC Regional Network of Training and Research on Marine Sciences" were highlighted to demonstrate how WESTPAC empowers countries in the region to sustainably use their coastal and marine resources by encouraging "self-driven" capacity-development in the spirit of "South-North" and "South-South" cooperation.

3.1.7 CB in the Pacific islands region

John Morrison

The Pacific Islands region is dominated by oceanic influences; it includes 22 small island countries, and covers a region of about 20 million km^2, but with a land area of about 500,000 km^2. The countries are generally small, ranging from Papua New Guinea at 470,000 km^2 down to Tuvalu and Tokelau at <50 km^2. The total population is about 10 million. Five "metropolitan" countries (Australia, France, New Zealand, USA and UK) are also involved in relevant regional activities. Marine research activity, although limited, is undertaken through universities and government agencies, as part of regional organization programs, and in NGO operations. The main regional organizations are the Secretariat of the Pacific Community (SPC – Fisheries Division and Applied Geoscience and Technology Division), Secretariat of the Pacific Regional Environment Program (SPREP) and the Forum Fisheries Agency (FFA). A range of activities occur in or adjacent to the region; for example, Australia and New Zealand have a full spectrum of research infrastructure and offer opportunities for Pacific Island researchers/students; France, through UFP (University Foundation Programme), IRD (Institut de Recherche pour le Développement), CRIOBE (Insular Research Center and Environment Observatory), IFREMER (French Research Institute for Exploration of the Sea) in New Caledonia and French Polynesia, undertakes a wide range of marine research activities; Papua New Guinea through universities and some government projects; Fiji has the University of the South Pacific (USP - Laucala), plus limited government activity (Fisheries, Environment); Guam through the University of Guam, and some USA federally funded activities, for example, through the U.S. Geological Survey/Department of the Interior/NOAA (CRI). In countries like Samoa, Tonga, Solomon Islands and Kiribati, there are well-trained people/tertiary institutions capable of good research, but lacking funding and facilities.

A range of CB activities (uncoordinated) is occurring in the region, including postgraduate/undergraduate research, regional agency activities – mainly applied, government

officer training – often done regionally or sub-regionally, plus NGO programs and overseas training. No assessment of the overall effectiveness of such capacity building has been conducted, but individual activities are often assessed. Limitations include universities in the region not having marine biogeochemistry as a high-priority theme and even ecological work does not always receive high priority. Funding for all marine research work in the region is limited, especially long-term options. Employment opportunities for researchers in this field in the Pacific Islands are restricted at present.

Capacity required includes skills to generate and interpret relevant information, linkage of research outcomes and benefits for local people and a balance between global scientific knowledge and local traditional knowledge. Several options are available, including linking with ongoing regional programs in both high-level research training and more practical aspects of marine environmental work, interacting with aid donors to try to add value to their activities; where possible, facilitate interchange of scientists within the wider region to broaden research experience, and develop twinning opportunities with external organizations (e.g., the USP/University of Victoria (Canada) partnership of the 1990s).

3.1.8 Capacity development for the provinces along the coastal areas in Cambodia

Chamroeun Pen

The Kingdom of Cambodia is 181,035 Km^2 in area and the coast of Cambodia is located along the Gulf of Thailand from the Thai border in the northwest to the Vietnamese border to the southeast. The coastal area includes several large bays, estuaries and 64 islands. The coastline of Cambodia is 435 Km long and extends across the provinces of Koh Kong, Kampot, Kompong Som and Kep. The Cambodian coastline includes sand, mud, rock, revetment and mangrove.

Mangrove forests occur in Cambodia's three coastal provinces on the Gulf of Thailand, Koh Kong, Kompong Som and Kampot; they are most abundant in Koh Kong. There are three main problems that harm the mangrove forest: (1) large amounts of charcoalare produced from mangroves, (2) mangrove areas have been invaded by coastal aquaculture farms, and (3) salt pans can deteriorate the soil, so that it can no longer grow mangroves. In order to have responsibilities for management, protection and sustainable use of the resources and environment, coastal management projects were established and supported by international donors and some NGOs: (1) Environment Management of Coastal Zone Project, (2) Integrated Coastal Zone Management, (3) the 5-year South China Sea Regional Project, (4) Participatory Management of Coastal Resources, (5) Commune- and Community-Based National Resource Environment Management. Finally, the Department of Forest attempted to control mangrove destruction by establishing three policies: (1) clearing of mangrove forests for charcoal/shrimp farming is prohibited, (2) wastes from shrimp ponds must be treated before discharging into the sea, and (3) shrimp ponds must be constructed at least 150 meters above the shoreline.

3.1.9 South Korean needs to build research capacity for understanding marine ecosystems using marine biogeochemical variables

Gi Hoon Hong

South Korean desires to build research capacity for understanding marine ecosystems using marine biogeochemical variables largely result from the need of quantitative and predictive understanding of the ecosystem changes occurring in the seas adjacent to Korean Peninsula. The seas have been reported to undergo rapid ecosystem changes due to both human impacts from the surrounding continents (increases in human population, inputs of plant nutrients and contaminants through the air and water, diversion of river flow, and fishing activities) and global climate changes (increases in air and water temperature, changed precipitation, acidification of the surface ocean and changing levels of macro-and micro-nutrients). At the same time, the seas are increasingly used by various stakeholders (vessel traffic, development of harbors, coastal urban development, aquaculture, marine tourism, reclamation, artificial habitat creation) at an unprecedented scale. The measurement of biogeochemical variables would certainly provide valuable information to understand in a quantitative way how ecosystems function in the seas adjacent to South Korea, for example, in transformation of organic matter in marine food webs, transfers of matter across ocean interfaces, material flows in end-to-end food webs, and sensitivity of these seas to global change (including fisheries) in order to sustain economic development in the country. Therefore, South Korea needs to develop its capacity to carry out IMBER-related research. Lack of scientific expertise domestically could be also complemented though networking with the Asia-Pacific regional pool of experts, as well as the global pool of IMBER experts. We welcome regional and global experts on specific scientific issues, such as scientific questions related to changing nutrient regime in the Yellow Sea and temporal variation of primary producers in the East Sea (Sea of Japan). South Korea also commits to share its expertise and laboratory facilities with countries in the region in the form of short-term scientific visits and on-the-job training for the longer term. A number of universities in South Korea including University of Science & Technology offers graduate studies in marine sciences to all nationals.

Country-based benefits from capacity-building to South Korea include the following:

- Enhanced ocean stewardship through ecosystem-based approach.
- Enhanced capabilities on adaptation and mitigation of the effects of climate change on oceans and coasts.
- Improved sanitary situation of the marine environment and seafood (fisheries) security.
- Enhanced effectiveness of the management of living marine resources and marine engineering intervention.
- Enhanced effectiveness of legal and institutional frameworks on the use of the marine area by incorporating the knowledge gained from the ongoing integrated marine biogeochemistry and ecosystem research.
- Supporting international ocean legal instruments.

3.1.10 Needs assessment of IMBER-related capacity building in China

Jing Zhang

China is one of the countries that have been involved in the SCOR/IGBP IMBER international activities since early this century. Based on the previous success of GLOBEC studies in China, the on-

going national 973-3 Project has a concrete research cluster of integrated research of biogeochemistry and ecosystem in marine environment for the period of 2011-2015. The implementation of the 973-3 project is focused on the East China Sea Shelf and marine aquaculture areas of North China. The work plans of the project include biogeochemical cycle of nutrients and trace elements and link to the food-web from microbial to top predators; the comparison of ecosystem functions between natural and cultural systems will be done through field observations, mesocosm experiments and data analysis, with outreach to the adaptive management at sustainable ecosystem level. The 973-3 Project pays attention to capacity building along with the implementation of research foci, including training activities of postgraduate students (i.e., MSc and PhD) and young scientists through lectures and on-board research activities and participation in international conferences. In this presentation was reported the questionnaires and statistics of information from postgraduate students and early-career scientists and feedback from trainees of a number of several international training courses. The statistics were gathered from students from OUC, ECNU, YSFRI, as well as trainees from the China-Japan-Korea 5th GLOBEC-IMBER Workshop and training courses (Shanghai, 22-25 November 2011) and IOC/WESTPAC Training Course on Ocean Dynamics (Qingdao, 16-22 July 2012). The suggestions and feedback from the participants of these two training activities can be summarized as below:

- Trainees prefer lectures plus hands-on activities that allow young people to become familiar with instrumentation and infrastructure of field work.
- There is a need to maintain close relationship between trainers and trainees, especially intellectual communication related to the courses.
- With regard to the levels and scope of lectures, it is suggested to match the background of trainees' education level to the course content, to maximize the output.

A survey of the post-graduate students and young scientists from ECNU, OUC and YSFRI indicate that the previous experiences of participation in international meetings and training activities are not evenly distributed among the people involved, depending on the ability of students and their supervisors to attract resources for meeting participation. Some of the students have participated in several international meetings and/or training opportunities, whereas others may not aware of any IMBER-related international events for training activities and scientific conferences.

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3.1.11 Harnessing and consolidating regional strengths for capacity enhancement

Laura T. David

The research capacities in the Asia-Pacific region are of different levels and depth. A pathway of going from a heterogeneous capacity to a comparable capacity to an enhanced capacity is proposed to harness regional strengths for marine capacity enhancement (fig 1). There are two major phases to this endeavor. At the "Catch Up" stage the recommendation is to harness regional strengths and make use information technology tools (e.g. Learning Activity Management System, LAMS) and hands-on trainings (NF-POGO training) to bring targeted audience to a comparable capacity. The LAMS series of lectures can be open to the public and only those who successfully finish the lectures

(i.e. pass a quiz at the end of each module) will be encouraged to apply for the hands-on training. This way the contact hours for the hands-on trainings can be kept to an efficient minimum since all the chosen participants will already have the requisite technical background.

The "Capacity Enhancement" stage should start with collaborative research of all the regional institutions that participated in the "Catch Up" Phase. Capacity Enhancement then could be done through actual regionally relevant research. At the same time, the end - of - training deliverable will include internationally refereed publications and proposals for future collaborations. A good example for such collaboration is IRD LMI (The French Research Institute for Development - International Mixed Laboratories Program), a collaborative research program between IRD and research institutes and universities aimed to develop and consolidate multidisciplinary research and educational capacities. Another phase of the "Capacity Enhancement" stage is continued mentoring, which can be done through LAMS or MOODLE (Modular Object-Oriented Dynamic Learning Environment). The ultimate goal of the capacity enhancement pathway is that these regional institutions will continue to work together on collaborative research and they can be tapped for future capacity enhancements of other institutions.

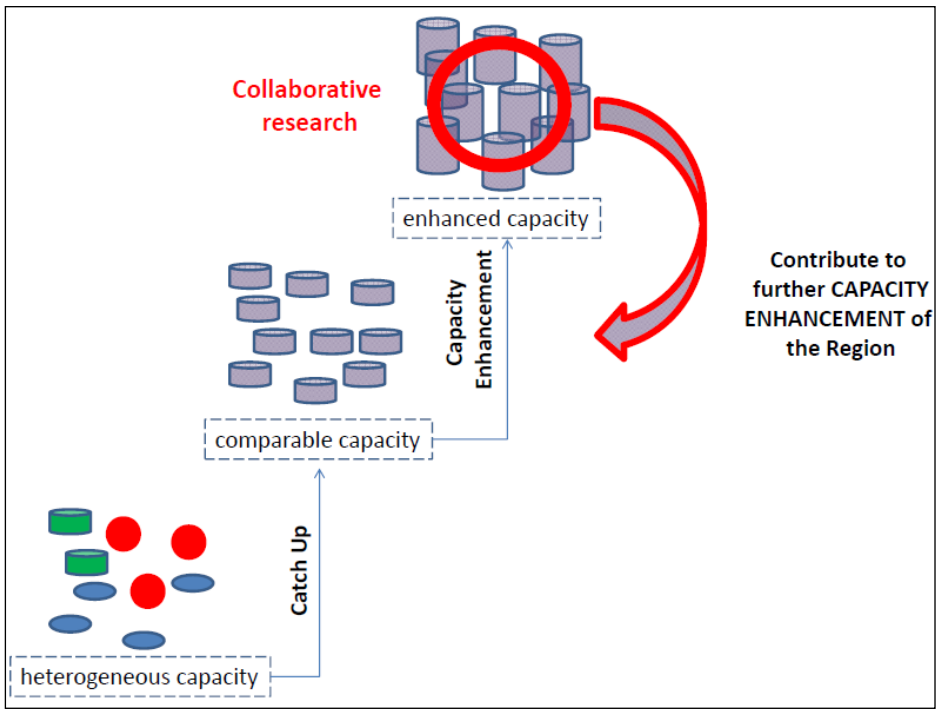

Figure 1. Illustration of a pathway on capacity enhancement in the Asia-Pacific region.

3.1.12 Capacity development in Philippine marine science

Maria Lourdes San Diego-McGlone

With a long coastline of 36,289 km and 74% of the Philippine's 95 million people living in coastal areas, the marine environment contributes to the sustainable development of the country. The Philippines is also a "hotspot" of marine biodiversity. However, the marine environment is faced with various threats from anthropogenic activities and climate change. Given the significance of marine ecosystems to the country, there is a need to develop capacity in marine science and technology in the Philippines.

One mechanism for capacity development in the Philippines is through academic institutions such as the Marine Science Institute of the University of the Philippines. This Center of Excellence in Marine Science offers MSc and PhD degrees in Marine Science with specialization in Marine Biology, Marine Physical Science, and Marine Biotechnology. Training programs on culture technologies, resource and habitat restoration management technologies, coastal resources assessment and management, climate adaptation, and science education are conducted at the marine station of the institute. There are 20 other government and private institutions with marine biology/marine science programs at the BSc, MSc, and PhD levels. The challenges faced by these institutions include increased recruitment of students, improvement in graduation rate of students, re-tooling of faculty to pursue PhD degrees, increased funding for infrastructure (facilities and equipment for research) and support (repair and maintenance; laboratory technicians), and access to on-line resources or e-journals.

Another mechanism for capacity development would be national agencies and analytical service laboratories that offer training on skills for chemical analysis and instrumentation. These training programs are limited in scope and will not include information on the marine environment. Capacity building can come through projects that are national in scope. The ICRMP (Integrated Coastal Resource Management Project) establishes ICRM Centers at academic institutions whose goal is to provide technical assistance to the local governments and other stakeholders in the coastal zone. The CTSP (Coral Triangle Support Partnership) capacity building activity is a university mentoring program where there is transfer of knowledge from the Centers of Excellence to other institutions, which can then assist local government units in biodiversity conservation and coastal zone management. The project on coral reef-targeted research and capacity building for management covered coral taxonomy, diseases, and connectivity studies. On a regional scale, PEMSEA (Partnership in Environmental Management for the Seas of East Asia) organizes training on coastal land and sea zoning, habitat zone development and management, preparation of state of the coast reports, among others. Training manuals are produced by PEMSEA. For these project-based capacity building efforts, an assessment of their usefulness and effectiveness is important. Moreover, proper motivation, opportunities, and support are needed by those who received capacity development.

3.1.13 Marine science in Pakistan: situation analysis and need assessment for capacity building

Samina Kidwai

Pakistan lies in the Northwest Indian Ocean forming the Arabian Sea, with a coastline of more than 1,000 km and an EEZ of about 240,000 km2.The coastal areas are influenced by two annual monsoon cycles, resulting in unique and complex oceanographic features of wind and surface water circulation. The coastal areas are formed by the Indus delta on the east coast with a broader shelf area, contributing to the country's fishery productivity.

Fisheries productivity further sets criteria by which capacity building is assessed via individual, organizational, and institutional factors. Key capacity building factors were identified as political will and strategic intent, establishment of an overall national policy or direction (short- to long-term), a collective and coordinated management strategy, institutional capacity building, strengthening the

technical and professional capacity in research institutions, and motivation and morale building of researchers. A list of research and academic institutions involved in the marine scientific research in the country with their current human resource capacity was presented. And finally, a strength-weaknesses-opportunities-threats (SWOT) analysis of the National Institute of Oceanography was presented, at the individual, organization, institution levels, with reference to capacity building, demonstrates alignment and validity of the 2003 assessment.

3.1.14 Capacity building and research needed for marine science in Thailand

Thamasak Yeemin

Marine science studies have been conducted in Thailand for more than a century. In the past, joint expeditions with Denmark and the USA provided basic knowledge in marine science, as well as capacity development. Several marine-related bilateral or multilateral academic collaborations have been successfully carried out, such as NRCT (National Research Council of Thailand)-JSPS (Japan Society for the Promotion of Science) cooperation, ASEAN-Australian project and UNESCO-IOC-WESTPAC. Most studies have been limited to inshore areas because of a lack of research infrastructure and financial support. Several universities offer bachelor, master and doctoral degrees in marine science-related fields. The universities and some government agencies also conduct training courses in marine science-related aspects and enhance capacity building in various ways. Limiting factors to the professional development of early-career marine scientists include limited research grants, research facilities for working in the offshore, opportunity for collaboration with advanced oceanography institutes and “brain drain”. High-level policy makers need to pay more attention to marine research. Economic values from marine research must be explained clearly. The capacity building for marine science studies should focus on research equipment/facilities, advanced technology sharing, exchange of researchers, maintaining resource persons, regional training centers and research funds. High priorities for research relate to various aspects of physical oceanography, chemical oceanography, marine geology, advanced biology of marine organisms, marine ecosystem processes and disaster management and recovery.

3.1.15 Key marine ecological issues in Russian Far East and Requirements for capacity building

Vyacheslav Lobanov

Marine research in Russia is conducted by various organizations which are part of Russian Academy of Sciences (RAS), Russian Hydrometeorological Service (RHS), Russian Fisheries Agency (RFA), Ministry on Environment, Ministry of Defense and the universities. In the Far Eastern area the main group of organizations is located in Vladivostok (e.g., V.I.Il’ichev Pacific Oceananological Institute of the Far Eastern Branch, RAS; Far Eastern Regional Hydrometeorological Institute, RHS; and Pacific Fisheries Research Center- TINRO, RFA) while there are smaller institutes located on Sakhalin Island, Kamchatka and Magadan. Among the recent research activities related to IMBER are studies of the Far Eastern Seas, such as rapid variability of the Japan Sea environment; gas hydrates and related methane fluxes in the Okhotsk Sea; environmental changes and methane in the Eastern Arctic ocean; consequences of Fukushima radionuclides input, as well as research of coastal waters and ecosystem such as Amur River impacts; recent increase of eutrophication and hypoxia formation in the Peter the Great Bay, Japan Sea; invasive species; red tides; etc. The marine research and education system in Russia is still in transition from the old model to a new one. Even having a large

number of well-trained and experienced specialists, there is a delay in reformation of the funding system, developing infrastructure necessary to conduct contemporary research, acquiring modern oceanographic equipment and analytical facilities, adopting available methods and technologies, and increasing the level of education in marine sciences. To conduct efficient IMBER-related research in the near future would require development of capacity to measure and study bioorganic tracers, isotopes and rare earth elements (REEs), and atmospheric chemistry, as well as oceanographic instrumentation and sustainable observing systems. Recent progress in creation of high technology centers in the country, as well as expected changes in the higher education (system) and universities, could improve capacity in marine sciences. Establishment of the Far Eastern Federal University in Vladivostok (expected to enroll 50,000 students) will increase the number of young scientists and international collaboration in the area. More involvement of Russian organizations and experts in global marine research activities and closer international cooperation would help develop the field more efficiently.

3.1.16 Capacity building in Chile, a history of success: the Austral Summer Institute

Carina Lange

Capacity building at the graduate level

The Austral Summer Institute is an activity that has resulted in an effective means of building human capacity in marine sciences for the South American region, giving the opportunity to students from the region to interact with renowned scientists lecturing at the University of Concepción. The ASI provides the venue for this interaction. Over the past decade, 699 students from Latin America and elsewhere have attended ASI, having the chance to interact and discuss a variety of topics with more than 100 renowned professors and leading scientists from around the world. There have been 12 ASIs since the creation of this activity in January 2001. Until 2010, most of the ASIs were held at the Marine Biological Station in Dichato. After the destruction by the earthquake and tsunami of 27 February 2010, the ASI was moved to the UDEC campus, and one module (ECODIM) was taught at the new Coastal Station ECIM of the Catholic University in Las Cruces. The ASI effort has always been organized by the Department of Oceanography and the Center for Oceanographic Research in the eastern South-Pacific (COPAS) of the University of Concepcion.

IMBER has sponsored (with US$2,000 each time) the following ASIs:

- ASI VII (January 2007) Methane biogeochemistry and geophysics & Remote Sensing and Ocean-Land interaction
- ASI VIII (January 2008): Topics on Automated plankton recognition, sediment biogeochemistry, microbial oceanography and oceanography and climate change.

Capacity building and outreach and the school level in the Chilean Patagonia

We have implemented a successful program among the public schools of Coyhaique, Puerto Aysén and Caleta Tortel (Patagonian fjord area). Priority was given to support non-formal education of marine-related content with out-door activities carried out in the Aysén fjord, a circuit of lakes and rivers near Coyhaique and the Baker River-estuary corridor. Lesson plans were developed for middle schools and workshops for teachers were taught by an interdisciplinary team which included marine biologists, science teachers and a journalist. Initial steps were advanced with fjord education specialists in Fjordland, New Zealand and Resurrection Bay in Alaska for the creation of a Fjord Education Center in southern Patagonia.

A professional training internship was developed for school science teachers with an interest in applying marine contents to the pre-established science curriculum based on the 7 essential principles of ocean literacy. This program was borrowed and worked on with colleagues from the Center for Ocean Science Education Excellence (COSEE) in the United States, as part of our partnership with the U.S. National Marine Educators Association (NMEA) and the International Pacific Marine Educators Network (IPMEN). We provided translation to Spanish of literature, curricula and lesson plans written in English. To apply this knowledge to the fjord context, several out door science initiatives were developed in partnership with county and regional governments (Tortel, Puerto Cisnes, Coyhaique), the Ministry of the Environment, the EXPLORA-Conicyt national funding program, the Center for Research of Ecosystems in Patagonia (CIEP), the Chilean Navy, and a prime Chilean NGO for empowering the people to conserve aquatic environments, AquaSendas. Fostering international collaboration has been part of our endeavors as we recognize the work done by marine educators around the Pacific Rim in creating awareness and action plans to involve the citizenry in marine conservation practices. The International Pacific Marine Educators Network (IPMEN) has chosen the Chilean Patagonia as the place for their next Conference, the first one in a Latin American country, to be held in November 2012.

Three outreach programs were implemented in the Chilean Patagonia: i) “School on Board” based in the Aysén Fjord; ii) “World Water Monitoring Challenge”, a water monitoring network of lakes, rivers, waterfalls and fjords in the region; and iii) “School Science Research” to improve interest among the young generations for Science and Technology.

3.1.17 Capacity development in marine sciences in Tanzania

John Machiwa

Marine science studies at the University of Dar es Salaam started in the late 1970s. Currently, there is a Department of Aquatic Sciences and Fisheries as well as the Institute of Marine Sciences, which both deal with research and training in marine affairs in Tanzania. The Western Indian Ocean (WIO) region, comprised of eight countries including Tanzania, through the support of UNEP and GEF in 2008, identified the following problems and issues that are common to the WIO region which needs national or at best regional approaches for intervention and/or restoration measures:

- Water quality and sediment quality degradation, focusing on microbial contamination, high suspended solids, chemical pollution, marine litter and nuisance/toxic algal bloom.
- Physical alteration and degradation of habitats resulting from destruction of mangrove forests, destruction of seagrass beds, destruction of coral reef ecosystems, destruction of coastal forests and changing of shorelines, which has severely impacted fisheries and marine life for both commercial and non-commercial species.

The University of Dar es Salaam offers undergraduate and postgraduate training in most disciplines of marine sciences except for specialized topics such as remote sensing. Therefore, the University of Dar es Salaam is capable of conducting research in the near-shore coastal areas; however, it is crippled by inadequate capacity in human resources, research facilities and funding. Support for capacity development from international organizations is needed in order to enhance training, research and community service in marine environment and fisheries issues.

3.1.18 Human capacity development in marine sciences in Turkey at national and international levels

Temel Oguz

Capacity building demands long-term concurrent efforts performed both at national and international levels, and needs motivation to CB activity from individuals and institutions. However, CB objectives and targets are various and need to be specified for countries having different levels of economical and social development. The presence of a certain level of infrastructure in the country (e.g. Lab facilities, research vessels, technicians, and scientists) may facilitate better CB efforts. Success on the CB is also closely related with whether the research on marine sciences is recognized among strategic priorities by governments (e.g. Long-term commitments for funding, positions, etc). The highly interdisciplinary approaches of marine research makes CB a more challenging issue as the gap in marine science research between developed and developing countries widens more and more.

At the national level, for example, the Institute of Marine Science at Middle East Technical University serves for a Center of Excellency for providing training for other less developed institutions in the country through summer practices for undergraduate students, technical training on lab facilities, measurement methodologies, MSc and PhD education, organizing conferences on the country level, helping on scientific paper writing at international level, providing informal mentoring, and promote joint projects with other institutions funded by Turkish Scientific and Technological Research Council (TUBITAK). One of the major CB efforts at the international level in Turkey is considered of organizing summer schools as a part of large international programmes in the form of high-level teaching activities (e.g. theoretical courses and practical workshops). Numbers of such summer schools have been held since 2002 by the international programmes, such as, North Atlantic Treaty Organisation, IMBER, and European Coastal Sea Operational Observing and Forecasting System programme (ECOOP). Other CB efforts include supporting students and early carry scientists to participate international conferences, participating international projects (mostly EU Framework projects), sending students abroad for PhD, developing collaborations with well-known institutions in USA and Europe on specific problems and projects, and interacting among Inter-Islamic Network on Oceanography (INOC) member institutions.

3.2 Problems and needs identified in global-regional groups

3.2.1 Marine CB problems and challenges in a global remit

Two inter-locking challenges complicate the role of international research projects in regional capacity building: creating regional capacity building activities from a global project, and creating long-term, sustained efforts from a temporary project. Different approaches (including through incentives, evaluation, follow-up, legal framework) are needed to deal with these two issues.

Indeed, the global but temporary nature of international research projects, such as IMBER, creates challenges for stimulating global and regional capacity building, which typically must be long-term, sustained, regionally focused efforts, to be successful. However, international research projects have been able to transcend this limitation to be important for stimulating regional capacity building in ocean science.

Capacity building and development can be sub-divided into "Human Capacity Building" (with individual and team-building aspects), "Organisational Capacity Building" (with research infrastructures that support observations, monitoring and 21 organizational capabilities) and "Institutional Capacity Building" (with relevance to responsibility, planning, accountability, transparency, conflict resolution, etc.). An analysis should be conducted of the current CB/CD practices and achievements regionally and globally, as well as the corresponding needs. Suggestions and recommendations for improvement of the CB/CD activities and initiatives relevant to marine research and education should be developed and implemented.

Finally, in addition to the problems associated with the requirement for different approaches for global and regional CB activities, other types of constraints and challenges are also worth mentioning in relation to the overall objectives of projects such as IMBER and other international programme. Namely, IMBER and other research projects could help improve human well-being (condition in which all members of society are able to determine and meet their needs and have a large range of choices to meet their personal and collective potential) and ecosystem well-being (condition in which the ecosystem maintains its diversity and quality and its potential to adapt to change and provide a viable range of future choices and opportunities). Capacity building activities for marine research should also consider the following issues:

- New research questions emerge that represent global challenges, and can be especially difficult to address for specific regions. Specific examples include resilience in the Anthropocene; co-design of adaptation/mitigation strategies; and transitions towards sustainability.
- New, specific tools that need to be developed and promoted. For example, marine protected areas as a means of ecosystem conservation; new ecological fishing gear and practices; and vulnerability maps.
- New management approaches. As research data emerge and evidence-based information becomes available, management approaches need to be adapted. Specific examples include adaptive management; co-management; participatory research/management; and risk assessment.
- Globalisation/competition for innovation, and need for better governance of human–nature interactions, and of innovative, sustainable uses of marine and coastal resources. Specific examples include integrated environmental assessments; cross-sectoral approaches; and cross-cultural cooperation.
- New lines of research funding to be identified and nurtured. Specific examples include new public–private co-funding schemes; new research programmes/priorities within existing governmental funding agencies; and sharing of ship-time and equipment.

3.2.2 Mapping Ongoing Regional /National CB Activities on Marine Sciences

Table 1 summarizes some of the capacity building activities (academic to hands-on type) in marine sciences (individual level- transgressing into the national capacity building initiatives), over the last 5 year period (2007-2012).

The overall synthesis suggests that there are some capacity building initiatives in these countries supported nationally, either built into projects, or through regional and international agencies. Obviously, these do not meet the tremendous need for capacity development. National institutions,

both academic and research/development, offer capacity building in the form of academic enhancement, short training courses, on the job training, “one-to-one” training, etc., but there is a range of disciplines that remain completely unaddressed. Integrated and multi- or cross-disciplinary research and approaches need much attention at national and regional levels. Regularity and continuity of capacity enhancement efforts is also much emphasized.

At the national level, a strategic, structured and systematic approach is somewhat lacking and most institutions do not conduct assessments based on the researchers’ or organizations’ needs. They are constrained heavily on “when and what” becomes available, not necessarily covering the capacity enhancement needs of individuals or organizations and obvious gaps exist. On a regional level, countries may not necessarily be at the same level of capacity building opportunities. The reach and scope of national, regional and international institutions is limited and therefore does not always trickle down to where it is actually most required.

The issues that are common to the region include maintenance of a “critical mass”; “brain drain” attracting students into marine science-related careers; individual, professional and infrastructural support; motivation to continue in these professions; and opportunities for growth for young and mid-career professionals.

Table 1. Template (with examples) for Mapping International, Regional, National CB Activities on Marine Sciences in the Asia-Pacific region

Organisations, Initiatives	Types of CB activities	CB Domains of Focus	Recipient	Geographic Coverage	Format, Characteristics	Funders
1. **Intergovernmental Body**: e.g., UNESCO / IOC Sub-Commission for the Western Pacific; IOC-WMO Regional Marine Instrument Center for the Asia and Pacific 2. **National Agency relevant to Marine Research and Education**: e.g. State Oceanic Administration, China; National Park , Wildlife and Plant Conservation Department, Thailand 3. **Marine University**: e.g., Ocean University of China, Qingdao, China; Tokyo University of Marine Science and Technology, Japan 4. **Department in a University / Centre of Excellence**: e.g., Dept. of Oceanography, Chungnam National Univ., Korea; Center of Excellence for Marine Biotechnology, Chulalongkorn Univ., Thailand; Centre of Excellence in Marine Biology, Univ. of Karachi, Pakistan 5. **International (medium to long-term) Support Initiative**: e.g., Partnerships in Environmental Management for the Seas of East Asia; Coral Triangle Support Partnership; Southeast Asian Fisheries Development Center, Training Department 6. **Integrated (Management or Research) Project**: e.g., Integrated Coastal Resource Management Project, Philippines; UNEP/GEF South China Sea Project	1. Academic education (BSc., MSc., PhD.) 2. Visiting Professorship / Scholarships 3. Training Course / Summer School / Advanced School 4. Training through Research 5. Training on Ship 6. Travel grants 7. Research apprenticeships, Internship, Secondment 8. Training for high school pupils and college students 9. High school and college teacher training programmes 10. Infrastructure & Technical support 11. CB-related activity in International Scientific Symposium 12. UNESCO/IOC Chair in Marine Sciences 13. Marine / Maritime events for policy makers and policy advisers 14. Marine events for general public	**Examples of specialized foci** - Advanced modeling techniques for physical oceanography and marine climatology - Benthic habitat restoration - Complexity, adaptation and emergence in marine ecosystems - Coral reef biodiversity and ecology - Integrated marine environmental analysis - Integrated, sustainable coastal resources management - Marine and coastal shellfish and crustacean aquaculture technologies - Marine biodiversity conservation - Marine chemical analysis - Marine harmful algal bloom - Marine fishery-related survey techniques - Marine instrumentation calibration - Marine mammals protection and conservation - Marine natural products - Marine pollution chemistry - Marine population genetics and molecular ecology - Marine Protected Area (MPA) establishment and monitoring - Marine radioactivity measurements - Marine taxonomy - Maritime tourism development and management - Modeling of coastal processes - Oil spills prevention and responses - Rapid response system for tsunami hazards - Remote sensing for marine and coastal environments	1. **Students**, including undergraduate and postgraduate 2. **Early Career Researchers**, including post-doctoral researchers and non tenure academics) 3. **Senior Researchers** (mid- to high-level researchers, visiting scholars or professors) 4. **Technical support staff** (technicians, engineers, local managers) 5. **High-level Managers, policy advisers, policy makers** 6. **Others** (high school pupils, high school and college teachers, general public)	1. **National** (open to its own nation) 2. **Regional** (with more than one country represented) 3. **International** (open to all participants, globally)	1. **Beneficiary/ies:** e.g., B.Sc. Students; MSc. Students, PhD. Students, post-doc. Researchers; junior faculty members; early career researchers; all faculty members 2. **Number of participants in the activity**: e.g., number of registered students in a curricula or of participants in a summer school 3. **Number of faculty / trainers involved** in the curricula or the activity 4. **Duration of the activity:** from 1 day to few years 5. **Frequency of the activity**:e.g., call for proposals once a year; offered every year; once every two years; tri-annually; as needed by project; once a year within life of the project; upon request 6. **Total number of trainees**	**Examples of Funders** 1. **Intergovernmental organization** Asian Development Bank Asia-Pacific Economic Cooperation IAEA Regional Co-operative Agreement for Research, Development and Training in Nuclear Science and Technology for the Asia and Pacific region UNESCO / IOC Sub-Commission for the Western Pacific World Bank 2. **National organization** Japan Society for the Promotion of Science Netherlands Embassy in the Philippines Korean Institute of Ocean Science and Technology United States Agency for International Development 3. **Private Foundations and NGOs:** World Wildlife Fund The Nature Conservancy Thai-Danish foundation for the Phuket Marine Biological Center (PMBC) 4. **Home or Host institution** East China Normal University Institute of Marine Science, Pakistan 5. **Personal funds**

3.2.3 Identification of capacity development needs for marine sciences in the Asia-Pacific region (2013 and beyond)

In the Asia-Pacific region, capacity development needs for marine science are predominantly driven by social and economic priorities. The top three research areas identified as priorities for capacity building efforts were climate change impacts, ecosystem health, and food security (Table 2). Climate change impacts such as enhanced flooding and storms have brought destruction to lives and property, hence there is a need to understand ocean responses, as well as to mitigate and reduce the risks brought about by such events. Capacity development efforts are particularly needed in terms of training on methods of observation and data collection, skills in interpretation of data, data calibration, and modeling. Vulnerability assessment on the impact of climate on coastal ecosystem and development of early warning systems are equally important. The challenges faced by this priority issue include sustained funding support for equipment and research, technical capability for data acquisition and analysis, the need to develop models, lack of expertise, the need for collaboration to share facilities and expertise for research, and recognition that natural and social scientists should create joint efforts to address this issue.

Ecosystem health as a socio-economic priority issue covers eutrophication, HABs, habitat loss, coastal erosion, sea water intrusion, and land subsidence. Capacity development to address these issues should include basic information such as mapping of habitats and potential resources to understanding, and identification and management of sources of nutrients and pollution that impact these habitats. Monitoring and prediction of HABs, as well as development of early warning systems and decision tools, are important. Rehabilitation efforts to restore habitats are needed. The challenges faced by this priority issue on ecosystem health are similar to climate change impacts, plus the need for community and stakeholder involvement and political will, and the need to transfer scientific knowledge to policy and legislation.

Food security is a priority issue due to the need to sustain fisheries production and assure seafood safety. Capacity development should include training on monitoring, collection and interpretation of data, development of technology such as integrated marine aquaculture, as well as early warning systems and decision tools. The challenges faced by this priority issue are similar to the other two priority issues.

Table 2. Synthesis on Capacity Development Needs for Marine Sciences in the Asia-Pacific Region (2013 and beyond)

Social and Economic Priorities	Capacity building efforts needed	Challenges
1. Climate change impacts (i.e. flooding, storms) • Ocean response to climate change • Disaster risk reduction • Mitigation of natural disasters	• New observation techniques and methods • Skills in interpretation of data • Data calibration • Numerical models on physics, biogeochemistry, ecosystems • Downscale global models to regional and national level • Prediction on ecosystem response and evolution • Vulnerability assessment of impact on ecosystem of sea level rise, temperature increase • Early warning system and techniques	• Sustained funding support for equipment and research in national and regional programs • Coupled ecosystem modeling using numerical simulation in 4D • Monitoring, data acquisition, data analysis • Lack of expertise • Sharing of facilities with more advanced institutions • Training on new methods and equipment • Research exchanges, collaboration, technical support • Wide recognition of interaction between human activities and climate change • Joint efforts of natural and social science • Political will
2. Ecosystem health • Reduction in eutrophication, contamination, pollution • Reducing incidence of HABs • Addressing habitat loss (mangrove deforestation, coral bleaching, reclamation activities) • Reducing coastal erosion, sea intrusion, land subsidence	• Identification and management of nutrient/pollution sources • Understanding nutrient transport, transformation, biogeochemical cycles • Prediction of HABs • Monitor, develop early warning systems, formulate decision tools • Methods of organic pollution estimation • Use of isotopes/REEs as tracers • Natural recovery and mangrove rehabilitation • Appropriate methods/ technology for coastal protection • Adaptation and mitigation • Mapping habitats and potential of resources	• Sustained funding support for research and equipment • Skills in relevant data collection and analysis • Sharing of facilities with more advanced institutions • Training on new methods and equipment • Lack of expertise • Research exchanges, collaboration, technical support • Community participation, stakeholder involvement and political will • Coordination among relevant organizations • Feed scientific knowledge to policy and legislation
3. Food security • Sustaining fisheries production • Assuring seafood safety	• Methods of collecting oceanic data • Skills in interpretation of data • Monitoring, developing early warning systems, decision tools • Aquaculture technology • Understanding oceanic food webs and changes in production system e.g. aquaculture • Science integrated marine aquaculture • Adaptive ecosystem-based management	• Sustained funding support for proposed activities • Support of designated MPAs or LMMAs • Skills in relevant data collection and analysis • Sharing of facilities with more advanced institutions • Training on new methods and equipment • Lack of expertise and technical support • Attraction and retention of more well qualified regional staff bringing social and natural science approaches together • Knowledge on biogeochemistry in aquatic ecosystem • Coordination, cooperation of all concerned organizations, and pooling of resources

3.2.4 Identifying the capacity building needs for IMBER-related research in the Asia-Pacific region

The identification process of capacity development needs for IMBER-related research in the Asia-Pacific region was conducted by designing a table (Table 3) and receiving the inputs from participants, concerning actions needed to address IMBER Science Theme 1: Key Interactions and Theme 2: Sensitivity to Global Change. The table required inputs on capacity building efforts and challenges to realize the capacity building needs. Eight participants from the region briefly presented their inputs.

Due to different levels of participants' knowledge on IMBER's science plans, inputs received on capacity building needs greatly varied from one person to another (Table 3). A huge knowledge gap exists between the IMBER Science Themes and current scientific knowledge of most participants. Except for the knowledge gaps identified by one participant to address the key issues of the Themes 1 and 2, inputs received were mainly focused on the more basic needs directed towards capacity building in the form of training, prospects for collaborative research, long-term observation schemes and possibilities and the capacity required to do so, ranging from postgraduate education to technical capacity enhancements that would enable further advancement of individuals' scientific understanding and as a result would be more relevant in the IMBER perspective.

It is also recognized that not all countries in the region can possibly be at the same level of research capacity (infrastructure and human); there are obvious similarities amongst some countries and there needs to be greater support coming from more advanced countries in the region to raise the level of those countries that need and desire that support.

Table 3: Capacity Development Needs preliminarily identified from the Theme 1 and 2 of the IMBER

Science Themes 1, 2 of IMBER	**Capacity building efforts needed** To generate such scientific inputs. (at most 2 under each issue)	**Challenges** to realize these capacity building needs
Theme 1---Key interactions		
Issue 1.1 Transformation of organic matter in marine food webs • What controls the stoichiometry and form of "bioreactive" elements in space and time? • What controls production, transformation, and breakdown of organic matter in marine food webs?	Postgraduate training in oceanic organic matter processes and carbon cycling Infrastructure and resources Improved capacity to integrate physical and biogeochemical processes	Sustainable funding Employment opportunities for graduate researchers Political/community support for marine research Stronger cooperation between donors Regional and in a few cases national 'critical mass' of marine scientists (other than in fisheries)
Issue 1.2 Transfers of matter across ocean interfaces • What are the time and space scales of remineralisation of organic matter in the mesopelagic layer? • How does nutrients exchange between continental margins and the ocean interior impact biogeochemical cycles? • How does exchange between the seafloor and the water column impact food web structure and function	Postgraduate training in organic matter processes and biogeochemical cycling of carbon and other elements including macro-micro-nutrient interactions Infrastructure and resources Opportunities for access to relevant cruises	Sustainable funding Employment opportunities for graduate researchers Political/community support for marine research Stronger cooperation between donors Regional and in a few cases national 'critical mass' of marine scientists (other than in fisheries)
Issue 1.3 Material flows in end-to-end food webs • How do food web dynamics affect nutrient availability? • How do key functional groups, species, and genes affect biogeochemical cycles? • How do species biodiversity and species interactions affect food web functioning and biogeochemical cycling? • How are the interactions between biogeochemical processes and food webs recorded in paleo-proxies?	Postgraduate training in nutrient biogeochemistry and link to food webs Infrastructure and resources for biogeochemistry (biomarkers and tracers) Data compilation on species interactions Dating information for paleobiogeochemical studies – access to facilities and training in data outputs interpretation	Sustainable funding Employment opportunities for graduate researchers Political/community support for marine research Stronger cooperation between donors Regional and in a few cases national 'critical mass' of marine scientists (other than in fisheries)
Theme 2- Sensitivity to Global Change		
Key issue 1: impacts of climate –induced changes through physical forcing and variability • What are the impacts of changes in circulation, ventilation and stratification?	Postgraduate training in oceanic data collection and interpretation Access to training via relevant cruises	Sustainable funding Employment opportunities for graduate researchers Political/community support for marine research Stronger cooperation between donors

• What are the direct effects of changes in ocean temperature and light environment? • What are the impacts of changes in the frequency and intensity of extreme and episodic events?	Integration of efforts by different agencies and greater involvement of small island scientists	Regional and in a few cases national 'critical mass' of marine scientists (other than in fisheries)
Key issue 2: Effects of increasing anthropogenic CO_2 and changing pH on marine biogeochemical cycles, ecosystems and their interactions • What are the effects of CO_2-driven changes in carbonate chemistry? • What are the effects of pH-driven changes in nutrient and trace metal speciation? • Which organisms and biological processes are most sensitive to pH and CO_2 changes, what are the consequences and to what extent can organisms adapt in response to these changes?	Postgraduate training in ocean acidification and its potential impacts – relating carbon dioxide changes in various components with effects on organisms Improved measurement of relevant data in small island countries	Sustainable funding Employment opportunities for graduate researchers Political/community support for marine research Stronger cooperation between donors Regional and in a few cases national 'critical mass' of marine scientists (other than in fisheries)
Key issue 3: effects of changing supplies of macro- and micronutrients • How will changes in macro- and micronutrient inputs to the ocean affect the cycles of these elements? • How will changes in the abundance, distribution and stoichiometry of nutrient elements affect food web structure and function? • How will increases in hypoxia and anoxia affect food webs and cycles of key macro- and micronutrients?	Postgraduate training in nutrient biogeochemistry Resources to support medium to long-term studies in different ecosystems	Sustainable funding Employment opportunities for graduate researchers Political/community support for marine research Stronger cooperation between donors Regional and in a few cases national 'critical mass' of marine scientists (other than in fisheries)
Key issue 4: impacts of harvesting on end-to-end food webs and biogeochemical cycles. • How do harvesting-induced changes in food web structure impact biogeochemical cycles? • What are the impacts of harvesting living marine resources on end-to-end food webs?	Postgraduate training in biogeochemical cycling and the link to food webs Opportunities to apply training to local situations in small island countries, e.g., atoll and high-island sites	Sustainable funding Employment opportunities for graduate researchers Political/community support for marine research Stronger cooperation between donors Regional and in a few cases national 'critical mass' of marine scientists (other than in fisheries)

3.3 Networking information-what currently exists?

3.3.1 Networking currently exists in the Asia and Pacific region

The Asia and Pacific region boosts vast areas of coasts, oceans, and accommodate half of the world's population, with 60% percent of its inhabitants living in and relying economically on coastal areas. Therefore, great importance has been ascribed to marine science by countries, organizations, and programs in the region. In addition to plenty of bilateral cooperation between countries, multilateral research networks have been established, mainly through the following organizations and programs in the region.

The IOC WESTPAC, established in 1989 as one of IOC's regional sub-commission, promotes international cooperation on marine science, observation, service and capacity building in the region. Various research networks among scientists, marine research institutes and national agencies were established through the development, coordination and implementation of WESTPAC's marine scientific programs, regional ocean observations, and capacity building initiatives (http://www.unescobkk.org/westpac/about-us/ioc-westpac/ioc-westpac/programmes-and-projects/?utm_medium=%2F). WESTPAC's capacity development activities seek to strengthen scientific, technological, and institutional structures through the establishment of "IOC Regional Network of Training and Research Centers on Marine Sciences", provision of regular training at those regional centers on their areas of specialization, and conduct of a series of topic-specific training activities at different locations to develop the capacities of young scientists and their national institutes to conduct the science and observations needed to underpin informed decision-making for sustainable use of the ocean and coastal seas. The Triennial WESTPAC International Scientific Symposia have been evolving as one of the largest regular scientific gatherings in the region, particularly for the scientists in the South East Asia region to develop their scientific networks and advance their scientific knowledge. More information on WESTPAC can be found at http://westpac.unescobkk.org

The North Pacific Marine Science Organization (PICES) is an intergovernmental scientific organization that was established and held its first meetings in 1992. Its present members are Canada, People's Republic of China, Japan, Republic of Korea, Russian Federation, and the United States of America. The objectives of PICES are to promote and coordinate marine research in the northern North Pacific and adjacent seas especially northward of 30 degrees North; to advance scientific knowledge about the ocean environment, global weather and climate change, living resources and their ecosystems, and the impacts of human activities, and promote the collection and rapid exchange of scientific information on these issues. More PICES information could be found at http://www.pices.int/.

Sustained Indian Ocean Biogeochemistry and Ecosystem Research (SIBER) is an emerging international program focused on the Indian Ocean research. SIBER co-sponsored by IMBER (Integrated Marine Biogeochemistry and Ecosystem Research) and IOGOOS (Indian Ocean Global Ocean Observing System), an association of marine operational and research agencies in the Indian Ocean region established in 2001 for the implementation of GOOS in the Indian Ocean and for promoting activities of common interest for the development of operational oceanography in the Indian Ocean region, The overarching goal of the SIBER program is to motivate and coordinate

international interest in Indian Ocean research in order to improve our understanding of the role of the Indian Ocean in global biogeochemical cycles and the interaction between these cycles and marine ecosystem dynamics. This understanding will be required in order to predict the impacts of climate change, eutrophication and harvesting on the global oceans and the Earth System and it is fundamental to policy makers in the development of management strategies for the globally important Indian Ocean. More information about SIBER can be found at (http://www.incois.gov.in/Incois/siber/siber.jsp)

3.3.2 International resources for capacity building

Capacity building in the Asia-Pacific region is assisted by resources from international organizations (Table 4). It is important for scientists in the region to be aware of these resources and to utilize them to the fullest extent possible.

The International Atomic Energy Agency (IAEA) Marine Environment Studies Laboratory sponsors a variety of training programs, both at its base in Monaco and in the regions. Training in the region can be arranged if several member states in the region request such training, but also within a Technical Cooperation programme on country level in a laboratory. More information about IAEA training programs can be found at http://www.iaea.org/technicalcooperation/Home/index.html. One particular project is currently dealing with the potential impact of the Fukushima derived radioactivity in the Asian-Pacific region and a number of trainings are planned for the participating countries including some small Pacific Islands as new comers in this area. Further information can be obtained from the IAEA website http://www.iaea.org/newscenter/news/2011/tcmarine.html.

The International Foundation for Science (IFS) is an organization that works with individual scientists to help them with small-scale research funding and travel support to report their research results at international meetings. IFS funding is not specific to ocean science, but ocean scientists in the Asia-Pacific region could take advantage of IFS programs. Information about IFS activities can be found at www.ifs.se.

IOC of UNESCO provides travel support through a variety of mechanisms, both at the international level and through regional programs, such as IOC/WESTPAC. Internationally, a major capacity building activity is the training on ocean data and information management conducted through IODE using its OceanTeacher platform (see http://classroom.oceanteacher.org/mod/page/view.php?id=2033). In the region, WESTPAC conducts many different training programs in different locations. Information about WESTPAC capacity development activities can be found at http://www.unescobkk.org/westpac/about-us/ioc-westpac/ioc-westpac/capacity-development/.

POGO is an international consortium of major oceanographic institutions, whose objectives focus on bringing institutional resources to establishment of the Global Ocean Observing System and to stimulating capacity for ocean science and observations in developing countries. Lack of trained personnel is considered to be a major obstacle to development of a global ocean observing system. Therefore, a central element of the POGO agenda is capacity building and training. POGO has developed an extensive array of training and education activities targeted primarily at scientists

from developing countries and those with economies in transition. Please refer to Part 3.1.5 for POGO program details.

SCOR promotes the enhancement of scientific capacity in developing countries and those with economies in transition by ensuring that every SCOR activity includes scientists from such countries. SCOR created a Committee on Capacity Building in 2007 to coordinate SCOR's activities in capacity building, develop new activities, and help develop funding for these activities. The following are the major ongoing SCOR capacity-building activities:

- Travel Grants-SCOR continues to offer travel awards to ocean scientists from developing countries and those with economies in transition, as it has since 1984. This program is supported through a grant from the U.S. National Science Foundation and approximately 60 scientists are awarded full or partial travel grants each year to participate in major international ocean science meetings and short-term training programs. Approximately one-third of travel grant recipients are from the Asia-Pacific region and some of the meetings that are supported are meetings convened in the region. Grants are limited to individuals who apply through the meeting organizers for meetings that have been approved by SCOR; direct applications to SCOR are declined. Eligible nations can be found at http://www.scor-int.org/Eligible_Countries.pdf.
- POGO-SCOR Visiting Fellowships for Oceanographic Observations (see POGO section above)
- SCOR Visiting Scholars. Since 2009, this program has been sending ocean scientists to developing countries to teach and mentor for two weeks or more. Scholars have served in Ghana, Guatemala, India, Iran, Namibia, and South Africa so far. The first Scholar will serve in Southeast Asia (Thailand) in early 2012. The program pays for the Scholar's airfare, but the host institution is expected to provide lodging. A call for Scholars and host institutions is made around 1 December each year. Scholars and hosts may self-organize, or SCOR will assist in matching available Scholars with requesting institutions.
- Ocean Summer Schools Portal—IODE hosts a portal for ocean-related summer schools at http://www.oceansummerschools.org/. SCOR and POGO are co-sponsors of this site and encourage their members to contribute events to it.
- Regional Graduate Education Networks for Ocean Sciences—SCOR is promoting the establishment of regional networks for ocean science graduate education, which will foster the establishment of regional centers of excellence in Southeast Asia, South America, Africa, and South Asia. These networks would bring together students from a region with faculty from the region and from developed countries for specialized short-term courses and would fund students through scholarships. Draft design principles for regional networks have been developed.
- SCOR maintains a Web portal of the capacity-building activities of many different international organizations that are relevant to capacity building for ocean science and observations. See http://www.scor-int.org/Capacity_Building/index.htm.

We recommend that organizations in the Asia-Pacific region take greater advantage of this wide range of activities.

Table 4. Capacity building activities available from some international organizations

CB Activity	IAEA	IFS	IOC	POGO	SCOR
Grants to attend meetings	X	X	X		X
Grants for short-term training in ocean observation	X		X	X	X
Summer Schools			X	X	X
Training for professionals	X	X			
Training through research	X	X	X		
Bursaries in developing country institutions				X	
Ship-board experience			X	X	
Visiting Professorships				X	X
Centers of Excellence in oceanography training				X	X
Leadership Training			X		
Internships in International Secretariats			X		

3.3.3 IMBER CB activities

Started in 2008, ClimECOs are biennial IMBER summer schools that offer students and early-career scientists lectured by internationally renowned experts as well as hands-on practical sessions.

The IMBER IMBIZO (a Zulu word for gathering) series has been conducted once every two years since 2008. Financial support is available to both young scientists and developing country scientists for their participation.

Data management workshops (including “dry cruise” workshops) at each IMBIZOs have provided training for scientists of all levels in data management requirements, particularly for sea-going activities.

Since 2002, the China-Japan-Korea (CJK) GLOBEC/IMBER Symposium series has provided marine scientists from the three countries with the opportunity to collaborate, exchange, and compare the results of their research. Following the IMBER-GLOBEC merger in 2010, the IMBER community decided to continue organizing these symposia. Combined with the 5th CJK IMBER Symposium in 2011, an IMBER training courses was conducted for early-career scientists and students from the participating countries.

IMBER also promotes CB activities through endorsed projects.

In addition to these CB activities, an IMBER regional project office (RPO) was established in Shanghai, China in 2011 to promote IMBER related research in the Asia-Pacific region and support the implementation of the *IMBER Science Plan and Implementation Strategy*.

3.4 Suggestions on CB enhancement in the Asia-Pacific region

3.4.1 Identify CB gaps and specific CB needs

Currently, demands of economic development have been a constraint in the development of capacity of marine sciences in many countries of the Asia-Pacific region. Universities in the Asia-

Pacific region may not have marine sciences as a high priority theme and the employment opportunities are restricted at present. Graduate programs in the ocean and marine environmental sciences have difficulties due principally to the lack of employment opportunities for postgraduates in those subjects. Good students do not opt for marine studies since there are more lucrative avenues which are monetarily more attractive. In general, the major challenges of the CB activities in this region include (1) sustained funding support for research and equipment in national and regional programs; (2) infrastructural and policy-relevant support in key marine research areas; and (3) attracting postgraduate students and early-career researchers into marine science–related careers, providing opportunities for the development of young professionals and mitigating regional brain drain.

Besides demand of infrastructure and resources for marine research, postgraduate trainings in organic matter processes, biogeochemical cycling of carbon and other elements, oceanic data collection and interpretation, and ocean acidification and its potential impacts are particularly needed in this region. Furthermore, modern marine research requires the integration of disciplinary skills, advanced observational techniques, and state-of-the-art infrastructure, which many developing countries in this region cannot afford. As many researchers tend to remain in their own research domain, development of capacity to conduct multidisciplinary research and overall synthesis of project results is also a key challenge for marine research. In addition to these, high diversity on culture, language, and education system in this region create berries between institutions/organizations from different nations on information/facility sharing, knowledge exchanging, and research collaborating.

3.4.2 Utilize existing CB resources

Taking great advantage of existing CB resources, including research facilities, human resources, information and knowledge is a cost-efficient way to improve the research capacity. In addition to plenty of bilateral cooperation between countries in the Asia-Pacific region, capacity building in marine science is also assisted by resources from regional and international organizations. At the regional level, PICES, IOC/WESTPAC, and IOGOOS have provide various internship, summer schools, workshops, and topic-specific training activities to researchers, particularly young scientists in this region to develop their capacities on the marine research and observations. APN has declared the capacity building and enhancement as an important part of its strategic goals since the inception. In 2003, the APN initiated CAPaBLE, a stand-alone programme on capacity building in response to the Johannesburg Plan of Implementation for the World Summit on Sustainable Development in 2002, to enhance the scientific capacity, particularly for developing countries. There are also many international originations offering opportunities that regional researchers can utilize to enhance their personal research capacity. For example, SCOR has provided travel grants since 1984 to ocean scientists from developing countries as well as those with economies in transition; SCOR Visiting Scholars has been sending ocean scientists to developing countries to teach and mentor for two weeks or more since 2009; IMBER conducts ClimECO Summer School and China-Japan-Korea IMBER Symposium every two years; POGO has developed an extensive array of training and education activities targeted primarily at scientists from developing countries and those with economies in transition; IAEA Marine Environment Studies Laboratory sponsors a variety of training programs, both at its base in Monaco and in the regions. There are also other non marine specific international

organizations, such as IFS, offering various funding and activities of which marine scientists in the Asia-Pacific region could take advantage.

3.4.3 Promote collaboration on conducting CB activities at regional and international levels

Most capacity building activities have been initiated by individual organization or project to address particular research issues, which resulted fragmented, short-term, and most likely overlapped CB efforts at all global, regional and national levels for marine research. In order to minimize overlaps and effective utilize CB resource, collaboration among efforts of having similar CB goals or research coverage is highly recommended. As to international projects, information and resource sharing and good communication between CB groups at both projects is needed for ensuring any possible collaboration on capacity building. The locations of CB activities should be shifted from region to region with particular skew to developing countries to help promote regional research contributions and regional CB efforts. At regional scale, countries in the Asia-Pacific region have a very wide variety in the ability of undertaking marine research at institutional and national levels due to the differences of their personnel resource, economical situation, facility status, and etc. On-site training, technical assistance, research facility and information sharing from more advanced countries (e.g. USA and Australia) in the region should help raise the CB level of those developing countries which need and request such support.

3.4.4 Maintain research network

It is essential to build a community of practice with senior researchers and educators and facilitate the emergence of new research generation focusing on marine research in this region. An IMBER-related mentoring program and alumni network for early-career researchers would help strengthen the regional marine research community.

3.5 What should IMBER do to advance its CB/CD/CE globally?

To advance capacity building globally in a coordinated and effective manner, the IMBER CBTT should develop a capacity building strategy which is focused on meeting the scientific objectives outlined in the *IMBER Science Plan and Implementation Strategy* and *Supplemen*. This strategy needs to provide a framework for capacity building activities until 2020 in line with the scientific themes and key questions, while meeting the specific needs to the IMBER regional projects, task teams and working groups and, where possible, endorsed projects. In developing this strategy the Capacity Building Task Team and the IMBER Scientific Steering Committee need to consider the following:

Needs analysis

The CBTT and SSC should undertake an analysis of the scientific areas and geographically relevant regions where different levels of capacity building are required. (An example may be increasing capacity for interdisciplinary research, particularly bringing natural and social science together; another example may be to strengthen the research capacity in a particular biogeographic region). This analysis will assess the needs for the future for each of the IMBER regional projects and task teams and working groups and, where possible, endorsed projects.

Evaluation of past capacity building activities

The CBTT should put in place a plan to assess past IMBER capacity building activities, create a schedule of activities until 2020, and establish metrics that can be evaluated for each activity. This can be achieved by the following actions:

- Compiling data and statistics about past IMBER activities and their impacts
- Analyzing CB-relevant results and questionnaires from previous IMBER-endorsed summer schools and programme-wide networking activities
- Improving the design of future CB activities, based on the results of the analysis of past activities
- Evolving IMBER's portfolio of capacity building activities as the project moves to completion in 2020

Timeframes

The strategy will need to priorities future activities for both the short and longer terms, and take into account the evolving needs of the IMBER project throughout its life time. For example, consideration needs to be given to building capacity for the synthesis phase of IMBER to ensure there is sufficient capacity to undertake this demanding interdisciplinary/integrating research. One suggestion for building this capacity is an interdisciplinary capacity building activity focused at the Post Doctoral/Assistant Professor level.

Partners

Potential scientific partners should be identified for involvement in IMBER capacity building, for example, SCOR, IGBP, IOC, POGO, and MB-ESF and potential funders of these activities. IMBER should also explore which organizations' capacity building resources could be utilised and advertise those opportunities within the IMBER community to stimulate applications (e.g., SCOR Visiting Scholarship, and POGO Visiting Professorship)

Identification of potential financial resources:

Identify potential funders for IMBER capacity building activities. These may include

- foundations such as Asahi Glass Foundation, Total Foundation, Agouron Institute, Gordon & Betty Moore Foundation, and the Soros Foundation EC;
- private companies such as Exxon, Total Foundation, and PetroBras;
- international councils such as World Business Council for Sustainable Development (WBCSD), World Ocean Council; and
- national and international funding agencies, for example, APN, IAI, TWAS (the Academy of Sciences for the Developing World), DAAD (Swedish International Development Cooperation Agency (SIDA), the German Academic Exchange Service, IRD, CIDA (Canadian International Development Agency), NORAD (Norwegian Agency for Development Cooperation), ASEAN (Asian Development Bank, Association of Southeast Asian Nations).

Development of early stage and continuous education and of mentoring initiatives

Identify mechanisms to facilitate the exchange of students and early-career researchers among institutions, through something like an IMBER-SCOR fellowship scheme, that would support parts of the costs for the student travel and/or stay in another research institution, and other relevant

schemes. The CBTT should help the International Project Office (IPO) and Regional Project Office (RPO) establish a mentoring programme for programme-wide networking activities, and create an IMBER mentor programme which would identify scientists who are well qualified scientifically and who are also good educators/tutors. IMBER should also develop an award scheme to attract more potential mentors. The CBTT should help the IPO and RPO establish an IMBER "alumni" network of IMBER-related students and early-career researchers and mentors, to help create a strong IMBER community.

Contribution to regional and global coordination of CB activities

Consider how to integrate some of the numerous existing CB activities within regions, such as the Asia-Pacific region and ensure, where possible, there is global coordination to transfer knowledge across the various regions. Globally, the IMBER CBTT should explore mechanisms to participate in CB discussion/coordination forums for regions of IMBER relevance and, for instance, facilitate and contribute to the creation of a virtual forum for coordination of CB activities for mutual benefit.

Promotion of CB activities through the use of Web-based networking tools

Explore the use of new electronic networking tools as an approach to future CB activities. Examples include GoToMeeting, Connect Pro Meeting, Skype, Wikipages, Google documents, YouTube, Webcasting of lectures, etc. The applicability of networking tools will depend on the activity and the local Internet capabilities, but potential applications include making initial contacts among organizers of the activity, general orientations for trainees, follow-up after meetings, etc. IMBER and other SCOR projects use GoToMeeting extensively for meetings of chairs with staff and among Executive Committee members. Skype is widely used among marine scientists to communicate internationally and sometimes for meetings. POGO and other organizations have employed social networking tools to create groups of alumni from CB activities. We recommend that more attention be given to creative ways to use social networking to make capacity building more effectively.

Maximise benefits of international cruises during visits from developed country research vessels

Explore how to identify and facilitate visits from developed country research vessels to developing and emerging countries and encourage IMBER scientists and endorsed projects to take advantage of such visits and, when possible, available berths. Capacity building based on cruise experience can be important. Examples of this approach are the POGO AMT Fellowship program, SCOR funding of developing country scientists on GEOTRACES cruises, and the German SPACES programs hosting of students in southern Africa. The POGO research cruise database (see www.pogo-oceancruises.org) provides information about cruises with empty berths. Visits from developed country research vessels also can be important for CB, in terms of scientists from the ship teaching and mentoring at institutions near ports of call.

CBTT Terms of Reference

The ToRs of the IMBER CBTT are ambitious and general, and could benefit from more concrete approaches and result-oriented planning and deliverables in the short term. The CBTT should work with the SSC on this matter of revising their ToRs and for preparing the IMBER CB plan. The membership of the CBTT should also be reviewed in line with the revision of the terms of reference.

Other issues that need to be considered at a larger scale than IMBER and also when preparing a specific CB activity

In the course of discussions regarding important strategies and actions for IMBER in terms of capacity building, it became obvious that some of the points raised by the group should be implemented more broadly by SCOR, POGO, IOC, and other organizations. One such task was to create a "cookbook" of capacity building approaches and techniques that would present basic information about each technique, an analysis of advantages and disadvantages of each approach, lessons learned from implementations of the approach, and any references available. The goal is to take advantage of past experience with each approach and to avoid "reinventing the wheel" in relation to these approaches. Work on a cookbook of CB approaches for ocean science was begun at a meeting convened by SCOR in Bremen, Germany in August 2010 (see www.scor-int.org/CB_Summit.htm) for use by interested organizations. A general goal of the cookbook is to help transfer knowledge within a region and among different regions. The participants in this meeting requested that the following information be included in the cookbook:

1. Information about the above-mentioned use of new electronic networking tools as an approach to future CB activates.
2. Additional information about how to plan, conduct, and follow up on summer schools[1] could include:
    - Questionnaires should be completed by summer school participants and the results of these surveys should be used to evolve courses over time.
    - It is important for any specific summer school to report both successes and shortcomings of courses, recognizing the potential negative impacts of reporting shortcomings.
    - The tendency of participants to return to their country after the training should be one measure of CB program effectiveness, although this is usually not a significant issue after short-term courses.
    - The planners of the activity should identify the target beneficiaries of each activity, in terms of education level (e.g., M.Sc/Ph.D students, post-doctoral fellows, early-career scientists) and scientific topic. There can be disadvantages of having a group of participants that is too heterogeneous in terms of education level, previous education on the target subject of the summer school, etc.
    - The length of the course should be appropriate for the goals of the summer school.
    - If a series of summer schools is desired and a goal of the series is to increase regional scientific capacity, the summer schools should involve more than one country and should move around to different countries in a region, taking advantage of different resources that can be contributed by multiple countries in a region.
    - The effectiveness of summer schools should be evaluated by continued tracking of summer school trainees, to determine their eventual career paths and continued involvement in the field.
    - It could be helpful to formalize the process of trainee selection and evaluation, with guidelines.

[1] "Summer school" is a generic term to indicate a program that brings together students to hear lectures and participate in hands-on activities related so specific subjects. The program many occur in any season and may last from one week to a few weeks.

- Summer schools should consider whether to include practical skills like how to prepare research papers, proposals for funding, oral presentations, poster presentations, etc.

3. Ideas and examples of alternatives to summer schools. For example, other activities that bring together groups of developing country and/or early-career scientists to pursue a common goal that could have a training component. The common goal could be oriented around research, production of a cross-disciplinary analysis (natural science-social science interface), model applications/intercomparison, etc., as contributions to the overall scientific goals of the project.
4. Mentoring is an important approach that needs more elaboration. Mentors are used increasingly to conduct CB at scientific meetings. Some factors to improve their contribution should be considered:
   - A pool of mentors should be developed over time, based on the identification of mentors who are well qualified scientifically and who are also good educators/tutors.
   - Some mentoring relationships may result in joint publications or at least acknowledgement in publications.
   - Mentors should be encouraged to have occasional contact with their mentee, by email and at future meetings.
   - Excellence in mentoring should be recognized by the community, sponsors, the mentors' institutions, scientific societies, research projects in which the mentor is involved, etc. Mentors might even list mentees on their CVs.
5. Minimizing "brain drain".[2] Since the main goal of CB activities is to increase scientific capacity in a developing country or region, these activities need to consider their impact on brain drain. Important approaches are to hold the CB activities in the region, address region-specific scientific issues, and use equipment and techniques in the training that are appropriate to the region. The evaluation process for CB activities should include some indicators of the applicants' desire to stay in or return to their home region to continue to contribute to the scientific capacity there. In some cases, applicants that seem equivalent in their scientific qualifications may seem to differ in their job stability and commitment to staying in the region. To address the issues of an applicant's intention to stay in their region, application forms can solicit information about (1) long-term goals, (2) how the applicant plans to use the skills/knowledge gained through the CB activity, (3) how the applicant plans to disseminate their new knowledge in their home institution, and (4) whether the applicant seems likely to stay at the same institution (i.e., they are a staff scientist, they indicate they will be moving from student to staff status, etc.). Such questions will help to determine whether the applicant views the CB activity as a "stepping stone" to leave their region or their commitment to stay in their region or return home if they have been trained in a developed region.

Some other ideas emerged that were not relevant to IMBER or to a cookbook of CB activities: Find out from Ocean Expert the demography of field globally, in order to better understand the research

[2] It is recognized that CB activities cannot and should not seek to completely eliminate brain drain. Humans have a natural desire to improve their employment opportunities and may seek to move to new regions for a variety of reasons. Most factors related to brain drain are beyond the control of the planners of CB activities (e.g., salaries and job opportunities in the home country).

capabilities in each country and region. The "Research Experiences for Undergraduates" (REU) program at the U.S. National Science Foundation may have some models for what information could be used. Information by field and age to retirement would be helpful.

4.0 Conclusions

Asia-Pacific region is a geographically, culturally and ecologically highly diverse region. The statuses of marine research capacity in this region are different from country to country; hence the needs for capacity building are various. The survey of ongoing regional and national CB activities shows that the common types of CB activities in this region include graduate educations, summer schools, training courses, training through research, training on ship, and grants to support travel & short-term training, while visiting professorship, internship, and infrastructure & technical support were also offered in some countries, for example, China and South Korea. The domains of focus of these CB activities in marine science were broad from fundamental theory (e.g. marine science, physical oceanography, marine biology, geology and geophysics, marine zoology, and fishery) to integrated research (e.g. coastal management, biodiversity conservation, climate change issue, air-sea interactions, and modeling). These CB activities mainly targeted at students and early career scientists, whereas, mid-high level scientists, technicians, managers, and policy makers were also involved in such activities in some countries (e.g. Thailand and Philippines).

In the Asia-Pacific region, capacity development needs for marine science are predominantly driven by social and economic priorities. Three marine research topics were identified as priorities for capacity building efforts in this region: climate change impacts, ecosystem health and food security. Regional needs and gaps for capacity development in these research areas were summarized as follows:

- Marine research requires expensive infrastructure and training, which many developing countries cannot afford. Technical and financial supports for capacity development from international/regional organizations and developed countries are needed.
- Capacity required includes skills to generate data and interpret relevant information, linkage of research outcomes and benefits for local people and a balance between global scientific knowledge and local traditional knowledge.
- Improved research–policy interface is needed. Marine biogeochemistry does not receive high priority in this region. Funding for all marine research work, especially long-term options, is limited. In developed country like Russia, even having a large number of well-trained experienced specialists, there is a delay in reformation of the funding system, developing infrastructure necessary to conduct contemporary research, modern oceanographic equipment, analytical facilities, available methods and technologies, as well as level of education in marine sciences.
- Employment opportunities for researchers in marine field are restricted at present in some areas (e.g. the Pacific Islands).
- Limiting factors to the professional development of early-career marine scientists include limited research grants, research facilities for working in the offshore, opportunity for collaboration with advanced oceanography institutes, and "brain drain".

Challenges faced by these issues include sustained funding support for research infrastructure and sea-going facilities, technical capability for data acquisition and analysis, the need to develop models, and attracting postgraduate students and early career scientists into marine science-related careers and providing opportunities for the development of young professionals. The need for more collaboration to share facilities and expertise for research, and recognition that there should be joint efforts between natural and social scientists to address the issues were noted.

Several recommendations were proposed to help enhance the regional marine research capacity:

- Current CB practices and achievements for marine research and education should be examined and evaluated regionally and globally.
- Capacity building in the Asia-Pacific region is assisted by resources from international organizations (Table 4). It is important for scientists in the region to be aware of these resources and to utilize them to the fullest extent possible. Collaboration among organizations and institutions is a cost-efficient way to maximize the existing capacity resources.
- IMBER should consider partnering with the regional/international organizations to build a platform and conduct specific CB activities that meet the regional research priorities.
- The CB activities should be topic specific and the locations of trainings and summer schools should be shifted from place to place with particular skew to developing countries to help promote regional research contributions and regional CB efforts.
- IMBER could establish a mentoring programme for programme-wide networking activities, and create an IMBER mentor programme which would identify scientists who are well qualified scientifically and who are also good educators/tutors. An award scheme to attract more potential mentors was also suggested.
- Building an IMBER "alumni" network of IMBER-related students and early-career researchers and mentors should help create a strong IMBER community. Lack of scientific expertise available domestically could be also complemented though networking with the Asia-Pacific regional pool of experts, as well as the global pool of IMBER experts.
- More dedicated financial resources for CB activities targeting the regional needs should be further explored.

It was also recognized that not all countries in this region are at the same level of research capacity and there should be greater support from more advanced countries to raise the level of those countries that need and desire that support.

5.0 Future Directions

Based on the results from this project, a strategic paper on "Developing human capacity for success in international marine research projects" is under preparation for publication in an international peer-reviewed journal. The paper will classify existing capacity building activities, identify gaps and needs, and provide practical suggestions on challenges for capacity building in the context of marine research.

Although the proposed workshop made great success bring together CB experts around the world to assess the current CB activities in marine science and provide recommendations for more effective CB efforts in the Asia-Pacific region, taking action will be the next step, a difficult but the most

important step towards successful CB effort. Now, we are pleased to see that the action has started. After the CB assessment workshop in 2012, IMBER has been putting more attention on CB efforts in the Asia-Pacific region. For example, IMBER conducted an international conference (IMBIZO III) and "Data management training course and workshop" in January 2013 in India. As one follow-up action to the 2012 CB assessment workshop, IMBER is also considering to hold its 2014 summer school (ClimECO4) in China to benefit more students and early career scientists in the Asia-Pacific region. Moreover, this project brought linkage between international/regional organizations and countries from the APN region, which may possibly facilitate future collaboration not only on CB activities, but also on marine research in this region.

As building research capacity is essential for achieving sustainable marine research for all regions of the world, the methods and tools explored in this project and some of the outcomes brought from this project would hopefully be a useful reference in developing research capacity for other regions.

Participants from the IMBER IMBIZO III conference held in January 2013 in India

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Website:

APN website: www.apn-gcr.org
IAEA website: www.iaea.org
IMBER website: www.imber.info
IOC/WESTPAC website: westpac.unescobkk.org
OceanTeacher website: classroom.oceanteacher.org/mod/page/view.php?id=2033
PICES website: www.pices.int
POGO website: www.ocean-partners.org
SCOR website: www.scor-int.org
SIBER website: www.incois.gov.in/Incois/siber/siber.jsp

Appendix

I. Agenda and participants for the international workshop on needs assessment for capacity development for integrated marine biogeochemistry and ecosystem research in the Asia-Pacific region (30 July-4 Aug, 2012, ECNU, Shanghai, China)

Workshop agenda

Monday, 30 July 2012

Time	Activities
14:00-18:00	Registration (At the lobby of Yifu Guest House)
18:00	Dinner
19:30-21:00	Ice-breaker

Day one: Tuesday, 31 July 2012

(Room431, Yifu Guest House)

Time	Activities	
09:00-09:30	Registration (Room 431, Yifu Guest House)	
09:30-10:15	Opening, introduction, review of agenda Jing Zhang, Yunxuan Zhou	
10:15-10:30	Group photo	
10:30-10:45	Coffee / Tea break	
Convener for morning session: Jing Zhang		
Time	**Speaker**	**Title of presentation**
10:45-11:10	Julie Hall	IMBER capacity building to date
11:10-11:35	Bernard Avril	Capacity development for marine sciences – new challenges and new opportunities
11:35-12:00	Xiaojun Deng	Asia-Pacific Network for Global Change Research and its role in capacity building
12:00	Lunch	
Convener for afternoon session: Bernard Avril		
14:00-14:25	Samina Kidwai	Marine Science in Pakistan: situation analysis and need assessment for capacity building
14:25-14:50	Vyacheslav Lobanov	Key marine ecological issues in Russian Far East and requirements for capacity building on the IMBER related research
14:50-15:15	Laura David (presented via Skype)	Harnessing and consolidating regional strengths for capacity enhancement
15:15-15:45	Coffee / Tea break	
15:45-16:10	John Machiwa	Capacity development for marine biogeochemistry and ecosystem research in the WIO region: the case of the University of Dar es Salaam, Tanzania
16:10-16:35	John Morrison	IMBER-related capacity building in the South Pacific Region

16:35-17:00	Temel Oguz	Capacity building efforts on marine ecosystem related issues in Turkey and their linkage to European initiatives
17:00-17:25	Maria Lourdes San Diego-McGlone	Capacity development in Philippine marine science
17:25-17:50	Ed Urban	How can international research projects stimulate regional capacity building?
18:00	Reception dinner	

Day two: Wednesday, 1 August 2012

(Room431, Yifu Guest House)

Time	Speaker	Title of presentation
Convener for morning session: Julie Hall		
09:00-09:25	Thamasak Yeemin	Capacity building and research needed for IMBER in Thailand
09:25-09:50	Jing Zhang	Needs Assessment of IMBER related Capacity Building in China
09:50-10:15	Wenxi Zhu IOC/WESTPAC	Empowering developing countries in the Western Pacific to sustainably develop their marine and coastal ecosystems--capacity development efforts of WESTPAC in marine science
10:15-10:45	Coffee / Tea break	
10:45-10:55	Liuming Hu for Carina Lange	Capacity building in Chile, a history of success: The Austral Summer Institute
10:55-11:20	Francis Gerald Plumley	Capacity building in POGO
11:20-11:45	Gi Hoon Hong	South Korean needs to build research capacity for understanding marine ecosystem using marine biogeochemical variables (Gi Hoon Hong and Suk Hyun Kim)
12:00	Lunch	
Convener for afternoon session: Ed Urban		
14:00-15:30	General discussions: ➢ Hot points ➢ Emerging and burning issues ➢ Frontiers and future directions of Capacity Building ➢ Proposed actions for the synthesis article and APN Final Report	
15:30-16:00	Coffee / Tea break	
16:00-18:00	Breakout groups & group discussion (divided into 3-4 groups)	
18:00	Dinner	

Day three: Thursday, 2 August 2012

Time	Activities
Convener: John Morrison	
09:00-10:30	Plenary reports by breakout groups
10:30-11:00	Coffee / Tea break
11:00-12:00	Group discussion
12:00	Lunch

14:00-15:30	Group discussion continued
15:30-16:00	Coffee / Tea break
16:00-18:00	Group discussion continued
18:00	Dinner

Day four: Friday, 3 August 2012

Time	Activities
09:00-10:30	Group discussion continued
10:30-11:00	Coffee / Tea break
Convener: Ed Urban	
11:00-12:00	Plenary reports by breakout groups
12:00	Lunch
14:00-15:30	Group discussion & report writing
15:30-16:00	Coffee / Tea break
16:00-18:00	Group discussion & report writing continued
18:00	Dinner

Day five: Saturday, 4 August 2012

Time	Activities
Convener: Julie Hall	
09:00-10:30	Plenary reports by breakout groups
10:30-11:00	Coffee / Tea break
11:00-12:00	Writing ➢ APN Final report ➢ Proposals for the activities ➢ Short article
12:00	Lunch
14:00-15:30	Writing ➢ APN Final report ➢ Proposals for the activities ➢ Short article
15:30-16:00	Coffee / Tea break
16:00-17:00	➢ Plenary reports by breakout groups ➢ Follow up activities
17:00-17:30	Workshop wrap up
17:30	Close of workshop
18:00	Dinner

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II. Agenda and participants for the small group meeting on needs assessment for capacity development for integrated marine biogeochemistry and ecosystem research in the Asia-Pacific region (25-27 March 2013, ECNU, Shanghai, China)

Meeting agenda

Day one: Monday, 25 March 2013

09:00-09:10 Opening welcome and introduction to the meeting agenda (Zhang)
09:10-09:30 Briefing on the draft of CB strategy paper (Morrison)
09:30-10:30 Discussion on CB gaps and needs
10:30-11:00 Coffee break
11:00-12:00
12:00 Lunch
13:30-17:30 Discussion on the paper contents and structure
17:30-18:00 Wrap-up and short discussion
18:00 Dinner

Day two: Tuesday, 26 March 2013

09:00-10:00 Challenges and recommendations for capacity building
10:30-11:00 Coffee break
10:00-12:00 Continued discussion
12:00 Lunch
13:30-14:00 Wrap-up of general discussion
Assign writing tasks
14:00-17:00 Writing
17:00-18:00 Re-convene (Bernard Avril joins the discussion via Skype), complete manuscript and circulate it before dinner
18:00 Dinner

Day three: Wednesday, 27 March 2013

09:00-10:30 Discussion, comments, and suggestions on the manuscript
10:30-11:00 Coffee break
11:00-12:00 Polishing and smoothing the manuscript
Follow-up action and time-table for publishing
12:00 Lunch
13:30-14:00 Re-cap from the 2012 CB meeting and the draft report to the APN (Zhang)
14:00-15:00 Comments and suggestions on the report
15:00-15:30 Coffee break
15:30-17:00 Potential follow-up activities of the CB meeting (Future direction)
17:00-18:00 Wrap-up for the meeting
18:00 Dinner

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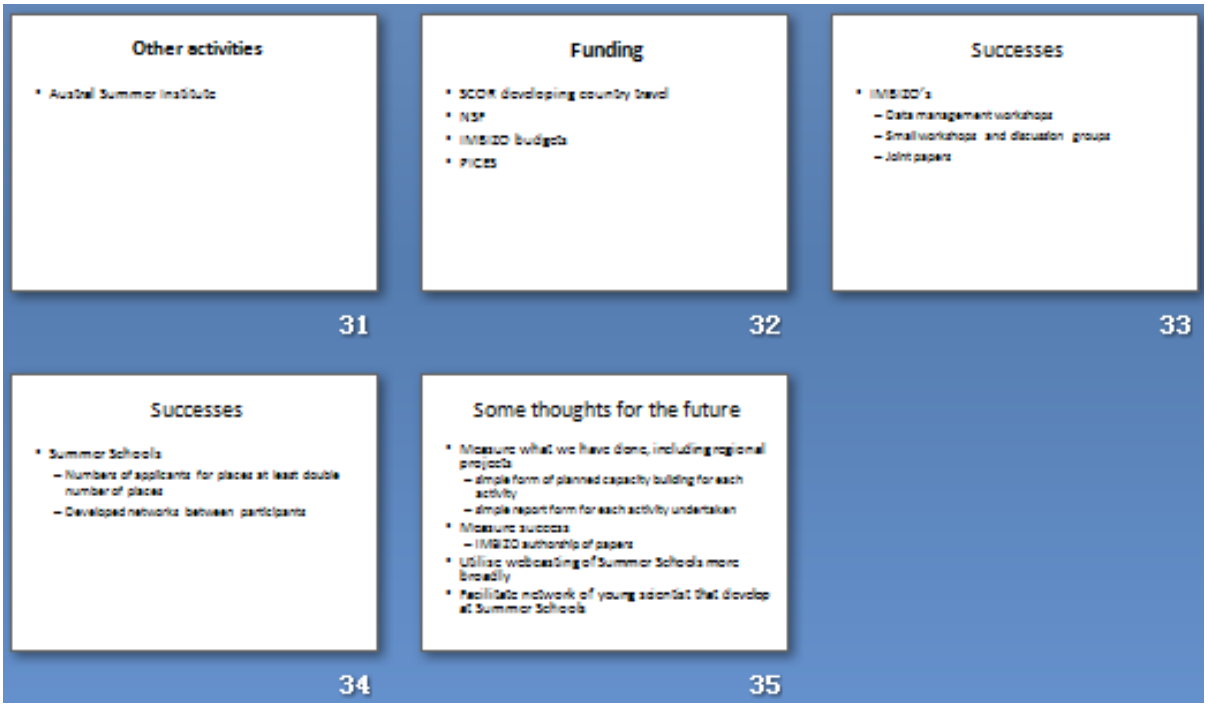
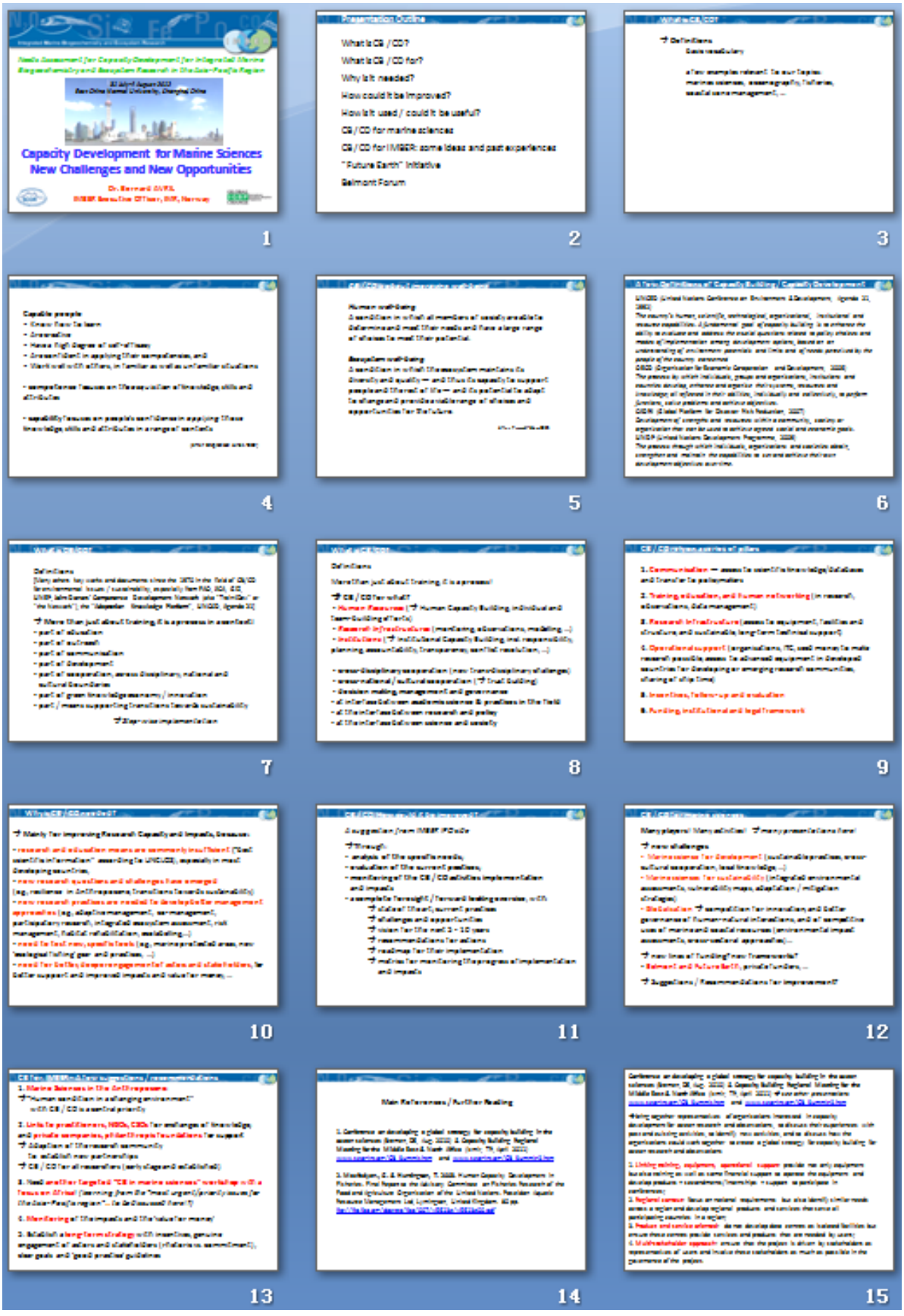
III. Presentations

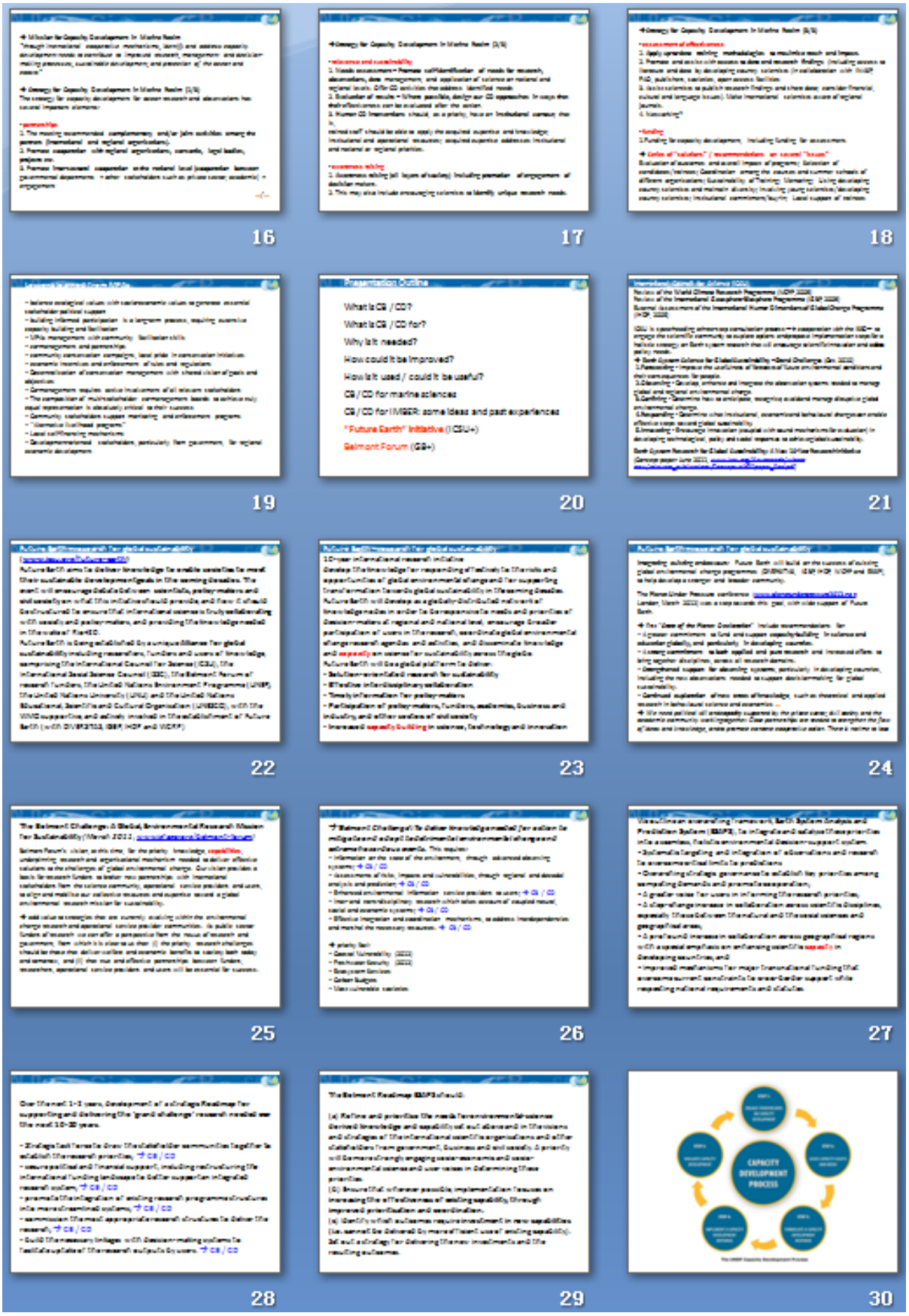
1. IMBER capacity building to date


Activities
Focus
16
Embedded Activities
17
IMBIZO I
Integrating Biogeochemistry and Ecosystems in a Changing Ocean
18
IMBIZO
120 participants
12 students
16 developing country scientists from 6 countries
Data Management Workshop
19
IMBIZO II
Integrating Biogeochemistry and Ecosystems in a Changing Ocean: Regional Comparisons
10-14 October 2010, Crete, Greece
15 participants from developing countries
Data Management workshop
20
IMBIZO III
The future of marine biogeochemistry, ecosystems and societies: Multi-dimensional approaches to the challenges of global change in continental margins and open ocean systems
January 2013, Goa, India
21
IMBER Regional projects
SIBER
ESSAS
CLIOTOP
ICED
22
Specific Capacity Building activities
23
ClimECO
Climate driving of ecosystem changes
April 2009, Brest, France
24
Co-convened CLIVAR and GLOBEC
50 students from 100 applicants
7 participants from developing countries
Webcasting of lectures
25
E2E EcoModel
19 students
6 from developing countries
26
Oceans, Marine Ecosystems, and Society facing Climate Change: A multidisciplinary approach
August 2010, Brest, France
27
70 students from 26 countries
14 students from 7 developing countries
Webcasting of lectures and remote questions
28
A View Towards Integrated Earth System Models: Human-nature interactions in the Marine World
29
50 students
17 developing country students from 10 different countries
Webcasting and remote questions?
30


Other activities
• AusDel Summer Institute
31
Funding
• SCOR developing country travel
• NSF
• IMBIZO budgets
• PICES
32
Successes
• IMBIZO's
– Data management workshops
– Small workshops and discussion groups
– Joint papers
33
Successes
• Summer Schools
– Numbers of applicants for places at least double number of places
– Developed networks between participants
34
Some thoughts for the future
• Measure what we have done, including regional projects
– simple form of planned capacity building for each activity
– simple report form for each activity undertaken
• Measure success
– IMBIZO authorship of papers
• Utilise webcasting of Summer Schools more broadly
• Facilitate network of young scientist that develop at Summer Schools
35

2. Capacity development for marine sciences: new challenges and new opportunities

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Presentation outline
What is CB / CD?
What is CB / CD for?
Why is it needed?
How could it be improved?
How is it used / could it be useful?
CB / CD for marine sciences
CB / CD for IMBER: some ideas and past experiences
"Future Earth" initiative (ICSU+)
Belmont Forum (G8+)
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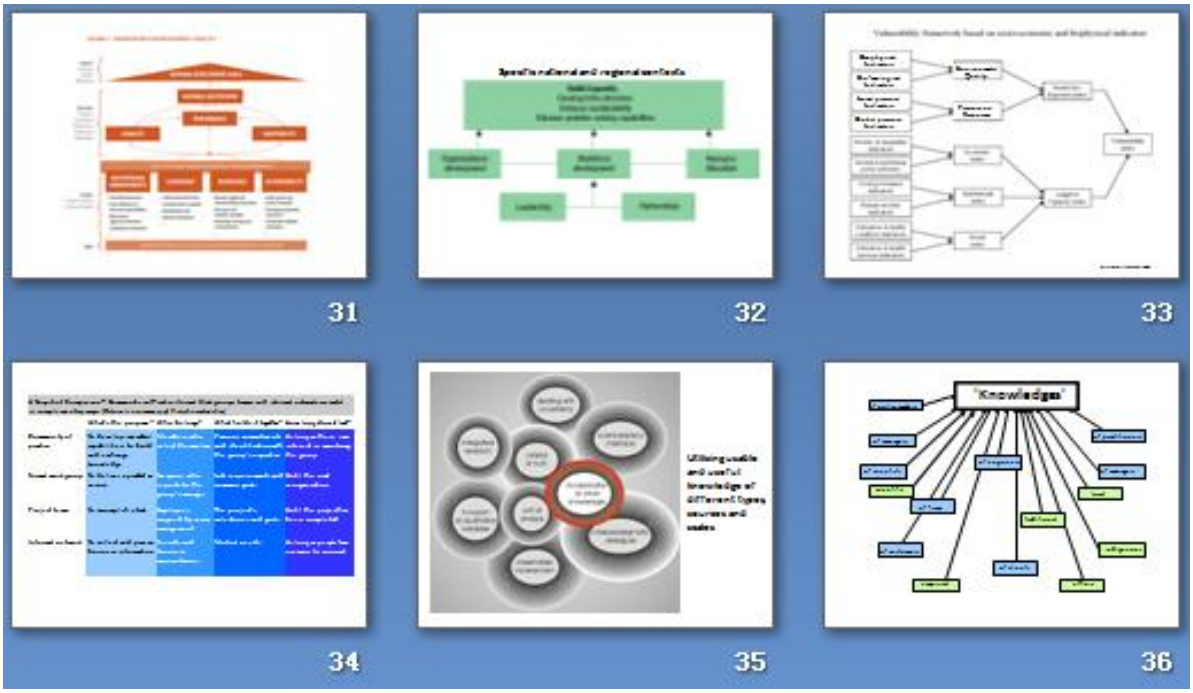
CAPACITY DEVELOPMENT PROCESS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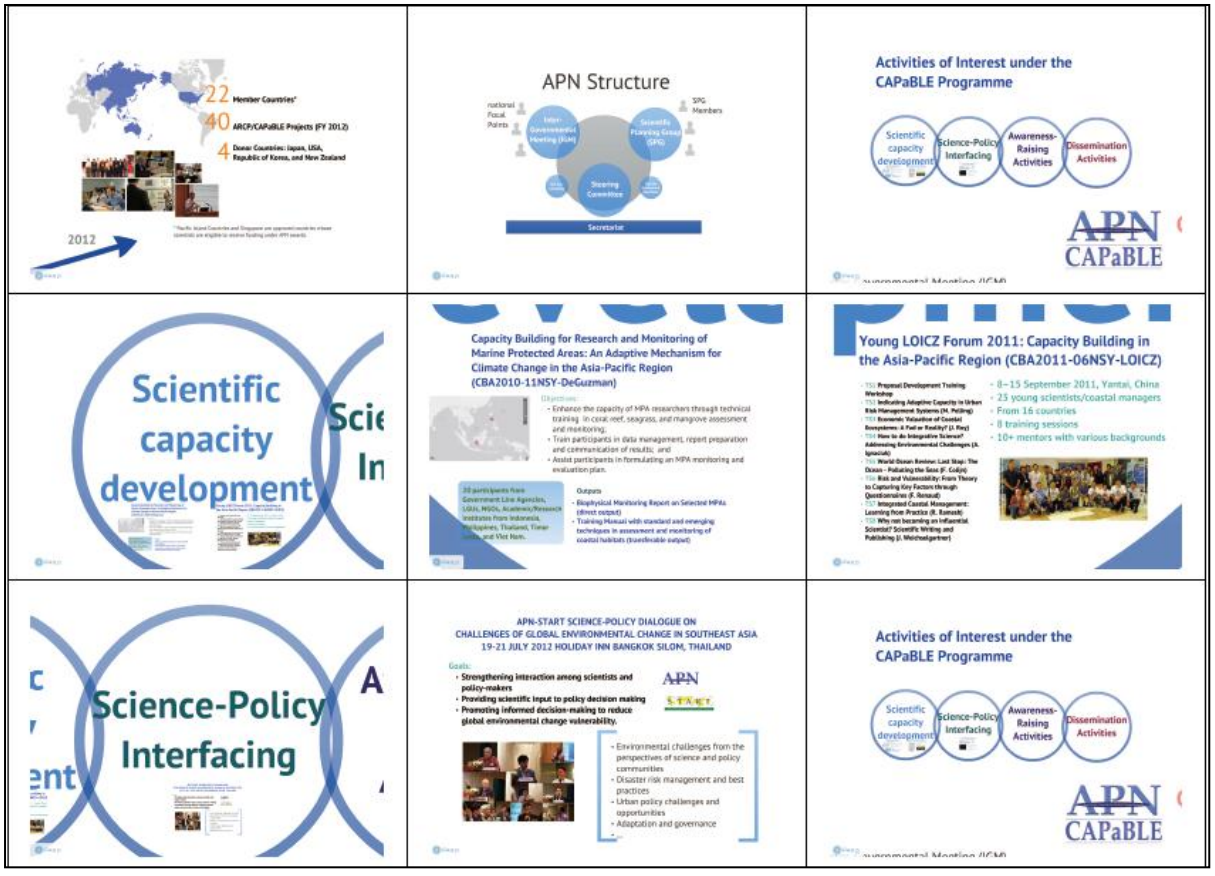
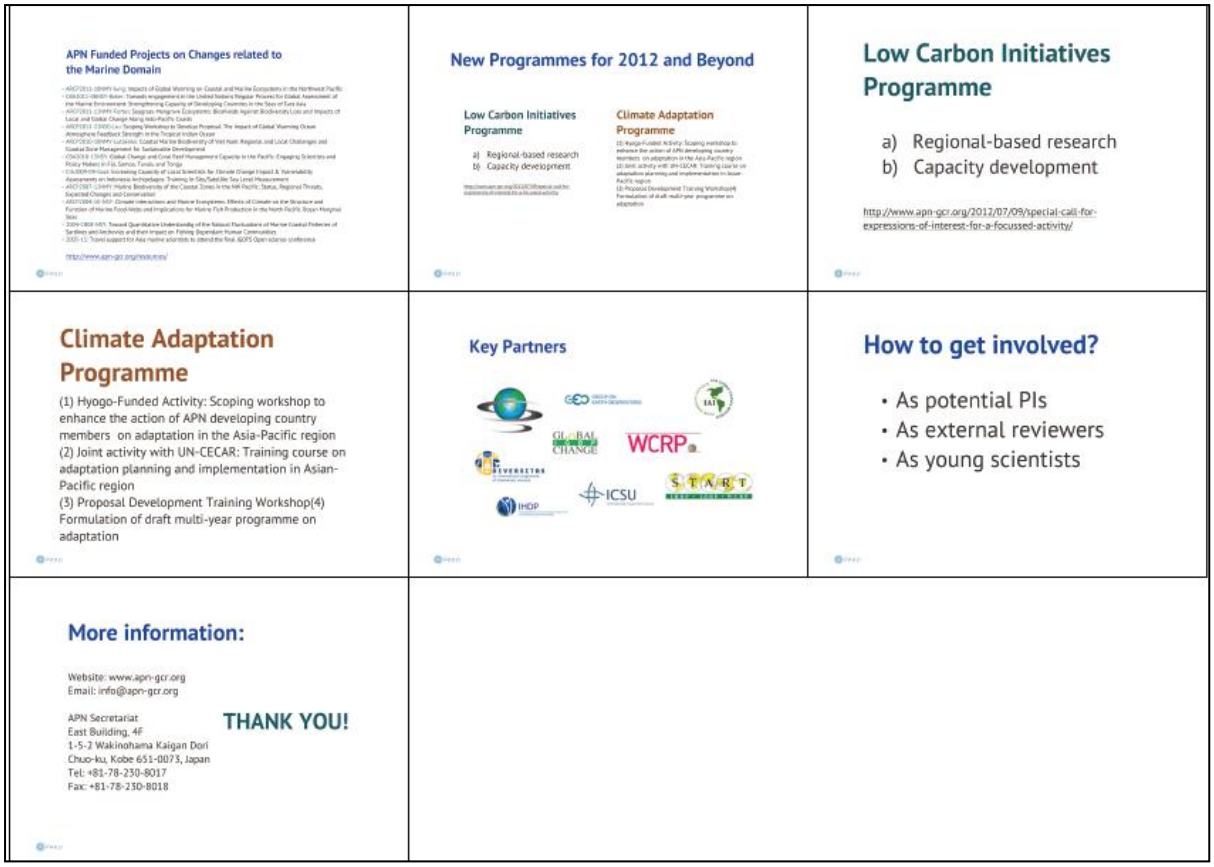
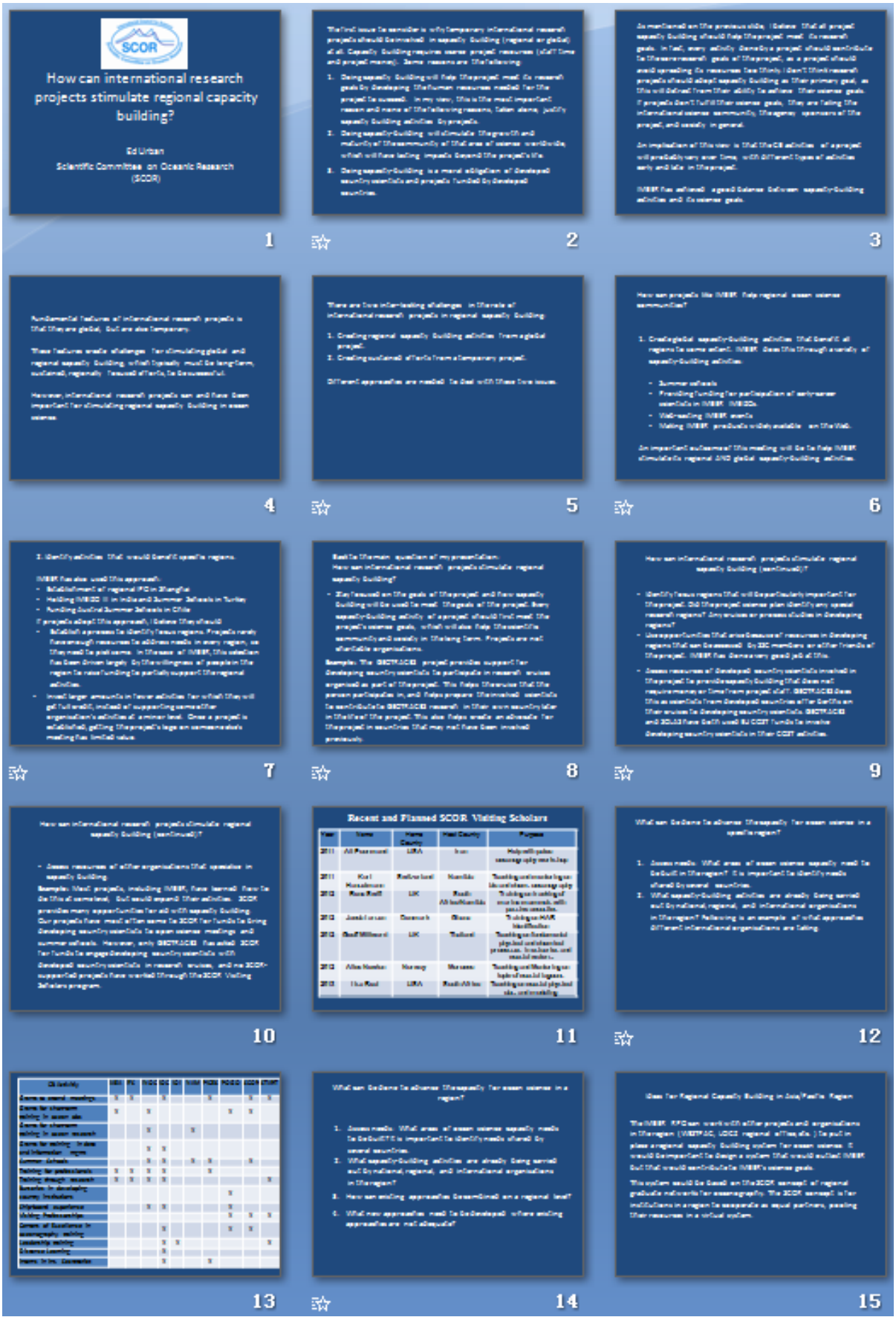
'Knowledge'

3. APN and its role in capacity building




APN Funded Projects on Changes related to the Marine Domain
New Programmes for 2012 and Beyond
Low Carbon Initiatives Programme
a) Regional-based research
b) Capacity development
Climate Adaptation Programme
Low Carbon Initiatives Programme
a) Regional-based research
b) Capacity development
http://www.apn-gcr.org/2012/07/09/special-call-for-expressions-of-interest-for-a-focussed-activity/
Climate Adaptation Programme
(1) Hyogo-Funded Activity: Scoping workshop to enhance the action of APN developing country members on adaptation in the Asia-Pacific region
(2) Joint activity with UN-CECAR: Training course on adaptation planning and implementation in Asian-Pacific region
(3) Proposal Development Training Workshop(4) Formulation of draft multi-year programme on adaptation
Key Partners
How to get involved?
• As potential PIs
• As external reviewers
• As young scientists
More information:
Website: www.apn-gcr.org
Email: info@apn-gcr.org
APN Secretariat
East Building, 4F
1-5-2 Wakinohama Kaigan Dori
Chuo-ku, Kobe 651-0073, Japan
Tel: +81-78-230-8017
Fax: +81-78-230-8018
THANK YOU!

4. How can international research projects stimulate regional capacity building?

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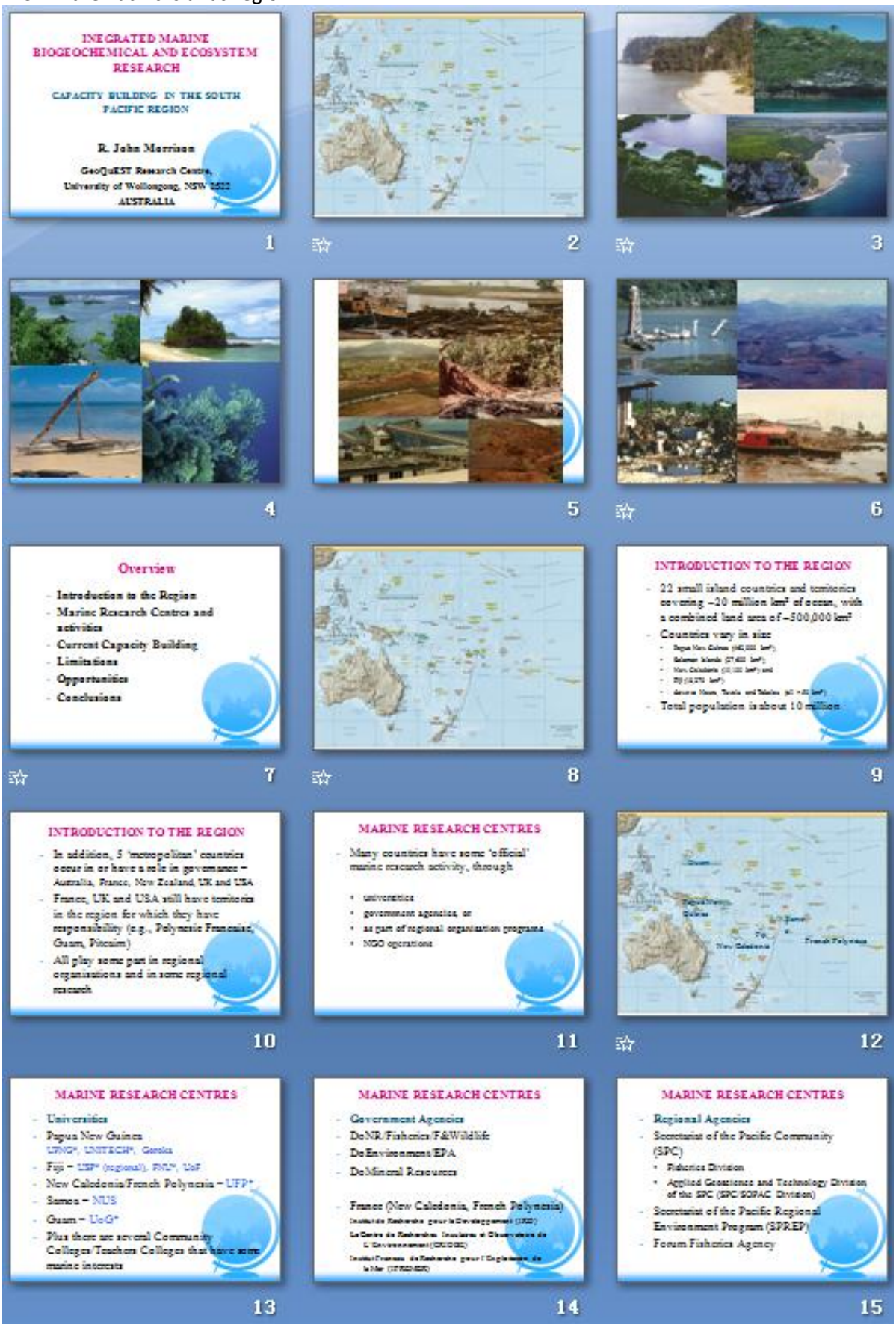
How can this meeting help the global IVEEN project?

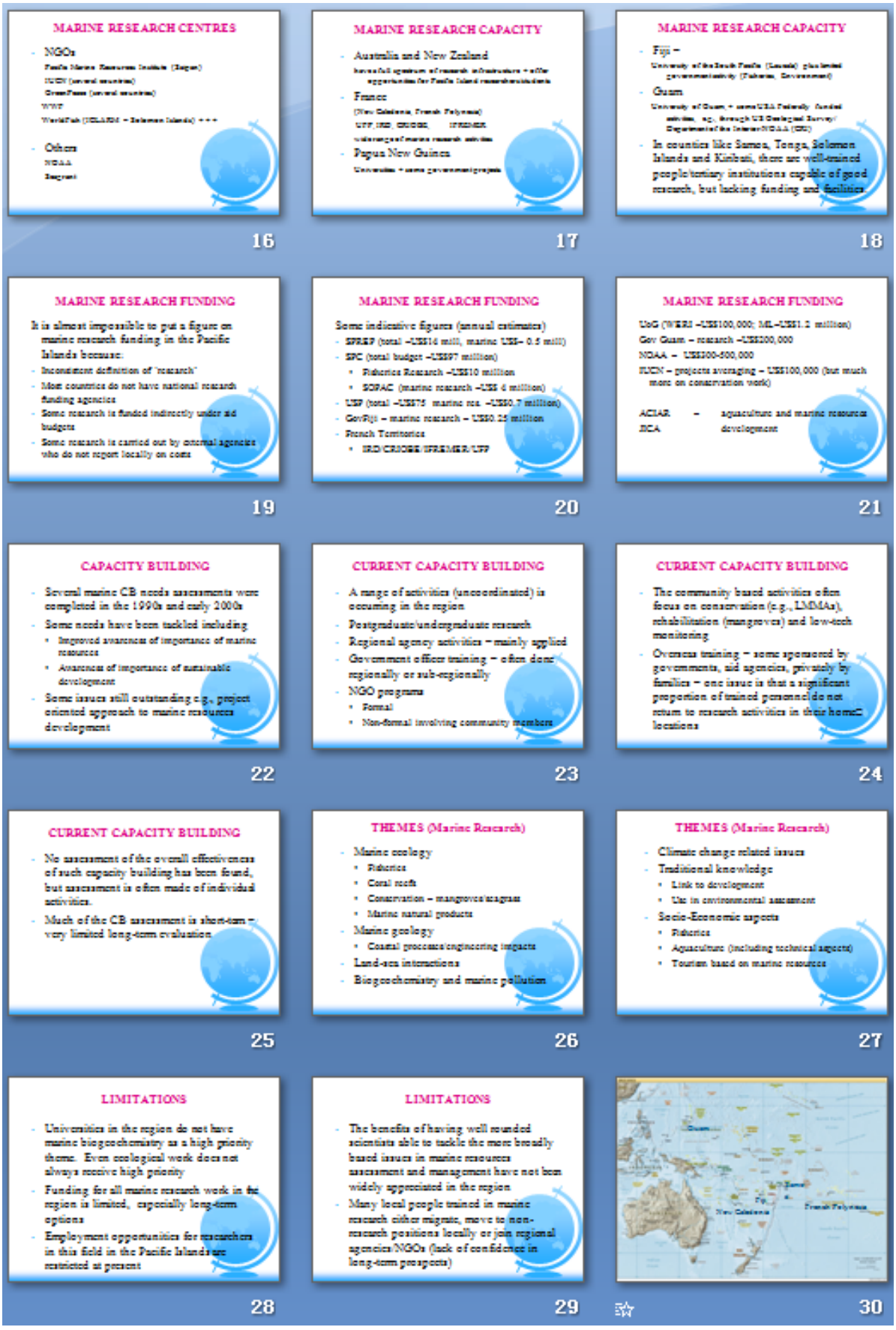
5. POGO capacity building


Nippon Foundation - POGO Alumni Network for Oceans (NANO)
Why an Alumni Network?
Alumni database
16
17
18
NANO Geography
NANO in numbers
NANO in numbers
19
20
21
Alumni success stories
nano
NANO News
22
23
24
NANO Research Projects
NANO Research Projects
NANO Research Projects
25
26
27
NANO Research Projects
Outlook
POGO Capacity Building Programmes
BACK TO THE BEGINNING
28
29
30
POGO Capacity Building Programmes
POSSIBLE OPPORTUNITIES FOR IMBER
31

6. Empowering countries in the western Pacific to sustainably develop their marine and coastal resources---WESTPAC's capacity building efforts in marine sciences

7. CB in the Pacific islands region




MARINE RESEARCH CENTRES
NGOs
Others
16
MARINE RESEARCH CAPACITY
Australia and New Zealand
France
Papua New Guinea
17
MARINE RESEARCH CAPACITY
Fiji –
Guam
In countries like Samoa, Tonga, Solomon Islands and Kiribati, there are well-trained people/tertiary institutions capable of good research, but lacking funding and facilities
18
MARINE RESEARCH FUNDING
It is almost impossible to put a figure on marine research funding in the Pacific Islands because:
Inconsistent definition of 'research'
Most countries do not have national research funding agencies
Some research is funded indirectly under aid budgets
Some research is carried out by external agencies who do not report locally on costs
19
MARINE RESEARCH FUNDING
Some indicative figures (annual estimates)
SPREP (total ~US$16 mill, marine US$~ 0.5 mill)
SPC (total budget ~US$97 million)
Fisheries Research ~US$10 million
SOPAC (marine research ~US$ 4 million)
USP (total ~US$75 marine res. ~US$0.7 million)
GovFiji – marine research ~ US$0.25 million
French Territories
IRD/CRIOBE/IFREMER/UPF
20
MARINE RESEARCH FUNDING
UoG (WERI ~US$100,000; ML~US$1.2 million)
Gov Guam – research ~US$200,000
NOAA ~ US$300-500,000
IUCN – projects averaging ~ US$100,000 (but much more on conservation work)
ACIAR – aquaculture and marine resource
JICA development
21
CAPACITY BUILDING
Several marine CB needs assessments were completed in the 1990s and early 2000s
Some needs have been tackled including
Improved awareness of importance of marine resources
Awareness of importance of sustainable development
Some issues still outstanding e.g., project oriented approach to marine resources development
22
CURRENT CAPACITY BUILDING
A range of activities (uncoordinated) is occurring in the region
Postgraduate/undergraduate research
Regional agency activities ~ mainly applied
Government officer training ~ often done regionally or sub-regionally
NGO programs
Formal
Non-formal involving community members
23
CURRENT CAPACITY BUILDING
The community based activities often focus on conservation (e.g., LMMAs), rehabilitation (mangroves) and low-tech monitoring
Overseas training ~ some sponsored by governments, aid agencies, privately by families ~ one issue is that a significant proportion of trained personnel do not return to research activities in their home locations
24
CURRENT CAPACITY BUILDING
No assessment of the overall effectiveness of such capacity building has been found, but assessment is often made of individual activities.
Much of the CB assessment is short-term ~ very limited long-term evaluation.
25
THEMES (Marine Research)
Marine ecology
Fisheries
Coral reefs
Conservation – mangroves/seagrass
Marine natural products
Marine geology
Coastal processes/engineering impacts
Land-sea interactions
Biogeochemistry and marine pollution
26
THEMES (Marine Research)
Climate change related issues
Traditional knowledge
Link to development
Use in environmental assessment
Socio-Economic aspects
Fisheries
Aquaculture (including technical aspects)
Tourism based on marine resources
27
LIMITATIONS
Universities in the region do not have marine biogeochemistry as a high priority theme. Even ecological work does not always receive high priority
Funding for all marine research work in the region is limited, especially long-term options
Employment opportunities for researchers in this field in the Pacific Islands are restricted at present
28
LIMITATIONS
The benefits of having well rounded scientists able to tackle the more broadly based issues in marine resources assessment and management have not been widely appreciated in the region
Many local people trained in marine research either migrate, move to non-research positions locally or join regional agencies/NGOs (lack of confidence in long-term prospects)
29
Guam
Fiji
New Caledonia
French Polynesia
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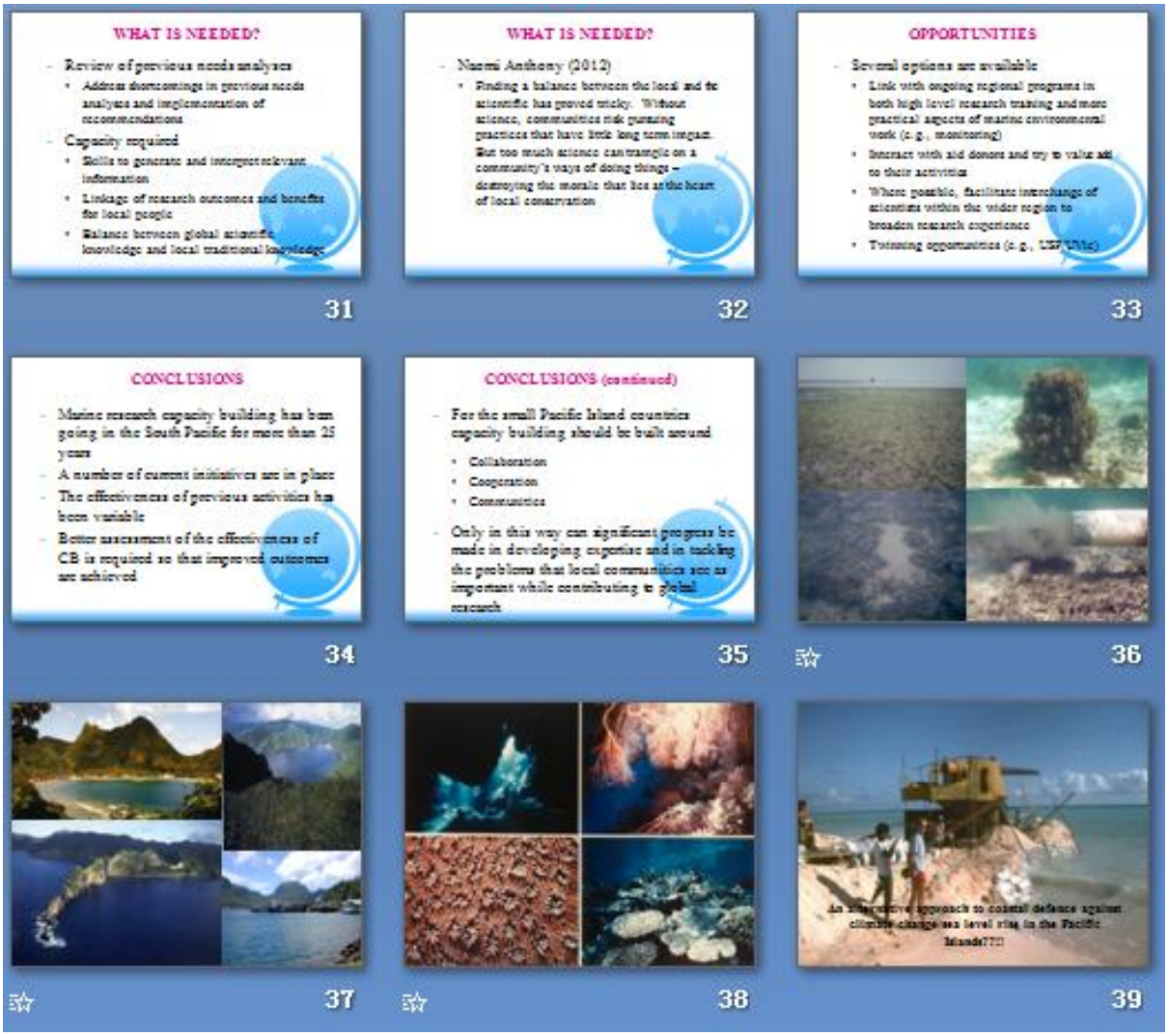
WHAT IS NEEDED?
- Review of previous needs analyses
• Address shortcomings in previous needs analyses and implementation of recommendations
- Capacity required
• Skills to generate and interpret relevant information
• Linkage of research outcomes and benefits for local people
• Balance between global scientific knowledge and local traditional knowledge
31
WHAT IS NEEDED?
- Naomi Anthony (2012)
• Finding a balance between the local and the scientific has proved tricky. Without science, communities risk pursuing practices that have little long term impact. But too much science can transgress on a community's ways of doing things – destroying the morals that lies at the heart of local conservation
32
OPPORTUNITIES
- Several options are available
• Link with ongoing regional programs in both high level research training and more practical aspects of marine environmental work (e.g., monitoring)
• Interact with aid donors and try to value add to their activities
• Where possible, facilitate interchange of scientists within the wider region to broaden research experience
• Twinning opportunities (e.g., USP/SPC)
33
CONCLUSIONS
- Marine research capacity building has been going in the South Pacific for more than 25 years
- A number of current initiatives are in place
- The effectiveness of previous activities has been variable
- Better assessment of the effectiveness of CB is required so that improved outcomes are achieved
34
CONCLUSIONS (continued)
- For the small Pacific Island countries capacity building should be built around
• Collaboration
• Cooperation
• Communities
- Only in this way can significant progress be made in developing expertise and in tackling the problems that local communities see as important while contributing to global research
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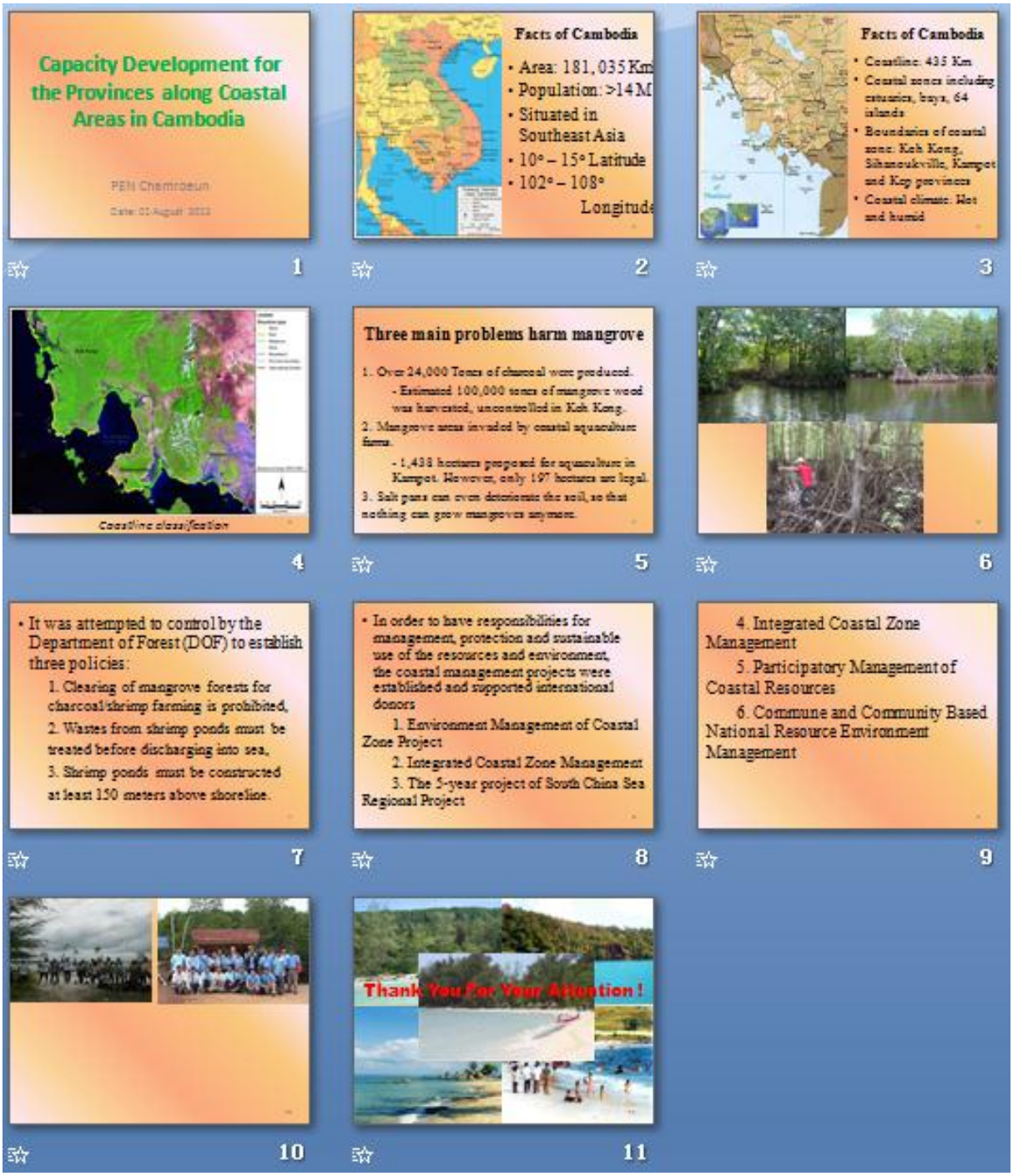
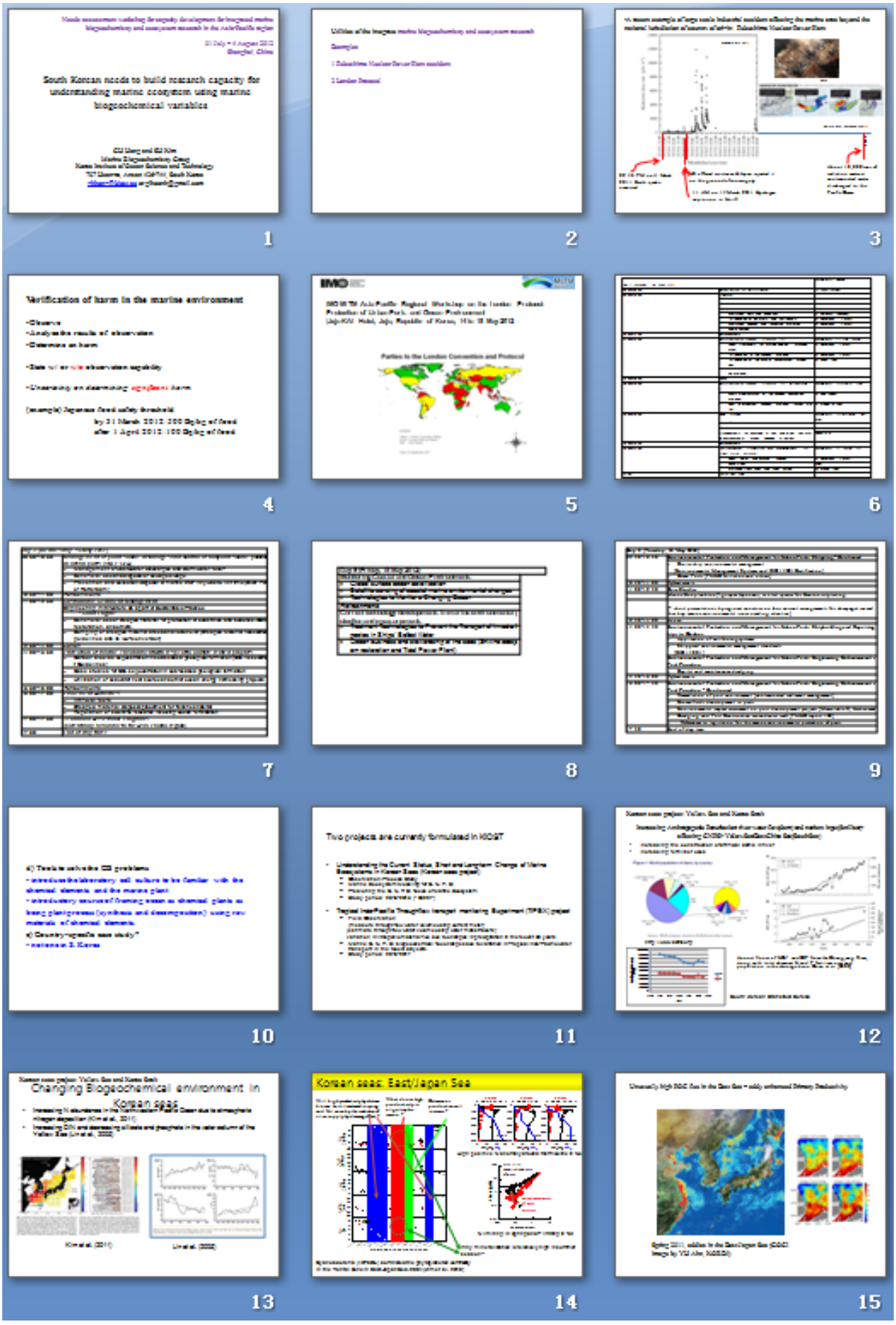
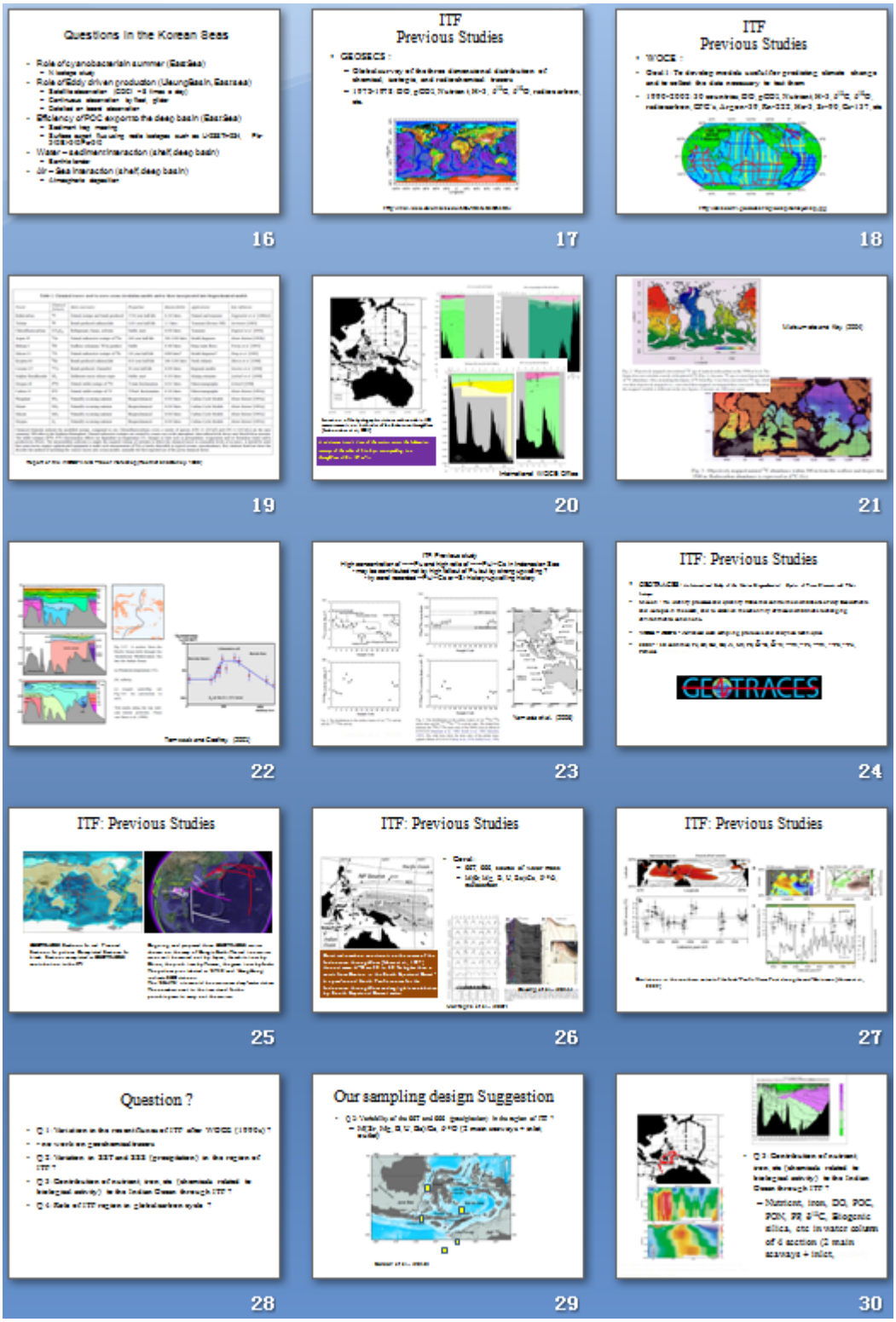
8. Capacity development for the provinces along the coastal areas in Cambodia



9. South Korean needs to build research capacity for understanding marine ecosystem using marine biogeochemical variables




Questions in the Korean Seas
16
ITF
Previous Studies
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ITF
Previous Studies
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ITF: Previous Studies
GEOTRACES
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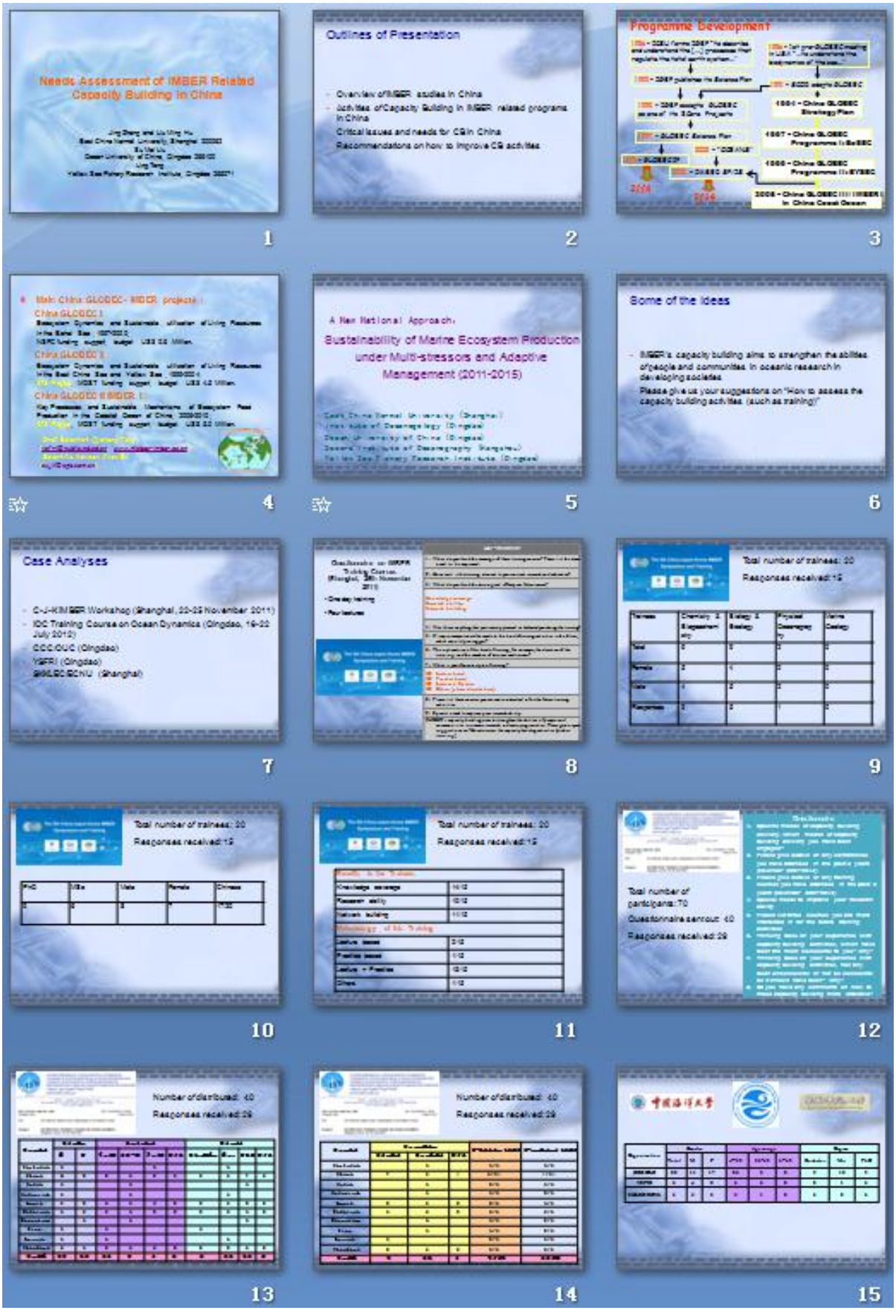
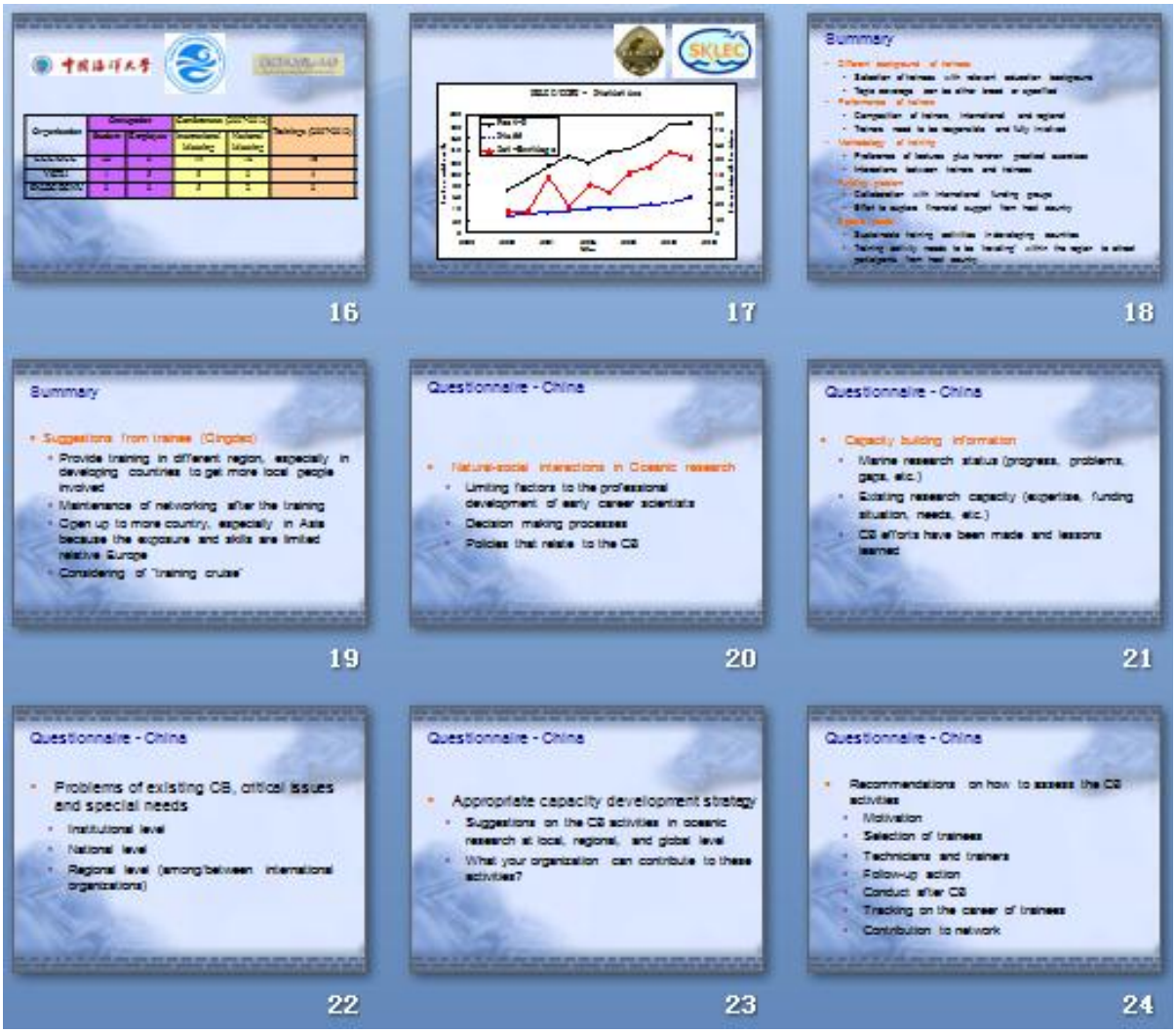
ITF: Previous Studies
25
ITF: Previous Studies
26
ITF: Previous Studies
27
Question ?
28
Our sampling design Suggestion
29
30
Data quality control
31
Design
32

10. Needs assessment of IMBER-related capacity building in China

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Summary
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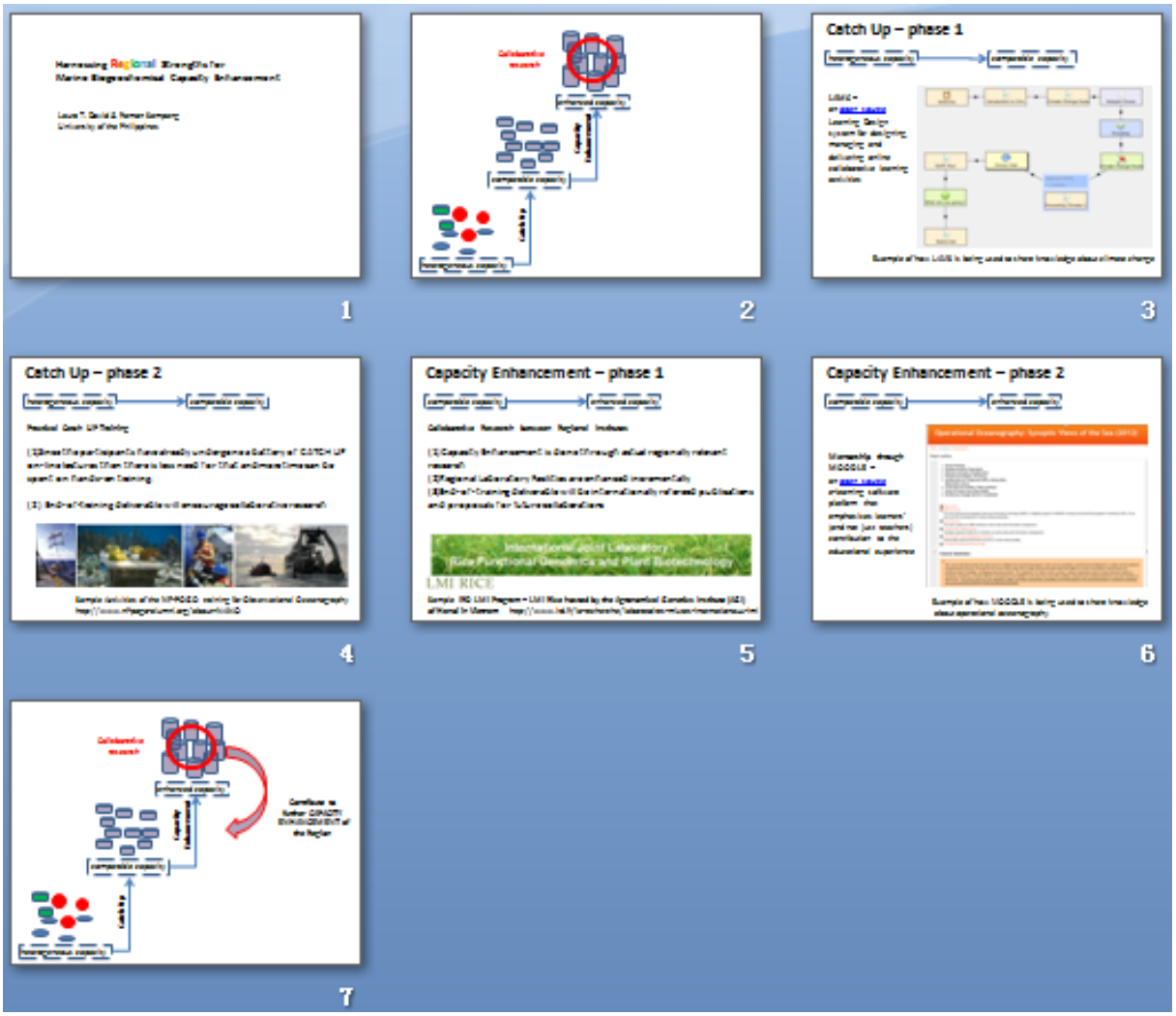
Summary
Suggestions from trainee (Qingdao)
Provide training in different region, especially in developing countries to get more local people involved
Maintenance of networking after the training
Open up to more country, especially in Asia because the exposure and skills are limited relative Europe
Considering of "training cruise"
19
Questionnaire - China
Natural-social interactions in Oceanic research
Limiting factors to the professional development of early career scientists
Decision making processes
Policies that relate to the CB
20
Questionnaire - China
Capacity building information
Marine research status (progress, problems, gaps, etc.)
Existing research capacity (expertise, funding situation, needs, etc.)
CB efforts have been made and lessons learned
21
Questionnaire - China
Problems of existing CB, critical issues and special needs
Institutional level
National level
Regional level (among/between international organizations)
22
Questionnaire - China
Appropriate capacity development strategy
Suggestions on the CB activities in oceanic research at local, regional, and global level
What your organization can contribute to these activities?
23
Questionnaire - China
Recommendations on how to assess the CB activities
Motivation
Selection of trainees
Technicians and trainers
Follow-up action
Conduct after CB
Tracking on the career of trainees
Contribution to network
24

11. Harnessing and consolidating regional strengths for capacity enhancement



12. Capacity development in Philippine marine science


MANGROVE LOSS
Mangroves give way to more prawn farms
16
Capacity Development through UP Marine Science Institute
17
Current mechanisms to address mandate on Instruction and Extension (CAPACITY DEVELOPMENT):
1. Graduate programs (MSc and PhD)
Marine Biology (ECOSYSTEM RESEARCH)
Marine Physical Science (BIOGEOCHEMISTRY)
Marine Biotechnology
2. Non-formal training courses – project-based
3. Collaboration with other institutions - Graduate program offerings
4. Outreach and extension programs – Bolinao Marine Laboratory
Summer internship programs for Science High schools
Summer camps for High schools students and teachers
Training programs –develop technologies, resource management
Science education
18
MSI is definitely growing
MSc Student Population
19
PhD Student Population
20
21
Still need to improve graduation rates
MSc Graduates
22
PhD Graduates
23
24
25
The role and reach of MSI faculty extend beyond MSI
26
27
Extension
28
Training Programs at Bolinao Marine Laboratory
29
Capacity Development through Other higher education institutions in the Philippines
30


Report on the Assessment of Marine Science/Marine Biology Programs in Philippine Higher Education
31
32
Issue: Faculty
33
Faculty: Identified Strengths and Gaps
34
Issue: Infrastructure and Information Access
35
Infra & Info: Identified Strengths and Gaps
36
Capacity Development through Analytical Services Laboratory/ National Agencies
37
Research and Analytical Services Laboratory of the UP Natural Sciences Research Institute
38
39
Capacity Development through Projects – National / Regional
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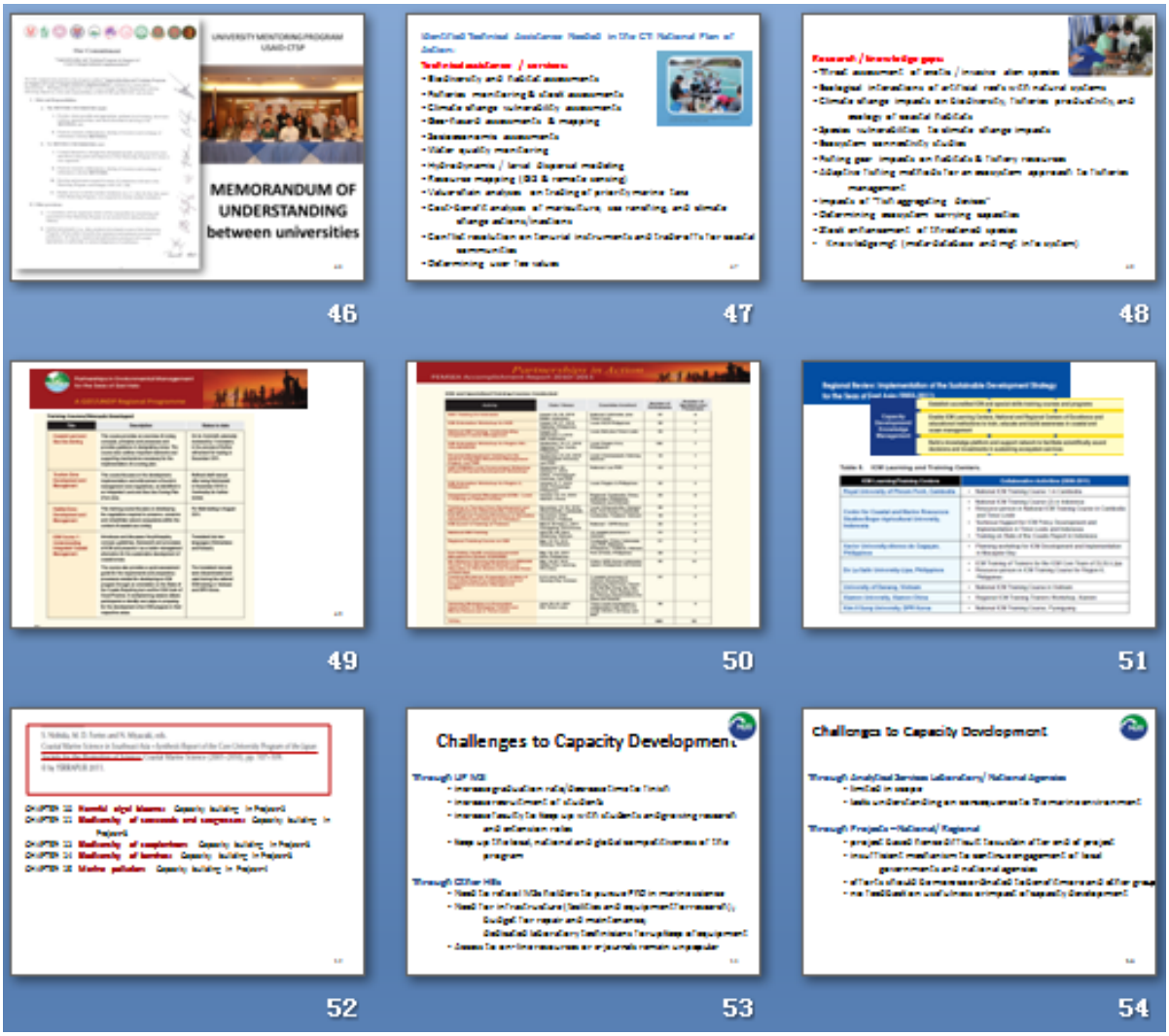
Coral Triangle Support Partnership (CTSP)
43
44
Mentoring Program for Marine Science
45


UNIVERSITY MENTORING PROGRAM
USAID-CTSP
MEMORANDUM OF UNDERSTANDING between universities
46
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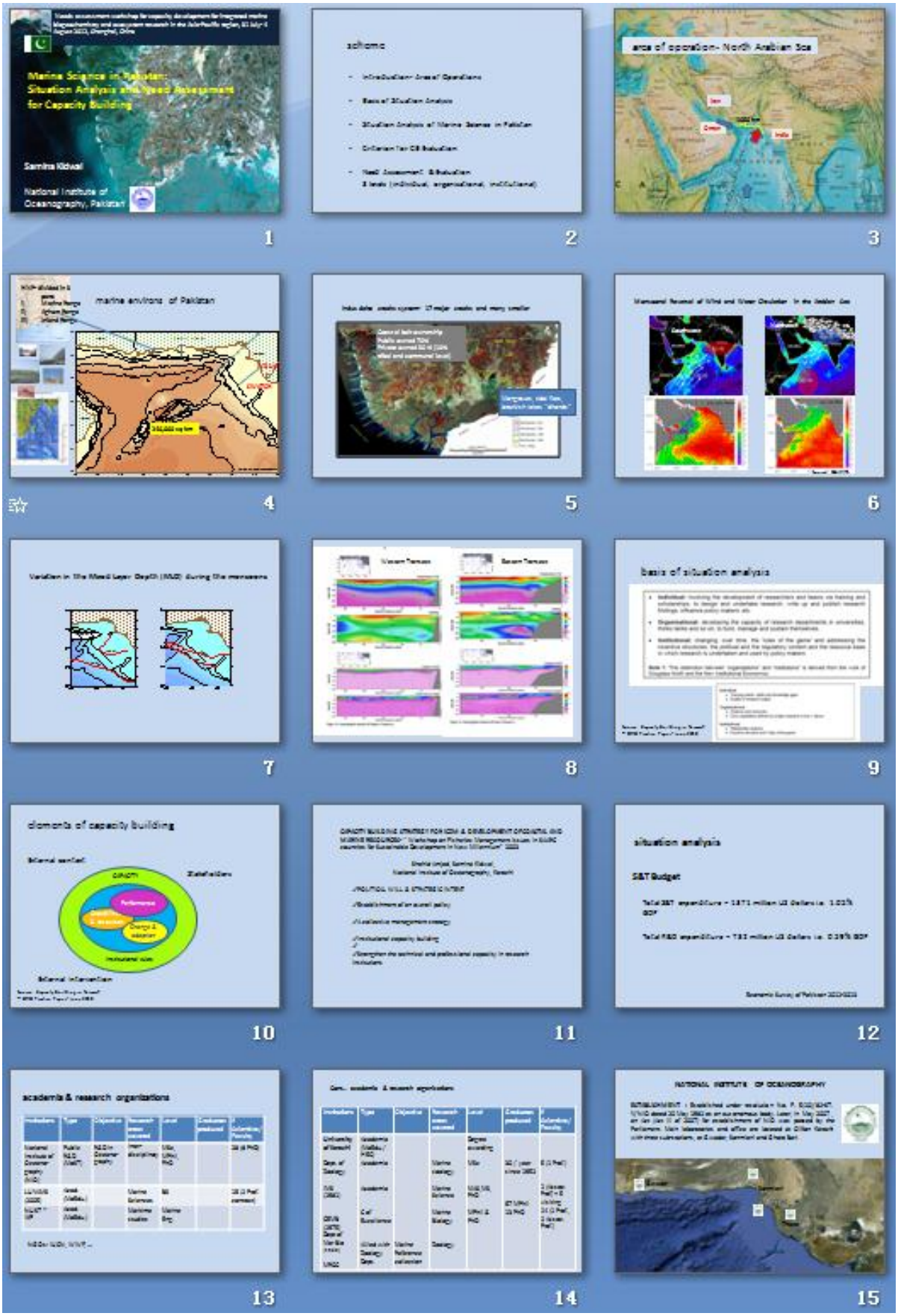
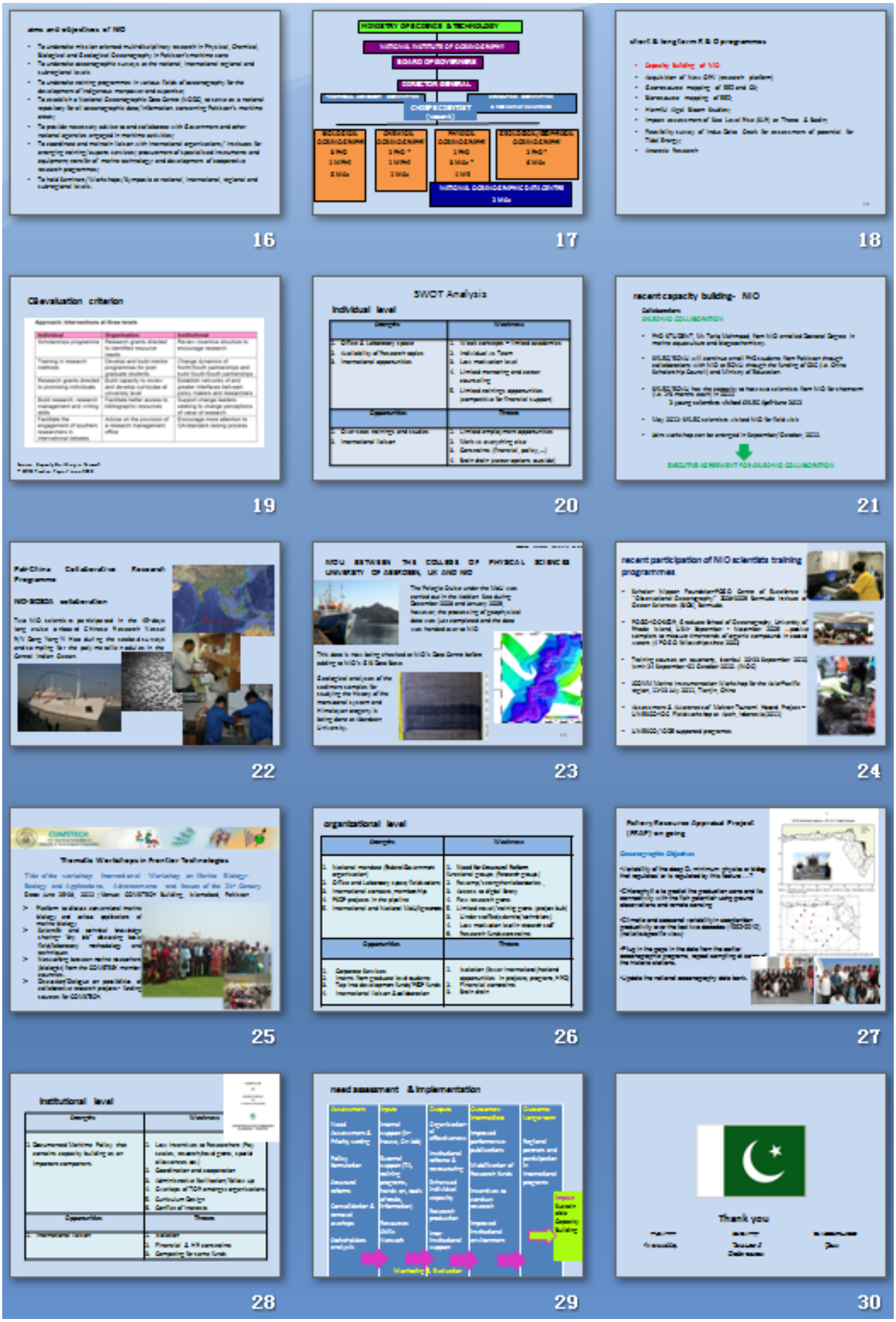
52
Challenges to Capacity Development
53
Challenges to Capacity Development
54

13. Marine science in Pakistan: situation analysis and need assessment for capacity building

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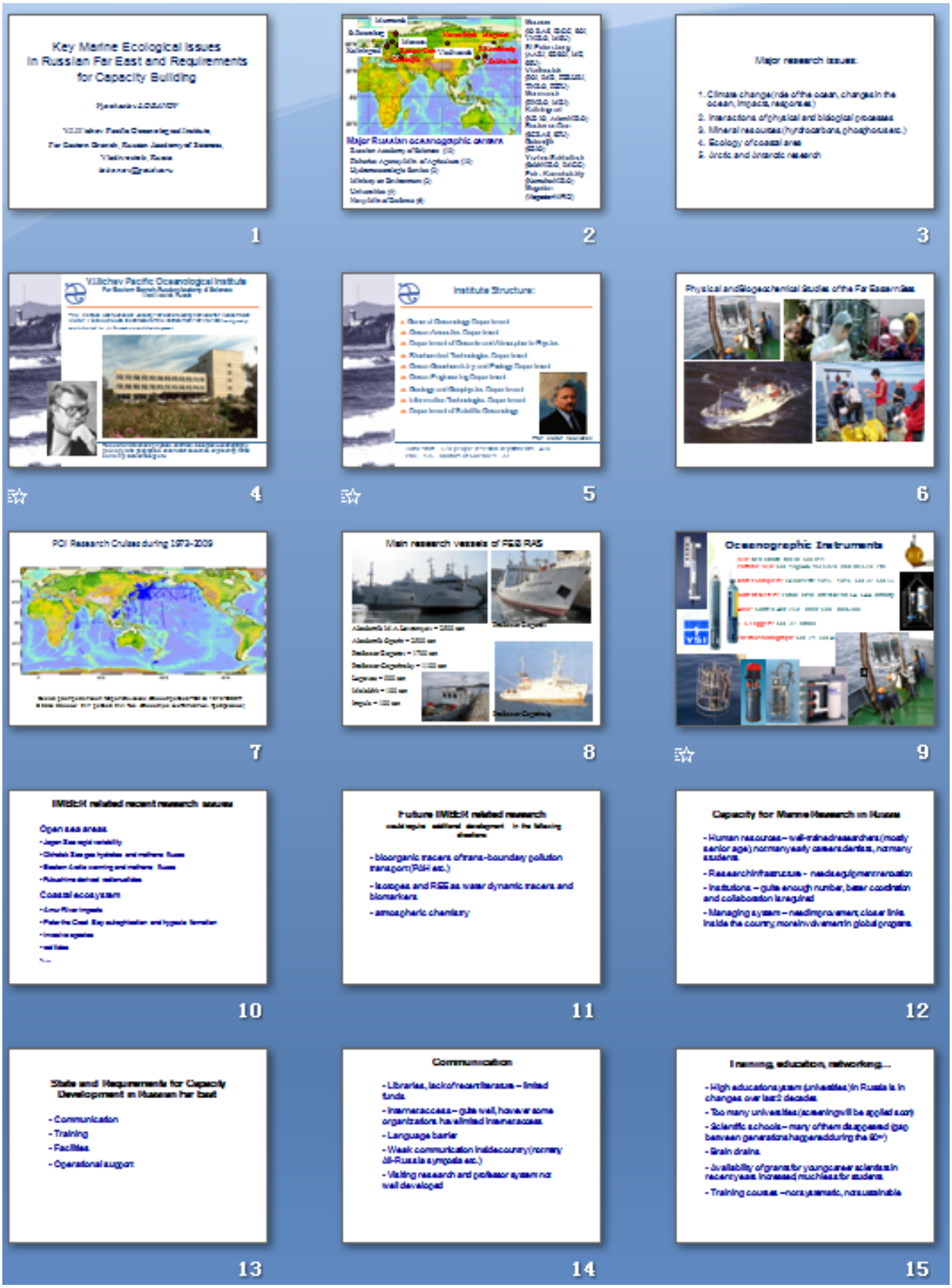
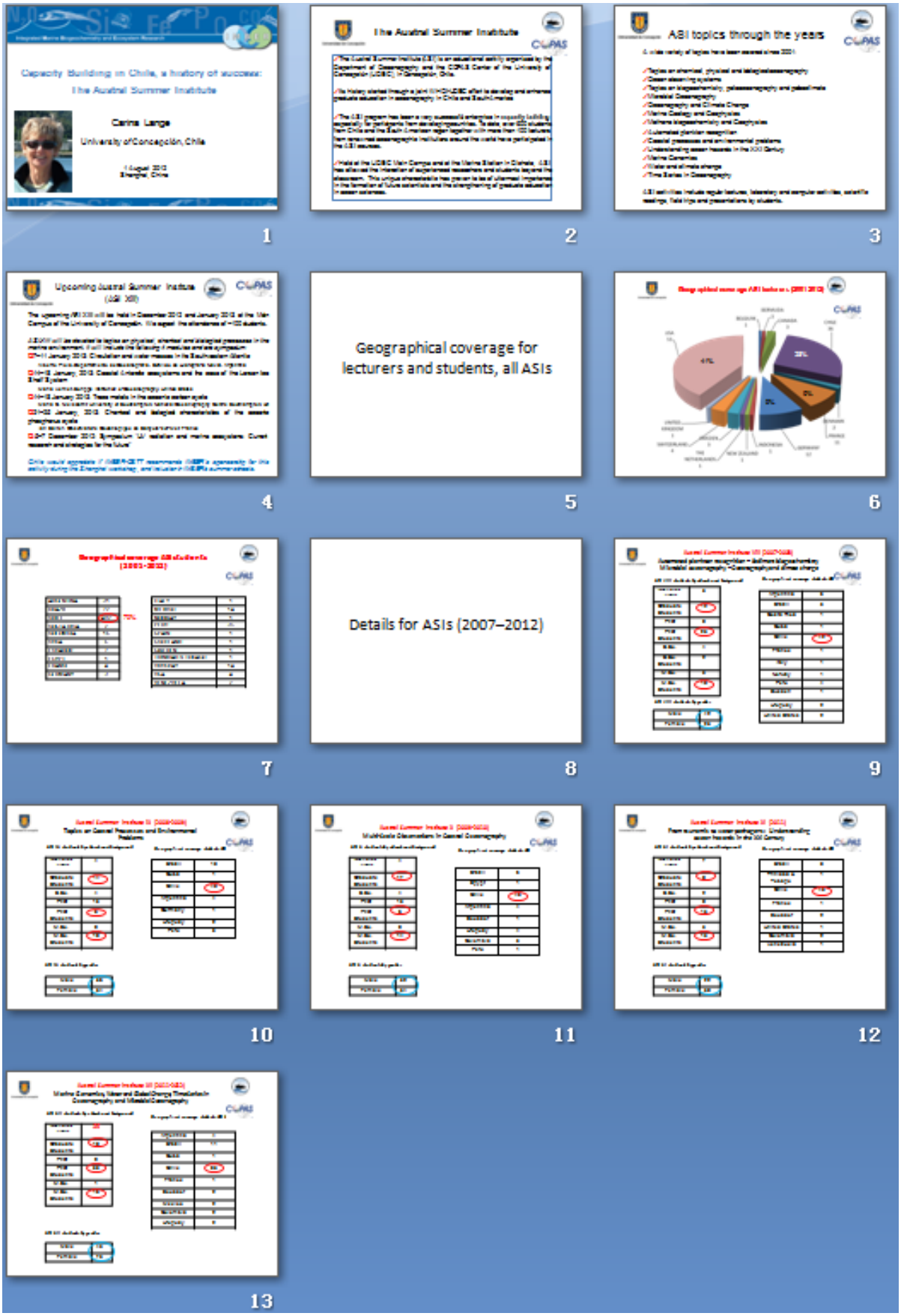
14. Capacity building and research needed for marine science in Thailand

15. Key marine ecological issues in Russian Far East and Requirements for capacity building

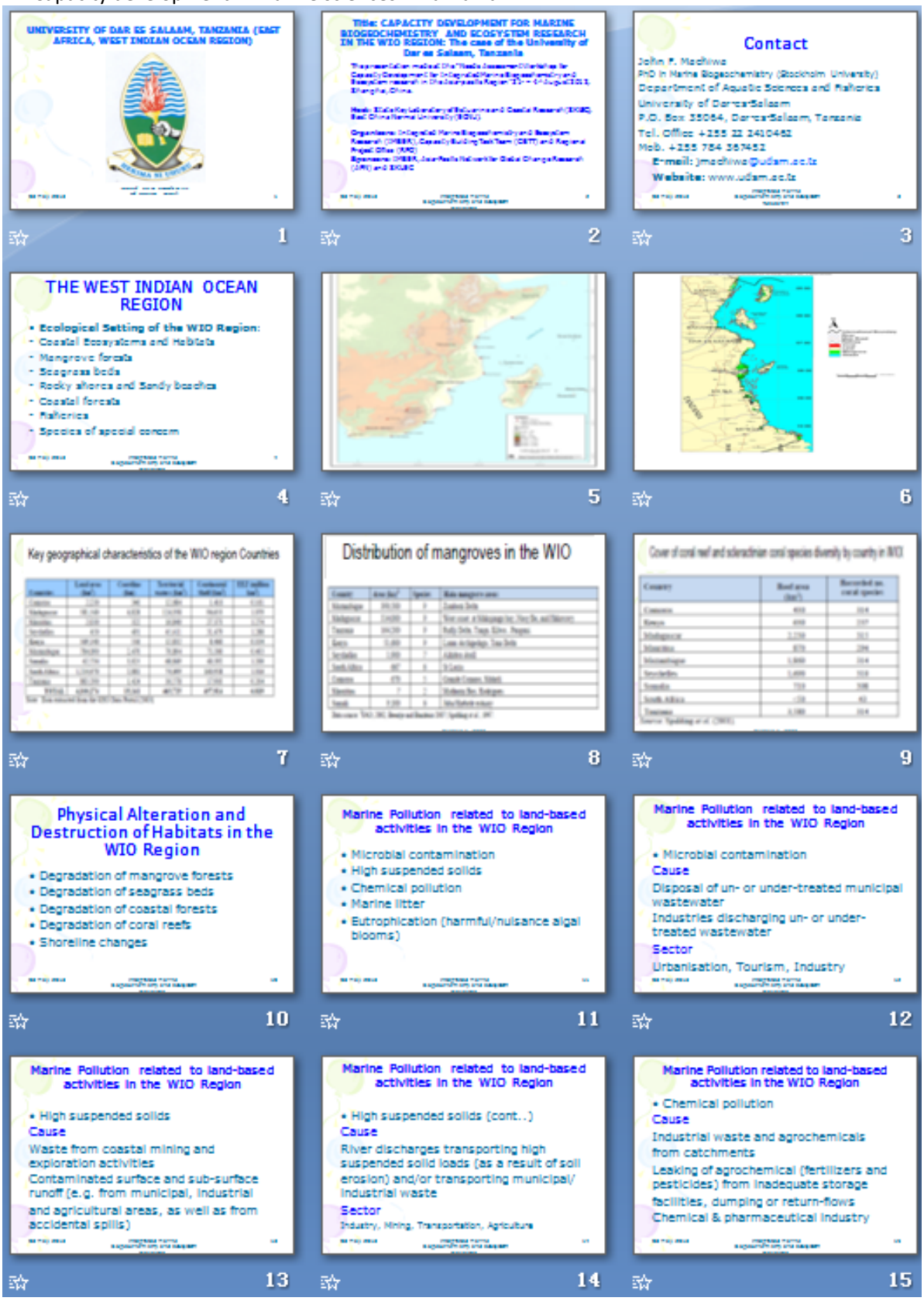



NOWPAP/PICES/WESTPAC Joint Training course on
Remote Sensing Data Analysis,
16
Research Infrastructure
- equipmentrenovationneglected,some improvementby
national funding in recentyears;
- operational support—joinprogram ith neighbor
countries:
17
On-going Improvement
18
Conclusion
19

16. Capacity building in Chile, a history of success: the Austral Summer Institute



17. Capacity development in marine sciences in Tanzania




Marine Pollution related to land-based activities in the WIO Region
• Chemical pollution (cont….)
Cause
Atmospheric emissions (e.g. incineration of waste, vehicle and industrial emissions and wood/coal burning)
Accidental spills
16
Marine Pollution related to land-based activities in the WIO Region
• Marine litter
Cause
Public littering on beaches and in areas where litter can be transported into coastal areas
Inadequate collection, treatment and disposal of solid waste
17
Marine Pollution related to land-based activities in the WIO Region
• Eutrophication (harmful/nuisance algal blooms)
Cause
Waste products from aquaculture farms that are high in nutrients
Sugar factories, fish and food processing industries, textile industries, tanneries, paper and pulp mills, fertilizer factories.
18
Institutions offering Marine Science Programmes
Higher Learning Institutions:
University of Dar es Salaam(Marine and Freshwater Sciences and Technology)
Sokoine University of Agriculture (only freshwater aquaculture)
Middle level (Diplomas/Certificates) Institutions:
Nyegezi Fisheries Institute
Mbegani Fisheries Development Centre
19
University of Dar es Salaam Historical Background
• Public University financed by the Government of the United Republic of Tanzania
• Launched in 1961 as a College of the University of London
• Became a Constituent College of the then University of East Africa in 1963.
• In August 1970, The University of Dar es Salaam was established by Act No. 12 of 1970.
20
University of Dar es Salaam Historical Background
• Now Operates Under:
-Universities Act No. 7 of 2005
-UDSM Charter of 2007
• Others:
- Institutional Transformation Programme
- Corporate strategic plan
- Five-year and Annual rolling plans
- Numerous policies, guidelines etc.
21
Student/staff population
• Student population grew from 13 in 1961/62 to about 20,000 in 2011/12
• Current staffing level – 1,127 academic and 1,466 administrative Staff
22
University of Dar es Salaam Core Functions
• Creation and transmission of knowledge
• Teaching
• Research
• Public Service/Consultancy
23
University of Dar es Salaam Institutional Transformation (ITP)
Institution Transformation Programme (ITP) which began in 1993/94 was informed by:
• Social-economic-political changes set in by 1985
• Structural adjustment programmes
• Liberalization and the market economy
• Political pluralism and multi-party politics
24
Social-economic-political changes and ITP (cont…)
Results:
• Re-definition of University Vision and Mission
• Institutional Transformation Program (ITP) launched in year 1993/94.
• Corporate strategic plan put in place to guide ITP
25
Current Corporate Strategic Plan (CSP) (2004 – 2013)
CSP Vision
• To become world-class University that is responsive to national, regional and global developmental needs through engagement in dynamic knowledge creation and application
26
Corporate Strategic Plan (2004 – 2013)
CSP Mission
• Pursuit of
-Training
-Research
-Public service
• Directed at attainment of equitable and sustainable development
27
5-Year Rolling Strategic Plan (2008 – 2013)
UDSM Mission is to:
Transmit knowledge from one generation to another,
conduct scientific research to advance the frontiers of knowledge, provide teaching and public services in order to continuously meet the high-level human resources needs of the general public and beyond.
28
5-Year Rolling Strategic Plan (2008 – 2013)
Strategic Objectives
1. Access to University Education Expanded
2. Quality of Graduates Increased
3. Volume and Quality of Research and Publication Enhanced
4. Volume and Quality of Public Services Enhanced
5. Outreach, Network and Partnerships Strengthened
6. Institutional Capacities Strengthened
29
University of Dar es Salaam Programmes
• PhD, Masters and First Degree
• Academic Disciplines
- Business Studies
- Education
- Engineering
- Humanities
- Law
- Information and Communication Technologies
- Natural Sciences
- Social Sciences
- Journalism and Mass Communication
30

University of Dar es Salaam
Programmes

- PhD programs : 3-4 years
- Masters Programs: 1.5-2 years
- First Degree programmes :3-4 years
- PhD programs by coursework
  - Economics and Political Science and Public Administration
- Certificates and diplomas (1 to 2 years)

31

Internationalism at UDSM

- There are 150 interinstitutional research and teaching agreements
- Over 50 Memoranda of Understanding with Universities inside and outside Africa
- Foreign students outside Africa are from Universities in Korea, Continental Europe, China, Japan, UK and US
- Between 2000/01 and 2008/09, 1021 passed through, 672 Female and 350 Male
- Staff and student exchange on the increase

32

University of Dar es Salaam Organization Structure

Constituent Colleges

1. Dar es Salaam University College of Education (located about 10 km from the University Main Campus)
2. Mkwawa University College of Education (located about 600 km from Dar es Salaam)

33

Organization structure (cont..)

Campus Colleges

1. College of Arts and Social Sciences (CASS)
2. College of Natural and Applied Sciences (CoNAS)
3. College of Engineering and Technology (CoET)

Schools

1. School of Education
2. School of Law
3. Univ. of Dar Business School

34

Organization Structure (cont..)

4. School of Informatics and Communication Technologies
5. School of Journalism and Mass Communication

Institutes

1. Institute of Resource Assessment
2. Institute of Marine Sciences
3. Institute of Development Studies
4. Institute of Kiswahili Studies

35

Organization Structure (cont..)

Directorates

1. Directorate of Undergraduate Studies
2. Directorate of Postgraduate Studies
3. Directorate of Research
4. Directorate of Planning and Finance
5. Directorate of Public Service
6. Directorate of Human Resource and Administration

36

Organization Structure (cont..)

Centres

1. Entrepreneurship Centre
2. Centre for Continuing Education (CCE)
3. Centre for the Study of Forced Migration (CSFM)
4. Centre for Virtual Learning (CVL)
5. University Computing Centre Ltd
6. Technology Development and Transfer Centre
7. Gender Centre
8. Centre for Physical and Health Education
9. Centre for Educational Research and Professional Development

37

Organization Structure (cont..)

Bureaux

- Quality Assurance Bureau (QAB)
- Bureau of Industrial Cooperation (BICO)
- University Consultancy Bureau (UCB

38

Institutional success stories

- Increased student enrolment including in Aquatic sciences
- More programmes in aquatic sciences introduced including masters and PhD by coursework and dissertation
- Research output and outreach activities in aquatic sciences and aqua-business increased
- Enhanced collaboration/partnership with universities worldwide and development partners
- Improvement of some infrastructure and facilities
- Acquisition of some library materials
- Staff development emphasized
- Improved capacity in ICT-mediated teaching and learning

39

Institutional Challenges

- Coping with increased student enrolment
- Declining flow of funds as demand of higher education increases
- Physical infrastructure and facilities
  - Classrooms/Teaching facilities (Lab. & Field Equipment)
  - Quality of e-Research Visual and landing area for open research activities
  - Classrooms/Student accommodation
  - Offices/staff laboratories and other academic buildings
- Limited Library capacity and resources
- Staff development needed due to aging staff and newly recruited staff needing Masters and PhDs
- Limited capacity to develop ICT-mediated teaching and learning

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UNIVERSITY-WIDE FUTURE OUTLOOK

- To expand and strengthen:
  - Postgraduate training
  - Research in areas like Climate change, Aquatic sciences, Composition processes, Energy and Material science
  - Public service delivery for practical problem solving
- Quality Output in terms of Students, Research and Public Service
- Develop further into a comprehensive University - Biotechnology, Medicine, Agriculture

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Nkrumah Assembly Hall

42

Students in a computer Lab.

43

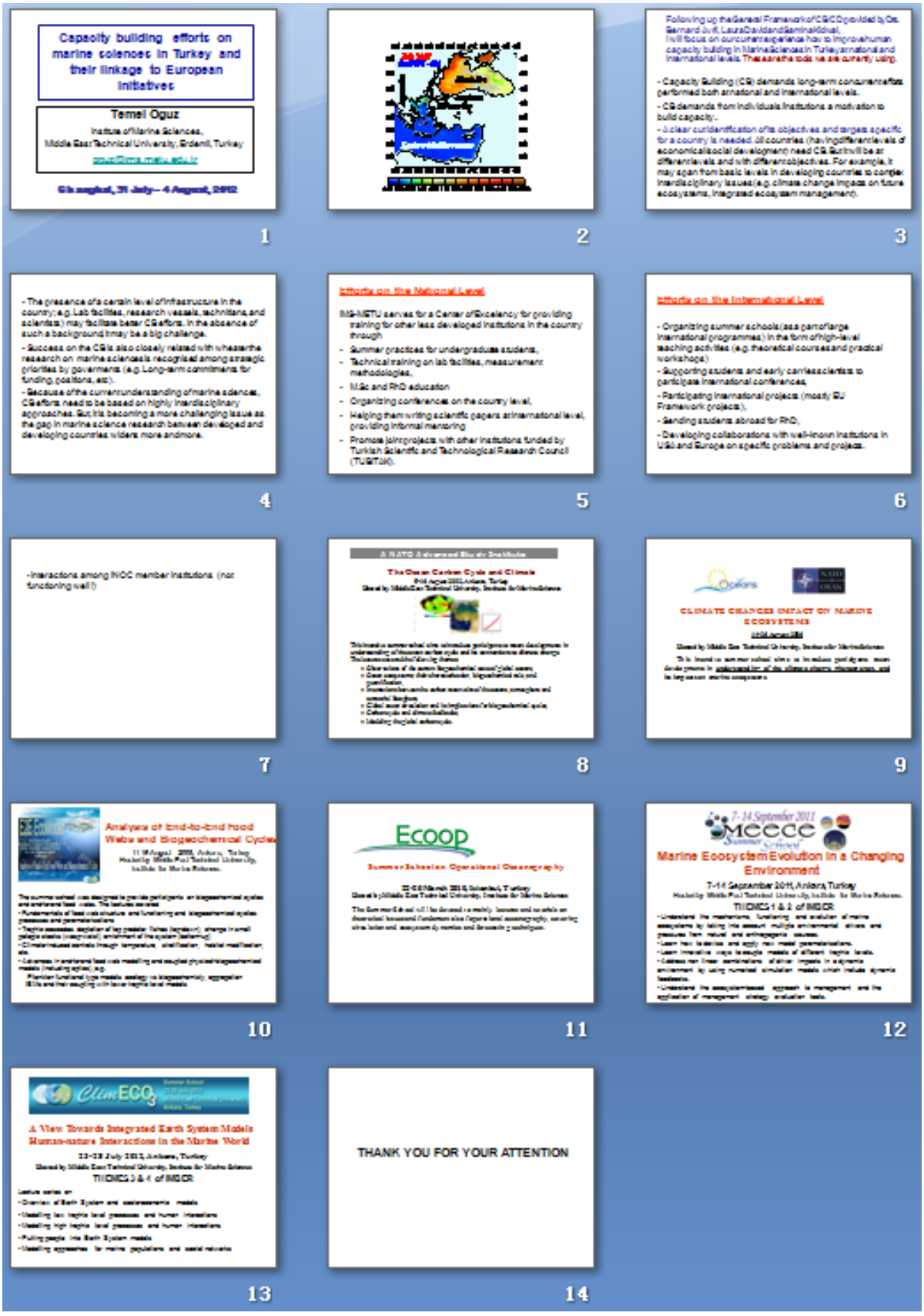
Twin Lecture Theatres

44

Students discuss under shades of trees

45

18. Human capacity development in marine sciences in Turkey at national and international levels



IV. Acronym index

AMT: Atlantic Meridional Transect
APN: Asia-Pacific Network for Global Change Research
ARW: Advanced Research Workshop
ASEAN: Asian Development Bank, Association of Southeast Asian Nations
ASI: Advanced Study Institute
ASI: Austral Summer Institutes
CBTT: Capacity Building Task Team
CB: Capacity Building
CD: Capacity Development
CIDA: Canadian International Development Agency
CIEP: Center for Research of Ecosystems in Patagonia
ClimECO: Climate and Ecosystems
CLIVAR: Climate Variability and Predictability project
CofEOO: Centre of Excellence in Ocean Observations
COPAS: Center for Oceanographic Research in the eastern South-Pacific
COSEE: Center for Ocean Science Education Excellence
CRIOBE: Le Centre de Recherches Insulaires et Observatoire de L'Environnement
CTSP: Coral Triangle Support Partnership
DAAD: German Academic Exchange Service
ECNU: East China Normal University
FFA: Forum Fisheries Agency
GLOBEC: Global Ocean Ecosystem Dynamics
GOOS: Global Ocean Observing System
IAEA: International Atomic Energy Agency
IAI: Inter American Institute for Global Change Research
IFREMER: French Research Institute for Exploration of the Sea
IFS: International Foundation for Science
IGBP: International Geosphere-Biosphere Programme
IMBER: Integrated Marine Biogeochemistry and Ecosystem Research
IOC/WESTPAC: Intergovernmental Oceanographic Commission, Sub-commission for the Western Pacific
IOGOOS: Indian Ocean Global Ocean Observing System
IRD: Institut de recherche pour le développement
JSPS: Japan Society for the Promotion of Science cooperation
LOICZ: Land-Ocean Interaction in the Coastal Zone
MARBEF: Marine Biodiversity and Ecosystem Functioning
MOMSEI Summer School: Summer School on Monsoon Onset and its Social & Ecosystem Impacts
IPO: International Project Office
NANO: Nippon Foundation – POGO Alumni Network for Oceans
NATO: North Atlantic Treaty Organization
NEARGOOS: North-East Asian Regional Global Ocean Observing System
NF: Nippon Foundation
NMEA: National Marine Educators Association
NORAD: Norwegian Agency for Development Cooperation
NRCT: National Research Council of Thailand
OUC: Ocean University of China
PIGOOS: Pacific Island Global Ocean Observing System
POGO: Partnership for Observation of the Global Oceans
RAS: Russian Academy of Sciences

RFA: Russian Fisheries Agency
RHS: Russian Hydrometeorological Service
RPO: Regional Project Office
SCOR: Scientific Committee on Oceanic Research
SeaGOOS: Southeast Asia Global Ocean Observing System
SIBER: Sustained Indian Ocean Biogeochemistry and Ecosystem Research
SIDA: Swedish International Development Agency
SPC: Secretariat of the Pacific Community
SPREP: Secretariat of the Pacific Regional Environment Program
START: Global Change System for Analysis, Research, and Training
SWOT: Strength-Weaknesses-Opportunities-Threats
TWAS: Academy of Sciences for the Developing World
UFP: Universite Francaise du Pacifique
USP: University of the South Pacific
UNEP/NOWPAP: United Nations Environment Programme Northwest Pacific Action Plan
YSFRI: Yellow Sea Fisheries Research Institute
WIO: Western Indian Ocean