



## Large marine ecosystems training and capacity development



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### ABSTRACT

In this LME Commentary we outline best practices and challenges in education and training as essential elements of the Large Marine Ecosystems (LME) approach at the convergence of science and policy. Case studies are outlined for the Baltic Sea, Bay of Bengal, Western Indian Ocean and Celtic Sea - Biscay.

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### 1. Introduction by Gotthilf Hempel

In this LME Commentary we shall outline best practices and challenges in education and training as essential elements of the LME approach at the convergence of science and policy.

#### 1.1. What kind of capacity is needed?

Various types of experts are needed for the recovery and sustainable development of coastal ocean resources. +Scientists covering a broad range of natural and social sciences. +Communicators at the interfaces of science to society and politics. +Administrators for the implementation and governance of ecosystem-based management. They have to take into account the scientific advice as well as the societal and political needs and constraints. In this brief introduction I will focus selectively on the formation of human capacity in the natural and social sciences sectors.

#### 1.2. The TEMA concept for capacity building

In the 1960s the newly established Intergovernmental Oceanographic Commission (IOC) of UNESCO realised the great need of developing countries (and not only of those) for establishing their own marine science capacity. Under the acronym TEMA (training, education, mutual assistance) we developed concepts and action plans for capacity building in those countries along four lines: (1) Higher Education at local universities and at universities overseas through the provision of fellowships and lecturers, (2) Specific training in methods and techniques through short-term courses on a regional or

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global scale and – with a wider scope–through learning by doing in joint research projects and research cruises, (3) Communication through conferences, workshops etc., publications and electronic media.

Mutual assistance meant mainly the provision of scientific and technical advisors and of research vessels, instruments and books.

Along those lines we established in Germany the Center for Tropical Marine Ecology (ZMT) in Bremen. It may serve to elucidate various aspects of TEMA

### 1.3. The ZMT as a center for TEMA

In the 1980s, German scientists had shown a growing interest in research related to tropical ecosystems, their exploitation and conservation. However, German expertise in those fields was insufficient. So we prepared a blue-print for an institute for tropical marine ecosystem research in its broadest sense including also socio-economic aspects. Three major objectives were identified: (1) Education and training of German and foreign students, (2) Longterm Research projects in partnership with institutions in the tropics, (3) Coordination of German research activities in tropical coastal waters including participation in major international projects.

Teaching started in 1991 with special courses of one to two weeks mostly on ecological methods. They were held in Bremen and at partner universities abroad. Later on, Bremen University and ZMT introduced a two years masters course on tropical aquatic ecology including its human dimensions for foreign and German students alike. The course in English named *International Studies of Tropical Marine Ecology* (ISATEC) starts with one year of class work in Bremen followed by one semester at a partner university in a tropical or subtropical country, and by a final semester for writing the MSc thesis in Bremen.

About 250 students have graduated in ISATEC. Many of them continued as Ph.D. students in Bremen or elsewhere. Earlier or later, most returned to their home country for positions in research, administration or industry or they became professors at local universities. Recently, an interdisciplinary graduate school SUTAS (Sustainable Use of Tropical Aquatic Systems) was established jointly with tropical partners. Zanzibar is presently the focal region of the first group of German and local PhD students under SUTAS. Training in research projects have been taking place over the past twenty years. Medium to long-term research programmes have been developed by ZMT in Brazil, Red Sea region, SE-Asia, China and in the Benguela LME. Those projects combine multidisciplinary research with training of local and German graduates and junior scientists. A number of rules, known as the Bremen criteria, have been adopted. The partnership projects shall provide:

- a significant contribution to a scientifically important theme,
- bi- and multilateral planning and execution, fully recognizing the scientific and societal wishes, competencies and other potentials of the host country. The incorporation of expertise available at various institutes from both sides respectively as well as full participation and recognition of young scientists is wanted,
- a major contribution to strengthening the scientific capacity in the host country and its region, and to fostering long-lasting scientific relations,
- projects of long duration (1–2 decades) with regular mid-term evaluations and firm long-term financial commitment with contribution from the host country,
- links to regional and global programmes–so both partners can also in part fulfil their international obligations via such partnership projects,
- full integration into the scientific structures of the host country and its universities,
- exchange of knowledge with non-scientific stakeholders throughout and beyond research projects and in collaboration with local partners,
- unrestricted exchange of data and storage of data in international data banks,
- joint publications, preferably in international journals, and joint participation in international conferences and workshops, including many young scientists.

## 2. Capacity building in LMEs at global scale

Over the years, much human capacity and technical infrastructure within the LME projects was created through national efforts. Further support came from outside through UN funding and bilateral assistance, Meanwhile several splendidly equipped institutes for marine science and fisheries have been established in Third World countries and staffed with local scientists. Much could be achieved by making full use of the regionally existing scientific capacity by sharing it between LMEs. Preventing brain drain is another important issue. In many places there seems to be adequately trained scientific personnel in sufficient numbers, but it is often difficult to retain promising young scientists who are frustrated by poor income and lack of adequate support in their scientific career. Nevertheless new capacity is needed. In the following case presentations three questions were addressed:

1. What kinds of capacity have to be created for the different LME projects and for the LME movement in general?
2. What are the institutional conditions to make good use of human capacity in LME projects?

3. What are best practices in capacity building within the different LMEs and through joint action of LMEs on a mega-regional and/or global scale?

### 3. Case study findings – compiled by Michael O'Toole

#### 3.1. The Baltic Sea LME project and BONUS programme synthesis of Jan Thulin's commentary

This commentary describes the Baltic Sea Large Marine Ecosystem highlighting the main characteristics of the system, including the oceanography, the retention time, the biomass as well as the catchment area and population density of 1surrounding member states. A short outline of the Baltic Sea LME project (1997–2007) includes how it started, the process of development including the Transboundary Diagnostic Analysis (TDA) and Strategic Action Programme (SAP), and the formation of the Baltic Sea Research Project (BSRP).

The overall aims and objectives of the Baltic Sea LME project were to introduce the LME concept, develop and implement an ecosystem approach to management and build and improve monitoring and assessment capacity for the region. The initiative primarily focused on the five eastern Baltic States of Estonia, Latvia, Lithuania, Poland and Russia.

The international management bodies with responsibilities for the Baltic Sea at the time of the project include the Helsinki Commission (HELCOM), the International Baltic Sea Fisheries Commission (IBSFC) and the International Council for the Exploration of the Sea (ICES), which provide scientific advice to the countries of the region through the European Commission.

The Baltic Sea LME project was coordinated through ICES with project level activity being implemented by lead laboratories and institutions in member states according to specific thematic areas within the framework of the five LME 1modules. For example, the Fisheries and Productivity module was based in Riga, Ecosystem Health in Gdynia, Socio-economics in Tallinn, GIS Data in Vilnius and Fisheries Surveys in Kaliningrad. The project employed about 40 persons in both full time but mostly part-time positions.

Education, training and capacity development at national and regional levels were an important component of the project especially for marine scientists and managers from the research institutions of the eastern Baltic States. Three working groups on LME's were formed within ICES which provided valuable fora for discussions and training in ecosystem based fisheries and environmental management.

Following the completion of the Baltic Sea LME project in 2007, a new project – BONUS was established based on the development of a comprehensive science plan and implementation strategy for the Baltic Sea. This programme, which will run until 2017, involves nine Baltic countries to undertake joint research programmes supporting cooperative marine science based on the LME concept of marine resource and environmental governance. The new BONUS programme which has a budget of Euro 100 million jointly financed by the nine countries and the European Commission has enabled the Baltic Sea Science Community and ICES to better link science and policy, to address ecosystem based management and to improve cooperation between the various international management structures operating in the Baltic Sea region.

The presentation concluded with a summary of best practices and strength and weaknesses of the Baltic Sea LME project and highlighted future challenges including the importance of on-going training in the LME concept of ecosystem based management and the need for continued education in marine scientific research as well as coordination, integration, networking and outreach.

Important achievements of the Baltic Sea LME project include:-

#### 1) Scientific Community Level

- Improved cooperation and communication between the two managing bodies HELCOM and ICES.
- Joint multi-country research projects based on the ecosystem approach to management (EAM) and the LME concept which included PhD students and training.
- Improved participation of scientists from Eastern European countries in ICES Working Groups.
- Improved interaction between marine science and socio-economics.

#### 2) Scientific National Level

- Upgrading of laboratories and research vessel equipment including training in instrumentation use.
- Specific training e.g. statistics and standardizations of procedures for improving ICES data collection which had long-time beneficial for participating institutes and project staff.
- Improved awareness and knowledge of holistic approaches to ocean governance i.e. the LME concept among scientists, directors and peers.

In terms of lessons learned, the following points were highlighted which could be usefully applied in relation to future projects:

- Need for specialised training for scientists on order to communicate results and action plans to decision makers.

- Need for further training for scientists on the LME concept.
- Need for an LME coordination manager in each of the countries to provide outreach and communication to scientists, directors and the media.

### 3.2. *The Bay of Bengal LME Project – training and capacity development synthesis of Rudolf Hermes commentary*

The World's 66 Large Marine Ecosystems (LMEs) are important sources of seafood, annually producing 80% of the global fisheries yields (Pauly et al., 2008). Since the mid-1990s, the Global Environment Facility (GEF) has been providing financial support to developing countries in Africa, Asia, Latin America and eastern Europe and supports the planning and implementation of ecosystem based assessment and management practices to sustain LME goods and services. The FAO has recently introduced an ecosystem-based approach to fisheries (EAF) whose three components are highly compatible with the LME five module framework including (i) productivity, (ii) fish and fisheries, (iii) ecosystem health and pollution, (iv) socio-economics and (v) governance.

There are also three EAF crosscutting themes in all LME Projects: these can be called enabling factors and can be defined as (a) the establishment of a knowledge base; (b) the promotion of regional cooperation and (c) the development of capacity (both human and institutional). It can be argued that capacity development is the most important among these three, as it also contributes to achieving the other two.

The approach to developing capacity in the BoBLME project has focused on producing an initial training needs analysis (TNA) including in-country institutional capacity analysis. This process involves using existing information on capacity development collected from previous project such as bilateral cooperation between countries or development banks and regional fisheries bodies or similar structures. For example, in the case of the BoBLME, some capacity development and training in ocean fisheries has already been undertaken within the framework of the Asian-Pacific Fisheries Commission and the Indian Ocean Tuna Commission (IOTC).

The current approach to capacity development used in the BoBLME incorporates a range of options and applications, which essentially uses a strategy of mixed interventions. This includes short term field courses, academic courses including post-graduate training, study visits and twinning between LME projects which uses existing opportunities provided by various parties i.e. IW LEARN as well as strategies where specific training is designed to address key areas of capacity development in cases where no suitable training offers are available.

Key capacity development requirements identified and addressed in the BoBLME project include the following:

- Project Management
- Monitoring and Evaluation (M&E)
- Ocean Governance
- Fish Stock Assessment
- Operational Oceanography
- Ecosystem Modeling
- Fisheries Data Collection and Analysis
- Mangrove Rehabilitation
- Coral Taxonomy
- Sea Grass Conservation
- Communication especially linking Science and Policy
- Ecosystem Approach to Fisheries Management (EAFM)

In order to improve fisheries management and environmental conservation in the BoBLME region, the capacity development requirements by mid-level managers especially in “soft skills” of communication and EAF management are viewed as essential to long-term sustainable use of marine resources. Other skills include facilitation, conflict resolution and co-management, many of which are now being addressed by partner agencies and regional bodies in the South and Southeast Asia region.

On-line methods of training such as “MOOC” are not really suitable for training in EAF management as its training methodology is highly interactive and requires role play and practice sessions. It was also stressed that EAFM training must also include additional modules designed for policy and decision makers as well as resource users and community members.

Of concern to countries of the BoBLME region is the fact that traditional fish stock assessment skills are been lost mainly as a result of the suspension of intensive training programmes in this areas by FAO and ICLARM over 15 years ago. Knowledge gaps have also developed in fisheries management, which need to take into account in future risk-based approaches to stock assessment. It was also noted that capacity development skills in some fisheries institutions are often lost over time to other sectors in the national economy. Although, this “brain drain” is not necessarily detrimental, it can be addressed by strengthening career paths within organisations and providing more competitive salaries.

In conclusion, it was felt that the best option for training and capacity development in the BoBLME was a mixture of different approaches including short-term courses, on-hand training in the field and furthering postgraduate education. It was recommended that LME projects should also partner with other marine science training initiatives such as those provided by the World Bank, the Asian Development Bank, IOC-UNESCO, the International Ocean Institute (IOI), and other

regional marine research and training initiatives such as BENEFIT (BCLME), SPICE 1-111 (Indonesia) and ASEAN (Canada/Australia). Such international capacity development initiatives should be continued as they provide vital support in addressing specific training and education needs in marine science and ecosystem based management to countries linked to global LME Projects.

Twinning of LME projects (IW:LEARN) also provides a useful mechanism to build capacity and share lessons learned. In the case of the BoBLME, close cooperation was fostered with the Agulhas and Somali Current Large Marine Ecosystem (ASCLME) project particularly on governance and the development of a Strategic Action Programme (SAP) and basin wide oceanography in the Indian Ocean. Other links were forged with the Canary Current Large Marine Ecosystem (CCLME) Project on Marine Protected Areas and more recently with a new Indonesian Sea LME (ISLME) Project.

#### 4. Potential contribution in ocean governance capacity development for LMEs through the International Ocean Institute (IOI)

##### 4.1. Werner Ekau's commentary

Werner Ekau outlined the potential contribution that the International Ocean Institute (IOI) makes in developing capacity and providing training courses on ocean governance to students and young scientists from member countries of Large Marine Ecosystem (LME) projects.

A summary of priority capacity development needs were identified which include the following:-

- Short courses (1–2 weeks) to cater for immediate needs and goals that address special needs and skills.
- Specific intensive courses (3–6 weeks) to further educate practitioners and young scientists.
- Strengthen local and national institutions e.g. high schools, universities and polytechnical schools to build a new generation of students and enhance awareness among the broader community and government officials in ecosystem-based management and ocean governance.
- Support capacity building and partnerships through building BSc and MSc study programmes.
- Provide support in project writing.

A comprehensive description of IOI as an independent non governmental organization was given in which its core activities are focused on providing training programmes in ocean governance. Its operational target is to train on an annual basis at least 100 young and mid-career practitioners from developing countries in the most contemporary approaches to coastal and ocean governance. IOI places a strong emphasis on moral, ethical and legal values in ocean governance and in promoting the equity and peaceful use of the oceans.

One of the key training activities of IOI is the annual intensive interdisciplinary eight-week course on ocean governance, which is given at Dalhousie University in Canada. This training course is primarily for developing country professionals working in ocean and coastal related fields and include topics such as ocean science, law of the sea, integrated coastal and ocean management, fisheries and aquaculture, marine transportation, maritime security, energy and informatics. Skills developed in training session's negotiation, project cycle management, disaster management, media and communications. So far over 600 students have taken part in this course from more than 100 countries.

The International Ocean Institute also provides an annual five-week intensive training course on regional ocean governance in Malta accredited by the University of Malta and targeting mainly practitioners from the Mediterranean as well as the Black, Caspian and Baltic Seas. This course has also been adapted and exported to China and the West-Pacific region and to South Africa. These courses target coastal states of the western Pacific and many of the African LME countries that participate in the Canary, Guinea, Benguela and the Agulhas Somali Current Large Marine Ecosystems projects.

Another popular course recently established is the IOI Masters Course on Regional Ocean Governance (M.A. Degree) based in the University of Malta. This post-graduate course comprises of a lecture component (12 units of study) and a research component (dissertation up to 25,000 words). Thematic study areas include the Marine Environment, Methodologies and Assessments, Resource Economics, Law of the Sea, Dispute Settlement, Maritime Safety and Policy Making.

The presentation concluded with a short summary of some of the capacity that was developed in the Benguela Current LME region between 1999 and 2015 mainly as a result of a number of German bilateral aid projects (SPACES and GENUS). Significant post graduate training was also undertaken which resulted in 6 PhD fellowships and 4 MSc fellowships and well as several specialized courses i.e. ichthyoplankton, and moorings. Shipboard training was also provided to many young trainees and students from the region on a variety of research vessels from Germany and South Africa.

#### 5. Developing best practices In training and capacity development in the Western Indian Ocean

##### 5.1. Synthesis of David Vousden's commentary

David Vousden provides a comprehensive overview of best practices on LME training and capacity development in the Western Indian Ocean region. Although the original Project Document of the Agulhas Somali Current Large Marine Ecosystem Project (ASCLME) called for a training needs assessment as well as oceanographic (ship-board) training, little or no provision was made through proposed activities, human resources, or infrastructural mechanisms in the project document to deliver or support through budget allocations.

The project subsequently created regional and national capacity development and training posts to coordinate training and use regional expertise to encourage and support mentoring in various research and technical work including shipboard oceanographic work. In following up on training needs, it was decided to coordinate with other initiatives in the region i.e. SWIOFS and to use local educators and experts wherever possible. Mentorship and supports was to be provided as part of any contract by experts from outside the region.

Training and capacity development undertaken by the ASCLME project was mainly directed at supporting long-term ocean and coastal monitoring needs of the region and to support the Transboundary Diagnostic Analysis (TDA) and Strategic Action Programme (SAP) implementation process. Some of the main initiatives undertaken include the following:-

(1) Oceanographic Training of 80 young scientists/technicians from the region

- Oceanographic sampling and instrumentation
- Data analysis and processing
- Coastal and ocean monitoring
- Cruise report writing
- Publication of results

Regional Centres: MA-RE Institute ,University of Cape Town ; Mauritius Oceanographic Institute

(2) Fisheries Analysis Training – Long Term Capacity Development

- Data management
- Genetics
- Pelagic sharks
- Fisheries stock assessments
- Resource mapping

Students: 21 MSc students; 12 BSc upgrades from diplomas.

The National Training Plans (NAP) coordinated capacity development needs and identified priority and gap areas to be addressed. The most immediate needs were technical training, socioeconomics, numerical expertise, governance, fisheries science, environmental monitoring including pollution and remote sensing. These NAPs were produced as a 10 year work plan for training and capacity development to support the TDA and SAP implementation. They were also subject to an external review.

The regional coordination of training and capacity development was later agreed to at a workshop in the Seychelles in 2012 where the national needs were integrated into a regional programme for the 9 countries. These key issues (see below) were incorporated into the TDA to be addressed through specific actions in the SAP.

The strategic need for a regional partnership to facilitate and coordinate training and capacity development in the ASCLME region resulted in the formation of a Pan-African structure – The African Centre for Capacity Development in Ocean Governance (AfriCoG) which was established in 2013 in Cape Town with international support including the Global Environment Facility (GEF). This Centre will enhance the development and strengthening of training skills for young African marine scientists in order to support more effective marine resource management and ocean governance.

- Shortage of equipment and infrastructure
- Courses needed in ocean and coastal management
- Lack of marine curricula in schools
- Capacity strengthening
- Lack of strategic planning
- Full utilization of trainees and dedicated career paths
- Language barriers.

One of the key outcomes of the ASCLME project was the formation of a regional alliance of training partners to facilitate and encourage the formation of specialized centers that could implement key courses and capacity development activities across the region. Some of the strategic and priorities activities that needed to be addressed within the framework of this partnership included the following:-

- Implementation of the training objectives of the TDA.
- Address key national training requirements identified in the National Training Plan.
- Provide selected short training courses on key topics.
- Support training institutions to create centers of specialization.
- Source ship-board training and offshore research opportunities.
- Provide for twinning activities throughout the region and beyond.
- Develop a mentor programme.
- On-going training in the development and implementation of EAF in the ASCLME.
- Provide training in marine and coastal data collection and management .
- Provide training opportunities conducted in French and Portuguese .

The presentation concluded by highlighting the complex nature of training and capacity development in the ASCLME and pointed out that these activities need to be regarded as long-term and ongoing processes that require continued support. The challenges of training and retaining of students and young scientists was also stressed as well as the needs for expanding existing and develop new skill sets to include other disciplines such as marine spatial planning, climate change adaptation, and socio-economics.

## 6. LME training and education in the Celtic Sea–Biscay Shelf – Ireland as a case-study

### 6.1. Synthesis of Michael O' Toole's commentary

This presentation provided a comprehensive overview of training and education in the marine science and maritime sectors in Ireland. It covered the courses provided by the Universities, Institutes of Technology, the National Maritime College and the Irish Sea Fisheries Board as well as those given by the private operators and companies. It also provided details on the Strategic Marine Alliance for Research and Training (SMART) initiative, which coordinates, specialized hands-on training at sea in various disciplines of marine and environmental science, which is based at the Galway and Mayo Institute for Technology (GMIT).

Under graduate and postgraduate degree courses in various aspects of marine and environmental science are offered by Irish Universities. For example, the National University of Ireland Galway (NUIG) offers degree courses in marine science, coastal process and marine policy whereas University College Cork (UCC) provides training in marine biology, coastal and marine management and marine renewable energy. Undergraduate courses in marine biology are also offered by the Galway and Mayo Institute of Technology. Although most students undertaking studies in marine science are from Ireland, although in recent years, there has been a significant increase in international students (those outside the EU) mainly from China, India, Brazil, USA, Tanzania, Zambia, Saudi Arabia and Canada.

The National Maritime College in Cork offers a three year course in nautical sciences and engineering to train ship's captains, officers and engineers. They also provide a number of specialized and specific short courses to the shipping industry, the offshore oil and gas sector and public in relation to safety at sea, radio communication, emergency response, port management and hazardous cargo handling. The Irish Sea Fisheries Board train students to become skippers, mates and deck hands for the fishing industry with courses being given on safety at sea, navigation, engineering and communication. Applied courses are also given to train personnel in the aquaculture and seafood processing industry.

There are several private operators that provide specialized training to meet various marine related industry needs including those related to marine tourism and leisure sector. These range from training in the operation of ferry and coastal passenger boats, to power boat management, sailing, diving, surfing and the safe use of jet-skis. Course participants often include some international students who mainly come from Eastern Europe, the Middle East and Africa.

The National Training Programme "Science @ Sea" offers hands-on training for undergraduates and postgraduate students in various cross-disciplinary skills used in offshore research aboard the R.V. Celtic Voyager and R.V. Celtic Explorer. These cruises last from between 2 and 14 days duration depending on the module and are designed to allow for the operation of a blended learning experience at sea in fisheries, oceanography, plankton and benthos sampling, data collection and processing, survey design and planning. Other specialised courses are run to support the marine mammal observer programme (MMO) and the monitoring of commercial fisheries and catch data.

Recent training courses which have been added to support post graduate training include:-

- The SMART Ocean module focusing on deployment and retrieval of moorings and sensors as well as passive acoustic monitoring (PAM), telemetry in relation to cetaceans detection and bio-fouling.
- Marine Geology and Geoscience investigations focus on training in seabed mapping technology and acoustic surveying techniques i.e. multi- beam sonar.
- Offshore renewable energy training associated with wind farms and wave energy test sites including environmental impact assessment (EIA) and applied oceanography.
- Selected participation in routine national survey cruises and occasional transatlantic cruises in fisheries stock assessment, oceanographic surveying and fish eggs and larvae.

A new collaborative development initiative in training in marine science has recently commenced with the Alfred Wegnar Institute for Polar and Marine Research (AWI), Germany. This will allow for joint participation by students on Irish and German research cruises such as the 2014 investigations by the R.V. Celtic Explorer on deep sea corals, west of Ireland and the forthcoming Atlantic Summer School 2015 cruise on the Polarstern from Bremenhaven to Cape Town in 2015.

The commentary concluded with a short summary on Ireland's links in marine science education with international partners which include the CSIRO National Marine Facility, Australia; the University of Sal Paulo, Brazil; the "Semester at Sea", University of Virginia, USA; the EuroFleet Project with partner institutions and universities and some collaborative training with the Southampton Oceanographic Centre, UK.

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