



# **IOC Intergovernmental Panel on Harmful Algal Blooms**

## **Eighth Session**

Paris, UNESCO Headquarters

17–20 April 2007

**Intergovernmental Oceanographic Commission**  
*Reports of Governing and Major Subsidiary Bodies*

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**UNESCO 2008**

IOC/IPHAB-VIII/3 Rev.  
Paris, 7 April 2008  
English only<sup>1</sup>

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<sup>1</sup> An Executive Summary of this report is available in French, Spanish and Russian as a separate document (IOC/IPHAB-VIII/3s).

## TABLE OF CONTENTS

	Page
<b>1. INTRODUCTION .....</b>	<b>1</b>
<b>2. PROGRAMME SUPPORT AND DEVELOPMENT .....</b>	<b>2</b>
2.1 STAFFING OF THE HAB PROGRAMME .....	2
2.2 IOC SCIENCE AND COMMUNICATION CENTRES ON HARMFUL ALGAE .....	2
2.3 REGIONAL IOC HAB GROUPS .....	3
<b>3. EDUCATIONAL PROGRAMME ELEMENTS .....</b>	<b>5</b>
3.1 HARMFUL ALGAE NEWS .....	5
3.2 WEB SITE AND PORTALS .....	5
3.3 DIRECTORY OF EXPERTS: HAB-DIR .....	5
3.4 CO-SPONSORSHIP OF HAB CONFERENCES AND THEIR PROCEEDINGS .....	5
3.5 TRAINING .....	6
<b>4. SCIENTIFIC PROGRAMME ELEMENTS .....</b>	<b>9</b>
4.1 IOC-SCOR PROGRAMME ON THE GLOBAL ECOLOGY AND OCEANOGRAPHY OF HARMFUL ALGAL BLOOMS: GEOHAB .....	9
4.2 ASSESS AND COMPARE SPATIAL RELATIONSHIPS BETWEEN CHANGING GLOBAL NUTRIENT EXPORTS AND LOADS AND THE PROLIFERATION OF MAJOR HAB SPECIES .....	10
4.3 ICES-IOC WORKING GROUP ON THE DYNAMICS OF HARMFUL ALGAL BLOOMS .....	11
4.4 BLOOMS OF <i>OSTREOPSIS</i> IN THE MEDITERRANEAN .....	12
4.5 ICES-IOC-IMO WORKING GROUP ON BALLAST AND OTHER SHIP VECTORS (WGBOSV) .....	13
4.6 TAXONOMY .....	13
<b>5. OPERATIONAL PROGRAMME ELEMENTS .....</b>	<b>13</b>
5.1 MONITORING AND RESOURCE PROTECTION .....	13
5.2 DATA MANGEMENT .....	14
5.3 IMPLEMENTATION OF HAB MONITORING WITHIN THE GLOBAL OCEAN OBSERVING SYSTEM (GOOS) .....	16
<b>6. HAB PROGRAMME WORKPLAN 2008–2009 .....</b>	<b>18</b>
<b>7. OPERATION OF THE IOC INTERGOVERNMENTAL PANEL ON HAB .....</b>	<b>18</b>

## **ANNEXES**

- I. AGENDA WITH ANNOTATIONS
- II. ADOPTED RESOLUTIONS AND RECOMMANDATIONS
- III. NATIONAL STATEMENTS
- IV. LIST OF WORKING DOCUMENTS
- V. LIST OF PARTICIPANTS
- VI. TERMS OF REFERENCE OF THE IOC INTERGOVERNMENTAL PANEL ON HARMFUL ALGAL BLOOMS
- VII. IOC HARMFUL ALGAL BLOOMS PROGRAMME PLAN
- VIII. IOC INTERGOVERNMENTAL PANEL ON HARMFUL ALGAL BLOOMS INFORMATION ON DEVELOPMENTS IN THE INTERSESSIONAL PERIOD
- IX. WESTPAC/HAB Report
- X. SEVENTH REGIONAL SCIENCE PLANNING WORKSHOP ON HARMFUL ALGAL BLOOMS IN SOUTH AMERICA, Quito, Peru, 2006
- XI. OVERVIEW OF IOC HAB TRAINING COURSES AND WORKSHOP
- XII. TERMS OF REFERENCE AND RULES OF OPERATION GEOHAB SCIENTIFIC STEERING COMMITTEE.
- XIII. ICES-IOC WORKING GROUP ON HARMFUL ALGAL BLOOM DYNAMICS
- XIV. ICES/IOC/IMO WORKING GROUP ON BALLAST AND OTHER SHIP VECTORS
- XV. IPHAB SELF ASSESSMENT 2007
- XVI. GLOSSARY OF ACRONYMS AND SPECIAL TERMS

## 1. INTRODUCTION

- 1 The IOC Intergovernmental Panel on Harmful Algal Blooms (IPHAB) was formed at the Sixteenth Session of the IOC Assembly, March 1991, in order to identify adequate resources for a broad programme to try to solve some of the problems caused by harmful algae. The Harmful Algal Bloom Programme Plan and proposals (Document IOC-FAO/IPHAB-I/3) were adopted by the Seventeenth Session of the IOC Assembly in February-March 1993, and are also seen as IOC follow-ups to the United Nations Conference on Environment and Development (UNCED).
- 2 The Eighth Session of the Panel was held at IOC UNESCO Headquarters in Paris from 17 to 20 April 2007. The Session was opened by the IOC Executive Secretary, Dr Patricio Bernal. The Panel was reminded of the reasons it was established including its function to address concerns of governments rather than areas of scientific interest. The Executive Secretary noted that the Panel has a core of dedicated members who have sustained the activities of the Panel often using research funds for this purpose. He emphasised the need to expand the funding base to encompass government level funding mechanisms, as this is part of establishing the role of IPHAB as an intergovernmental mechanism. The Executive Secretary also emphasised that the Panel should consider transferring some activities to other organisations such as ISSHA to accommodate new HAB related issues which are of concern to governments. The relevance of strong links to FAO and WHO in regard to HABs and food safety was addressed by the Executive Secretary and he reminded the IPHAB of the opportunity to use the IOC Assembly to engage with FAO and WHO to strengthen or renew collaboration. The Panel was commended for its efforts and results in capacity enhancement and he noted the importance of careful assessment of the needs and geographical balance in the implementation of capacity enhancing activities. The Executive Secretary summarised the positive outcome from the synthesis of the science to underpin coastal management (including physical oceanography, chemistry, geological-chemical-physical interaction, etc.) which has been published in the monographic volumes *The Sea*. The Executive Secretary informed the Panel that the Editors of *The Sea* are seeking new topics and expressed his willingness to inform the Editors that harmful algal science could be a suitable topic. He therefore invited the Panel to consider whether such a synthesis would be useful for those involved in HAB science and management. He emphasised that the production of the Coastal Ocean volume had provided an opportunity to bring together the best scientist. Dr Patricio Bernal ended by expressing the appreciation of IOC for the commitment of a stable group of Member States to IPHAB.
- 3 The Agenda for the Session was introduced by the IPHAB Chairperson, Dr Beatriz Reguera (Spain), ([Annex I](#) hereto). Dr L. Guzman (Chile) was designated as Rapporteur.
- 4 The Session was attended by representatives from: Benin, Canada, Chile, Colombia, Croatia, Denmark, Egypt, France, Germany, Italy, Japan, Namibia, Morocco, New Zealand, Slovenia, Spain, Sweden, United Kingdom, United States of America, the Scientific Committee on Oceanic Research (SCOR), and the International Society for the Study of Harmful Algae (ISSHA). The List of Participants is attached as [Annex V](#) hereto.
- 5 The Chairperson recalled the Terms of Reference for the Panel, as set out in Resolution XVI.4 of the Sixteenth Session of the IOC Assembly, March 1991 ([Annex VI](#) hereto) and the objectives in the IOC HAB Programme Plan ([Annex VII](#) hereto). **The Panel noted** that the Twenty-third Session of the IOC Assembly, Paris, 2005 had endorsed all the recommendations of the Seventh Session of the Panel. The Resolution of the Twenty-third Session of the Assembly was introduced.
- 6 During its Eighth Session, the Panel reviewed the actions completed during the intersessional period. The detailed report on HAB Programme developments in the intersessional period is included as [Annex VIII](#) hereto. **The Panel noted with satisfaction** that

considerable progress had been made and that good progress had been made in implementing the Recommendations of the Seventh Session of the Panel.

7 The objectives in the HAB Programme Plan ([Annex VII](#) hereto) were affirmed, priorities were set, actions to be taken were discussed and decided upon, and resources were sought, identified and committed as far as was possible.

8 The Session was organized into six panel discussions: Panel 1 on capacity enhancement was chaired and introduced by A. Cembella (Germany); Panel 2 on the joint IOC-SCOR GEOHAB Research Programme was chaired and introduced by R. Raine (Ireland); Panel 3 on biotoxin regulations was chaired and introduced by P. Busby (New Zealand); Panel 4 on HAB data bases was introduced by H. Enevoldsen and M. Lion (Secretariat); Panel 5 on regional activities was introduced by the regional Chairs and chaired by B. Reguera (Spain); Panel 6 on HAB observations and their potential for inclusion in GOOS Regional Alliances was chaired by B. Karlson (Sweden), and Panel 7 on the operation of the HAB Programme the role of the IPHAB and its future mission was chaired by D. Anderson (USA) and B. Reguera (Spain).

9 **The Panel endorsed** a number of intersessional activities to be implemented by Member States and the IOC Secretariat. These activities are summarized in the Work Plan for the IOC HAB Programme 2008–2009, which is included in [Annex II](#) hereto.

10 A summary of the deliberations made and the decisions taken is given below. The report is structured according to the HAB Programme Plan and the Work Plan 2008–2009.

## 2. PROGRAMME SUPPORT AND DEVELOPMENT

### 2.1 STAFFING OF THE HAB PROGRAMME

11 **The Panel noted with concern** that staffing of the programme continues to be completely dependant on extra-budgetary funding and that the present donor agreement with Denmark phases out the earmarked extra-budgetary funding during 2005–2007 as regards funds for IOC staff for the HAB Programme. The Panel reiterated that dedicated IOC staff for the HAB Programme remains crucial for focused development and implementation of the Programme, and the Panel expressed concern over how to finance the post in the period of the coming IOC-UNESCO Medium Term Plan, 2008–2013.

12 As at its previous session, **the Panel acknowledged the importance** of the long standing support of Denmark and Spain for the IOC Science and Communication Centre. This decentralized programme office is essential for the Commission to implement the HAB Programme. An appropriate level of IOC staff for the Programme is still considered to be one senior and one junior staff member (Document IOC-FAO/IPHAB-I/3, Annex VII). **The Panel strongly reiterated its encouragement** to all Member States to consider financial support for staff to the HAB Programme, and **urged** the IOC Executive Secretary to ensure continued staffing of the HAB Programme.

### 2.2 IOC SCIENCE AND COMMUNICATION CENTRES ON HARMFUL ALGAE

13 **The Panel welcomed** the developments and initiatives by the IOC Science and Communication Centres on Harmful Algae established in Copenhagen (Denmark) and Vigo (Spain). The Science and Communication Centres on Harmful Algae were established as a decentralised programme office to provide assistance to Member States, and developing countries in particular (Document SC/MD/101, para.80). Through Recommendation IPHAB-VI.7, the Panel sought expansion of the IOC Science and Communication Centres to provide a broader and longer-term platform for the implementation of capacity-building activities including courses, workshops, training through research, and individual training. Since 2005, The Alfred

Wegener Institute for Marine and Polar Research, the Senckenberg Research Institute, and the Friedrich Schiller University Jena (Germany) have become partners. The Panel recalled IOC Resolution XX-3 through which the IOC Assembly endorses the continuation of the Centres and urges Member States to continue to provide support.

- 14        **The Panel recalled the decision of the Sixth Session of the Panel** that the IOC Science and Communication Centres develop along the lines recommended by the External Review Committee in 2002. This development takes into account the revised HAB Training and Capacity Enhancement Programme (Resolution IPHAB-VI.3), which endorsed continuation of ongoing activities with increased priority for capacity enhancement in monitoring and management and for activities responding to GEOHAB requirements. The framework for and specification of activities of the Centres are given in the biennial Work Plans adopted by IPHAB.

## 2.3 REGIONAL IOC HAB GROUPS

- 15        **The Panel took note** of the results and reports under the regional components of the HAB Programme, WESTPAC/HAB (Western Pacific), IOC/FANSA (South America), and IOCARIBE/ANCA (Caribbean), and HANA (North Africa).

- 16        The Chair of WESTPAC/HAB, Y. Fukuyo (Japan) gave a summary of activities and developments (see [Annex IX](#) hereto for details). The activities are lead by the Chair WESTPAC-HAB and. R. Azanza (University of the Philippines), A. Anton (University of Malaysia Sabah), and K. Furuya (University of Tokyo). The Chair WESTPAC/HAB noted with concern that the WESTPAC/HAB network had not been established although this is in the terms of reference. This is mostly because WESTPAC does not have clear procedures for the selection of focal point(s) in each member country for various IOC programmes and it is not clear whether these focal points can be selected by programme coordinators, or whether they are assigned by the IOC-UNESCO committee in each country. This issue was also considered an impediment to WESTPAC/HAB development at IPHAB-VII.

- 17        The Chair COI-FANSA, L. Guzman (Chile), gave a summary of achievements and proposed future activities (see [Annex X](#) hereto for details). Members to FANSA are designated by Member States, although some FANSA meeting participants are participating in the personal capacity as experts or are representing institutions which are not primary IOC contacts such as Universities or fisheries agencies. When possible, FANSA endeavours to have two attendees from each country which allows a balanced participation. FANSA has become an important mechanism for regional cooperation on HAB and related issues. An issue of particular concern is the regional inter-calibration on marine biotoxins. FANSA is also focussed on providing data to HAEDAT and HABMAP and thus the new Harmful Algae Information System. Cooperation with ANCA via the PortalOceanico component [www.algascnocivas.net](http://www.algascnocivas.net) will be launched at a workshop 22–27 May 2007 in San Andres, Colombia. FANSA has planned its next meeting for 2008 to be held in Argentina. **The Panel endorsed** the recommendation of FANSA that the IOC Executive Secretary should communicate with each FANSA country and encourage them to maintain their financial contribution to FANSA.

- 18        On behalf of the Chair COI-ANCA, E. Mancera (Colombia), M. Lion (Secretariat) gave a summary of ANCA objectives. Unfortunately due to logistical problems, the ANCA WG could not meet before the IPHAB and it was not possible to updated IPHAB with recent activities and priorities for the region. The next meeting (ANCA-IV) will be held in the San Andres Islands, Colombia, 21–23 May 2007 and will be followed by a workshop to discuss and plan the internet portal on Harmful Algae for the Caribbean to be held at the same venue (24–26 May 2007). The Portal will be an extension of the portal on Harmful Algae already established within Portal Oceanico (<http://www.portaloceanico.net/>) by the sister group in South America (FANSA). One of the main objectives of the next WG of ANCA is to increase the participation of IOCARIBE Member States in their meetings. In previous meetings only participants from Colombia, Costa Rica, Cuba, El Salvador, Guatemala, Mexico and Venezuela had participated.



Recommendations and work plans of ANCA-IV will be included in the work plan of the HAB Programme for 2008–2009 depending on resources.

- 19 The Chair of IOC HANA, Y. Halim (Egypt) gave a summary of HANA objectives and activities to date, and presented priorities for the coming biennium (see [Annex X](#) hereto for details). **The Panel decided** to identify a HANA focal point in each country with the aim of facilitating communication and participating in HANA meetings. IPHAB-VI recommended that regional bodies including UNEP-MAP (Mediterranean Action Plan), FAO-COPEMED (Cooperation on Mediterranean Fisheries), and the International Commission for the Scientific Exploration of the Mediterranean Sea (ICSEM), (CIESM, Commission Internationale pour l'Exploration Scientifique de la mer Méditerranée) be invited to cooperate in HANA. This still has to be implemented and **the Panel instructed** the Secretariat to contact the relevant organisations for co-sponsorship and support. .
- 20 The representative of Kuwait, M. Hussein, presented to the panel a proposal for a new regional network for the Gulf. Since the first major incident in September 1999, HABs appear to be spreading and increasing along the coast of Kuwait, (northern part of the Arabian Gulf) causing damage to the marine environment and posing a threat to human health.
- 21 Kuwait, and other Gulf countries including the Islamic Republic of Iran, Oman, Saudi Arabia and United Arab Emirates, has experienced frequent HABs. Referring to Decision CN12/28 of the ROPME Council-12 of the Regional Organization for the Protection of Marine Environment (ROPME), Kuwait was nominated as lead member state for “HAB and Fish Mortality”. Accordingly, ROPME finalized a Memorandum of Understanding with EPA-Kuwait for coordinating meetings of the Regional Group of Experts on HAB and Marine Mortality with active participation of fishery authorities (Priority A), international expert visits to member states for technical advice during fish kill incidents (Priority A&B) and co-sponsoring International Conferences, workshops and training courses on HABs, to be convened by EPA-Kuwait.
- 22 In view of the ROPME decisions, the Kuwait Environment Public Authority (EPA) recognizes the importance of setting up a regional HAB working group for the Gulf region under the umbrella of IOC-UNESCO in co-operation with ROPME.
- 23 The main objective of this working group will be to enhance national and regional capabilities in the detection of HABs by improving skills in monitoring, sample preparation and identification of HABs species and toxins, and knowledge on taxonomy and toxin chemistry.
- 24 Madagascar and Namibia proposed to explore the possibility of establishing a regional HAB group or network among the coastal countries of the Southern African Development Community (SADC).
- 25 **The Panel expressed its appreciation** and recognized the importance of the work carried out by the regional leaders and of the resources made available to regional activities by Japan, Spain and UNESCO Cross-Cutting Projects.
- 26 **The Panel endorsed** the proposed regional activities of WESTPAC/HAB, FANSA, and for 2008–2009 and integrated them in the Work Plan (see [Recommendation IPHAB-VIII.1](#) and its Annex 1). The priorities of ANCA will be included in the work plan after ANCA-IV according to availability of resources.
- 27 **The Panel reiterated its recognition** of the need for regional groups and networks on harmful algal blooms in different areas of the world and **welcomed** the proposals for new regional networks and decided to pursue co-sponsorship with the relevant regional organizations and requested the new networks to present their terms of reference and membership to next session of the IPHAB.

28           **The Panel adopted** [Resolution IPHAB-VIII.4](#).

### 3.       **EDUCATIONAL PROGRAMME ELEMENTS**

#### **INFORMATION NETWORK**

##### 3.1       HARMFUL ALGAE NEWS

29           The IOC newsletter *Harmful Algae News* (HAN) on toxic algae and algal blooms has been published since January 1992 and the number of subscribers has stabilized to approximately 2000. HAN is available in print and via the IOC HAB website. **The Panel endorsed** the continuation of the current editor (T. Wyatt) for the period 2008–2009 and expressed its appreciation for his dedication to the newsletter. **The Panel recommended** that HAN be issued as regularly as possible (quarterly), even if some issues would have relatively few pages. **The Panel reiterated** the value of HAN to those involved in HAB science and management and as a unique way of making the work of IOC and its IPHAB more visible.

##### 3.2       WEB SITE AND PORTALS

30           **The Panel welcomed** the development and rejuvenation of both the IOC HAB Programme web site at [www.ioc.unesco.org/hab](http://www.ioc.unesco.org/hab) and the GEOHAB web site at [www.GEOHAB.info](http://www.GEOHAB.info) (see [Annex VIII](#)).

##### 3.3       DIRECTORY OF EXPERTS: HAB-DIR

31           The Sixth Session of the Panel noted with satisfaction that the on-line International Directory of Experts in Toxic and Harmful Algae and their Effects on Fisheries and Public Health, HAB-DIR, had been re-launched as a sub-section of IOC expert database 'OceanExpert'. OceanExpert has a system that automatically calls for update of information. However, the Secretariat reported to the Eight Session of the Panel that few people respond to the requests for update and this weakens the value of the directory. **The Panel encourages** the HAB science and management community to register, update, and make use of the HAB-DIR and Ocean Expert.

##### 3.4       CO-SPONSORSHIP OF HAB CONFERENCES AND THEIR PROCEEDINGS

32           **The Panel noted with satisfaction** the follow-up of IPHAB Recommendation VI.6 and the continued co-sponsorship of the International HAB Conferences and the publication of their proceedings. IOC co-sponsored the XIIth International Conference on Harmful Algae, Copenhagen, Denmark, held on 4–8 August 2006, and the publication of the proceedings as a co-publication with ISSHA.

33           **The Panel reiterated** the recommendation of IPHAB-VI and subsequent sessions for the continued co-sponsorship of the series of international HAB Conferences as it has done since 1987. Support provided by the IOC has been crucial in securing the attendance of scientists from developing countries. **The Panel reiterated** the importance of consolidating the international HAB conferences under the auspices of the International Society for the Study of Harmful Algae (ISSHA) and **acknowledged** that this was a means of strengthening the international NGO network on HABs, which provides good opportunities for partnerships within the IOC HAB Programme.

34           **The Panel recommended** that the IOC maintains close cooperation with ISSHA.

### 3.5 TRAINING

35        **The Panel recalled** the adoption by the Sixth Session of a revised IOC HAB Training and Capacity Enhancement Programme, and **noted** with satisfaction the training courses and workshops on harmful algae successfully implemented, regionally and globally, in 2005–2006 (listed in [Annex XI](#)).

36        **The Panel expressed its appreciation** of the significant support provided by Denmark, Japan, and Spain, and strongly encouraged Denmark, Japan and Spain to continue to support IOC capacity enhancing activities.

37        The Panel made a thorough reassessment of the capacity enhancing activities implemented or fostered by the Programme and in particular how to: identify requirements; acknowledge the different needs among regions and of countries in a region; assess the impact of capacity building.

38        **The Panel reiterated** that capacity building is a core component of the IOC HAB Programme, and that specific effort is needed to develop activities that will reduce the heterogeneity in capacity and will promote collaborative activities between countries and regional groups.

#### **Impact assessment**

39        The Panel had a thorough discussion on ways to assess the value of capacity enhancing activities within the Programme.

40        Assessment of value is only useful if it is followed up by adjustments in activities (protocols, training methods, course formats, selection procedures of trainees, etc.) or by offering supplementary training. In WESTPAC, it is estimated that only about 10% of the trainees end up in permanent positions. However, when a person leaving the field it does not necessarily mean that the skills of that individual are lost. They constitute a network and may in their further career benefit from their knowledge on HABs in the broader context of coastal area management and other environmental and societal issues.

41        In terms of maintaining learned or enhanced skills this was recognized as primarily national issues within each Member States. However, it was also recognized that it is useful to maintaining acquired skills if former trainees are used as trainers at both in-country and regional courses. **The Panel reiterated** its viewpoint expressed of former sessions of IPHAB, that priority in the selection of trainees should be given to training of trainers and that any future assessment among former trainees should include questions on whether the trainees applied the acquired skills as a trainer of trainers.

42        **The Panel noted** that the availability of quality microscopes is a major constraint on maintaining the species identification and taxonomic skills of individuals. This problem limits sustainability of the trainees acquired competences. However, it was also noted that some places with limited microscope facilities have done excellent work and that capacity enhancing activities should not only be for well resourced organisations. It was agreed that enthusiasm, self motivation and institutional back-up are key elements in the development of competence for good HAB science and management.

43        The experience from FANSA was that the short-term impact of training may be lost for some trainees, but that there was longer term benefits and this made any assessment of the value of training difficult.

- 44 There was general agreement that the selection of appropriate trainees is essential and on occasion, selection via intergovernmental mechanisms (via IOC national focal points) identifies the wrong people.

### **Requirements for Capacity enhancement in Member States**

- 45 It is evidently important to match training to needs. Namibia referred to how important it is to target national priorities and that such a targeted approach to training had a significant positive impact in Namibia. .
- 46 **The Panel acknowledged** how much capacity enhancing activities contributed to science by allowing a global flow of samples via trainees. Several new taxa and toxins have been discovered this way. This needs to be acknowledged in any assessment of the impact and value of capacity enhancing activities. Similarly, the networks which often arise through participation in training courses should also be viewed as an important long term element of capacity building.
- 47 The Panel discussed whether demand for training courses in identification and taxonomy or toxin chemistry was saturated or if IPHAB generate a demand by offering the courses.
- 48 **The Panel concluded** that the over-subscription of courses with appropriately qualified applicants in appropriate positions; was a valuable indication of a real demand. It was also noted that the willingness for organizations to part or fully fund staff training provides an additional indication of the importance training courses.

### **Training course content and level**

- 49 **The Panel noted** that a good model to follow was that practices of the IOC Science and Communication Centre, where courses were offered at two levels. A basic level designed for technicians and a higher level of advanced course for experts or former trainees. It was agreed that in some cases courses should be area specific, while for some courses it may be relevant to link adjacent regions.
- 50 The Panel discussed whether IOC should include more advanced technologies (e.g. molecular probes, EM, PCR). It was agreed that the inclusion of such topics should depend on the type of course. Basic courses should stay simple but focused (e.g. targeted at regulatory monitoring) while there it would be more appropriate to include advanced techniques in more advanced courses which aim to teach a range of skills. However, it was recognized that good microscope skills and knowledge of microscope methods were needed for regulatory monitoring. The IOC courses on identification were acknowledged to be good and it was recognized that the need for such courses was truly global. Some delegates stressed the need for more frequent courses and also for self-paying (by employer or other organizations) trainees. It was also noted that basic training courses can be independent of the IOC HAB Programme, but that the IOC has a role to facilitate this upon request from Member States.
- 51 **The Panel also concluded** that there is a continuing need for reliable identification of toxic microalgae species for monitoring purposes and welcomed the introduction of certification of competence on specific identification skills as a means of documenting competence.
- 52 **The Panel recommended** that IOC continue to provide and facilitate both elementary and advanced certifying microalgae taxonomy/identification training courses.
- 53 Regarding capacity enhancing activities in the field of toxin analysis and assays, it was concluded that course organizers need to be careful not to promote the products of specific manufacturers, and to be aware that such products may not be validated. This is of particular concern if training is for regulatory monitoring but less so if training is for research purposes.

Science can develop when tests or methods are used at training courses, and courses should be used to inform participants of new techniques under development.

- 54 Discussions referred to experience with the ELISA method and the Receptor Binding Assay (RBA) which are not AOAC approved. However, the RBA assay, which is promoted by the IAEA, may be undergoing AOAC approval.
- 55 The WESTPAC/HAB TTR uses the ELISA method for research and will not recommend ELISA for regulatory monitoring. While the TTR Project receives support from the ELISA Company, it was noted that this can be linked to a microscope manufacturer providing microscopes for a course on phytoplankton species identification.
- 56 Countries which have worked or work with IAEA on the RBA assay identified a dilemma in that the assay was used for research although the basis of the projects were regulatory monitoring capacity enhancement. WESTPAC/HAB noted that several groups in SE Asia wish to use RBA routinely, but it is at present unclear how this will influence export to some markets (e.g. EU) where only approved methods are valid. It was noted that while methods may not be validated labs may be accredited to ISO 1725. This addresses the issue even if methods are not validated.
- 57 **The Panel concluded** that only validated methods should be taught on courses designed to train people working in regulatory monitoring. If the training offered is targeted towards research the choice of methods is less critical. However, good practice should be followed when companies or organizations having an interest in specific methods present their products at training courses.
- 58 The Panel ended its discussions on capacity enhancement by considering other areas where Member States have a need for internationally organized training. Relevant areas identified (and in accordance with the priorities identified at earlier sessions) were the design of HAB monitoring programmes and forecasting systems. It was proposed to use the TTR model for this type of training rather than courses. The United States (NOAA) offered to receive individual visitors to learn from the Gulf of Mexico HAB monitoring system.
- 59 **The Panel recommended** that the IOC HAB Programme could set up a roster of individual training opportunities with national monitoring schemes and disseminate this via the web site. Furthermore, training on policy matters and regulations were identified as a requirement and the Panel acknowledged the need to seek the cooperation of FAO and WHO in this respect.
- 60 A. Zingone (Italy) informed the Panel of the plans for the 9th Advanced Phytoplankton Course, Taxonomy and Systematics, 5–26 April 2008, Naples, Zoological Station A. Dohrn. This series of courses, which from the outset has been sponsored by UNESCO and IOC, has had 144 participants from 45 countries in the period 1976–2005. The Honorary Director of the 2008 course will be Dr Grethe R. Hasle (Norway), and the organising committee is composed by Drs Marina Montresor, Diana Sarno, and Adriana Zingone (Italy). Sponsorship will be sought from EU/VI FWP-MARBEF, Carl Zeiss: microscopes, IOC: support to students from developing countries, US NOAA and US NSF: support to US students, UNEP-MAP: support to students from the Mediterranean area, and ISSHA: support to students. **The Panel acknowledged** the uniqueness of the series of courses, **recommended** their continuation, **and encouraged** sponsors to respond favourably to requests for support.
- 61 **The Panel endorsed** the implementation of a number of proposed capacity building activities (listed in [Annex II](#) hereto (annex to [Recommendation IPHAB-VIII.1](#))).

#### 4. SCIENTIFIC PROGRAMME ELEMENTS

##### ECOLOGY AND OCEANOGRAPHY

#### 4.1 IOC-SCOR PROGRAMME ON THE GLOBAL ECOLOGY AND OCEANOGRAPHY OF HARMFUL ALGAL BLOOMS: GEOHAB

- 62 At its Fourth Session the Panel, through Recommendation IPHAB-IV.2, endorsed the establishment of an international research programme on the global ecology and oceanography of harmful algal blooms, GEOHAB. GEOHAB was established jointly with SCOR and has the overall goal of developing the scientific knowledge needed to increase capability to mitigate the impacts of HABs. This will be addressed through improving capabilities for modelling the population dynamics in a number of geographical regions identified as particularly suited for international research cooperation. Furthermore, GEOHAB is intended to help Member States in setting national priorities and in particular to promote the establishment of national, regional and international research projects. GEOHAB has its web site at [www.geohab.info](http://www.geohab.info)
- 63 The GEOHAB SSC and the SCOR and IOC Secretariats are still seeking to establish an international project office (IPO). However, to date the necessary resources have not been identified. The GEOHAB IPO functions are therefore shared between the SCOR Secretariat and the IOC Science and Communication Centre on Harmful Algae at the University of Copenhagen, and funded with resources earmarked for GEOHAB and resources available in general to SCOR and the IOC Centre.
- 64 The Chair of the IOC-SCOR Scientific Steering Committee (SSC) for GEOHAB, R. Raine (Ireland), gave a summary of GEOHAB and reported on GEOHAB developments 2005–2006. The Terms of Reference for the GEOHAB SSC, the List of SSC Members, and a summary of GEOHAB activities and achievements are attached as [Annex XII](#) hereto.
- 65 **The Panel expressed its appreciation** of the work of the GEOHAB SSC and in particular the advanced in developing the GEOHAB Core Research Projects.
- 66 **The Panel welcomed** the activities targeted at developing regional GEOHAB initiatives.
- 67 In particular the Panel took note of the joint ICES-IOC-SCOR Working Group on GEOHAB Implementation in the Baltic (WGGIB) and of the recommendations made by the ICES-IOC Working Group on Harmful Algal Bloom Dynamics (WGABD) regarding the future of the WGGIB. **The Panel endorsed** the continuation of the WG for one year (2008) to finalise and seek funding for a regional cooperative GEOHAB research project in the Baltic. The WGGIB should thereafter be merged into WGABD as the remaining terms of reference of the WGGIB are similar to those of the WGABD and as a number of individuals participate in both working groups. **The Panel instructed** the Secretariat to consult with ICES in order reach agreement on the proposed plan for the WGGIB.
- 68 The Panel took note of the First Asian GEOHAB Meeting (held in conjunction with the GEOHAB SS 2007 meeting, 16–17 March 2007 in Tokyo, Japan) to evaluate the potential for an Asian GEOHAB programme. **The Panel urged** the SSC to further develop this initiative in coordination with WESTPAC/HAB and encouraged the proposed follow-up workshops in Nha Trang, Viet Nam (January 2008) and at the XIII<sup>th</sup> International Conference on Harmful Algae in Hong Kong (November 2008).
- 69 **The Panel reviewed and endorsed** the revised Terms of reference for the GEOHAB Scientific Steering Committee as submitted to the Session by the SSC. The revised terms of reference are included in [Annex XII](#) hereto.



#### 4.2 ASSESS AND COMPARE SPATIAL RELATIONSHIPS BETWEEN CHANGING GLOBAL NUTRIENT EXPORTS AND LOADS AND THE PROLIFERATION OF MAJOR HAB SPECIES

- 70 The Chair of GEOHAB, (R. Raine, Ireland) introduced the subject. Nutrient over-enrichment has degraded estuarine and coastal marine waters worldwide, and has been linked to the increased prevalence of harmful algal blooms (HABs) that cause serious ecological, economic, and human health impacts. Yet, this linkage currently lacks a firm, quantitative foundation.
- 71 A new working group is to be proposed to SCOR to assess and compare *spatial* relationships between changing global nutrient exports and loads and the proliferation of major HAB species, and will place these patterns in the context of coastal and estuarine typology. The rationale is that nutrient loads alone are not sufficient to predict where certain HABs may occur; their distribution is also a function of the physical character of the receiving waters (the typology) as well as the physiological characteristics of the algae in relation to the quantity and quality of the nutrients. We will apply a range of models, including spatially-explicit nutrient export models, ecosystem and physiological models, and statistical approaches. This project will advance predictive capability of the extent of blooms, the dominant harmful taxa involved, and our ability to manage these HABs by an improved understanding of the impacts of nutrients on HABs.
- 72 The proposed working group will build on existing data sets and models and will synthesize relationships and will lay the groundwork for new research which can, and likely will, be proposed under the auspices of global programmes such as LOICZ, GEOHAB and IMBER. Global NEWS has received endorsement from LOICZ, and will seek endorsement from GEOHAB and IMBER. The proposed working group will be composed of biologists, chemists, oceanographers, modellers and statisticians.
- 73 The activities of the working group also stem from the activities of the Global Nutrient Export from Watersheds Programme (Global NEWS, an IOC working group) which has developed and applied spatially explicit watershed nutrient export models that predict land-based nutrient loading to coastal systems globally. The questions of nutrient export and its effects in the coastal zone are also relevant to the mission of LOICZ and nutrient fluxes and their key impacts are also of interest to the IMBER Programme.
- 74 **The Panel considered** the activities of the proposed working group directly relevant to GEOHAB which has specifically identified the following questions as priorities in the core research project on HABs and Eutrophication “What HAB species or species clusters are indicators for nutrient enrichment at global and regional levels?” and “How are long-term trends in nutrient loading changing HAB bloom patterns and dynamics?” The working group can address these questions in a fundamentally different way from the activities of GEOHAB, since GEOHAB is focused on ecology, physiological adaptive strategies of species, and oceanography.
- 75 **The Panel recommended** IOC to offer co-sponsorship of the proposed working group to link it with GEOHAB.
- 76 **The Panel noted that** SCOR normally expects that a co-sponsorship of its WG’s imply financial support for the members to attend the meetings of the WG and that this may be difficult for IOC/IPHAB to commit without identification of additional resources for the HAB Programme or GEOHAB.

#### 4.3 ICES-IOC WORKING GROUP ON THE DYNAMICS OF HARMFUL ALGAL BLOOMS

- 77 The Secretariat, on behalf of the Chair (J. Silke, Ireland) of the ICES-IOC Working Group on Harmful Algal Bloom Dynamics (WGHABD), reported on the achieved results, and presented the 2007 Terms of Reference (attached as [Annex XIII](#) hereto).
- 78 **The Panel noted with appreciation** the work of WGHABD and in particular the outcome of the ICES-IOC inter-comparison workshop on “New and classic techniques for the determination of numerical abundance and biovolume of HAB species”, 22–26 August 2005, the Kristineberg Marine Biological Station, Sweden, which was endorsed through Recommendation IPHAB-VI. 4. **The Panel noted with satisfaction** that the encouragement of IPHAB-VII to seek publication of the results in an appropriate journal to ensure wide dissemination of the inter-comparison had been followed up.
- 79 The Chair IPHAB had commissioned a review of the WGHABD which was presented to the Panel by A. Zingone (Italy). The review was based on an evaluation of the 2005 and 2006 WG reports. It was concluded that: the WG is generally well attended (24-27 participants), and has been functioning effectively for two decades (under modified names and mandates), thereby ensuring continuity and consistency in the WG’s activities. Given that the WG operates under the auspices of IOC-ICES, attendance is heavily weighted towards northern European countries, some of which send additional participants in addition to a national delegate. The WG has a strong identity and is distinct from other ICES WGs with potentially overlapping terms of reference by focussing on national HAB reports, the dynamics, toxicity, and consequences of harmful algal events and topical new findings on HABs in the ICES region. The structure of the WG is well set up, with future terms of reference identified and proposed at each WG meeting. The WG has been very active, including the production of cooperative research reports and reviews, organizing inter-calibration exercises (e.g. growth rate determinations, cell enumeration methods), contribution to the design and maintenance of the HAEDAT data base and reporting on new harmful taxa and toxins, primarily in the ICES region. The working group certainly fulfils the role of networking participating member countries. The annual exchange of information on HAB events and new findings in member countries apparently maintains a good flow of information among participants. However, general dissemination of output from the WG within individual countries appears to be weak. Reports are available and accessible at the ICES website but efforts should be made to distribute the report more widely. One means would be to condense the main findings of the report for publication in *Harmful Algae News*.
- 80 More than half of the WGs terms of reference are related to practical issues, e.g. data collation, national reports of HAB events, and efforts to build decadal maps of species occurrence. This is probably a reflection of the high representation of participants involved in national programmes for harmful algae and biotoxin monitoring. Other terms of reference concern technological issues, such as remote sensing, *in situ* methodologies for detecting HABs, the relationships between toxic species abundance and toxins in bivalves and cell counting/identification problems. In some cases these discussions have resulted in the organisation of specific workshops, whose results have been widely disseminated.
- 81 Other activities relate to the discussion and review of scientific topics, many of which are derived from the reported new findings. This type of activity should be further developed to better balance the mandate of the WG. The WG should make better use of the scientific experience participants and that of invited experts, in the discussion of special themes. This was undertaken by the WG for reviewing remote sensing techniques and establishing relationships between numbers of toxic cells and shellfish toxicity, but these efforts have tended to resolve technical issues, rather than addressing scientific topics. The WG should maintain an important focus on HAB *dynamics* as the name and general terms of reference indicate. Several important bloom dynamic topics are mentioned, without being developed fully. For example, factors related to bloom termination could be a topic for the WG to consider, and this would compliment efforts to parameterize species-specific models of bloom dynamics. A final goal for



these scientific evaluations should be a publication either as an ICES Cooperative Research Report, a review publication for Harmful Algae or a short note for *Harmful Algae News*.

82 A closer link with GEOHAB is clearly needed. GEOHAB has developed an international comparative science agenda for research but cannot address all of the technical requirements for reviewing method development, time-series and models on HABs, and inter-calibration exercises. Linkage of GEOHAB research activities to the deliverables of the WG would facilitate more efficient use of limited resources and expertise within the HAB community.

83 **The Panel reiterated** Recommendation IPHAB-VI.4. on the importance of the ICES-IOC WG in having provided, and still providing, a significant part of the basis for the development of GEOHAB and other HAB activities, and the importance of the continuation of the WGHABD.

84 **The Panel concluded by deciding** to: (i) request the WGHABD to identify and address terms of reference on the dynamics of harmful algal bloom; (ii) request the GEOHAB SSC on a yearly basis to consider terms of reference for the WGHABD; (iii) request the WGHABD to systematically strive to publish the results and conclusions of their reviews, discussions on new developments, etc. in the appropriate fora ranging from smaller communications in *Harmful Algae News* to papers in peer-reviewed journals; and (iv) communicate the conclusions of the Panel on the functioning of the WGHABD to its members.

#### 4.4 BLOOMS OF *OSTREOPSIS* IN THE MEDITERRANEAN

85 A. Zingone (Italy) presented a summary of the recent problems related to blooms of *Ostreopsis* species in the Mediterranean area. These species produces palytoxin-like toxins that are released into seawater and can form an aerosol. The effects following exposure to seawater and aerosols include mortality in benthic macrofauna and in humans, respiratory distress and dermatitis. Blooms of *Ostreopsis* have caused problems in Tuscany (1998), Apulia (2000) Liguria (2005 and 2006) and in Sicily (2006). The most acute event was in Genoa (Ligurian Sea) in July 2005, when more than 200 people who were on the beaches, were hospitalised. Blooms with no associated symptoms have been noticed in other areas, e.g. coastal waters of the mid- and northern Adriatic. The problem appears to be spreading to other Mediterranean coastal areas.

86 There is little information on these species of *Ostreopsis* and on marine benthic dinoflagellates in general. One reason for this is because they live in an environment that is generally neglected by microalgal ecologists. A series of important scientific questions needs to be addressed to further our understanding of these organisms to better monitor their occurrence and protect human health. In December 2006, Italian scientists with experience in phytoplankton and harmful algae formed BENTOX-NET, a network for the study of Harmful Benthic Algal Blooms (HBABs), Details of the network can be found at the website [www.bentoxnet.it](http://www.bentoxnet.it).

87 **The Panel discussed** the need to widen networking at international level to disseminate information on blooms, of these benthic species which could be a major problem for tourism in the Mediterranean area, and to take advantage of the experience available in Italy on monitoring and management. In addition, it was recognised that from an ecological and monitoring point of view, these blooms exhibit similarities with blooms of species which include the ciguatera-producing species in tropical seas, although the effects and impacts can be very different.

88 **The Panel concluded by recommending** the initiation of a new Core Research Project of GEOHAB which relates to the biodiversity, biogeography and ecology of the toxin-producing benthic, epiphytic and psammobious dinoflagellates, including the ciguatera-related communities, and that this be communicated by the Chair IPHAB to the IOC Assembly.

#### 4.5 ICES-IOC-IMO WORKING GROUP ON BALLAST AND OTHER SHIP VECTORS (WGBOSV)

89 Reports of the ICES-IOC-IMO WGBOSV from the intersessional period were made available. The Panel noted with satisfaction that Recommendation IPHAB-VII.4 had been followed up and that the WG now actively contributes to the process of developing the IMO guidelines for implementation of the IMO Ballast Water Convention. The Panel re-assessed the justification for the Group and concluded that the Group has a clear mandate at least until the completion of the IMO Guidelines.

90 **The Panel endorsed** the co-sponsorship of the Working Group for 2008–2009 and **urged** IOC to ensure representation at the meetings of the WGBOSV. The 2007 Terms of Reference of WGBOSV are attached as [Annex XIV](#) hereto.

#### 4.6 TAXONOMY

91 The Fourth Session of the Panel established a Task Team on Phytoplankton Taxonomy through Resolution IPHAB-IV.1. The Fifth, Sixth and Seventh sessions of the Panel decided to continue the Task Team and revised the Terms of Reference. The Seventh Session reviewed the progress report of the Task Team Chair (Ø. Moestrup, Denmark) and reaffirmed the strong need in the international research and management community for a reference list on potentially harmful algae.

92 **The Panel acknowledged** the co-publication with ISSHA of the '*Manual on Aquatic Cyanobacteria*', by Cronberg, G., and Annadotter, H., ISSHA and IOC of UNESCO 2006, as a valuable contribution to the taxonomic literature for identification of HAB species.

93 **The Panel decided** to continue the Task Team with revised Terms of Reference. **The Panel adopted** [Resolution IPHAB-VIII.6](#).

94 **The Panel endorsed** the proposed expansion of the reference list and its integration into the new Harmful Algae Information System (see below) established jointly with IODE. This includes a feasibility study of the potential interaction and linkages with the MICROBIS (the data base management system for the International Census of Marine Microbes under the auspices of 'Census of Marine Life') and Encyclopaedia of Life initiatives which builds more comprehensive taxonomic databases.

### 5. OPERATIONAL PROGRAMME ELEMENTS

#### 5.1 MONITORING AND RESOURCE PROTECTION

95 **The Panel recalled** its Resolution IPHAB-VI.2 where **the Panel established** a Task Team to address incompatibilities among biotoxin regulations in major markets (e.g. EU, US, APEC). The Task Team merged during 2004–2006 into a FAO/IOC/WHO Joint FAO/IOC/WHO *ad hoc* Expert Consultation to address the specific questions posed by the WHO-FAO Codex Committee on Fish and Fisheries products (CCFFP). See report IOC/IPHAB-VII/3 for a summary of the recommendations of the Expert Consultation.

96 The Chairman of the Task Team P. Busby (New Zealand) regretted to report that it appeared as if WHO had lost focus in finalising the process and that staff changes in WHO meant that no one was presently charged with the task. This implies that by default, the European Commission will set standards and from a global perspective this may not be the most desirable way of revising standards.

97        **The Panel noted with concern** that the Report of the Joint FAO/IOC/WHO ad hoc Expert Consultation on Biotoxins in Bivalve Molluscs has not been finalised for publication, **and requested** the assistance of the IOC Secretariat and Assembly to strengthen the formal relationship between IOC/IPHAB and FAO and between IOC/IPHAB and WHO to facilitate the completion of the background papers to the Summary Report of the Joint FAO/IOC/WHO Expert Consultation and ensure its publication.

98        To continue to address the issue systematically, **the Panel decided** on revised Terms of Reference for the Task Team. **The Panel adopted** [Resolution IPHAB-VIII.3](#).

## 5.2 DATA MANGEMENT

99        Over the past decade, IOC has developed a number of internet-based data bases on various aspects of HABs. This has been undertaken independently and with partners.

100       HAE-DAT is a data base containing records of [harmful algal events](#). It is a joint activity with ICES and PICES.

101       HAE-DAT contains records from the ICES area (North Atlantic) since 1985 and from the PICES area (North Pacific) since 2000. The IOC Regional networks in South America and North Africa are preparing to start contributing. In 2006–2007, HAEDAT was moved to a newly designed platform.

102       The [IOC Taxonomic Reference List of Toxic Planktonic Algae](#) provides a reference for the use of names and information on each species of toxic microalgae. It was established and maintained by the IPHAB Task Team on Taxonomy. The Reference list is at present in the form of a web site (not data base).

103       MON-DAT is the '[Design and Implementation of Some Harmful Algal Monitoring Systems](#)' data component which holds detailed information on HAB monitoring programmes, legislation, regulatory toxin limits and responsible agencies in most of the countries that have such programmes in place. Data were compiled in 1995/96 and 2000/01. Until March 2007, MON-DAT was available on-line but the data base application is out of date and not compatible with the new platform for HAEDAT. IPHAB-VII decided to merge MON-DAT into HAE-DAT.

104       HAB-MAP is an initiative jointly by IOC and ISSHA and is a data component on the biogeography of harmful algal species. It is in preparation and some regions are completed. Data is structured to fit the new HAE-DAT format.

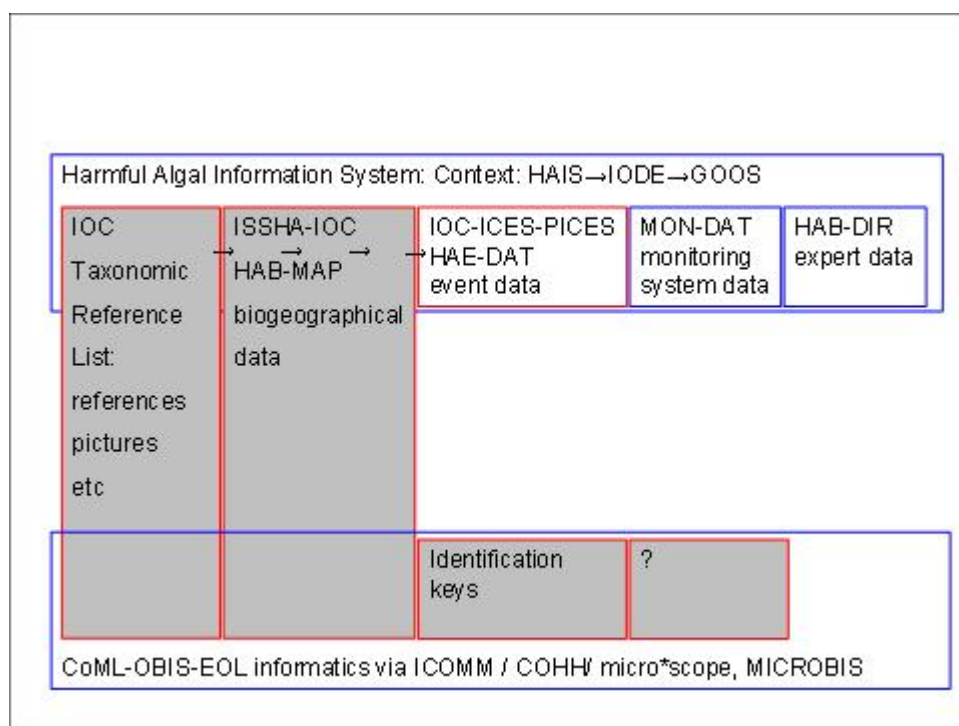
105       The [International Directory of Experts In Harmful Algae and Their Effects on Fisheries and Public Health](#) is a specialised section of the IOC OceanExpert directory.

106       The [IOC Bibliographic HAB Data-base is a specialised section of the Aquatic Science and Fisheries Abstracts \(ASFA\)](#)

107       Based on an introduction by the Secretariat (H. Enevoldsen), **the Panel discussed** the overall strategy for a merge and/or linkage of these products into one integrated 'Harmful Algae Information System'.

108       It is envisaged that when fully established, the information system will consist of access to information on harmful algal events, harmful algae monitoring and management programmes worldwide, currently used taxonomic names of harmful algae, and in cooperation with ISSHA, information on the biogeography of harmful algal species. Supplementary components will be an expert directory and a bibliography.

- 109 There are two levels of framework that offer potential for this development. At the recent session of IOC's International Oceanographic Data and Information Exchange (IODE), IODE endorsed the inclusion of the IOC HAB data products as an element of IODE. This will embed the HAB data products in a well established and larger data management structure. IODE was established in 1961 to enhance marine research, exploitation and development by facilitating the exchange of oceanographic data and information between participating Member States and by meeting the needs of users for data and information products.
- 110 Discussions have taken place with people working with Encyclopaedia of Life (EOL) informatics, The International Census of Marine Microbes (ICoMM), and US Centers for Human Health and Ocean Sciences (COHH) as well as micro\*scope, MICROBIS —and therefore OBIS.
- 111 There is potential for elements of the future Harmful Algae Information System to be linked with the above initiatives. For example:
- The HAB Reference List: This is largely a suite of static documents, but needs to evolve into dynamic documents that can be augmented and updated.
  - Biogeographic data: Once established, to maintain such a data base requires input from the scientific and management community. It will be necessary to create an on-line environment in which individuals can add new data that goes into a common pool as a source of information and decision making. The Encyclopaedia of Life project will be designed so that the software and content are of this nature. There can be interfaces through plankton\*net, EOL or micro\*scope; or through MICROBIS or through OBIS. HABP and IODE may or may not wish/need custom interfaces if we went along this path.
  - Identification keys: The issue is to discriminate the toxic species from the similar but non-toxic species. The intention is to build matrix keys, (which e.g. can be built through LUCID software). MICROBIS/OBIS has relevant experience and keys could focus on suites of species although not all of the relevant species.



**Figure 1.**  
A conceptual outline of how existing data products can be developed within the context of the IOC HAB and IODE programmes and in cooperation with CoML-OBIS-EOL-ICoMM (to be clarified in detail)

112       **The Panel concluded by adopting** [Resolution IPHAB-VIII.5](#) regarding the development of a Harmful Algae Information System in cooperation with IODE.

### 5.3      IMPLEMENTATION OF HAB MONITORING WITHIN THE GLOBAL OCEAN OBSERVING SYSTEM (GOOS)

113       **The Panel recalled** recommendation IPHAB-V.3, IPHAB-VI.3 and IPHAB-VII.3, and that the operational observation of HABs is a constituent of the Coastal Ocean Observations Modules of The Global Ocean Observing System (GOOS).

114       The implementation of the coastal module of GOOS will happen through GOOS Regional Alliances [GRA], National GOOS programmes, and global elements (e.g. GLOSS, GCRMN, etc.)

115       Through Recommendation IPHAB-VI.3 IPHAB acknowledged that the Joint IOC-WMO Technical Commission for Oceanography and Marine Meteorology (JCOMM) is the vehicle for the collection, archiving, distribution and utilization of ocean and meteorological data, and that their Terms of Reference allow for the coastal module of GOOS to include non-physical variables.

116       **The Panel therefore recommended** that it cooperate with JCOMM to identify and develop appropriate and effective methods for the monitoring of harmful species, which can be used to detect changes in the occurrence of harmful algal events and the causative algal species.

117       JCOMM has noted that, as with the global (basin-scale) module of GOOS, the specification of techniques and protocols for observations, data management and products should be demonstrated by pilot projects. Such projects might be carried out independently by the GRAs or jointly with JCOMM.

118       In December 2006, the Scientific Steering Committee for GEOHAB opened a dialogue with the GOOS Regional Alliances to address the inclusion of, and approach to, observation systems for HABs and the occurrence of HAB species in the regional components of GOOS. GOOS has a national reporting template that is used in preparation for the meetings of the Intergovernmental Panel for GOOS (I-GOOS). The reporting template for I-GOOS-VIII was added questions on HAB observations. The survey will provide the information needed to table the inclusion of HAB observations at the moment, as well as the wish in the regions to do so onwards. These GRA's are those where interaction with the GEOHAB SSC and IPHAB is relevant.

119       **The Panel noted** that the GOOS Scientific Steering Committee (GSSC) has proposed a pilot project involving automatically detected chlorophyll (an estimate of phytoplankton biomass) through *in situ* measurements and remote sensing, which, potentially, offers a framework for a pilot project on observations of HABs and HAB species harmful algal in the context of GOOS. However, the Panel pointed at that a global HAB observation and prediction system should consist of relatively small regional systems where end users benefit from the results. Systems for HAB-observations and predictions may thus be different in different regions, but should be part of a global system for dissemination of information on natural ocean hazards.

120       **Recognising** that different HAB-species and environmental conditions require specific observation systems and predictive models, there are however, certain elements which are considered to be essential for HAB observation and prediction. The number of elements may vary due to the species and the area. See Table 1.

121       **Furthermore the Panel recommended** compilation of a list of HAB species that fit the following criteria:



- 122 Species for which there are environmental indicators that can be used to issue alerts as to where and when a harmful event is likely to occur; a description of the environmental indicator(s) and observational requirements (time-space resolution, accuracy) should be included.
- (i) Species that can currently be detected through use of remote sensing (from satellites or aircraft) with *in situ* sampling and measurements for validation and calibration;
  - (ii) Species that can only be detected through *in situ* sensing (e.g., instrumented buoys, optical sensors, traditional microscopy, etc.) in near-real time; indicate those where automated, *in situ* sensing technologies are well developed.
- 123 **The Panel envisaged** that the ultimate goal should be Harmful Algal Bloom Observation and Prediction Systems consisting of coordinated networks of regional systems. To achieve this goal the following plan was accepted as the first steps:
- (a) To identify areas where most or all of the elements are present
  - (b) To identify which HAB species can be observed using automated techniques
  - (c) To start the process of sharing HAB data in near real time using existing data management systems. A first step is to share quality controlled chlorophyll data, an estimate of total phytoplankton biomass.
- 124 The new technologies and advances in science made possible by GEOHAB and other national and international programmes should be used to improve operational capabilities of GOOS.
- 125 The Panel was introduced to the IOC Global Tsunami and other Ocean-related Hazards Early Warning System (GOHWMS) by the Secretariat (U. Wolf). GOHWMS is defined around the early warning and mitigation of coastal inundation created by oceanic phenomena such as tsunamis, storm surges, strong swells and climate change driven sea-level rise. This choice is based on the view that inundation is a major hazard facing coastal communities and accounts for the increasing pressure (environmental and human) to which coastal areas are subjected. It also accounts for the fact that the sustainable development of coastal communities appears among the Millennium Objectives. Such a definition of GOHWMS is to be considered as a first step towards a more comprehensive system covering other ocean-related risks such as harmful algal blooms.
- 126 **The Panel responded** to the presentation by raising a number of questions related to whether or not it was the role and wish of IPHAB to engage in operational warning systems. The Panel discussed how such an operational warning system might work for HABs and HAB species
- 127 **The Panel noted** that the geographical area for which HAB warnings are given is typically relatively small and that high-data resolution is required. It is not easy to see how such a regional system would be integrated in to a global network. It was also noted that the diversity of HABs and HAB species has to be recognised and that any models used to predict occurrence are likely to be both species and region specific.
- 128 **The Panel concluded** that it could advice on guidelines for the geographical scale for HAB warnings, but in the near future could not see how it could underpin an operational system because forecast models are limited and operational instrumented moorings for detecting HABs and HAB species are judged to be at least five years away. The Panel agreed to follow GOHWMS developments and continue to consider how it can interact with GOHWMS.
- 129 **The Panel adopted** [Resolution IPHAB-VIII.2.](#)

**Table 1.** Elements for HAB observation and prediction systems.

<i>The systems elements</i>	
	1. Regional information dissemination systems
	2. Near real time identification and estimates of abundance of HAB-species in water samples using:
	a. Microscopy
	b. Molecular biological techniques
	c. Optical techniques etc.
	3. Automatic <i>in situ</i> systems for HAB-observation
	a. Instrumented buoys
	b. Ferrybox systems
	c. Automated Underwater Vehicles etc.
	4. Remote sensing
	a. Satellite
	b. Air etc.
	5. Predictive models
	a. Transport
	b. HAB-species population dynamics
	6. Volunteer observations – public outreach
	7. Systems for sharing of data in near-real time
	a. The IOC International Oceanographic Data and Information Exchange (IODE) may play a role in defining standards for data formats
	b. The JCOMM Data Management Programme Area may play a role in defining standards for data formats to meet near real time information exchange requirements, and to ensure interoperability between the IOC's International Oceanographic Data and Information Exchange (IODE) and the WMO Information System (initially the GTS) to provide highly reliable delivery of time-critical data and products.

## 6. HAB PROGRAMME WORK PLAN 2008–2009

130       **The Panel summarized** the priorities and needs for the next intersessional period and recommended a work plan for the period 2008–2009 as indicated in [Annex II](#) hereto. **The Panel adopted** [Recommendation IPHAB-VIII.1](#).

## 7. OPERATION OF THE IOC INTERGOVERNMENTAL PANEL ON HAB

131       **The Panel recalled** the definition of its purpose by the Sixth Session which included initiating and monitoring an improved dialogue on harmful algal events between the scientific community and the user community. The role of IPHAB is therefore to serve as a mechanism to aid national governments to more effectively protect human health and ensure the sustainable development of aquaculture and fisheries through regional and international cooperation.

132       The Mission of IOC HAB Programme is:

- To initiate new and strengthen existing regional and international HAB programmes that can guide and help national governments to improve understanding of, and procedures for managing HAB events, through enhanced

education and effective dialogue with producers, consumers, policy-makers, managers and the general public.

- To help plan and provide guidance on the implementation of regional and international activities such as workshops and inter-calibration exercises in order to harmonize and improve national management of HAB events.

133 Furthermore, **the Panel recalled** the need for a broad perspective when harmful algal blooms, harmful algal species and their effects. There are important social science considerations and as such it was recognised that both natural and social sciences need to be encompassed.

134 **The Panel regretted** that the expertise on the IPHAB is almost exclusively from natural sciences.

135 **The Panel recommended** the invitation of experts on social sciences to integrate into task teams, working groups or other activities that may need special input from social sciences.

136 Through a questionnaire, the Panel made a self assessment of its impact and future role. The results are summarized in [Annex XV](#) hereto. In conclusion, the impact of IPHAB activities at the national level is assessed as high whereas the formal recognition of the Panel is varied and needs to be strengthened. Amongst the Panel Members there was strong agreement that the Panel has a role to fulfil in the coming 5-10 years in relation to capacity enhancement, research and networking.

137 The IOC Executive Secretary, P. Bernal, in particular stressed the need to critically and routinely assess whether IPHAB is fulfilling its intergovernmental function; does IPHAB succeed in mobilizing governments? The importance of delivering services and products that help development and integrates with related issues such as coastal area management was recognised. Provision of guidance to politicians was also considered as crucial to intergovernmental recognition.

138 The IOC Executive Secretary further stressed that the Panel needs to be fully supported by FAO and WHO. He noted that IPHAB has made a significant contribution to science but how can this be better communicated and how can IPHAB assist and enhance GOOS and other science programmes? He stated that policy and budget decisions should be based on results — not planned or ongoing activities, but visible outputs. There is still time to re-cast the HAB programme in this new framework and he encouraged the Panel to sharpen the focus of the Programme.

139 **The Panel recognized** the particular challenge of effective communication and reaching the IOC Assembly Delegates within the short time available every 2<sup>nd</sup> year. This is particularly challenging in circumstances where the majority of delegates are from a governmental/administrative background or science background remote from HAB science.

140 IPHAB has demonstrated the value of coordination and IOC should continue to strengthen the HAB science and management community. D. Anderson (United States) asked the Panel to identify the major accomplishments of IPHAB and the IOC HAB programme, reasoning that this would provide valuable information that can be used to highlight the effectiveness of the programme to IOC Member States. The response is summarised in Table 2.

141 **The Panel adopted** [Resolution IPHAB-VIII.1](#) on 'Visualising the IPHAB Strategy for Assisting Member States in the Mitigation of Harmful Algal Events'

142 **The Panel recalled** the wish of the Seventh Session for a three and a half day session and **welcomed** that it had been followed.



- 143        **The Panel decided** to continue its intersessional activities under the co-ordination of the Chair. L. Guzman (Chile) was elected Chairman, and P. Busby (New Zealand) was re-elected Vice-Chairman.
- 144        **The Panel and the Secretariat expressed their gratitude** to B. Reguera and P. Busby for their wise and competent chairing of the Panel.
- 145        **The Panel stressed the importance** of the attendance of the Chairs of regional IOC HAB groups at IPHAB sessions, **and urged** the Secretariat to ensure this for the Ninth Session of the Panel.
- 146        **The Panel recommended** that the Eighth Session be announced to Member States no less than 12 months in advance.
- 147        **The Panel adopted** [Recommendation IPHAB-VIII.2](#). **The Panel requested** the Chair to present an Executive Summary, Resolutions and Recommendations to the Twenty-fourth Session of the IOC Assembly in June 2007.

**Table 2:**

#### **Major Accomplishments**

- Expertise has been provided to developing countries –networking.
- Capacity building for shellfish safety.
- Training for capacity building in taxonomy, toxin chemistry.
- Regional groups have been established, share similar problems (network)
- Exchange experiences; learn about what is happening elsewhere.
- Involvement and leadership in addressing issues that WHO and FAO asked CODEX to address. Co-Chair of IPHAB was made chair of the Expert Panel.
- Assistance in creation and guidance of programs – GEOHAB, GOOS, etc.
- Harmful Algae News – very useful, tremendous outreach
- Set up task forces, groups of experts - a critical function of the IOC HAB programme
- Established Science and Communication Centres in Copenhagen and Vigo – extremely effective in outreach, training and communication.
- At these courses, participants meet established and beginning scientists and establish networks.
- IOC HAB Manual – very popular, best seller.

#### **Possible Improvements**

- Create and disseminate roster of experts. Issues: how to select them, how to structure an emergency response mission.
- Communication and public awareness of IPHAB's role in CODEX, etc. This was a big accomplishment – but it is not well known.
- Improve communication to Assembly.
- Have not been able to make the HAB program sustainable in time – budget could disappear tomorrow.

.../...

#### **Possible Improvements (cont'd)**

- Each of us in our countries needs to convince our IOC delegation to support the HAB Programme.

- Craft a succinct and hard-hitting strategic plan - a piece that expands on our mission and describes priorities for science, for capacity building, for communication. This is a structure on which you could hang your accomplishments. Identify deliverables and demonstrate a track record.

## ANNEX I

### AGENDA WITH ANNOTATIONS

#### 1. OPENING

- 1.1 OBJECTIVES OF THE INTERGOVERNMENTAL PANEL ON HARMFUL ALGAL BLOOMS. DECISIONS TAKEN BY THE IOC ASSEMBLY

#### 2. ADMINISTRATIVE ARRANGEMENTS

- 2.1 ADOPTION OF THE AGENDA
- 2.2 DESIGNATION OF RAPPORTEUR

#### 3. SUMMARY DESCRIPTION OF THE IOC HARMFUL ALGAL BLOOM PROGRAMME

#### 4. HABP DEVELOPMENTS IN THE INTERSESSIONAL PERIOD:

- 4.1 CHAIR IPHAB AND TECHNICAL SECRETARY'S SUMMARY REPORT on activities and implementation of IPHAB-VII decisions

#### 5. NATIONAL STATEMENTS

Panel Members will report on their **national priorities** for international cooperation on HAB. The National Statements will be summarized by the IPHAB Chair and Vice-chair into an overview of national priorities 2008–2009.

#### 6. MAJOR ISSUES REQUIRING INTERGOVERNMENTAL COOPERATION

(INCLUDING INTERACTION WITH OTHER PROGRAMMES AND ORGANIZATIONS)

The aim is to stimulate efforts at the regional level in HAB science and management, and coordination between the HAB community and other communities (e.g. GOOS, ICAM, coastal managers, and users etc). This agenda item will be organized as a series of Panels:

**Panel 1. Capacity Building:** based on the strategic plan for capacity building adopted by the seventh session of the Panel, assess progress and actions to be taken to its further implementation; chaired by Allan Cembella.

**Panel 2. The GEOHAB Research Programme:** Assessment of advances in GEOHAB implementation and identification of IPHAB assistance required in implementation; Chaired by Robin Raine.

**Panel 3. Biotoxin Regulation:** Identification of priorities 2007-2009 for the IPHAB Task Team on Biotoxins Regulation. This will be based on a review of the inter-sessional activities of the IPHAB Task Team on Biotoxins. Chaired by Phil Busby.

**Panel 4. HAB Databases:** Status and priorities 2008-2013 for HAB related data and meta databases including HAE-DAT, MON-DAT, HAB-DIR and the IOC Reference List of Toxic Microalgae. Included herein how to strengthen regional ownership in these databases where relevant and assessment of interaction and cooperation between the IPHAB Task Team on Taxonomy and HAE-DAT with the ISSHA HAB-MAP initiative. Discussion of strategy for cooperation and integration with products of the International Ocean Data Exchange programme of IOC, IODE. Chaired by Beatriz Reguera.

**Panel 5. Formulation/endorsement of specific objectives for regional activities:**

Strengthening of regional HAB Programme components through formulation and endorsement of specific objectives for regional activities based on input from regional HAB Working Groups (ANCA, FANSA, HANA, WESTPAC). Chaired by Beatriz Reguera and regional chairs.

**Panel 6. HAB observations and their potential for inclusion in GOOS Regional Alliances.** Chaired by Bengt Karlson.

**Panel 7. Operation of the HAB Programme, role of the IPHAB and its future mission:**

Brain storm session. Staff and extra-budgetary resources are crucial to focused development and implementation of the Programme. Member States are urged to consider financial support to, or secondment of staff, to the HAB Programme. Chaired by Donald M. Anderson and Beatriz Reguera.

**7 OTHER RELEVANT ITEMS**

The Panel will discuss any other proposal for activities.

**8 RECOMMENDATIONS OF THE IPHAB, OVERVIEW OF RESOURCES AND NEEDS — WORKPLAN 2008–2009**

**9 OPERATION OF THE IPHAB**

**10 ELECTION OF CHAIR AND VICE-CHAIR**

**11 ANY OTHER BUSINESS**

**12 ADOPTION OF EXECUTIVE SUMMARY AND RESOLUTIONS /RECOMMENDATIONS**

**13 CLOSURE**

## ANNEX II

### ADOPTED RESOLUTIONS AND RECOMMENDATIONS

<u>Code</u>	<u>Title</u>
Resolutions	
<b>Resolution IPHAB-VIII.1</b>	Visualising the IPHAB Strategy for Assisting Member States in the Mitigation of Harmful Algal Events
<b>Resolution IPHAB-VIII.2</b>	Implementation of HAB Monitoring within the Global Ocean Observing System
<b>Resolution IPHAB-VIII.3</b>	Task Team on Biotoxin Monitoring, Management and Regulations
<b>Resolution IPHAB-VIII.4</b>	Regional HABP Development
<b>Resolution IPHAB-VIII.5</b>	Development of a Harmful Algal Information System
<b>Resolution IPHAB-VIII.6</b>	Task Team on Algal Taxonomy
Recommendations	
<b>Recommendation IPHAB-VIII.1</b>	HABP Work Plan 2008–2009
<b>Recommendation IPHAB-VIII.2</b>	Operation of the IOC Intergovernmental Panel on Harmful Algal Blooms

Resolution IPHAB-VIII.1

**VISUALISING THE IPHAB STRATEGY FOR ASSISTING MEMBER STATES  
IN THE MITIGATION OF HARMFUL ALGAL EVENTS**

The IOC Intergovernmental Panel on Harmful Algal Blooms,

**Recalling** IOC Executive Council Resolution EC-XXXIX.1, on the IOC Draft Medium-Term Strategy 2008–2013,

**Noting in particular** the High-Level Objectives and Associated Activities:

1. Prevention and reduction of the impacts of natural hazards
3. Safeguarding the health of ocean ecosystems
4. Management procedures and policies leading to the sustainability of coastal and ocean environment and resources,

**Recognising** the advice relative to IPHAB provided by the Advisory Group for the IOC Ocean Science Section, November 2005, in particular the need to develop linkages with other initiatives such as those addressing nutrients, climate change and coastal zone management,

**Reiterates** that meaningful development and implementation of the IOC HAB Programme has to be with appropriate linkages and cooperation with the other activities of the Commission as well as cooperation with other organisations as required by the context;

**Recalling** the priorities set out in the HAB Programme Plan (Document IPHAB-VIII-3 Annex V),

**Recognizing** the need to raise the visibility and impact of IPHAB at national governmental level and among other UN agencies,

**Decides** to develop a strategy document within the context of the IOC Medium-Term Plan for 2008–2013, identifying the deliverables of IPHAB to governments. The document will have a format that will facilitate communicating the accomplishments and future plans of the IPHAB to higher-level managers and politicians, and highlight the benefits of participating in and financially supporting it. The strategy document should address:

- Focus areas including economic and social justifications
- Priorities
- Deliverables
- Metrics of impact assessment
- Implementation schedules
- Identification of stakeholders

**Notes** that the above analysis should be retrospective as well as prospective —i.e. looking from the beginning of the programme and towards future needs;

**Decides** to establish a Task Team on Strategy to:

- (i) work by correspondence to assist the IOC Secretariat in the preparation of the document
- (ii) circulate (within 6 months) a draft document and a dissemination plan to the IPHAB for review
- (iii) finalize (within 8 months) the document;

**Decides** that the Task Team that will consist of R. Magnien (United States) as Chair, L. Guzman (Chile), P. Busby (New Zealand). The Chair may establish the membership of the Task Team as required addressing the Terms of Reference.

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Financial implication: 5,000 USD for design, printing and distribution.

Resolution IPHAB-VIII.2

**IMPLEMENTATION OF HAB MONITORING  
WITHIN THE GLOBAL OCEAN OBSERVING SYSTEM**

The IOC Intergovernmental Panel on Harmful Algal Blooms,

**Recalling** Recommendation IPHAB-VIII.1 on 'Implementation of HAB Monitoring Within the Global Ocean Observing System',

**Recognizing** the need to maximise the operational effectiveness of regulatory monitoring of Toxin Producing Algae (TPA) and harmful algal blooms (HAB) species to protect human health and for cost effective fish and shellfish production,

**Noting with appreciation** the dialogue between IPHAB and GEOHAB and the Scientific Steering Committee of the Global Ocean Observing System (GSSC),

**Noting** that three of the six societal goals of GOOS are to provide data and information needed to manage public health risks, restore and protect healthy marine and estuarine ecosystems, and sustain living marine resources,

**Recognising** that the incorporation of rapid detection and timely predictions of TPA and HABs and their impacts is a high priority,

**Recognising** the need to incorporate data on TPA and HABs into regional observation and early warning/forecasting systems,

**Envisaging** that the ultimate goal should be Harmful Algal Bloom Observation and Prediction Systems consisting of coordinated networks of regional systems,

**Recognising** that different HAB-species and conditions require specific observation systems and predictive models, that several elements are essential for HAB observation and prediction systems, and that the number of elements may vary depending on the species and the area,

**Noting** that although it is realised that the regional pilot projects initiated by GOOS should be focused on developing areas, it was felt that a project that utilises areas where the above elements are present or in development should be given highest priority, as success is most likely. These areas would then be used for training and development of joint initiatives in other regions,

**Recommends** that the GSSC, in collaboration with IPHAB, work with GOOS Regional Alliances to include monitoring and prediction of HABs in their operational programmes;

**Instructs** the Scientific Steering Committee of GEOHAB to:

- (i) collaborate with the GSSC in the development of joint GEOHAB-GOOS pilot projects with the goal of establishing operational HAB observing systems regionally (as a first

step, this may be done under the umbrella of the GOOS chlorophyll pilot project, ChlorOGIN)

- (ii) establish an inventory at the GEOHAB web site of 'show cases' where integrated HAB observation systems are operational and linked to GOOS Regional Alliances (GRA) – Regional Operational Observing Systems (ROOS);

**Requests** ICES to modify the Terms of Reference for the ICES/IOC Working Group on Harmful Algal Bloom Dynamics (WGHABD) to take on the following terms of references:

- (i) Identify the requirements for observing specific TPA and HAB species
- (ii) Use information from (i) above together with knowledge of bloom dynamics and existing modelling capabilities to identify:
  - regional locations where the first HAB observation and forecasting systems should be implemented
  - the observational and infrastructural components required to achieve these capabilities;

**Decides** to establish an IPHAB Task Team on HAB Observations and Forecasting Systems with terms of reference to:

- (i) Act as the focal and coordination point of the IPHAB regarding interaction with GOOS, the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), and the IOC Global Tsunami and other Ocean-related Hazards Early Warning System (GOHWMS) with respect to HAB observations, forecasting and warning systems
- (ii) Ensure coordination of the interaction on specific activities of the GEOHAB SSC and ICES-IOC WGHABD with GOOS
- (iii) Keep informed, and seek input from, the regional IOC HAB networks in relation to development within GOOS and its GRA's of HAB observation, forecasting and warning systems;

**Decides also** that the Task Team will be composed by B. Karlson (Sweden) as Chair, the Chair GEOHAB SSC, and P. Gentien (France). The Task Team may be expanded as required to fulfil the Terms of Reference;

**Invites** the GSSC to either i) establish a HAB Task Team to work jointly with the IPHAB Task Team and the GEOHAB SSC to achieve the goal of establishing operational HAB observing systems regionally, or ii) identify GSSC members for a Joint IPHAB-GSSC Task Team on HAB Observations and Forecasting Systems;

**Notes** that the Task Team will work until otherwise decided by the Panel and that it will work by correspondence and/or meet on an opportunistic basis, and will provide a progress report including a work plan for the intersessional period to the Chair IPHAB prior to IPHAB-IX.

### Resolution IPHAB-VIII .3

#### **TASK TEAM ON BIOTOXIN MONITORING, MANAGEMENT AND REGULATIONS**

The IOC Intergovernmental Panel on Harmful Algal Blooms,

**Recalling** Resolution IPHAB-VII.2 concerning compatibility of regulations on aquatic biotoxins,



**Acknowledges** the result of the IPHAB-VII Task Team on Biotoxin Regulations as a result of its merger with the Joint FAO/IOC/WHO ad hoc Expert Consultation on Biotoxins in Bivalve Molluscs;

**Acknowledges also** the continued existence of various groups which address the scientific aspects of methodology and legislation with regards to the contamination of seafood with phycotoxins, and that each group generates valuable scientific information that may be used to recommend on regional or national policies [such as those of the Asia Pacific Economic Cooperation (APEC), EU National Reference Laboratories, CEN, AOAC];

**Notes** with concern that there is limited coordination and exchange of information among these groups;

**Notes** with concern the potential incompatibility of regulations and the associated impediments to trade in seafood products;

**Notes** with concern that the Report of the Joint FAO/IOC/WHO ad hoc Expert Consultation on Biotoxins in Bivalve Molluscs has not been finalised for publication;

**Requests** the assistance of the IOC Secretariat and the IOC Assembly to strengthen the formal relationship between IPHAB and FAO and between IPHAB and WHO;

**Decides** to continue the Task Team with the following Terms of Reference:

- (i) identify incompatibilities in biotoxin standards between various markets;
- (ii) take initiative to expand the participation in the Task Team eg EC, USFDA, the Working Group Chairs from the Joint FAO/IOC/WHO ad hoc Expert Consultation on Biotoxins in Bivalve Molluscs and relevant experts to address the tasks, in particular:
  - a. promote the inclusion of the recommendations contained in the Report of the Joint FAO/IOC/WHO ad hoc Expert Consultation on Biotoxins in Bivalve Molluscs into the CODEX Committee on Fish and Fishery Products Standard and Code of Practice for Bivalve Molluscs;
  - b. in cooperation with the Joint FAO/IOC/WHO Executive, complete the background papers to the Summary Report of the Joint FAO/IOC/WHO Expert Consultation in preparation for publication. The background papers will address:
    - the chronic effects of consuming bivalve molluscs containing biotoxins;
    - the effect and subsequent regulatory controls of consuming bivalve molluscs containing more than one toxin group now that parent toxins and their metabolites can be readily identified using chemical test methods;
    - the toxicological assessment of metabolites of existing biotoxins and potential new toxins in accordance with the OECD Guideline;
    - a guideline on the validation on new methods of analysis for routine testing and for screening;
    - the availability of certified reference materials;
    - the availability of guidelines on biotoxin monitoring and management;
    - the validation of Oshima's saxitoxin toxicity conversions factors;
    - the determination of Toxic Equivalent Factors (TEFs) for toxin analogues to facilitate the replacement of mouse bioassay methods;

**Decides** that the Task Team will be chaired by Phil Busby (New Zealand). The Chair may establish the membership of the Task Team as required to address the Terms of Reference;

**Encourages** the relevant organizations to invite the IPHAB Task Team to participate as observer at the principal meetings of their respective groups in order to facilitate international compatibility of applied methodology and legislation with respect to phycotoxins;

**Notes** that the Task Team is established until otherwise decided by the Panel, and that it will work by correspondence and/or meet on an opportunistic basis, and provide a progress reports for the inter-sessional period to the Chair IPHAB prior to IPHAB-IX.

#### Resolution IPHAB-VIII.4

### **REGIONAL HABP DEVELOPMENT**

The IOC Intergovernmental Panel on Harmful Algal Blooms,

**Recalling** the priority of the implementation of IOC programmes at the regional level,

**Noting with appreciation** the reports of the regional activities within WESTPAC/HAB, ANCA, FANSA, and HANA,

**Acknowledging** the initiative expressed by the countries in the Gulf region and via the Regional Organisation for the Protection of the Marine Environment (ROPME) for a regional network,

**Acknowledging** the initiative by Namibia and Madagascar to explore the interest for and feasibility of a regional network on HAB among Member States in the region in cooperation with the IOC and relevant regional organizations,

**Taking note** of the impediment to WESTPAC/HAB to make progress, in relation to the Term of Reference to establish WESTPAC/HAB as a network, due to uncertainty on how to identify members of the WESTPAC/HAB as well as the appropriate channels of communication,

**Requests** the assistance of the IOC Secretariat and the IOC Assembly to clarify the operation of WESTPAC/HAB within the combined framework of IPHAB and IOC/WESTPAC;

**Endorses** the proposed work plans of FANSA WESTPAC/HAB and HANA for 2008-2009 subject to availability of funding, and notes that the priorities of ANCA will be included in the work plan after ANCA-IV according to availability of resources;

**Decides** to assess the feasibility, and potential for cooperation with the relevant regional organisations, in the establishment of regional HAB networks in the Gulf and the Southern African regions with the view to:

- (i) Improve scientific knowledge of the physical, biogeochemical and physiological factors governing HABs in the regions
- (ii) Establish a data-base relative to the incidence of HABs in the region as a contribution to HAE-DAT
- (iii) Establish a directory of the personnel involved in HABs, their area of specialization and their level of expertise as a contribution to the HAB-DIR
- (iv) Compile an inventory of regional publications relevant to HABs
- (v) Promote the exchange of information through regular working groups, workshops and otherwise
- (vi) Promote capacity building for scientists and managers involved in HABs;

**Requests** that the regional Chairs maintain contact and coordinate activities when feasible and appropriate and ensure that activities for e.g. data bases use the same IOC formats;

**Urges** Member States to contribute resources to help implement the work plan of the regional networks and groups.

#### Resolution IPHAB-VIII.5

### **DEVELOPMENT OF A HARMFUL ALGAL INFORMATION SYSTEM**

The IOC Intergovernmental Panel on Harmful Algal Blooms,

**Recognizing** the benefits to policy administrators, managers of regulatory monitoring programmes and scientists of access to high quality data on current taxonomic names of harmful algae, the biogeography of harmful species and occurrence of harmful algal events, together with details of monitoring and management systems worldwide, directories of experts, and bibliography on harmful algae,

**Acknowledging** the value of the data and information products already developed by the IOC or by IOC and partners: IOC-ICES-PICES HAE-DAT, IOC Taxonomic Reference List of Toxic Plankton Algae; IOC-ICES MON-DAT, IOC-ISSHA HAB-MAP, IOC International Directory of Experts In Harmful Algae and Their Effects on Fisheries and Public Health; and the IOC Bibliographic HAB Data-base as a specialised section of the Aquatic Science and Fisheries Abstracts (ASFA),

**Noting with appreciation** Recommendation IODE-XIX.1 (A HARMFUL ALGAL EVENT INFORMATION SYSTEM) through which the IODE Committee endorses the IOC Harmful Algal Event Information System as a joint IPHAB-IODE activity,

**Noting** that there are elements within Encyclopaedia of Life (EOL) informatics, The International Census of Marine Microbes (ICoMM), and US Centers for Human Health and Ocean Sciences (COHH) as well as micro\*scope, MICROBIS - and therefore OBIS, that has potential for a close cooperation in the further development of these data products,

**Acknowledging** the development in information technology systems for the compilation, storage access and presentation of data and the need to apply this progress to IOC HAB data products,

**Decides**, with reference to the HAB Programme Plan (Annex V), to develop an integrated harmful algal information system building on the existing data products and developing these further in close cooperation with IODE and appropriate partners (e.g. JCOMM Data Management Programme Area);

**Decides** to establish a Joint IPHAB/IODE Task Team on the development of the Harmful Algal Information System to:

- (i) prepare, by December 2007, an inventory of available data and information as relevant to the proposed Harmful Algal Information System
- (ii) identify, by December 2007, stakeholders and benefits of, and potential partners in the proposed Harmful Algal Information System
- (iii) develop, by July 2008, and submit to the IPHAB Chair and IODE Co-Chairs, a detailed project proposal for the development of a Harmful Algal Information System, including detailed workplan, timeline and resource requirements
- (iv) guide and advice on the further development and implementation of the system

- (v) assist in identifying the resources required to develop the system;

**Instructs** the Chair IPHAB to solicit proposals for members from the Panel and identify suitable HAB experts to participate in the Joint IPHAB-IODE Task Team on the development of the Harmful Algal Information System;

**Invites** the IOC Committee on International Oceanographic Data and Information Exchange (IODE) to identify suitable experts as members of the Joint IPHAB/IODE Task Team on the development of the Harmful Algal Information System;

**Notes** that the Task Team will work by correspondence as much as possible, and until otherwise decided by the Panel and IODE.

#### Resolution IPHAB-VIII.6

### **TASK TEAM ON ALGAL TAXONOMY**

The IOC Intergovernmental Panel on Harmful Algal Blooms,

**Recognizing** the pivotal role of taxonomy in training, scientific and monitoring activities in the HAB programme,

**Acknowledging** the valuable sources for identification of harmful algae e.g. provided by the *IOC Manual on Harmful Marine Microalgae*, Hallegraeff, G. *et al.* (eds.), UNESCO 2004, *Identifying Marine Phytoplankton*, Tomas, C. R., (ed.) 1995, and *Manual on Aquatic Cyanobacteria*, Cronberg, G., and Annadotter, H. , ISSHA and IOC of UNESCO 2006,

**Recalling** the frequent change of names of many harmful algae,

**Noting** that frequent name changes is a source of confusion for ecologists, toxicologists, and those working regulatory monitoring,

**Recalling** the decisions of the previous Sessions of the Panel regarding the Task Team on Algal Taxonomy,

**Acknowledging** the progress of the Task Team and the Internet publication of the IOC Taxonomic Reference List of Toxic Plankton Algae,

**Decides**, with reference to the HAB Programme Plan, objective 6.2.2, ii (Annex V), to continue the Task Team on Algal Taxonomy with the following terms of reference:

- (i) actively interact in the development of and Harmful Algal Event Information System
- (ii) maintain, complete and update the list of toxic algal species in marine and brackish waters
- (iii) maintain, complete and update the information about the known occurrence of toxic strains of each species
- (iv) include illustrations showing diagnostic features of each species or reference to such illustrations or links to such illustrations
- (v) include a description of each species or a link to such a description
- (vi) provide the Reference List with a short section on application of the botanical and zoological codes of nomenclature to microalgal taxonomy;

**Decides also** that the Task Team will be chaired by Ø. Moestrup (Denmark), Y. Halim (Egypt), M. Elbraechter (Germany), A. Zingone (Italy), M. Faust (USA), S. Fraga (Spain), J. Larsen (Denmark), G. Cronberg (Sweden), G. Hansen (Denmark), N. Lundholm (Denmark). The Task Team may be expanded as required to fulfil the Terms of Reference;

**Notes** that the Task Team will continue its work until otherwise decided by the Panel, and that it will work by correspondence and/or meet on an opportunistic basis, as for example during the XIII<sup>th</sup> International Conference on Harmful Algae, Hong Kong 2008, and provide a progress report including a work plan for the inter-sessional period to the Chair IPHAB prior to IPHAB-IX.

#### Recommendation IPHAB-VIII.1

#### **HABP WORKPLAN 2008–2009**

The IOC Intergovernmental Panel on Harmful Algal Blooms,

**Referring** to the deliberations of its Eighth Session and the priorities identified prior to the session by ANCA, FANSA, HANA, and WESTPAC/HAB,

**Endorses** the implementation of the Work Plan for the IOC Harmful Algal Bloom Programme as presented in Annex 1 (*next page*) to this Recommendation within the resources available;

**Urges** Members of the Panel and the IOC Secretariat to identify the required resources.

#### Recommendation IPHAB-VIII.2

#### **OPERATION OF THE IOC INTERGOVERNMENTAL PANEL ON HARMFUL ALGAL BLOOMS**

The IOC Intergovernmental Panel on Harmful Algal Blooms,

**Recommends** that the IOC Intergovernmental Panel on Harmful Algal Blooms continue until otherwise decided by the IOC. The Terms of Reference should remain unchanged.

**Annex 1 to Recommendation IPHAB-VIII.1**

IOC HAB PROGRAMME WORKPLAN 2008–2009  
(Activities and funding identified as of 1 May 2007 only)

SCC HA = IOC Science and Communication Centres on Harmful Algae; HQ = IOC-UNESCO Headquarters Paris; in 1000 USD

ACTIVITY	ORGANIZER/ RESPONSIBLE	TARGET GROUP/ Region	WHERE	WHEN	FUNDING IDENTIFIED		FUNDING REQUIRED TOTAL	AUTHORITY & REMARKS
					IOC	Ex Bud		
OPERATION & SERVICES								
IOC SCC HA & HAB Programme Office	IOC/H.Enevoldsen	Global	Copenhagen	2008- 2009	0	IOC TF/ pending	2 x 10 K and in kind	IPHAB-VIII
IOC SCC HA	IOC/M. Lion	Latin America & North Africa	Vigo	2008- 2009	0	2 x 7 K IOC TF/Spain and in kind	2 x 7 K and in kind	IPHAB-VIII
PUBLICATIONS								
HAB Programme Strategic document	IOC	Global	HQ / SCC HA	2008	0	pending	5 K	IPHAB-VIII
Harmful Algae News	T. Wyatt (Spain), Editor	Global	HQ / SCC HA	2008- 2009	2 x 2 K		2 x 2 K	IPHAB-VIII
GEOHAB CRP Plan: HAB's in Stratified Systems	P. Gentien (France)	Global	HQ with SCOR	2008	3 K		3 K	IPHAB-VIII
GEOHAB CRP Plan: HAB's in Fjords and Coastal Embayments	A. Cembella (Germany)	Global	HQ with SCOR	2008	3 K		3 K	IPHAB-VIII

ACTIVITY	ORGANIZER/ RESPONSIBLE	TARGET GROUP/ Region	WHERE	WHEN	FUNDING IDENTIFIED		FUNDING REQUIRED TOTAL	AUTHORITY & REMARKS
					IOC	Ex Bud		
IOC Manuals and Guides: Manual on Plankton Analysis	B. Karlson (Sweden)	Global	HQ, possibly with ICES	2008		3 K	3 K	IPHAB-VIII
XIIth HAB Proceedings	Ø. Moestrup (Denmark)	Global		2007/08	0	17 K	20 K	IPHAB-VII
<b>CO-SPONSORSHIP OF CONFERENCES</b>								
XIIIth ICHA	ISSHA	Develop. Country.	Hong Kong	2008	0	5 K	Unknown	IPHAB-VIII
<b>TRAVEL</b>								
IOC Staff	H. Enevoldsen	-		Yearly	2 x 2 K	2 x 5 K	2 x 10 K	IPHAB-VIII
Chair IPHAB Travel	L. Guzman (Chile)	-		Yearly	2 x 2 K		2 x 2 K	IPHAB-VIII
<b>SCIENTIFIC ELEMENTS</b>								
GEOHAB SSC	IOC/SCOR	Global	-	-	2 x 20 K incl. publication	2 x 50 K via SCOR	2 x 120 K	Agreement with SCOR
ICES-IOC WGHABD	J. Silke (Ireland)	Develop. Country		Yearly	0		4 K	IPHAB-VIII
ICES/IOC/IMO WGBOSV	A. Jelmert (Norway)	Global		Yearly	0		4 K	IPHAB-VIII
ICES/IOC/SCOR WGGIB	M. Vitaasalu (Finland)	Baltic		2008	0			IPHAB-VIII
Harmful Algal Information System development	HABP-IODE	Global	-	2008-2009	0		25 K	IPHAB-VIII and IODE-XIX
<b>REGIONAL GROUPS</b>								
Regional Working Group on Harmful Algal Blooms in South America (IOC FANSA)	L. Guzman (Chile)	S-America	Argentina	2008	0	7 k	10 K	IPHAB-VIII

ACTIVITY	ORGANIZER/ RESPONSIBLE	TARGET GROUP/ Region	WHERE	WHEN	FUNDING IDENTIFIED		FUNDING REQUIRED TOTAL	AUTHORITY & REMARKS
					IOC	Ex Bud		
Regional Working Group on Harmful Algal Blooms in the Caribbean (IOC ANCA)	E. Mancera (Colombia)	Caribbean	To be decided	2009	0	7 K	10 K	IOCARIBE and IPHAB-VIII
Regional Group on Harmful Algal Blooms in the Western Pacific: WESTPAC-HAB	Y. Fukuyo (Japan)	WESTPAC	To be decided	To be decided	0			IPHAB-VIII and pending WESTPAC-7
Regional Working Group on Harmful Algal Blooms in North Africa (IOC HANA)	Y. Halim (Egypt)	North Africa	To be decided	2009	0	7 K	10 K	IPHAB-VIII
Regional Network for the Gulf Region	t.b.d. Possibly with ROPME	Gulf	To be decided	2008-2009	0		unknown	IPHAB-VIII
Regional Network for Southern Africa	t.b.d.	Southern Africa	To be decided	2008-2009	0		unknown	IPHAB-VIII
<b>CAPACITY ENHANCEMENT</b>								
IOC Training Course on Identification and Qualification in Harmful Marine Microalgae	IOC SCC HA CPH	Global, Develop. Country	University of Copenhagen, Denmark	2008 and 2009	0		2 x 50 K	IPHAB-VIII
IOC-IEO-AECI Training Courses	IOC SCC HA Vigo	Latin America, and North Africa Develop. Country	Instituto Español de Oceanografía, Vigo, Spain	Yearly	0	2 x 36 K IOC TF/Spain 2 x 10 K IEO	2 x 46 K	IPHAB-VIII



ACTIVITY	ORGANIZER/ RESPONSIBLE	TARGET GROUP/ Region	WHERE	WHEN	FUNDING IDENTIFIED		FUNDING REQUIRED TOTAL	AUTHORITY & REMARKS
					IOC	Ex Bud		
IOC Training Course on Qualitative and Quantitative Determination of Algal Toxins	A. Cembella/B. Luckas (Germany)	Global, Develop. Country	Germany, AWI	2008/ 2009	0	German partners and IOC TF	40 K	IPHAB-VIII
WESTPAC-HAB TTR Project	Y. Fukuyo (Japan)/ R. Azanza (Philippines)	WESTPAC	To be decided	Cont 2008/ 2009	0	2 x 17 K Japan FiT	2 x 42 K	WESTPAC and IPHAB-VIII
Regional Training Course on Taxonomy and Ecology of Harmful Marine Microalgae (E-learning)	t.b.d.	FANSA	Brazil	2008/ 2009	0		15 K	IPHAB-VIII
Regional Training courses on Present Official Shellfish Biotoxin Techniques	t.b.d.	FANSA	Chile		0		15 K	IPHAB-VIII
Intercalibration exercise of PSP determination (AOAC, 2000) between EU-CRL and the NRLs of the Region	t.b.d.	FANSA	In country	2008	0			IPHAB-VIII
Regional Training Course Identification and Quantification of Harmful Marine Microalgae	t.b.d.	ANCA	t.b.d.	2008/ 2009	0			IPHAB-VII and IOCARIBE
Reg. Training Course on HAB Monitoring and Management: toxin assessment	t.b.d.	ANCA	Mexico or Venezuela	2008/ 2009	0		30 K	IPHAB-VII and IOCARIBE

ACTIVITY	ORGANIZER/ RESPONSIBLE	TARGET GROUP/ Region	WHERE	WHEN	FUNDING IDENTIFIED		FUNDING REQUIRED TOTAL	AUTHORITY & REMARKS
					IOC	Ex Bud		
Regional Workshop: Socio-Economic impacts of HABs	t.b.d.	ANCA	ANCA	2008/ 2009	0			IPHAB-VII and IOCARIBE
Regional Training Workshop on HAB Monitoring and Management	IOC SSC HA/Anil	Indian Ocean	Tentatively India	2008 or 2009	0		30 K	IOCINDIO/ IPHAB-VII, pending confirmation by MS
INOC Training Course on Harmful Algal Blooms	INOC/S. Cirik, T. Koray	Mediterranean and Gulf Countries	Turkey	2008 or 2009	0		4 K requested from IOC to cover books and 1 lecturer from SCC HA	IPHAB-VIII

Identified funding (2008–2009):    US\$ 52,000 from IOC Regular Programme (2006–2007 level)  
     US\$ ~150,000 from expected extra-budgetary resources  
     US\$ ~500,000 to be identified from extra-budgetary resources herein funds for continuation of one P4 staff post

## ANNEX III

### NATIONAL STATEMENTS

#### A. CANADA

##### ***National Programs***

Fisheries and Oceans Canada, the Canadian Government Department that is responsible for Harmful Algal Bloom issues, has restructured its mandate to focus on a broad Ecosystem Management approach. The national priority is to link operational oceanography to the client needs. In this case the clients are Oceans and Habitat management and regulations and Fisheries and Aquaculture Management. The ultimate mandates of Fisheries and Oceans Canada are Sustainable Fisheries and Aquaculture and a Healthy and Productive Ecosystem. There are several programs that have been established to accomplish these mandates.

The Alien Invasive Species Strategy is led by Environment Canada and is intended to minimize the risk of aquatic invasive species in Canadian waters. This strategy will protect the Canadian environment, restore and maintain native species, and prevent new invasions of these harmful species. The Department of Fisheries and Oceans (DFO) will take strategic actions to minimize the risk of aquatic invasive species in Canada. Emphasis will be put on the prevention of new invasions and the mitigation of harmful established invaders. DFO is engaged in a partnership with 13 universities to develop a national research network to improve knowledge needed to prevent new invasions and control existing ones. Included in the Alien Invasive Species Strategy is the role of ship ballast water in the introduction of invasive species including harmful algae and toxic cysts. Ballast water exchange is an important issue in Canada with the high level of ship traffic in coastal regions. The introduction of alien and harmful species is of particular concern with the shellfish and finfish aquaculture industry. In the last two years, several risk assessments have been completed, particularly relating to ballast water exchange zones. Several projects with the Canadian Centre of Expertise for Aquatic Invasive Species involve ballast exchange and survival of phytoplankton species and cysts in transit with ballast water. A risk assessment for ports of high risk is being established.

Another program that is relevant to harmful algae blooms is the Ocean Action Plan II which is led by Fisheries and Oceans Canada. The Ocean Action Plan II is continuing a strategy for Integrated Management of whole regions or bays, combining science, management and multi-user groups to manage the ecosystem for sustainability for all users.

Internationally the GOOS programme is important to the future expansion of harmful algae research and monitoring in Canada. The government is actively seeking methods to utilize operational oceanography to meet the needs of the internal governmental departments and agencies and the needs of external groups such as Aquaculture and the Fishery. The Aquaculture Framework Agreement is a document combining the needs of the industry, with the needs of provincial and federal governments.

##### ***Research Projects***

Fisheries and Oceans Canada (DFO) has research programmes on harmful algae in most regions with several recent studies funded through the Aquaculture Collaborative Research and Development Program (ACRDP). This program is Industry driven and provides research and development toward the sustainability of Canadian Aquaculture. Additional HAB research is conducted at Universities and other government agencies including the Institute for Marine Biosciences (IMB) National Research Council and provincial departments.

There is an increasing interest in research that builds on remote sensing and satellite imagery. In British Columbia there are research projects that combine satellite detection of ocean temperature as well as phytoplankton blooms. These projects are focused on climate change and how increased temperatures in Canadian waters will change or increase the occurrence of harmful algae blooms. Eutrophication and upwelling areas related to climate change are also a concern. In the Atlantic Provinces and Quebec improved remote sensing and monitoring innovation are the primary research objectives. Satellite up-links for moored environmental instruments and ground-truthing of coastal satellite imagery are being investigated. The use of the FlowCam for *in situ* monitoring for harmful algae at aquaculture sites in New Brunswick and Newfoundland will be priorities in the next years.

Harmful algal bloom (HAB) research within the federal government is discussed through the national advisory group that was created in 1987 called the Phycotoxin Working Group (PWG). This group is comprised of a project leader from each of DFO's regions, a national representative from CFIA and a representative from the National Capital region. Included in the mandate for the PWG is the coordination of a Canadian Workshop on Harmful Marine Algae.

### ***HAB observations systems/monitoring***

Harmful algal bloom monitoring is conducted through several separate programs including the Atlantic Zonal Monitoring Program which is a program that focuses on transects that extend from coastal regions to open ocean. The Aquatic Invasive Species monitoring programs often include phytoplankton monitoring in their sampling protocols. The research mentioned previously also provides observations and monitoring at aquaculture sites. The Pacific coast does not however have a monitoring program due to recent retirements within the government. This is one reason why the remote satellite program is of extreme interest.

### ***Communications***

- A. Electronic – Phycotoxin mailing list. This bulletin board was initiated to deal with marine phycotoxins and HABs. This list was established in 1994 and has subscribers all over the world and is maintained by Don Richard (CFIA).
- B. Canadian Workshop on Harmful Marine Algae.

The 9<sup>th</sup> Canadian Workshop on Harmful Marine Algae was held in association with the Aquaculture Association of Canada 05 Conference in St. John's, Newfoundland and Labrador (July 2005). A technical report of the proceedings of the workshop is being compiled.

The 10<sup>th</sup> Canadian Workshop on Harmful Marine Algae will be held in Mont Joli, Quebec, May 9-11, 2007.

### ***Capacity***

Due to the retirement of several key harmful algae researchers and taxonomists there is a shortage of trained personnel in this area within the government as well as Universities. There is a realization that the coastal areas are particularly important with multi-user groups and there is a lack of environmental information in these areas.

## B. CHILE

The relevant results and the more important research and operational activities on harmful algal blooms (HABs) and marine toxins performed in Chile, considering the period March 2005 and March 2007, are presented. Although the synthesis is not exhaustive, the more important aspects developed during this lapse, are included.

Activities and status of HABs as well as PSP, DSP and ASP in the considered lapse are informed, also relevant results of conducted studies and monitoring activities during this period are reported.

Paralytic Shellfish Poison (PSP), Diarrhetic Shellfish Poison (DSP) and Amnesic Shellfish Poison (ASP) has persisted, being more frequent the first two, since ASP is rare, appears geographically localized, for short periods and not reaching the quarantine level and not been linked to human intoxications. Also the presence of the dinoflagellates *Alexandrium catenella*, *A. ostenfeldii*, *Dinophysis acuta*, *D. acuminata*, *Protoceratium reticulatum* and the diatoms *Pseudonitzschia australis* and *P. pseudodelicatissima* have been observed. But also new toxins have been detected, as pectenotoxins (PTX2) and yessotoxins (YTX), confirming okadaic acid (OA) and dinophysis toxin1 (DTX1), but DTX2 was not detected by using SPATT and HPLC-MS. In Northern Chile, in some bays of the Coquimbo region (IVth region), *D. acuminata* has recently been encountered as a PTX producer, but not linked to OA and DTX toxins. This result emphasizes the need of an assessments of DSP bioassays results since during 2005 DSP outbreaks associated to *D. acuminata* were reported in the Northern area of the country as the regions of Antofagasta (IIth region), Atacama (3rd region) and Coquimbo (4th region). *Alexandrium ostenfeldii*, a rare species in fjords and channels from southern Chile, has not been linked to marine toxins.

The more affected geographic area is the southernmost macro region of the country, involving Los Lagos (Xth), Aysén (XIth) and Magellan (XIIth) regions, encompassing from 42° to 55° S.L, which have been affected by PSP and DSP and occasionally by ASP. This fact has recently determined the establishment of an integrated monitoring programme encompassing the three regions, which started on March 2006, replacing local or regional, independent and diverse monitoring activities. The programme is under the responsibility of the Fisheries Undersecretary (SUBPESCA), conducted by the Institute for the Promotion of Fisheries and Aquaculture (IFOP) and in coordination with each of the three Regional Health Secretaries. The programme considers 151 fixed sampling stations, and includes marine toxins and harmful species periodical evaluations, qualitative and quantitative phytoplankton and chlorophyll estimations as well as hydrographic and meteorological information. In specific areas nutrients and zooplankton it is also collected.

The second PSP outbreak along the Southern area of Chiloé Island was detected during the Spring of 2006 (November) lasting about five to six weeks, causing difficulties to public health and strong effects to mytiliculture activities and principally to small independent fishermen. The mean PSP values reached 619 µg STX eq.100 g<sup>-1</sup>. This outbreak represented the Northern border of a large geographic *A. catenella* abundance increase associated to a PSP outbreak since October 2006 affecting the region of Aysén and the Magellan region. The highest PSP records were registered at the Aysén region with records as high as 5,358 µg STX eq.100 g<sup>-1</sup>; at the Magellan region mean PSP values in the Northern sector of this region were as high as 1,649 µg STX eq.100 g<sup>-1</sup>.

Results of studies initiated as a consequence of the expansion to the North of *A. catenella* associated to the PSP outbreak that occurred in the inner waters of Chiloé Island during 2002 are today available. The more relevant results are the following:

- a) Information technologies for early warning and training activities to environmental sentinels at Chiloé Island and an improvement of the ASP liquid chromatography technique;

- b) The design of a monitoring programme for Chiloé Island inner waters including sampling and analyses methodologies and standardized presentation of obtained information system were developed, also an administration model to support the HABs and marine toxins monitoring was designed, and a geographic information system (GIS) to present obtained results was developed. Also information on the physical effects on phytoplankton distribution and abundance was obtained from areas affected and non affected by *A. catenella* and PSP presence
- c) Polyclonal antibodies to recognize *A. catenella* cells as the basis to develop a kit to detect this harmful species are available; also facilities to culture and maintain harmful algae is available, constituting the Chilean centre for harmful microalgae.
- d) A gene data base of more than 12.000 sequences for *A. catenella* is available, principally related to cellular division, energy obtention, luminescence, photosynthesis, carbohydrates, amino acids, lipids and nucleotides metabolisms,
- e) A conceptual model to access harmful algal blooms events is available; a strong relationship between cobalt (component of B12 vitamin) and chlorophyll was observed; no evidences supporting the hypothesis between an increase of aquaculture activities and increment of HABs events were found.

The structure and organisation of Chilean institutions and the role of the Health regional Units, the National Fisheries Service and the Public Health Institute to assure shellfish quality for internal consumption and for exportations in relation to marine toxins, and new capabilities to increase shellfish safety were informed.

Among the issues requiring intergovernmental cooperation, the need on taxonomy abilities (traditional and emerging techniques), techniques for the detection of marine toxins techniques, HAB observation systems for research and monitoring are relevant. Also a strong interest to participate in research projects dealing with fjords and coastal embayments, is considered.

## C. CHINA

1. HAB issues requiring intergovernmental cooperation
2. Research
3. Monitoring system of HABsin China
4. Capacity building needs

### **Part 1 HAB issues requiring intergovernmental cooperation**

#### **Intergovernmental cooperation requirement**

Cosmopolitan occurring of HABs;  
Use for reference between different countries on HAB research;  
Conforming to one standard by intergovernmental cooperation;  
Decrease consumption for the same investigation or research.

### **Part 2, Research**

#### **Government's Administrative Support**

Chinese Government and officers attach importance to HABsin China and neighboring countries;  
Five-year-Plan for National Economic and Social Development ask to strengthen research into the prevention and control of red tides;  
The State Oceanic Administration has now listed the red tide management and disaster

mitigation as one of its focal tasks;

Under the unified planning of the Central Government, the coastal local governments have positively organized and carried out the work of red tide disaster prevention and mitigation.

### **Intensify Scientific Research**

China has made a great deal of explorations in the scientific research on red tide. Research has been conducted successively in the fields of ecological dynamics of red tide populations; process, genesis, decline and mechanism of red tide; interactions between algal species or the relationship with bacteria; red tide toxins; evaluation of eutrophication; technologies of monitoring, prediction and assessment of red tide; biological and chemical control methods ; ecological numerical simulation of the red tide, etc.

Now, the State has further increased input into the scientific research on red tide with modern molecular biology remote sensing, automatic survey methods to strengthen scientific research in red tide.

### **Intensifying the actions of monitoring and surveillance**

SOA has established tridimensional marine environmental monitoring system comprised of coastal station, buoy, ship, radar, aerial and satellite remote sensing related to marine hydrology, meteorology, water quality, biology, sediment and atmospheric environment.

The monitoring and surveillance scope of HABs has spread all over the sea areas such as culture and stock enhancement zone, estuarine area, sea areas adjacent to the major outlets for discharging sewage and marine recreational zone.

### **Promoting the actions of typical HABs demonstration sites**

There are 19 HABs monitoring and control zones and 16 ecological monitoring and control zones have bestrew the Chinese coastal areas and enhance the discovery of harmful algal blooms greatly.

Now we have initially established the red tide monitoring, warning and management demonstration system, taking emergency response measures and evaluation of red tide damages, promoting the coordinated development of the red tide prediction, forecast and disaster mitigation.

## **Part 3 Monitoring system of HABs in China**

### **1- Organization**

#### **State Oceanic Administration (SOA)**

##### **National Professional Centers**

National Marine Environmental Center (NMEMC)

National Marine Data and Information Service (NMDIS)

National Marine Environmental Forecast Center (NMEFC)

National Satellite Ocean Application Service (NSOAS)

##### **Regional centers**

North China Sea Branch of State Oceanic Administration (Qingdao)

East China Sea Branch of State Oceanic Administration (Shanghai)

South China Sea Branch of State Oceanic Administration (Guangzhou)

Coastal stations —13

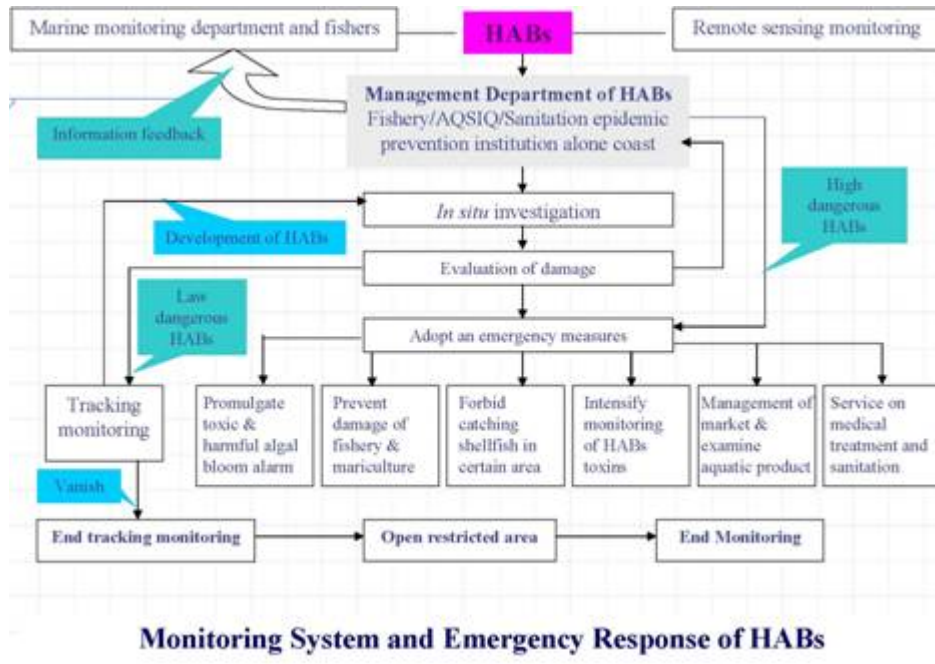
Coastal Laboratories —66

##### **Local Governments**

Province stations —11

Municipality stations —50

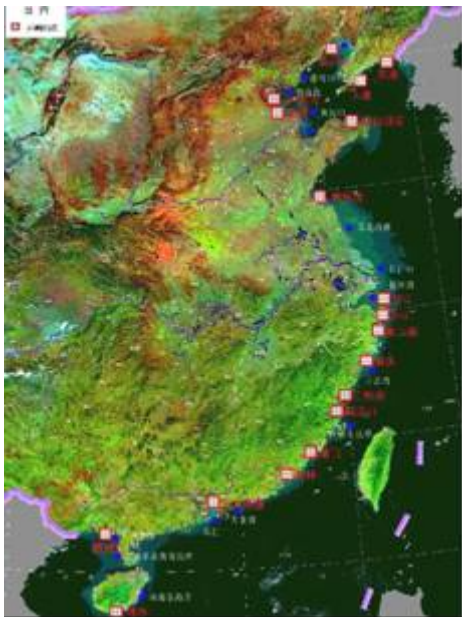
**Others:** Institutes\Scientists\volunteers



## 2- HABs monitoring & control zones

The national monitoring system on HABs started in 2002, 10 HABs monitoring zones have been set up. By now, there are 19 HABs monitoring and control zones and 16 ecological monitoring and control zones have bestrew the Chinese coastal areas and enhance the discovery of harmful algal blooms greatly.

HABs monitoring and control zones were selected mainly in: aquaculture areas, ecological protection areas, recreation resorts and HABs frequently occurrence areas, etc. Harmful algal blooms frequently occurring areas mainly concentrated at East China Sea and Bohai Sea.





### 3- Work Scheme for HABs Monitoring and Mitigation

#### Guidelines

Attach most importance to HABs monitoring, precaution and mitigation in HABs monitoring and control zones, work together for the prevention and control of HABs, issue the information of HABs disaster in time in order to decrease the risk furthest. Develop the monitoring of marine sediments quality and aquaculture species quality, estimate the edible risk of aquaculture species for the safety of people.

#### Goals and Tasks

Perfect the emergency respond system of HABs, discover and notify HABs in time, issue *Aquaculture Environmental Quality Report* termly.  
Develop the monitoring of marine sediments quality and aquaculture species quality termly based on the results of water quality monitoring.  
Develop the estimation of the edible risk of aquaculture species in order to advance the safety of aquatic products.

#### Contents

Monitoring in HABs monitoring & control zones  
HAB survey, monitoring and pre-warning in China  
Data transmission & information issuance

#### Monitoring in HABs monitoring & control zones

<b>Observational Data of Hydrology and Meteorology</b>
<b>Survey Data of Water Quality</b>
<b>Survey Data of HAB species</b>
<b>Survey Data of Shellfish Toxins</b>
<b>Main culture species\type\scale and disease</b>

#### Contents of Survey Data in HABs Monitoring & Control Zones

##### *HAB survey, monitoring and pre-warning in China*

HABs survey in entire sea areas  
Aviation and satellite remote sensing  
Voyage monitoring  
Coastal station survey  
Volunteer survey  
Emergency tracking monitoring for HABs  
Pre-warning and forecast for HABs

## Data transmission & information issuance

### ◆ Data transmission

#### ■ Monthly Report

HABs information	time, location, duration, scale, colour, distribution, causative species and their densities, toxins, etc.
Disaster information	economic damage, ecosystem impact and mitigating steps
HABs survey and monitoring	important areas, number of people who worked both along coast and at sea, amount of hydrographic and flight cruise

#### ■ Results of HABs monitoring and control zones

### ◆ information issuance

Monitoring results were estimated by NMEMC and conclude the aquaculture environmental qualities, and issued *Aquaculture Environmental Quality Reports* every half month. In addition, complied *Oceanic Special Reports* and delivered to SOA.

## Part 4 Capacity building needs

Develop the monitoring and emergency response system of HABs and enhance the capacity of HABs warning、forecasting and emergency response;  
Strengthen process of legislation and planning, perfect the HABs managerial system;  
Improve ecological circumstance, decrease and control the occurrence of HABs;  
Enhance the levels of research, develop new technologies for preventing and controlling HABs;  
Strengthen the public education and propagandize related knowledge on HABs;  
Promote international cooperation and exchange between intergovernmental and scientists on HAB.

## D. CROATIA

National monitoring program “Systematic Research of the Adriatic Sea as a Base for Sustainable Development of the Republic of Croatia” (Project JADRAN) includes the biggest part of the HAB research activities in Croatia. This interdisciplinary program includes a large number of physical, chemical, biological and fishery research activities, as well as regular meteorological and oceanographic measuring. The Program is initiated in 1998 and funded by the Government of Croatia through the Ministry of Science, Education and Sports.

Targeted investigations, related to toxic phytoplankton species and shellfish toxicity events are carried out through “National monitoring program of the shellfish toxicity on the Croatian breeding areas”. In the frame of this program, sampling of sea water and shellfish are performed fortnightly or, in case of positive results, once a week. This program initiated in 2000 and is funded by the Croatian Ministry of Agriculture, Forestry and Water management.

The problem of HAB is also addressed in the frame of international collaboration with Slovenia and Italy. Program «Harmful marine microalgae (HAB) in the Adriatic Sea: methodology, monitoring and mitigation of harmful blooms» is implemented jointly by Croatia and Slovenia. Through INTERREG IIIA program - project ADRIASAFE, Italy, Croatia, Albania and Montenegro are taking joint research of HAB problem and intercalibration of methodology. Intercalibration exercises have also been run through QUASIMEME.

Research activities focusing on harmful algal blooms problem in Croatia include a study examining the correlation between the presence of potentially toxic phytoplankton species in the water column and occurrence of shellfish toxicity, research on bloom dynamics and on the response of HAB species to climatic and environmental factors (eutrophication, etc). In the

research of HAB problem in Croatia special attention is given to taxonomic study of HAB species. During the last five years, a large number of scientific reports and scientific paper related to problem of HAB species and biotoxins has been published.

In the frame of national monitoring program “Project JADRAN”, Croatia develops observing system and data management system. Among the Adriatic countries, together with Italy and Slovenia, Croatia organizes CAOS (Coordinated Adriatic Observing System) whose main goals are:

- To Characterize The Status Of The Adriatic Sea In Terms Of Its Health (Habs, Hypoxia, Mucilage) And Living Marine Resources (Fisheries);
- To detect the role of ballast waters from ships in the introduction of invasive species, including harmful algae and toxic cysts, and to prevent the new invasions and mitigate the harmful influence of the established invaders;
- To Forecast And Mitigate The Effects Of Extreme Meteorological Events And Climate Change On The Adriatic Sea And Its Bays And Lagoons;
- To Detect And Predict Changes In Status As The Means To Protect And Restore Healthy Coastal Ecosystems And Sustain The Living Resources And The Economic Activities They Support;
- To Ensure Public Health And Safety.

In the frame of the “National monitoring program of the shellfish toxicity on the Croatian breeding areas” an environmental monitoring has been performed (including phytoplankton composition, toxic species, chlorophyll a, transparency, temperature, oxygen, pH and sanitary bacteriology) together with monitoring of phycotoxins in shellfish (PSP, DSP and ASP). Mouse bioassay is used for determination of PSP and DSP shellfish toxicity, whereas HPLC method is used to determine ASP toxicity. The majority of toxicity examinations is performed on mussels (*Mytilus galloprovincialis*) and minor part on *Pecten jacobaeus*.

At the last IPHAB IOC meeting (Paris, 2005) Croatia proposed the following priorities:

- *Provision of standards for shellfish toxins*
- *Participation in regional (international) inter-calibration of shellfish toxins identification*
- *Participation in regional (international) inter-calibration of identification of toxic species*
- *Participation in training courses for identification of shellfish toxins and toxic species*
- *Exchange of information on shellfish toxicity with the neighbouring countries*

The majority of listed priorities for 2005 is released through local and regional collaboration.

Newly proposed Croatian priorities are:

- *Education of new experts in monitoring activities trough continued training courses (taxonomic training and training for LC-MS biotoxins detection) with the goal of extending the HAB monitoring along the whole eastern Adriatic coast*
- *Implementation of Liquid Chromatography Mass Spectrometry (LC-MS) methods for the detection of shellfish toxins*
- *Adoption of CAOS program and stronger collaboration between all Adriatic countries and its strengthening on regional level.*

In 2006 laboratory accreditation for the identification and enumeration of toxin producing phytoplankton and the detection of shellfish toxins started in Croatia (in compliance with 91/492/EEC) under ISO 17025, with the goal of fulfilling the international shellfish export/import regulations. Institute of Oceanography and Fisheries is approaching the end of the accreditation procedure.

## E. DENMARK

Harmful algae in marine Danish waters fall into 3 categories: species causing DSP, fish-killing algae and cyanobacteria. PSP and ASP are uncommon (PSP occurs, however, in scallops in Greenland waters). DSP problems are encountered several times annually and regular monitoring has been in place for many years. Apart from fish kills caused by *Prymnesium*, which are fairly infrequent, the occurrence of fish-killing algae appears to be on the increase, and now hits regularly, mainly in spring. Whether this is a new phenomenon or the organisms were overlooked previously, is uncertain. Neither the causative organisms nor the toxins produced have been identified satisfactorily. Blooms caused by cyanobacteria (mainly *Nodularia*) occur mainly in warm summers, the algae being transported from the inner part of the Baltic and causing problems for tourism.

At the Dept of Phycology, University of Copenhagen, there is a tradition for and interest in algal taxonomy, and this interest was extended around 1980 to include harmful algae. The present report will concentrate on the situation at University of Copenhagen, where serious issues are now arising related to the research on harmful algae.

Since the 1980s, staff at the Dept of Phycology, from the 1990s including the IOC Centre for Harmful Algae, has been strongly involved in research and teaching on harmful algae. This activity culminated in the hosting of the XII International Conference on Harmful Algae in Copenhagen in September 2006, with ca 550 participants from 60 countries. The Proceedings of the conference are now underway, containing ca 100 manuscripts.

The teaching activities at the Dept of Phycology and the IOC Centre are continuing, and they develop very satisfactorily, with international courses on harmful algae being taught regularly both in and outside Denmark.

The research aspect, however, is approaching a serious situation. Due to lack of funding, part of the dinoflagellate research has had to stop, at least for the time being, as attempts to secure funding for Gert Hansen have failed. This is a serious situation, considering that Gert Hansen has become a leading international expert in both freshwater and marine dinoflagellate taxonomy, and loss of his expertise will be a major setback for dinoflagellate research. Further attempts will be made to secure funding for his research to continue.

We hope to be able to continue also the research on harmful diatoms. Nina Lundholm has contributed very significantly to research on *Pseudo-nitzschia* taxonomy, and she is a leading expert on this group of organisms. However, her financial situation is a source of concern due to the strained economy at the Biology Institute. Following prof. Hasle's retirement from the University of Oslo, Norway, no diatom experts are employed in permanent positions at universities in Scandinavia.

The IOC Centre and the research in harmful algae is a priority for the Dept of Phycology and we aim to maintain this activity, which we believe has contributed significantly internationally to the general knowledge and knowledge dissemination on harmful algae.

Priorities for cooperation within IPHAB:

- Capacity enhancement in research and management of HABs
- Cooperative research on HABs with developing countries
- Development of the Harmful Algal Event Information System

## F. GERMANY

### **Summary of Recent HAB Events**

During the period 2006-early 2007 no harmful algal events were reported from the North Sea or Wadden Sea coast of Germany, including waters adjacent to Helgoland, Bremen State, Lower Saxony and Schleswig-Holstein. The toxigenic gonyaulacoid species *Alexandrium tamarense*, *A. minutum* and *A. ostenfeldii* were recorded several times but never in “bloom” concentrations, i.e. always  $<1 \times 10^3$  cells  $L^{-1}$ . At the end of May 2006, a low magnitude bloom of *Phaeocystis* was recorded at the Wattenmeer Station (Sylt) as part of the long time-series on plankton; a second higher magnitude bloom of this species at the end of June was associated with a second annual peak in chlorophyll biomass ( $\sim 15 \mu g L^{-1}$ ) and a nutrient (nitrate) minimum. Only low concentrations of the DSP-toxin producers, *Dinophysis acuminata*, *D. acuta* and *D. norvegica* were found in routine monitoring of the coastal North Sea waters. In particular, *D. acuminata* was observed from early May to the beginning of July and from late August to the end of September from the Wadden Sea coast. The related (probably non-toxic) species *D. rotundata* was found from the end of May until early July from the same station. The taxon originally attributed to the raphidophyte “*Chattonella verruculosa*”, but now recognized as a member of the Dictyophyceae, was noted episodically at non-bloom conditions in the coastal waters of Schleswig-Holstein. No major harmful events were associated with the typical appearance of cyanobacterial blooms on the German Baltic coast including, transitional waters. Transient beach-fouling, an inconvenience to bathers, did occur along the margins of Mecklenburg-Western Pomerania in 2006.

### **HAB Issues requiring intergovernmental cooperation**

German coastal waters are only minimally affected by HAB events that directly impact upon fisheries and aquaculture production. Nevertheless, as a member of the EU and a significant global importer of seafood for domestic consumption and processing, intergovernmental cooperation in seafood safety control and regulations related to phycotoxins is a major concern.

HAB events in German coastal waters are most often associated with biofouling and other noxious consequences of high biomass noxious algal blooms (e.g. of cyanobacteria [blue-green algae] or gelatinous prymnesiophytes) on beaches that support recreation and the tourist industry. Since some of these high biomass blooms have been attributed to nutrient enrichment (eutrophication) or shifts in nutrient input ratios in north European coastal waters, intergovernmental cooperation in the North Sea and Baltic regions would facilitate better coastal zone management and water-quality practices.

As a leading exporting nation, Germany is heavily dependent upon the efficient operation of its ports and container terminals. The risk of transfer of invasive species, including those of harmful algae, via discharge of ballast water and cleaning of ballast tanks is now being addressed at a high international level (IMO). Germany has played a major role in the development of criteria for risk-assessment and mitigation strategies against the introduction of exogenous species. It is expected that this role should continue in coordination with other intergovernmental agencies with regulatory responsibilities.

### **Research Status and Priorities**

Unlike certain other nations, Germany does not have a coordinated national research programme on HABs and their effects. Nevertheless, the German research community is generally very well represented at international congresses and a few research groups are highly active in this field. Most HAB-related research is currently conducted at the HGF institutes – Alfred Wegener Institute and GKSS, which also hosts the LOICZ international programme office, the Max Planck Institute for Chemical Ecology, Senckenberg Museum, and a few universities, including Friedrich-Schiller University, Jena and Bremen University. Research

funding is normally provided from institutional resources and national funding agencies (DFG, BMMF), but German scientists are participating in many international programmes, especially as coordinators and participants in EU-funded research projects on HABs.

The focus of current and future HAB research priorities is expected to be on the following issues:

- Seafood safety and quality (analytical determination of new and emerging toxins; alternatives to the mouse bioassay; development of advanced technology for toxin detection)
- Biodiversity and invasive species (development of monitoring and mitigation technologies for HAB taxa)
- HAB events and regime shifts (global change effects; long time-series analysis; nutrient dynamics; related food web structure changes, especially in the North Sea and Baltic Sea)
- Toxin dynamic studies (sources and fate of toxins in various ecological compartments)
- Chemical ecology and novel bioactive compounds (search for structure-function relationships of natural products – toxins, etc.; ecological roles and pharmaceutical potential)
- Biotechnology and Molecular Sciences (functional genomic studies; development of molecular probes and biosensors for HAB taxa and toxins)
- Observational and field monitoring technology (development of real-time monitoring systems for field deployment; integration of biooptics and biotechnology topics)

## Capacity Building

Via conducting IOC training courses on toxin analysis and taxonomic training in HAB species recognition, at FSU, Jena and recently at the Wattenmeerstation, Sylt, Germany has made a major contribution to capacity building. Current efforts are directed towards establishing a long-term series of IOC training courses, with a special focus on toxin analytical technologies, in coordination with the IOC HAB Centre in Copenhagen.

## G. GREECE

### HABS Events

Greece is one of the many countries affected by harmful algae. In coastal waters three types of harmful algae have been recorded:

The first types are high biomass blooms, caused by massive growth of several diatom species, as well as, of dinoflagellates (several species of the genus *Prorocentrum* (*P. redfieldi*, *P. micans*, *P. triestinum*, *P. dentatum*, and *P. obtusidens*), the heterotrophic *Noctiluca scintillans* and species of the genus *Gymnodinium*, *Gyrodinium* etc.). These dinoflagellates' blooms were occasionally accompanied not only by water discoloration but by odour, hypoxia/anoxia and even fish mortality.

The second and most important type are low biomass blooms of species producing potent algal toxins. The most serious diarrhetic shellfish poisoning (DSP) outbreak, associated with a *Dinophysis cf. acuminata* bloom (maximum abundance:  $8 \times 10^4$  cells  $l^{-1}$ ) was observed in January 2000 in Thermaikos Gulf, a major shellfish cultivation area in Greece (95% of total production). The outbreak lasted until March 2000, resulting in great economical losses in the shellfish industry due to closing of bivalve mussel production zones. The same organism was also observed in the following years but was of shorter duration and lower abundance. Other blooms include: *Alexandrium minutum* (Pagassitikos Gulf, Central Aegean Sea; maximum abundance:  $2.5 \times 10^5$  cells  $l^{-1}$ ); *Pseudo-nitzschia cf. pungens* (Thermaikos Gulf). A bloom of blue-green algae occurred in Evoikos Gulf (central Aegean Sea), during late summer 1999, while high densities of the toxic blue-green algae *Microcystis* spp. have been recorded in lakes of the

northern Greece. Moreover, the toxic epiphytic species *Ostreopsis ovata*, *Ostreopsis cf. siamensis* and *Coolia cf. monotis* were recorded along the North Aegean coasts.

The third type concerns the phenomenon of large gelatinous aggregates in the surface waters and thick clouds in the water column. This phenomenon occasionally extends several kilometers along the coast, creating discoloration of the water and having strong negative impacts in fishing and tourism activities.

### Research Projects

A number of research projects were conducted in the framework of EU Projects related to HAB species taxonomy, physiology, ecology and biogeography, and on toxins' methods to detect marine biotoxins. Greece participated in the Projects 'New strategy of monitoring and management of HABs in the Mediterranean Sea' (STRATEGY) and 'Transfer and fate of Harmful Algal Bloom (HAB) toxins in European marine waters' (FATE), both projects within the 5th EU FWP, and in the project 'Impact of natural and trawling events in re-suspension, dispersion and fate of pollutants' (INTERPOL), within the 4th EU FWP. In the framework of NATO, Greece participated in the Project 'Dynamics and trophic impacts of harmful algal blooms in differing environmental conditions'. All Projects combined field and laboratory experimental studies in a coordinated effort to characterize the physical, chemical and biological processes governing the growth of HAB species, the production of their toxins and their transport into the food web.

Research tasks on HABs monitoring are also conducted through several programmes, funded by national sources. Targeted investigations, related to toxic phytoplankton species and shellfish toxicity events are carried in the frame of harmful algae monitoring programs conducted in a wide network of fixed points at the main fishing and shellfish growing areas of Greece. Mussels are examined for three categories of toxins: DSP, PSP and ASP in compliance of the Decision 2002/225/EC, which is an amendment of Council Directive 91/492/EEC. For the first two categories, mouse bioassay is used, whereas HPLC method is applied to determine the ASP toxicity. The majority of the examined mussels belong to *Mytilus galloprovincialis*.

During the last seven years a large number of scientific papers and scientific reports have been published concerning HABs species and mussels' toxicity.

### Priorities (not in any special order)

- Continuation of monitoring harmful algal blooms and phycotoxin programmes especially in the aquaculture areas to ensure a sustainable shellfish activity
- Development of knowledge on the relationships between phytoplankton distribution (including toxic species and discoloration events) and water quality, in compliance with the EU Water Framework Directive
- Participation in training courses for identification of toxic species and shellfish toxins
- Participation in Regional (International) inter-calibration for identification of shellfish toxins and toxic species
- Application of new methodologies for toxic species identification and toxins' determination in shellfish material
- Exchange of information on toxic species and shellfish toxins with other countries
- Predicting HAB events, with close link to operation oceanography

## H. ITALY

Over the last couple of years the attention of Italian scientists, public administrators and institutions has been focused on problems created by blooms of the benthic species *Ostreopsis cf. ovata*, which produces respiratory symptoms and dermatitis following exposure to aerosol and seawater or causes mortality in benthic macrofauna. Blooms of *Ostreopsis* first created

problems in Tuscany in 1998, followed by Apulia in 2000, Liguria in 2005 and 2006 and in Sicily in 2006. The most acute event was in July 2005 in Genoa (Ligurian Sea), where more than 200 people were hospitalised. Blooms with no associated symptoms have been noticed in other areas, e.g. along mid- and north Adriatic coastal waters. The phenomenon is apparently expanding also in other Mediterranean coastal sites.

A series of initiatives have been taken in Liguria in response to the problem, including the diffusion of brochures, the information to hospitals and careful monitoring operations in the periods of higher risk (July, August). Upon request from the Ministry of Environment, the national Agency for environmental protection (APAT), has initiated a coordination action, with the aim of informing and training the personnel at regional environmental agencies (ARPA). A group of experts has been formed which also includes the Ministry of Environment and Ministry of Public Health representatives, with the aim of providing guidelines for local environmental agencies (ARPA) during the development of these blooms.

In December 2006, Italian scientists with experience in phytoplankton and harmful algae joined to form BENTOX-NET, a network for the study of Harmful Benthic Algal Blooms (HBABs), whose composition, aims and activities can be found at the website [www.bentoxnet.it](http://www.bentoxnet.it).

PSP problems due to the presence of *Alexandrium catenella* and *A.minutum* have been recorded in Sardinia since 2002. Over these years *Alexandrium catenella* has apparently widened its range. In 2006, PSP mussel contamination has been recorded for the first time on the eastern coast of the island. In addition, problems related to PSP have been for the first time recorded in the southern Tyrrhenian area (Siracusa, Sicily), where mussel plants were closed due to toxins exceeding the sill concentrations.

A national monitoring program of Italian coastal waters funded by the Italian Ministry of the Environment and carried out by the maritime regions was run from 1996 to February 2007. The program has now been stopped but should restart with some changes in the near future. For this program, reference methods have been published on 2001 and intercalibration exercises have been run through QUASIMEME. The data collected are published in internet ([www.Sidimar.it](http://www.Sidimar.it)).

A Manual for the Identification of phytoplankton species along the Italian coasts, including all the toxic ones, has been published as a joint effort of several Italian scientists under the coordination of ICRAM (Central Institute of Applied Marine Research) and the Italian Ministry of the Environment. A website, WeMP-website for Mediterranean Phytoplankton, has been published in internet at [www.szn.it/botanica](http://www.szn.it/botanica) as a result of a project funded by the Italian Ministry of Research and University (MIUR-ASTAPLAN). Plans are made to increase the number of species and information of this website.

A number of research projects are conducted with Italian funds on HAB species taxonomy, physiology, ecology and biogeography as well as on new detection methods, comparing traditional and molecular methods. Projects are also ongoing on conventional and new methods to detect marine biotoxins. Two projects funded within the 6<sup>th</sup> FWP, address harmful algae: SEED (*Life cycle transitions among HAB species and the environmental and physiological factors that regulate them*) - also endorsed by GEOHAB - and ESTALL (*Expression of toxicity in harmful algae*). Research tasks on HABs are included in the national project VECTOR (*Vulnerability of coasts and Italian Marine Ecosystems to Climate Change and their role in the Carbon Cycle in the Mediterranean seas*) funded by the Italian Ministry of University and Research (MIUR).

The Eighth Advanced Phytoplankton Course (APC8), with several sessions on harmful species, took place in Naples from 2 to 23 April 2005. The course was funded by the Stazione Zoologica and by the EU Network of Excellence on Marine Biodiversity (MARBEF). Participation of three students from developing countries was supported by IOC, who also provided publications and teaching support material. The Ninth Advanced Phytoplankton Course (APC9), planned for 5-26 April 2008, will be supported by Stazione Zoologica of Naples and the University of Tromsø



(Norway). Additional support will be asked from IOC, MARBEF, ZEISS and other agencies.

The main Italian priorities on HAB research/management/education concerns the emergency caused by *Ostreopsis* and includes:

- The development of appropriate methods for monitoring benthic micro algae and detecting toxins produced during *Ostreopsis* blooms in the seawater, aerosol and possible animal vectors.
- Research on the dynamics of benthic harmful algal blooms and of their relationships with environmental factors and benthic populations.
- Taxonomic training to operators involved in monitoring activities at local level.
- Increased awareness and communication on HABs (including benthic HABs) and related activities among marine scientists, operators in monitoring, public health and food control agencies, and common people.

## I. JAPAN

Japan recognizes the importance of IOC Harmful Algal Bloom Programme in the Ocean Science and has actively participated to the Programme directly and indirectly through WESTPAC, IOC subsidiary regional activity for the western Pacific. Japan appreciates the leadership by the Chair and the Secretariat and continuously supports its activities.

### 1. HAB condition in Japan

Harmful Algal Blooms encompass “red tides” and “toxic plankton blooms”. The former is defined as discoloration of water by unicellular microorganisms, and the latter includes only paralytic and diarrhetic shellfish toxin producers (PSP and DSP, respectively) in data management in Japan, although some other toxin producers such as *Pseudo-nitzschia* spp. responsible for amnesic shellfish toxins (ASP) could be found. HAB problems often occur in coastal waters where aquaculture activities are extensively operated, i.e. red tides in western Japan mainly in Seto Inland Sea and toxic plankton blooms in northern Japan. Although HAB case number does not decrease much, HAB has not been considered very serious in Japan in these decades, as management to avoid fisheries and public health problems are smoothly operated.

#### 1-1. Red tides

Figure 1 shows change of case number of red tides in Seto Inland Sea. In these two decades the number is more or less 100 cases, in which about 10 cases associate with fisheries losses. Main harmful species are *Karenia mikimotoi* and *Cochlodinium polykrikoides*. About 40 red tides species such as *Noctiluca scintillans*, *Skeletonema* sp. *Eutreptiella* sp, *Chattonella* spp., *Heterosigma akashiwo* and *Heterocapsa circularisquama* are reported.

Establishment of countermeasures to red tide occurrence is intensively sought mostly by local fisheries experimental station together with fisheries agencies. Reduction of nutrients level in water by controlling land based inputs of pollution into the sea was achieved and then occurrence of a large scale red tide becomes quite rare, especially in Seto Inland Sea. Instead, reduction of fisheries catch could be observed, and some scientists suggested that too much reduction of nutrients led water mass not useful for fisheries activities.

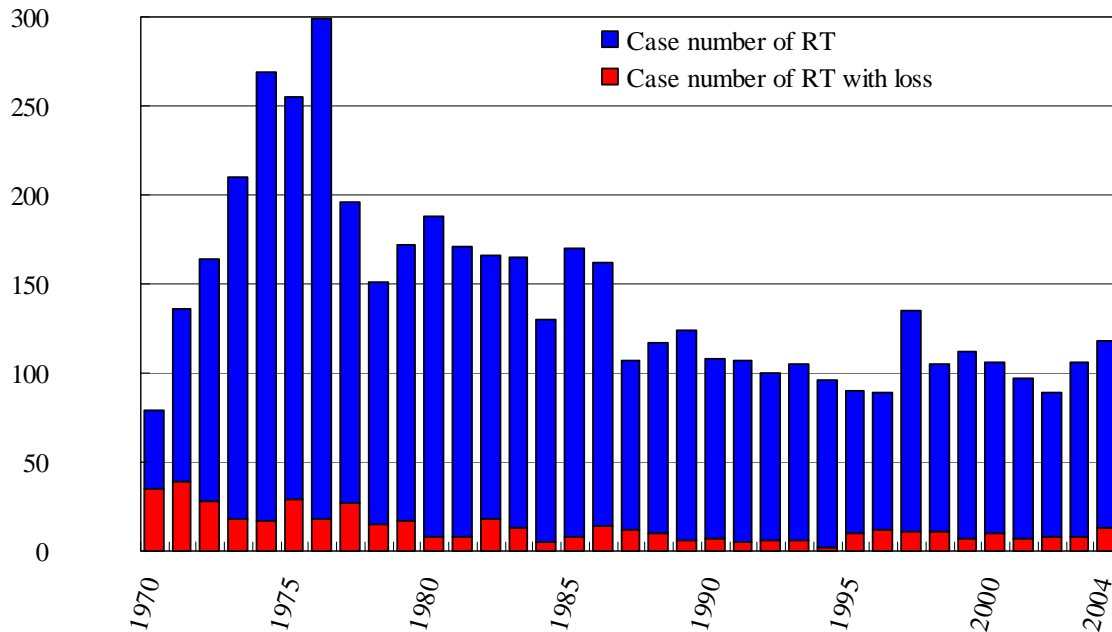


Figure 1. Red tide case number in Seto Inland Sea during 1970 and 2004.

Recent large scale red tide by *Cochlodinium polykrikoides* occurred mostly in bays and coasts facing open sea, such as western and northern coasts of western Japan. Some scientists consider that blooms of the species originated from Korea might be driven by water current and reached to Japanese coastal waters. In this context, international cooperation for observation of red tide occurrence and movement, and cooperative research to elucidate blooming and expanding mechanisms are urgently necessary.

### 1-2 Toxic Plankton Blooms

Most common shellfish toxins originated from toxin producing plankton in Japan are those responsible for PSP and DSP. Species known to cause these poisoning include *Alexandrium catenella*, *A. tamarensis*, *A. tamiyavanichii* and *Gymnodinium catenatum* for PSP, and *Dinophysis fortii* and *D. acuminata* for DSP.

Around 900 people have suffered from PSP and DSP in Japan since 1976 when an official monitoring guideline was set. Careful monitoring of PSP and DSP toxins in marine plankton feeders such as scallop and oyster, and voluntary shipping and marketing control has resulted in no fatalities since 1980. In these several years the area and duration closed from marketing has not expanding.

Monitoring of shellfish toxicity is mandatory for local governments and is the only substantial mitigation measure. Shipping and marketing of harvested shellfish should be voluntarily banned when the toxin amount exceed the quarantine level (PSP; 4MG/g, DSP; 0.05MU/g). Mouse bioassay is the method for analysis currently used, and possibility to develop and apply ELISA kit is sought intensively.

### 2. International cooperation

Scientists working on *Cochlodinium polykrikoides* started cooperative study on its blooming and spreading mechanisms with scientists in Korea and China. Also comparison of phylogenetical and morphological characters of *Cochlodinium* has been extensively studies with scientists in western pacific area.

Efforts to establish GEOHAB project in western Pacific region has been made with the initiative of Dr. Ken Furuya, a GEOHAB SSC member from Japan. He organized a workshop in March 2007 to discuss appropriate topics with scientists in the region, and is expected to make an implementation plan sometime before HAB Conference to be held in Hong Kong in 2008.

Japanese Society for Promotion of Science (JSPS) provides a fund for the cooperative project on HAB (entitled ORI-HAB) science through its multilateral cooperative program for Asian countries. About 80 members join the ORI-HAB and conduct various field surveys such as on ASP in Vietnam and the Philippines, green *Noctiluca* in Thailand and the Philippines, and *Pyrodinium* in Malaysia and the Philippines.

Japan also provides opportunities for international cooperative study on HABs through TTR projects of WESTPAC-HAB by using JFiT. The information of WESTPAC HAB activities is available in IOC/IPHAB-VIII/Inf.5.

Beside IOC activities, Japan participates WG3 (HAB) of NOWPAP/UNEP and HAB Section of PICES. Thorough them HAB international cooperative study is actively promoted.

Japan is one of very active countries joining ICES/IOC/IMO BOSVWG to discuss ship mediated bioinvasion and its mechanisms through IOC. Japan wish to continue this participation to reduce expansion mechanisms and chance of harmful microalgae via ships.

#### J. MALAYSIA

For many years HABs and shellfish toxicity in Malaysia were considered problems unique to the west coast of Sabah. In 1976, marine dinoflagellate *Pyrodinium bahamense* var. *compressum* bloom in Brunei Bay. In 2005, samples of bivalves taken from Kuala Penyu as well as samples of water off Sepangar Bay have shown to contain toxic level PSP toxins. Routine test by the Fisheries Department showed the level of red pollution in the affected water had risen. The level of pollution recorded increase of three times the dangerous level of 400 mouse units.

In Malaysia, the most seafood intoxication due to algal toxins in paralytic shellfish poisoning (PSP). At least three species of PSP-toxin producing dinoflagellates are currently known, viz. *P. bahamense* var. *compressum* in Sabah, *Alexandrium tamiyavanichii* in Sebatu, Malacca and *A. minutum* in Tumpat, Kelantan. More extensive survey may well reveal the presence of other PSP-toxin producing species. The primary vector for PSP toxins are bivalve mollusks, although planktivorous fish such as 'tamban', *Sardinella* sp. can also contain the toxins.

Diarrhetic shellfish poisoning (DSP) is the second important seafood toxicity due to algal toxins. Experiences of several other countries showed that DSP emerged with the establishment of large scale mussel farms (Lembeye et. al. 1993; Gestal-Otero, 2000). The toxin that causes DSP is produced by several species of the cosmopolitan marine dinoflagellates, i.e. *Dinophysis caudate*, *D. fortii*, *D. acuminata*, *D. rotundata* and *Prorocentrum lima*. In Malaysia water, survey carried out in several locations showed that potentially toxic *Dinophysis* and *Prorocentrum* are common and can occur in high densities. It is, however, difficult to prove the toxicity of these species since laboratory cultures have not been established. Furthermore, symptoms of DSP are very similar to gastrointestinal ailments caused by bacteria poisoning and can be easily confused. In addition, it is also likely that DSP would not be reported due to the fact that diarrhea last for only 2 to 3 days. No report of fatality or DSP has been reported so far in Malaysia waters.

Ciguatera fish poisoning (CFP) is one of the most interesting seafood poisoning, in that it is of solely tropical origin. The toxins are produced by benthic epiphytic dinoflagellates, and the vectors are various species of marine fishes. Export of fishes to other countries can result in the

occurrence of CFP in places far from where the ciguatoxic fishes originated (Geller et.al. 1991). In Malaysia waters, several species of benthic dinoflagellates which may be involved in CFP have been identified, they are *Gambierdiscus toxicus*, *Ostreopsis ovata*, *O. lenticularis*, and *Coolia* sp. Toxicity screening based on hemolytic assay, antimicrobial and mouse bioassay has proven the existence of biological activities in aqueous and organic phase extract of these cultures. However, the toxins compound are yet need to be determined.

Amnesic shellfish poisoning (ASP) is the other group of algal intoxication which remains little studied. Although the existence of the diatom, *Pseudo-nitzhia* species are common in most plankton samples collected from coastal areas in our waters. This may be due to fact that difficulty in identification and toxins screening. The occurrence of cyanobacteria blooms and toxins in our freshwater body has never been studied systematically to date. Irregular study on several freshwater ponds, lakes and rivers disclose to existence of known toxic cyanobacterial species, i.e. *Anabaena*, *Nostoc*, *Oscillatoria* and *Cylindrospermum*. Moreover, there have been quite a number of cattle fatality which we believed may be linked to cyanobacterial blooms that contaminated the freshwater body. Some of these species have been established in laboratory culture for identification and toxicity screening.

National priorities in:

1. HAB issues requiring intergovernmental cooperation.  
Malaysia will participate in any regional HAB activities in the IOC/WESTPAC region, particularly the ASEAN GEOHAB.
2. Research  
On our part we are currently actively carrying out studies on the characterization of HAB species using conventional and molecular approaches. Activities have picked up in Sabah with the return of Dr. Normawaty. We also expect increased activities in Sarawak once Dr. Lim Po Teen comes back in June.
3. HAB observation systems / monitoring  
Monitoring activities continue to be implemented by the Dept. of Fisheries. Focus now on Tebrau Straits where *Pyrodinium bahamense* was recently detected for the first time. In March there was also a significant bloom of *Dinophysis* sp. In the Straits. West coast of Sabah continues to be plagued by blooms of *Pyrodinium* and *Cocchlodinium*. UKM has successfully produced species-specific DNA probes for *Alexandrium* and *Pyrodinium* species present in Malaysian waters. We are now figuring out the best way to apply these probes in monitoring activities.
4. Capacity building needs  
Malaysia would like to see training workshops on non-PSP toxin detection in the region, especially those related to ciguatera and DSP. Current training courses organized by the IOC are often either too limited in the number of seats available or too expensive to attend. Malaysia would be willing to host such workshops. We have the necessary instrumentation for the purpose, especially at the Fisheries Research Institute in Penang. Currently efforts are underway to establish a collaborative MOU between the Institute and the University of Jena (Prof. Dr. Bernd Luckas). This could be made use of by the IOC to hold a toxin workshop for the ASEAN region.

K. MOROCCO

The National monitoring programme of HAB in Morocco, was operational since 1996, implanted by the National Institute of Fisheries and financed by government, it's the task of the department of Quality and safety marine environment.

It's composed of 7 coastal laboratory of monitoring of HAB, based on the Atlantic and Mediterranean coast.

7 eminent scientists have the responsibility to monitor the areas depending of their center, and make their observations on regular samples taking weekly.

All the results and the comments about the exceptional events like toxic outbreaks, blooms and discoloration waters, were reported to the Head of department of Quality and Safety marine environment for mitigation measures.

In Moroccan Atlantic coast, the most important HAB events, is the contamination of mussels by DSP, caused by the proliferation of different species of *Dinophysis*, thus cause the closure of area for harvesting, in the last few years, the closure take a long time (more than 3 month), this event have a serious economic impact.

The PSP outbreaks is permanently detected in Mediterranean coast, the causal agent is *Gymnodinium catenatum*, and cause the contamination of the shellfish which the natural decontamination take a long time, this is the most serious threat for the export of our shellfish product to the European countries.

*Alexandrium minutum*, a serious PSP producer, is frequently observed in Nador lagoon (Mediterranean coast).

The first ASP toxic events occur on the Atlantic coast at the 2006 summer, when a bloom of *Pseudo-nitzschia* identified by electron microscopy as potentially toxic *Pseudo-nitzschia*: *P. australis*, *P. fraudulanta* and *P. Pseudo-delicatissima*, was correlated with a high rate accumulation of domoic acid in mussels (*Mytilus galloprovincialis*) and clams (*Ruditapes decussates*).

In 2005 summer, a mortality of fish were reported along the beach of the Atlantic south region, it's appears subsequently at the bloom of *Karenia mikimotoi*, observed by our scientist along the Atlantic shores.

Since 1999, red tides is frequently identified at walidia lagoon (Atlantic water), caused by *Lingulodinium polyhedrum* Stein Dodge, but the phycotoxin's test show any toxin's in Oyster (*Crassostrea gigas*).

## Training Courses

Morocco has benefited to 2 training courses from IOC:

1- Regional training course on "Harmful algae in North Africa" organized by IOC, in cooperation with AEI, Nauta, COPEMED and DANIDA, from 1 to December 2003 at INSTM, Salammbou, Tunisia (3 participants).

2- IOC-Training course on Qualitative and Quantitative determination of algal toxins, Germany, 22 February to 03 March 2005 (1 participant).

## Priorities

- ✓ A base-line study of toxic microalgae for the safeguarding of living resources,
- ✓ To improve the scientific level of the local experts working in Monitoring programme: the development of the new technique of identification of new toxic species and toxins
- ✓ Organization of our data base,
- ✓ Participation in an inter-calibrate exercises,
- ✓ The effect of sediment disturbance on resting stages of toxic phytoplankton: Training course for cyst identification

### **Research Projects: hope the support of IOC-IPHAB**

✓ In Morocco, there is no local research programme on HAB, there is individual participation in local project: hope to give Morocco as well as the countries of North Africa more opportunities to be include in European research projects.

✓

- a- Examine the influence of eutrophication and climate change on the Harmful algal blooms
- b- Creation of culture laboratory: important for the identification, systematic position, pigment content, ultrastructure, genetics, life cycles, storage products, nucleic acid contents toxin production, and toxin identification.
- c- The correlation between toxin producing cells in the water and toxin levels in shellfish  
Development, validation and assessment of methods for the determination of ASP, DSP, and PSP using liquid chromatography mass spectrometry techniques
- d- Development of methods for the toxins recently discovered in Moroccan shellfish: production of toxins standards and development of liquid chromatography mass spectrometry techniques, the toxins to be studied are: the azasparacides, yessotoxins, pectenotoxins.

### L. NAMIBIA

In 2004 Namibia initiated inshore HAB monitoring to cater for the budding mariculture industry, which is based on molluscan shellfish (oysters and abalone). The success of these filter-feeding mariculture products is due the highly productive northern component of the Benguela upwelling system. Through national effort and expert international assistance sourced mainly through the Benguela Current Large Marine Ecosystem BCLME programme, a shellfish safety monitoring programme has been established, which is aimed to ultimately satisfy both EU and FDA/US standards. The model programme is presently being drafted as a regulation under the Aquaculture Act. The main challenge regarding implementation is establishment of local laboratories for biotoxin analysis.

Potentially toxic phytoplankton species are present in Namibian waters along with the bulk of non-toxic species. Data from the monitoring programme has provided a good overview of the range of species expected in Namibian waters and provided the foundation of a species database. Research possibilities are obvious and will develop as the monitoring continues.

Government commitment to the importance of HABs is recent, and a direct consequence of the development of aquaculture in the country. Limited national competence in the field of HABs requires that capacity building is an essential component of the HAB monitoring programme.

### **HAB issues requiring intergovernmental cooperation**

Setting up a shellfish sanitation and biotoxin monitoring system continues to be a priority issue to the Government. Through the Benguela Current Large Marine Ecosystem BCLME programme, Namibia spearheaded projects aimed to establish such monitoring programmes in the northern Benguela (Namibia and Angola). With minimal in-house capacity regarding both identification and toxin analysis, Namibia continues to seek both the necessary facilities and training.

Collaborative research involving techniques which presently are not available in Namibia (e.g. culture, genetic determinations, specialized toxin analysis, specialized environmental monitoring) will help to increase the knowledge base for this area

## Research

Limited staffs are kept fully occupied with monitoring and administrative duties. However even from the short monitored period, some obvious research opportunities are desirable, regarding e.g.

- the role played by the abundant, possibly toxic *Pseudo-nitzschia* species in the ecosystem,
- the persistence of PSP in low levels in farmed abalone,
- the possibly toxic role played by *Karlodinium veneficum* in the Namibian system,
- the interaction between the hydrogen sulphide events and blooms,
- the cause of the occasional, isolated positive DSP (lipophilic) tests on shellfish

## HAB observation systems/monitoring

The present monitoring system comprises inshore (farm and potential mariculture sites) water sampling every two weeks from shore and small craft; and a single offshore transect over the shelf, every 2 months. Water samples are analysed for phytoplankton species, and farmed shellfish are analysed outside the country for biotoxins responsible for PSP, DSP and ASP. It is planned to increase the frequency of monitoring as capacity increases. Turnover times for analyses must decrease.

Namibia has no moored monitoring systems; an inshore mooring to monitor oceanographic conditions would greatly enhance our understanding of the development of blooms. Funding is needed for such a monitoring buoy.

## Capacity building needs

Limited capacity to monitor biotoxins is the greatest restraint recognised by the government. Presently efforts are being made by the Competent Authority to establish biotoxin analytical laboratories locally in order to cater for the export needs of the shellfish industry. Increased financial input with regard to both equipping the laboratories and further appointments and training of staff is essential if Namibia is to attain its goal of internationally certified shellfish products.

Training with regard to phytoplankton monitoring and identification is ongoing, both in-house and through opportunities with international experts

In the last two years national efforts to build capacity have included:

- Projects of the Benguela Current Large Marine Ecosystem BCLME programme (reports referenced):
  - EV/HAB/02/01: Harmonization of Regulations for Microalgal Toxins for Application in Countries Bordering the Benguela Current Large Marine Ecosystem
  - EV/HAB/02/02a: Development of an operational Capacity for Monitoring of Harmful Algal Blooms in Countries Bordering the Northern Part of the Benguela Current Large Marine Ecosystem: Phase I – Design
  - EV/HAB/04/Shellfish: Development of a Shellfish Sanitation Program Model for Application in consort with the Microalgal Toxins Component
  - EV/HAB/06/01 Development of an operational Capacity for a Shellfish Sanitation Monitoring Program in Countries Bordering the Northern Part of the Benguela Current Large Marine Ecosystem: Phase II - Implementation

- National recognition (Cabinet acceptance) of the urgent need to establish local analytical laboratories for biotoxins
- Budgetary allowance by the Competent Authority (Ministry of Trade and Industry) to equip such laboratories
- Sponsorship by Government, BCLME and BENEFIT to participate in the 8th - Advanced Phytoplankton Course (APC8) Taxonomy and Systematics (1 person, Naples, Italy, 2-23 April 2005)
- Training in biotoxin analysis (intergovernmental support to scientist to Thailand for 6 weeks January-February 2007)
- Government sponsorship to attend the 12<sup>th</sup> International Conference on Harmful Algae (1 person, Copenhagen, 4-8 September 2006) and to the 6<sup>th</sup> International Conference on Shellfish Safety (1 person, New Zealand 18-23 March 2007)
- BENEFIT/IOC sponsored regional workshop on phytoplankton identification held in Namibia: "Harmful algal bloom workshop and distance learning course" 22 February - 2 January 2007
- Government commitment to representation at the IOC International Panel for HABs meetings

Namibia continues to seek capacity building opportunities.

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Bordering the Northern part of the Benguela Current Large Marine Ecosystem: Phase 1 – Design

M. NEW ZEALAND

**1. HAB Issues requiring intergovernmental cooperation**

The priority issues are those that the CODEX Fish and Fish Products Committee (CCFFP) requested assistance from the World Health Organisation on and were subsequently addressed and reported on by the Joint FAO/IOC/WHO ad hoc Expert Consultation on Biotoxins in Bivalve Molluscs. The expert Consultation recommendations are mainly being acted upon, at an international level, separately by the CCFFP and the European Food Safety Authority (EFSA) and

The ECVAM (European Centre for the Validation of Alternative Methods) Workshop Report 55 “Three Rs Approaches in Marine Biotoxin Testing” (ATLA 34, 193-224, 2006) also contains recommendations that would be best dealt with at an intergovernmental level, rather than within the EU.

A current international guideline is required for the validation of analytical methods for marine biotoxins – for both routine testing and screening (AOAC adequately addresses reference methods). Despite being recommended in both the Expert Consultation and the ECVAM Reports, this is not being progressed at an international/intergovernmental level

The (internationally agreed) resolution of recommendations in the above Reports is a priority to facilitate international trade in bivalve molluscs, as at the moment trade is being restricted due to regulatory levels for biotoxins requiring re-assessment and the imposition of mouse bioassay methods by the EU .

**2. Research**

Further research is required on:

- the chronic effects of consuming bivalve molluscs containing biotoxins;
- the effect and subsequent regulatory controls of consuming bivalve molluscs containing more than one toxin group now that parent toxins and their metabolites can be readily identified using chemical test methods;
- the toxicology of metabolites of existing biotoxins and potential new toxins such as spirolides;
- the toxicity of brevetoxin analogues (NZ & USA);
- genetic detection methods for toxigenic microalgae
- the validation of Oshima's saxitoxin toxicity conversions factors;
- environment factors that precede *Gymnodinium catenatum* blooms where they recur in commercial shellfish growing areas (NZ);
- the determination of Toxic Equivalent Factors (TEFs) for toxin analogues to facilitate the replacement of mouse bioassay methods.

## N. PORTUGAL

### **Monitoring program of HABs**

The Portuguese Monitoring Program started in 1987 covering the whole coast of Portugal but not including Madeira and Açores islands. This program is a responsibility of the National Fisheries Research Institute (IPIMAR) where it is also located the Portuguese National Reference Laboratory for Marine Biotoxins, a lab with accreditation for some of the toxin detection techniques. Monitoring is being financially supported by both national (IPIMAR and research projects budget) and EU structural funds.

**HAB taxonomy and bloom dynamics studies.** Studies on HABs taxonomy have been conducted mainly by the Universities of Lisbon and Aveiro while major studies on HABs dynamics were developed by IPIMAR research projects in collaboration with other research institutions.

### **Major HAB impacts**

In Portugal the major persistent impacts of HAB events have been associated to proliferation of *Dinophysis* species, with the highest concentrations registered in 2002 (*D. acuminata*) and 2005 (*D. acuta*). However, the most serious problems were caused by the PSP producing species *Gymnodinium catenatum*, from 1985 until 1995. After an interval of 10 years, the outbreaks of this species started again in autumn 2005 and 2006.

Short ASP events were related to *Pseudo-nitzschia australis* in both the western and south coasts. Intense blooms of the potentially toxic *Lingulodinium polyedrum* were observed in the last decade during summer with some negative impacts on tourism on the beaches of the Algarve and Lisbon bay coasts.

Very recently, a new serious economic problem is arising from aquaculture farms where annual sudden massive mortalities of fish are being associated with their infection by the parasitic dinoflagellate *Amylodonium ocellatum*.

### **Priorities of Portugal at national and international levels.**

1. **Taxonomic training needs.** National monitoring program in Portugal will strongly benefit from an urgent assistance of IOC training courses to some of the younger researchers already involved in the program.
2. **Optimization of monitoring.** Due to a national decrease in the number of technicians and researchers involved in the monitoring program, a selection of particular sites for an early detection of blooms is currently being done, in some cases with the help of hydrodynamical models. The development of the necessary expertise in phytoplankton taxonomy in institutions of Madeira and Açores will help to initiate a HAB species sampling and detection program in those islands, with particular focus on benthic dinoflagellate species.
3. **Prediction of blooms** A collaborative research in regional national and international oceanographic observation activities and projects such as those covered by IBIROOS is considered a national priority to achieve predictive skills of HABs based on the understanding of physical forces underlying the areas of bloom development and further transport.
4. **Mitigation.** To resolve the problems arising from *Amylodonium ocellatum* infestations in Portuguese marine fish farms, it is a priority to produce fishes with increased immunity and develop environmental friendly mitigation methods against that dinoflagellate parasite.

## Other International cooperative studies on HABs

1. **Involvement in GEOHAB program.** Continue an active implementation of research projects HABs in Upwelling systems and HABs in stratified systems.
2. **Toxin detection.** Due to the problems occurring in some Mediterranean countries related to *Ostreopsis*, it is a possibility that these problems could appear in the warm waters of southern Portugal and Madeira island. The development of methodologies for determination of palytoxins in bivalves is a major concern (Portugal should participate on the Community Reference Laboratory on Marine Biotoxins Working Group on Palytoxins - Cyprus, Oct/2007).
3. **Involvement in the EU project PLANKTON-NET.** After two nodes created by AWI and CNRS-Roscoff, a third node of this project (an online image taxonomic database of phytoplankton from Portuguese waters) is under construction in the University of Lisbon and will have the collaboration of IPIMAR and Madeira University.

## O. SLOVENIA

1. HAB issues requiring intergovernmental cooperation

One of the priorities in the frame of intergovernmental cooperation is to build up an early-warning system on the regional level in the northern Adriatic area. Not only would the scientific community benefit from setting-up such system but also the broader public. Some information that is gathered from the observing station is already exchanged between Slovenia and Italy. This cooperation is important since this area suffered in the past from episodes of bottom oxygen depletion due to phytoplankton blooms and specific hydrological and geomorphologic properties. The area is also well known, as well as other parts of the Adriatic and Mediterranean Sea, for large macroscopic gelatinous aggregates (third type of HABs) and several activities have been undertaken hereupon: from basic research projects to common monitoring activities and actions for mitigation of the consequences of macroaggregates (mainly in tourism).

Another HAB issues that requires international cooperation are ballast waters. It is of national importance that this issue is considered since maritime transport and oil refinery and industry are important economic branches of countries settled on the shore of Adriatic Sea (e.g. budget money-financed projects dealing with ballast waters, one of the priorities of the trilateral intergovernmental commission between Croatia, Italy and Slovenia)

2. Research

There is not a national HAB research strategy. Researchers interested in HAB issues compete for budget money equally as from any other scientific field when calls for applications for basic and applied research are opened. Researchers are also encouraged to collaborate in EU projects. For instance, in the 6<sup>th</sup> FW Programme a Slovenian RTD organization was designed as a partner in one collective research project (SHELLTOX), which integrated industrial associations, small and medium enterprises and research and technological development (RTDs) performers. The objectives of the proposed project SHELLTOX is to improve the cost effectiveness and the competitiveness of the European shellfisheries by increasing consumer safety based upon improved monitoring and management practice to ensure that consumers are protected against the risk of consuming shellfish, which contain algal toxins above the regulatory limits.

### 3. HAB observation systems/monitoring

Monitoring of HABs is of major national priority as can be seen by the settled legislation of HAB issues adopted by two governmental bodies (Ministry of Agriculture, Forestry and Food and Ministry of Environment). Legislation acts determine safety of the sea products as well as the quality of sea water for living and growing of molluscs. National monitoring program is flexible in a sense that is subjected to changes due to continuous improvements and novelties (in taxonomy, monitoring design etc.) and deliverables.

Observing system, although presently not strictly related to HABs, is also one of the national priorities. It is also a part of the activities of the IOC national committee of National commission of UNESCO. These activities are integration part of IOC-GOOS program of which national IOC-HAB program could benefit. Presently two sensors for chlorophyll *a* are mounted on the oceanographic buoy in Slovenian coastal waters, providing continuous data on basic meteorological and oceanographic parameters, as well as information on phytoplankton blooms. On the same buoy there are also two submersible cameras mounted at different depths that monitor organisms as small as few mm, mainly from gelatinous plankton.

### 4. Capacity building needs

Likewise for the research, also for the capacity building there isn't a national HAB strategy. However, researchers have been trained in the past at UNESCO/IOC training course on the taxonomy and systematics of harmful algae and were (partially) supported by the state. Lately, cases of graduate students that continued with graduate university education and got supported by state through national program of young researchers for 4 years, based their research objectives of HAB issues (e.g. ecological characteristics of toxic algae, invasive species and introduction by ballast waters).

In the academic year 2007/08 a new graduate joint study programme Marine biology will be launched in which HAB issues will be integrated in the course Marine resources and coastal zone management.

## P. SPAIN

### **Research and Technological Development**

#### **1. Ecology and Oceanography**

Improve prediction capabilities of the occurrence of toxin-producing (PSP, DSP, ASP) microalgae: interannual variability; initiation, maintenance and decay. These issues are included in the research priorities identified in the GEOHAB programme.

- Spanish institutions lead/participate in two EU Projects of the 6<sup>th</sup> Framework Programme (with cooperation with USA): SEED and HABIT. SEED explores the importance of life history transitions in the initiation and termination of blooms. HABIT studies the population dynamics of harmful microalgae aggregated in thin layers.
- Spain would benefit from a regional project with Portugal, France, Ireland and United Kingdom where recent advances in physical models and operational oceanography would help in the development of biophysical models to forecast blooms of toxin-producing microalgae.
- Implementation of GEOHAB Core Research Projects, especially those of HABs in upwelling systems and HABs in stratified systems.

## 2. Initiation, persistence and termination of shellfish harvesting closures

Improve prediction capabilities on the onset and duration of harvesting closures of shellfish exposed to toxin-producing microalgae populations:

- Explore species-specific factors affecting seasonal and interannual variability in toxin profiles and toxin content per cell, especially in relation to species of the genus *Dinophysis* that lead to very lengthy harvesting closures.
- Improve available species-specific toxin uptake and detoxification models, with special emphasis on ASP outbreaks affecting scallops.

### Respiratory irritations by toxic aerosols (RITA)

Explore the causes of mass respiratory irritations, in recent years, on Mediterranean beaches

- Identify the causative agents (presumably members of the genera *Ostreopsis* and *Karenia*), and the toxins they produce;
- Explore the mechanisms by which phycotoxins contained in the microalgae are transferred to the atmosphere

### Monitoring and Management

Most of the priorities listed below are part of those identified by the CODEX Fish and Fish Products Committee (CCFFP) and addressed and reported on by the *Joint FAO/IOC/WHO ad hoc Expert Consultation on Biotoxins in Bivalve Molluscs*

- Development of feasible alternatives to mouse bioassays for PSP and DSP tests. Concern about the present alternative method for PSP tests.
- Availability of certified phycotoxin standards.
- Sound toxicological studies to determine the toxicity of various lipophilic shellfish toxins.
- Effective monitoring protocols to prevent RITA events
- Mitigation of toxic outbreaks: reallocation of affected shellfish, toxin-decreasing shellfish processing.
- Advanced methods for the identification of toxigenic species of the genus *Pseudo-nitzschia* and *Alexandrium*

### Training and Communication

A new Memorandum of Understanding (MoU) is now ready to be signed between the IOC Secretariat and Spain to extend the operation of the *IOC-IEO Science and Communication Centre on Harmful Algae* for 5 more years (end of 2011).

## Q. SWEDEN

### Background

The Harmful Algal Bloom (HAB)-problems for the waters surrounding Sweden are very different for the Baltic and the Skagerrak-Kattegat area. In the brackish water of the Baltic blooms of cyanobacteria, e.g. the toxic species *Nodularia spumigena*, is the major problem. Surface accumulations of blooms are a nuisance to tourists etc. In the Skagerrak-Kattegat two other problems are important. The first are high biomass blooms of fish killing species such as *Chattonella* aff. *verruculosa* (preliminary new name *Verrucophora farcimen*) and the second is low biomass blooms of species producing algal toxins. Diarrhetic shellfish toxins (DST) from *Dinophysis* spp. is a problem for the mussel farming industry. The Swedish National Food Administration administers chemical analyses using LC-MS is used for analyses of okadaic acid, and DTX:s. Paralytic shellfish toxins (PST) from *Alexandrium* spp. is a minor problem. Potentially

toxic diatoms from the genus *Pseudo-nitzschia* is common but amnesic shellfish toxins (AST) have not been observed in Sweden. It is now nineteen years ago since the bloom of *Chrysochromulina polylepis* that devastated the marine environment in the Skagerrak-Kattegat. This bloom affected fish, benthic animals as well as macro algae. The genus does occur regularly in the area but have not reached bloom densities since 1988.

**Priorities** (not in any special order)

1. The first priority should be to promote regional international observation and warning systems for harmful algal blooms (HAB:s). The regional systems should be interconnected in a global network. Two such areas are relevant for Sweden: 1. The Baltic Sea and 2. The North Sea, Skagerrak-Kattegat area. Systems need to include four components (A-D) and the results should be integrated into information relevant to the public published on web sites. The components are: A. water sampling e.g. from ships, and identification with abundance estimates of harmful species, B. automatic measurement systems on moorings and ships of opportunity (e.g. Ferry Boxes), C. Remote sensing using satellites and airborne sensors and D. Models to predict transport and development of HAB:s. A possible fifth component, E, is a combined public outreach and volunteer observation programme.
2. The second priority should be to promote long term HAB-monitoring in connection to climate change. Climate is changing and at present knowledge on the effects on HAB is limited. The goal would be to use cutting edge scientific techniques as well as the more traditional monitoring techniques to monitor HAB:s and supporting parameters at strategic locations in the different water bodies. For Sweden this implies one or a few locations in the Baltic and a few locations in the Skagerrak-Kattegat. The work should be internationally co-ordinated.
3. The third priority is to promote courses and web sites that facilitate information for identification and counting of HAB-species. Also international intercalibrations are important.
4. The fourth priority is to promote the work for making standards of algal toxins available and to promote the arrangements of courses for algal toxin analyses.
5. The fifth priority is to promote activities that reduce the HAB problem. For Sweden the major problem area is the Baltic and the cyanobacteria blooms occurring there.

The components A-D for priority number one do exist but they all have some problems. Component A Species identification and abundance determination, is necessary because most algae blooms are not harmful and harmful algae are often constitute only a small component of the phytoplankton community. It is thus necessary to identify algae to the species level. The only technique operational today is microscopy although molecular biological techniques and optical techniques may be possible to use in the near future. Microscope analyses works well but logistical problems for quick transport of samples etc. need to be solved. Component B, automatic *in situ* systems, needs to be further developed to make sure that biological measurements are consistent with reference measurements. The problem with bio fouling needs to be under control. Regarding moorings it is essential to use profiling systems to make sure that thin layers of HAB:s are detected. Component C, remote sensing, is well developed for estimates of total phytoplankton biomass at the surface but data is not always made available quickly. Remote sensing techniques complement *in situ* techniques but frequent cloud cover is a problem and also that only the surface blooms are detected. Remote sensing techniques in general only give data on the whole phytoplankton community, not on HAB-species. Component D, modelling, is well developed for transport of e.g. oil spills. This is applicable also to HAB:s, at least for surface blooms. Regarding forecasting models more work is needed. This is a scientific

challenge for the HAB and modelling communities. It should be noted that this text was prepared without consultations with the Swedish Natural Environment Agency.

## R. TURKEY

### **Introduction**

The national monitoring programme of Harmful Algal Blooms (HAB) was started in 1982 by some research institutes in Turkey. Potentially toxic and harmful phytoplankton species along southern coastlines of Black Sea, sea of Marmara, Eastern Aegean Sea, and the Northeastern Mediterranean were detected between 1980-2002 (Koray, 2004; Koray et al, 1996; Koray and Büyükşık, 1988; Fevzioglu and Tuncer, 1989; Polat et al, 2000; Türkoglu and Koray, 2002) (Table.1). Twenty-one potentially toxic microalgae were recorded: three cyanophytes that can cause hepatotoxic effects; fourteen dinoflagellates with a potential to cause Diarrhetic Shellfish Poisoning, Paralytic Shellfish Poisoning, Azaspiracid Poisoning, and yessatoxin-like poisoning symptoms; three diatoms, which can cause Amnesic Shellfish Poisoning; and a raphidophyte species. Harmful but non-toxic blooms were very frequent in the eutrophic Black Sea, Sea of Marmara, and the eastern Aegean coasts.

The local phytoplankton studies were gathered for preparing a check-list for the Turkish coastline of southern Black Sea, Sea of Marmara, eastern Aegean Sea and northeastern Mediterranean Sea. A total of 7 procaryotes and 485 eucaryotes taxa were listed from the studies realized the region beginning from the second half of twentieth century (Koray et al, 1996; Koray, 2002). Although the existence of the dinoflagellate *Gonyaulax tamarens* (= *Alexandrium tamarense*), *Gymnodinium* cf. *mikimitoi* (= *Karenia mikimitoi*), diatom *Nitzschia seriata* (= *Pseudonitzschia seriata*) and *Heterosigma* cf. *akashii* were reported by several scientist, they were not valid due to the insufficient local sistematic data on these species.

Analysis of HAB effects on human health is investigated by Regional Institute of Hygiene under auspices of Ministry of Health. On the other hand, Laboratories of Ministry of Agriculture detect the levels of some biotoxins in marine food products. These two separate bodies work with academic institutions collaboratively in Turkey.

### **National Priorities**

- Education of experts on harmful algal blooms
- Developing of laboratory conditions related to biotoxin analysis
- Mutual collaboration with other experienced countries in our region
- We believe the benefits of a possible regional training course on HAB for Eastern Mediterranean Region.

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**Table 1** Toxic and harmful microalgae from the Turkish coasts (abbreviations: mc–mean cell concentration observed (cells L<sup>-3</sup>); T–potential toxicity; D–distribution, indicates the localities marked in Fig. 1; \*–common; HT, hepatotoxic; MC, microcystin; PSP, Paralytic Shellfish Poisoning; DSP, Diarrhetic Shellfish Poisoning; ASP, Amnesic Shellfish Poisoning; AZP, Azaspiracid Poisoning; YTX, Yessotoxin; ho, Hyperoxia; ao, Anoxia; NH<sub>3</sub>, ammonia; ?, unknown.

Species	mc	T	D	Species	mc	T	D
<b>CYANOPHYCEAE</b>				<i>Protoperdinium crassipes</i> (Kofoid)			
<i>Anabaena spiroides</i> Klebahn	?	HT	H	Balech	?	AZP?	E+H
<i>Anabaena variabilis</i> Kützinger	2.0 × 10 <sup>3</sup>	HT	H	<i>Scrippsiella trochoidea</i> (Stein)			
<i>Microcystis aeruginosa</i> Kützinger em. Elenkin	?	MC	C,D	Loeblich III	6.0 × 10 <sup>6</sup>	?	E+I
<b>DINOPHYCEAE</b>				<b>PRYMNESIOPHYCEAE</b>			
<i>Alexandrium minutum</i> Halim	10 <sup>7</sup>	PSP	G	<i>Emiliania huxleyi</i> (Lohmann)	10 <sup>6</sup>	?	E+H
<i>Dinophysis acuminata</i>				<b>BACILLARIOPHYCEAE</b>			
Claperède and Lachmann	26	DSP	E,F	Biddulphiales			
<i>Dinophysis acuta</i> Ehrenberg	35	DSP	E,F	<i>Rhizosolenia alata</i> f. <i>gracillima</i>			
<i>Dinophysis caudata</i> Saville-Kent	50	DSP	*	(Cleve) Gran	2.7 × 10 <sup>6</sup>	ho-ao	C+J
<i>Dinophysis fortii</i> Pavillard	1	DSP	*	<i>Rhizosolenia calcar-avis</i> Schultze	1.7 × 10 <sup>6</sup>	ho-ao	*
<i>Dinophysis mitra</i> (Schütt) Abé				<i>Thalassiosira allenii</i> Takano	10 <sup>6</sup>	ho-ao	A+G
vel Balech	1	DSP	D+H	<i>Thalassiosira anguste-lineata</i>			
<i>Dinophysis rotundata</i>				(A. Schmidt) G. Fryxell and Hasle	10 <sup>5</sup>	ho-ao	E+G
Claperède and Lachmann	32	DSP	E+G	<i>Thalassiosira rotula</i> Meunier	2.0 × 10 <sup>6</sup>	ho-ao	E+G
<i>Dinophysis sacculus</i> Stein	24	DSP	E+J	Bacillariales			
<i>Dinophysis tripos</i> Gourret	5	DSP	*	<i>Pseudo-nitzschia delicatissima</i>			
<i>Gonyaulax grindleyi</i> Rein	?	YTX	G	(P. T. Cleve) Heiden	?	ASP	*
<i>Lingulodinium polyedrum</i>				<i>Pseudo-nitzschia pseudodelicatissima</i>			
(Stein) Dodge	5.0 × 10 <sup>4</sup>	YTX	G	(Hasle) Hasle	2.0 × 10 <sup>6</sup>	ASP	A+C
<i>Noctiluca scintillans</i>				<i>Pseudo-nitzschia pungens</i> (Grunow			
(Macartney) Kofoid	2.0 × 10 <sup>4</sup>	NH <sub>3</sub>	*	ex P. T. Cleve) Hasle	8.0 × 10 <sup>6</sup>	ASP	*
<i>Prorocentrum balticum</i> (Lohmann)				<b>RAPHIDOPHYCEAE</b>			
Loeblich III	9.0 × 10 <sup>6</sup>	ho	A,B	<i>Heterosigma akashiwo</i> (Hada)	2.0 × 10 <sup>5</sup>	?	G
<i>Prorocentrum cassubicum</i>				Hada ex Hara (Chihara)			
(Woloszynska) Dodge	?	DSP	G	<b>EUGLENOPHYCEAE</b>			
<i>Prorocentrum dentatum</i> Stein	6.0 × 10 <sup>4</sup>	ho-ao	E+H	<i>Eutreptiella gymnastica</i> Throndsen	7.0 × 10 <sup>5</sup>	ho-ao	C+G
<i>Prorocentrum lima</i> (Ehrenberg)				<b>PRASINOPHYCEAE</b>			
Stein	10	DSP	G	<i>Pyramimonas orientalis</i> McFadden,			
<i>Prorocentrum micans</i> Ehrenberg	9.0 × 10 <sup>7</sup>	ho-ao	*	Hill and Wetherbee	10 <sup>5</sup>	ho-ao	A
<i>Prorocentrum minimum</i>				<i>Pyramimonas propulsa</i> Moestrup			
Pavillard (Schiller)	?	?	E, H	et Hill	3.7 × 10 <sup>7</sup>	ho-ao	G

## S. UNITED KINGDOM

### Monitoring of Harmful Algal Species

Monitoring harmful algal species in UK waters is performed in compliance with the EU Regulation (EC) No 854/2004. This work which is funded by the Food Standards Agency is carried out by the Agri-Food and Biosciences Institute (AFBI) in Northern Ireland, The Centre for Environment, Fisheries and Aquaculture Science (Cefas) in England and The Scottish Association for Marine Science (SAMS) in Scotland. Additional monitoring for the purposes of the Water Framework Directive, OSPAR eutrophication assessments and long term changes in phytoplankton (including harmful species) is undertaken by The Environment Agency, The Department of Environment in Northern Ireland, the Scottish Environmental Protection Agency, Fisheries Research Services (FRS) marine laboratory in Aberdeen and by Plymouth Marine Laboratory.

Species of *Alexandrium*, *Dinophysis* and *Pseudo-nitzschia* continue to be detected in UK waters with closures of shellfish harvesting areas enforced when concentrations of the toxins associated with paralytic shellfish poisoning (PSP), diarrhetic shellfish poisoning (DSP). Amnesic shellfish poisoning (ASP) continues to be detected in mussels.

Other toxin producing species, for example *Prorocentrum lima*, *Lingulodinium polyedrum* and *Prorocentrum reticulatum*, have been observed in low numbers in UK waters. However,



concentrations of Pectinotoxins or Yessotoxins in shellfish tissue which exceed the closure limits have not been recorded.

High numbers of *Karenia mikimotoi* were reported in coastal waters of the West of Scotland and the Orkney and Shetland Islands between July and September 2006. The occurrence of *K. mikimotoi* coincided with mortalities of wild fish and benthic organisms.

The UK National Reference Laboratory for Marine Biotoxins Phytoplankton Working Group has harmonised methods for the sampling, identification and enumeration of toxin producing phytoplankton species between regional laboratories. Two UK laboratories have accreditation for the identification and enumeration of potential toxin producing phytoplankton under ISO 17025. A number of UK laboratories have participated in a joint UK/ Irish quality assurance scheme for identification and enumeration of phytoplankton.

### Research Activities

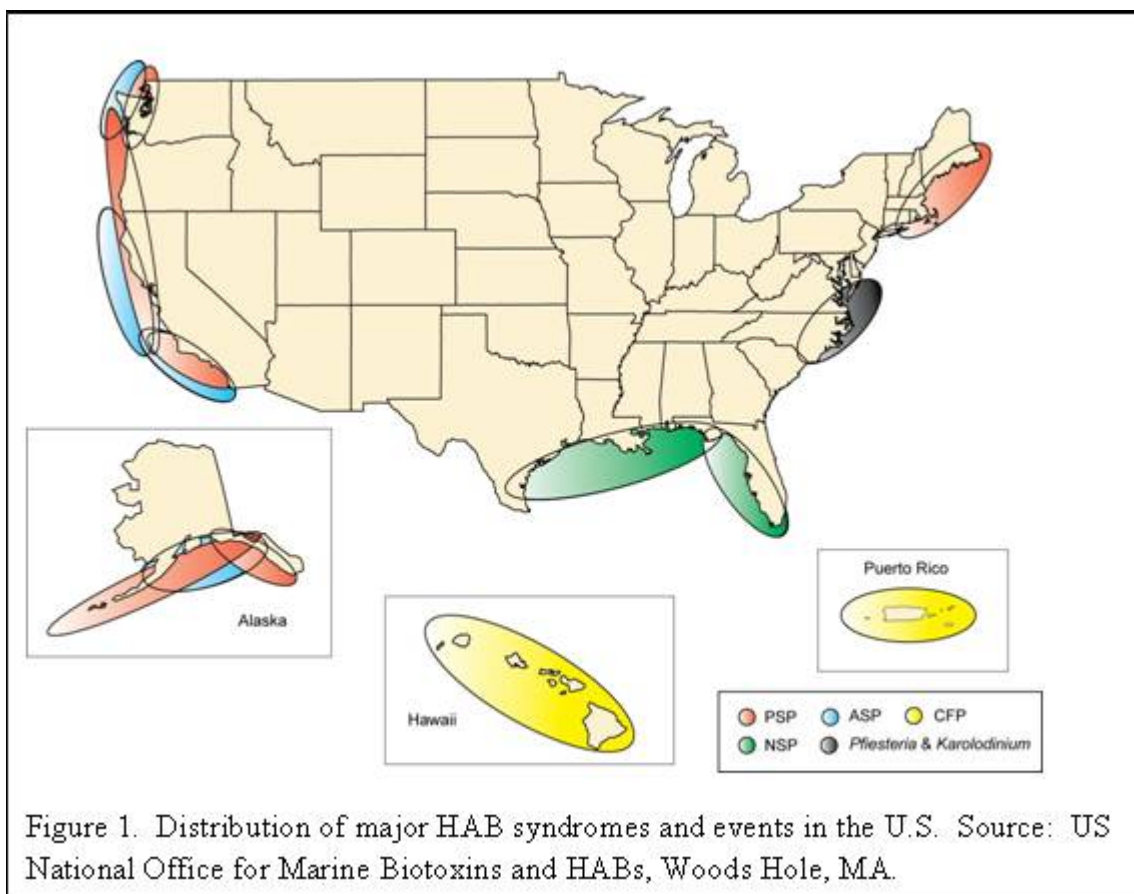
Research activities into HABs in the UK include development of molecular methods from the detection of toxin producing species, dynamics of toxin production in selected species, modelling of harmful bloom initiation, new methods for the in situ detection of toxins in seawater and new chemical methods for the detection of toxins in shellfish material.

### Future Priorities

1. Capacity Building and Training. Within the UK there is a requirement for training in the identification and enumeration of HAB species (and phytoplankton in general). In this respect the value of the IOC centre in Copenhagen is acknowledged for its provision of taxonomic training courses. In addition the IOC has provided certified phytoplankton material for use in national accredited monitoring systems.
2. New methods for detecting biotoxins. A lack of standard material for lipophilic toxins is considered to be hampering progress on non-animal methods. International collaboration to validate LC-MS methods and agreement on regulatory limits are considered important.

## T. UNITED STATES

Harmful algal blooms (HABs) are now recognized as persistent threats to coastal resources, local economies, and human health in the U.S. Increased attention to the occurrence and problems associated with HABs is being demanded at National and State levels. Currently, with the exception of diarrhetic shellfish poisoning (DSP), U.S. waters are subject to most of the major HAB poisoning syndromes and impacts (Figure 1). These include paralytic shellfish poisoning (PSP), amnesic shellfish poisoning (ASP), neurotoxic shellfish poisoning (NSP), ciguatera fish poisoning (CFP), as well as a host of HABs that kill fish or cause ecosystem or recreational impacts. A recent discovery is that more than half of all marine mammal mortalities in U.S. waters are now being attributed to marine biotoxins, compared to a small percentage just a few years ago. Improved techniques and increased sampling of animal tissues may account for this apparent increase, but the lack of earlier data make it impossible to determine if this also represents an expansion of the problem. Another development in recent years is the absence of significant apparent impact from *Pfiesteria* sp. blooms, replaced perhaps with a number of events linked to *Karlodinium micrum*. Research over the past several years has, however, resulted in the discovery of a *Pfiesteria* toxin by a NOAA researcher.



## National Activities

Most monitoring of shellfish and shellfish waters is implemented at the state level including measurements of accumulated toxins in fisheries resources, and these states and others are now adopting state-Federal partnerships for monitoring HABs and responding to HAB events. These partnerships are co-sponsored with the states and at least three Federal agencies Food and Drug Administration (FDA), National Oceanic and Atmospheric Administration (NOAA), and the Environmental Protection Agency (EPA). Further, through a NOAA program, states can request Federal assistance for immediate response to HAB events that exceed normal state response capabilities.

The national commitment to develop new understanding of the causes of HABs in order to develop new tools to predict, mitigate, and prevent HABs was renewed when the Harmful Algal Bloom and Hypoxia Research and Control Act, originally passed into law in 1998, was reauthorized in December 2004 (HABHRCA 2004, <http://www.cop.noaa.gov/stressors/extremeevents/hab/habhrca/>). Besides authorizing the research and response programs listed below, HABHRCA 2004 calls for four HAB reports.

1. *Prediction and Response Report*  
([http://www.cop.noaa.gov/stressors/extremeevents/hab/habhrca/Predict\\_Resp\\_IntRpt\\_0107.pdf](http://www.cop.noaa.gov/stressors/extremeevents/hab/habhrca/Predict_Resp_IntRpt_0107.pdf))
2. National Scientific Research, Development, Demonstration, and Technology Transfer (RDDTT) Plan on Reducing Impacts from Harmful Algal Blooms
3. *Scientific Assessment of Freshwater Algal Blooms*
4. *Scientific Assessment of Marine Algal Blooms*

These reports will provide a blueprint for future US HAB research and response programs. The first of these, the *Prediction and Response Report*, has been completed ([http://www.cop.noaa.gov/stressors/extremeevents/hab/habhrca/Predict\\_Resp\\_IntRpt\\_0107.pdf](http://www.cop.noaa.gov/stressors/extremeevents/hab/habhrca/Predict_Resp_IntRpt_0107.pdf)) and the other three are due to be completed by Dec. 2008.

The large commitment to HABs at the National level is through an assemblage of various agency activities that address the goals originally articulated in the *National HAB Plan* (Anderson et al., 1993) and revised recently in the *Harmful Algal Research and Response National Environmental Science Strategy 2005-2015* (HARRNESS, 2005). HARRNESS called for increased efforts to assess socioeconomic, seafood safety, public health and recreational/drinking water impacts of HABs. The NOAA-sponsored *Harmful Algal Research and Response: A Human Dimensions Strategy* workshop and report (Bauer, 2006) provides a detailed implementation plan. Implementation of other major recommendations of HARRNESS will be guided by the HABHRCA reports described in the preceding paragraph.

Basic research on bloom development, persistence, and food web interactions as well as basic ecology, physiology, behavior, and toxicity of individual HAB species is addressed through several agencies, with the largest effort being the interagency ECOHAB Program (Ecology and Oceanography of Harmful Algal Blooms). This Program, established in 1997, has provided research funding through peer and panel review to over 114 projects (11 of them regional studies) with almost US\$88.6 million (1996 through commitments in 2011) contributed by NOAA, EPA, NSF, ONR, and NASA. There are 4 regional studies in progress now (Pacific Northwest *Pseudonitzschia* project, macroalgae in Hawaii, *Alexandrium fundyense* in the Gulf of Maine and *Karenia brevis* in the Gulf of Mexico). Recent projects focused on the following themes: regional projects that improve understanding of HABs leading to predictive models that can be used for forecasting and prevention, trophic transfer of toxins, economic analyses, cyanoHABs in the Great Lakes, development of new methods, especially automated sensors, and newly emerging problems.

NOAA also operates the Monitoring and Event Response for Harmful Algal Blooms (MERHAB). It has provided US\$26.4 million (1998 through commitments in 2010) for 25 projects, including 9 regional projects and 16 targeted projects. Peer reviewed projects fund scientists and state managers to demonstrate functional methods for detecting, tracking, and predicting HABs and incorporate advances into operational monitoring programs. Targeted projects are focusing on new assays and sensors for a variety of HAB toxins and cells. Ongoing regional projects are enhancing monitoring and response capabilities for *Karenia brevis* in the Eastern Gulf of Mexico, cyanobacteria in the lower Great Lakes, *Pseudo-nitzschia* along the central and southern California coast, and *Karlodinium micrum* and other HAB species in the Chesapeake Bay.

NOAA also provides Event Response funding to support local response efforts and to take advantage of the unique opportunity for research that such events provide ([http://www.cop.noaa.gov/stressors/extremeevents/hab/current/fact-ev\\_resp.html](http://www.cop.noaa.gov/stressors/extremeevents/hab/current/fact-ev_resp.html)). Both 2005 and 2006 were eventful years, with funding granted for 8 events, but 2005 was especially active with major events occurring in the Gulf of Maine and along the Florida coast in the Gulf of Mexico.

NOAA sponsored the *State of the Research on Red Tide in the Gulf of Mexico Workshop* in July of 2006 so that researchers and managers could summarize current research on *Karenia brevis* and develop priorities for future research. A Workshop report and a dedicated issue of *Harmful Algae* are anticipated in late 2007 or early 2008.

Two major Federal initiatives for “Oceans and Human Health” (OHH) were initiated in 2004, one by NSF and NIEHS and the other by NOAA. The NSF and NIEHS program established four national “centers” with external funding and the NOAA program established three “centers of excellence” within NOAA. The NOAA program also has an external research grants program. All of these programs encompass a wide range of research topics concerning the impacts of the

oceans on human and animal health. A large part of the portfolio of research in each of these initiatives is HAB-related. Another aspect of human health, seafood safety, including monitoring for HAB toxins, is also an identified Federal responsibility, generally under the purview of the FDA. Research on HAB-seafood safety linkages is focused in two Federal agencies (FDA and the CDC (Centers for Disease Control), developing diagnostics for HAB exposure and therapies as well as determining toxin pharmacologies, with intra- and extramural programs.

The total 2007 Federal investment in HAB-related extramural research grants under ECOHAB, MERHAB and OHH is expected to be in the range of \$10-15 Million.

A few agencies also have other non-specific internal funding programs that provide support for HAB oceanographic research projects as well. Toxin identification, chemistry, assay development and research on linkages between oceans and human health is primarily centered in three agencies (NOAA, FDA, and the NIEHS (National Institute for Environmental Health Sciences). Findings from these two activities, basic ecology/oceanography and toxin/cell identification and assay development, are rapidly incorporated into the expanding Federal-State partnered monitoring programs described above.

This coordinated effort results in a rather comprehensive National research capability for HABs, toxins, and human health, communicated to the national and international community through the NOAA-supported *National Office of Biotoxins and Harmful Algae* at the Woods Hole Oceanographic Institution. This national office also works closely with the IOC HAB programme, and is the North American “node” for distribution of conference proceedings and other publications of the IOC.

Every two years, a U. S. National HAB meeting is convened. The 4<sup>th</sup> National HAB meeting will be held October 29 - November 1, 2007 in Woods Hole, MA, to be hosted by the U.S. National HAB Office and supported by NOAA.

Another coordinating effort is led by the newly formed National HAB Committee (NHC), created under the guidance of HARRNESS. The NHC has been established for the purpose of providing a collective voice of the academic, management and stakeholder communities interested in national HAB issues. Composed of 15 rotating members, and presently led by two co-chairs, the NHC will:

- Facilitate implementation of HARRNESS and garner support among all stakeholders;
- Interface with the U.S. Interagency Working Group on HABs, Hypoxia, Human Health;
- Foster communication between all components of the HAB community and communicate these activities through the National HAB Office, through oral reports at the biennial National HAB Conference, and through listserves and websites as appropriate;
- Establish and promote interactions with related national and international programs by interfacing with related initiatives, such as GEOHAB, IOOS, GOOS, CUAHSI, CLEANER, NEON, and ORION;
- Respond to requests from Congress or federal and state entities for information or guidance on HAB issues;
- Respond to other stakeholders as appropriate
- Lead development of future National HAB Plans as needed
- Form ad hoc technical advisory committees as needed to address issues or requests; and
- Raise the visibility and understanding of HAB issues nationally

### **International activities**

The US remains very active in international HAB activities. It participates in numerous working groups and sections, such as those by ICES/IOC (Harmful Algal Bloom Dynamics Workign Group) and PICES (Harmful Algal Bloom Section), and sends high-level delegations to the

IPHAB panels. In particular, NOAA NOS has provided support for the further development of the Harmful Algal Event Data Base (HAEDAT) maintained by ICES and IOC. Many US scientists and centers also maintain bi-lateral research cooperation with scientists from many other countries. There is an ongoing program of cooperation with the EU on comparative and collaborative science on the ecology and oceanography of harmful algal blooms through the US National Science Foundation. One call for proposals has been issued, and two EU-US partnerships are being supported. The future of the EU-US program is not clear, but discussions are ongoing to try to keep the concept alive. This is anticipated to continue through International GEOHAB efforts. In 2006, NOAA provided funding to support a two year planning effort by the GEOHAB core project on Harmful Algal Blooms in Eutrophic Systems and NSF continues to support the GEOHAB office annually.

NOAA's labs (Northwest Fisheries Science Center in Seattle, Charleston, SC Lab and the Beaufort, NC Lab) have continued to assist foreign countries with toxin assays and HAB identification.

NOAA has also regularly supported international HAB meetings including meeting and student travel support for the recent 12<sup>th</sup> International Conference on Harmful Algae Copenhagen in 2006 and plans to provide support for the Hong Kong meeting in 2008. NOAA also sponsored the workshop and report, *Global Ecology and Oceanography of Harmful Algal Blooms: Harmful Algal Blooms in Eutrophic Systems* (GEOHAB, 2006). Pat Tester, a NOAA researcher, now chairs the International Society for the Study of Harmful Algae (ISSHA).

With respect to future priorities to be pursued in coordination with the IOC HAB Programme, the U. S. comments and recommendations about international activities that could be coordinated by IPHAB include:

- 1) **Capacity building and training.** We note that the IOC Science and Communication Centres in Copenhagen and Vigo have shown clear benefits to the international community through their outreach and training efforts, and continued support for these centers should be provided. U. S. scientists are willing to assist in these activities. It is recommended that a list of course prospectuses be developed to help secure the necessary funding or in-kind support from various sources for these training efforts in the future.
- 2) **The newsletter, *Harmful Algae News*,** is an excellent communication tool, and should be continued.
- 3) **Regional IOC HAB groups,** such as WESTPAC, FANSA, and ANCA are important mechanisms to prioritize, plan, and implement HAB activities throughout the world. Efforts should be made to continue these activities, and to expand their activities. The U. S. does not presently participate in many of these regional groups, but would like to do so in the future.
- 5) **Regional and national regulations** on algal toxins in seafood products are unfortunately not uniform internationally. The U. S. supports activities that will lead to harmonization of regulations, as this is critical to efficient importation and exportation of seafood potentially contaminated with algal toxins. Other health-related activities that could benefit from international coordination, including potential interactions with UN intergovernmental committees responsible for human health, is also encouraged.
- 6) **HAB databases** of international scope are a valuable service that is provided by the IPHAB and by ICES. NOAA has recently provided support to obtain the necessary expertise to add interactive mapping capabilities to the Harmful Algal Event Data Base (HAEDAT) and continues to support the inclusion of U. S. data through the National Office of Biotoxins and Harmful Algae.
- 7) The **Global Ocean Observing System (GOOS)** is of great relevance to HAB monitoring and research activities worldwide. Likewise, there is a growing recognition in the global observing

community that capabilities to detect HABs, their toxins or environmental conditions that may indicate that a HAB is likely, increase the value of observing systems. The incorporation of HAB-related detection capabilities, tailored to regional needs would be of great value in documenting trends and in facilitating monitoring and management efforts, and may lead to prediction and forecasting of HAB events. For example, Regional Coastal Ocean Observing Systems (RCOOSs), components of the United States IOOS effort, are meant to provide the local-scale data and information to address issues that are important to the stakeholders in a particular region, which in some cases includes HABs. The Gulf of Maine Ocean Observing System (GoMOOS), which has provided oceanographic data for use in conjunction with other data in order to monitor and predict *Alexandrium* bloom movement in the Gulf of Maine, offers a preliminary example of their application for enhancing HAB prediction. Continued involvement of HAB scientists and management experts in the GOOS program is highly recommended, and pilot projects on HABs should be considered by GOOS during program implementation.

We believe that highlighting specific elements of international programs and their benefits to contributing nations holds the best promise of near and long-term support.

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## U. VIET NAM

### Summary

Studies on Harmful Algal Blooms (HABs) in Vietnam during the last two decades have gained significant results through both national and international activities. In particular the HABViet Project facilitated via the IOC has contributed through its three phases I (1999-2002), II (2002-2005) and III (2005-2007). The Project included: building up a HAB network in Vietnam; a guide book for HAB species; data on HAB species/plankton in coast of Vietnam; and most of all, the strong supports on research capacities. Other projects were small scaled and regional. The two current monitoring programs which included HABs have been not by mean of the fully successful HABs management, one is only for the exported culture areas, and other is aimed mainly for pollution with low sampling frequency. With the results of the last decade, with mistakes accounts and demand of the country, a stronger and more effective monitoring program should be established at national scale. A better co-operation between some ministries/institutions in Vietnam as well as countries/institutions in Southeast Asia should also be set up as it has proven inadequate.

## Introduction

Studies on Harmful Algal Blooms (HABs) in Vietnam started with a small fund from the National Centre for Natural Science & Technology to the National Institute of Oceanography (both in Nha Trang and Hai Phong cities) in 1995. By this time the two primary reports were: Nguyen & Doan (1996) on blooms of *Noctiluca scintillans*, *Trichodesmium erythraeum*, and some potentially harmful algae in the Van Phong Bay (Khanh Hoa Province); and Nguyen & Chu (1997) on harmful algae in the coastal waters of the Tonkin Gulf. The following international cooperation programmes have established with the resource scientists from the National Institute of Oceanography: the Association of South East Asian Nations (ASEAN) – Canada programme; the Japanese-Vietnamese scientific co-operation; and the current ENRECA/DANIDA project, HABViet. Each of these project, although with small or large scale, short or long term, has contributed it important results in studies of HABs in Vietnam.

Through these studies, publications on HAB's issues were generally increasing with various aspects. Literatures on taxonomy would be listed as Lundholm & Moestrup (2000), Nguyen-Ngoc (2002), Chu (2002), Nguyen-Ngoc & Larsen (2003); on toxicity: Dao (1999); Yoshida *et al.* (2000), Kotaki *et al.* (2000); on physiology and autecology: Nguyen-Ngoc (2003); and on the bloom records: Nguyen (1999), Nguyen *et al.* (2003), Doan *et al.* (2003).

During these years, Vietnam has been served with few HABs events with some ecological and economical damages and the regulations for exported sea products (e.g. molluscs) together with both scientific and public increasing knowledge in harmful algal blooms, Vietnamese government has paid more attention on HAB research. Since 2004, there have been two national projects funded.

## A- HABs Research

HAB events: Bloom of *Trichodesmium erythraeum* in 1993, 1995, 1999 in Binh Thuan water (Nguyen & Doan, 1996; Nguyen, 1999) and in Khanh Hoa in 1995 (Nguyen & Doan, 1996); Bloom of *Noctiluca scintillans* in 1995 in Khanh Hoa coast (Nguyen & Doan 1996); the serious bloom of *Phaeocystis globosa* in Binh Thuan in 2002 (Nguyen *et al.*, 2003); *Heterosigma* sp. in 2002 in Khanh Hoa Province (Nguyen *et al.*, 2003); and *Microcystis* sp. in 2002 in Rach Gia Bay (Nguyen *et al.*, 2003).

### II-1. The HABViet Project

“A base-line study of toxic microalgae for the safeguarding of living resources in Vietnam: HABViet” 1997-January 2008

Project leaders are Mr. Henrik Enevoldssen, IOC, and Dr. Nguyen Ngoc Lam, ION, Vietnam. The immediate objective of the project: to survey the occurrence and distribution of harmful marine microalgae along the coast of Vietnam in order to assess potential risks for a developing aquaculture industry.

The long-term objective is to strengthen the scientific expertise in Vietnam. Such expertise will allow future environmental research programmes on the effects of harmful algal blooms including management and mitigation initiatives to rely on a scientific basis established in the country. The long-term objective also includes an up-grading of the educational system to produce marine botanists at both MSc and PhD level, with expertise in phytoplankton and marine algae.

The project has built up a national network on HABs in Vietnam, and the envolved institutions in the project have been developed expertise during the project phases:

- 1) ION (Institute of Oceanography, Nha Trang) is a national focal point for HAB studies. The HABViet Project will continue to enhance the ability of ION in providing data to the regional APEC and ASEAN network and to interact better with colleagues in the surrounding countries.
- 2) IOH (now is IMER- Institute for Marine Environment and Resources) will focus on further development of the taxonomic expertise in order to function as HAB expert centre for the northern part of the country.
- 3) HUS (Hue University of Sciences) will focus on curriculum building with emphasis on HAB. Strengthening of the teaching capacity in HUS will enhance the possibilities of educating HAB experts nationally.
- 4) ITB (Institute for Tropical Biology, Ho Chi Minh City) will focus on Cyanobacteria studies as well as HABs in the southern waters.

Throughout Phase I-II contact has been maintained with MOFI/NAFIQACEN (now as NAFIQAVED) and its Director Mr. Nguyen Tu Cuong, as well as Professor Thanh, vice-president of the Vietnam National Centre for Natural Science and Technology and Chair of the National Committee of the Intergovernmental Oceanographic Commission, the coordinators of MOFI/SEAQIP, and MOFI/SUMA to ensure that HABViet continues to build up the scientific expertise in algal identification and eventually also in ecology and toxicology that will back-up and underpin the monitoring and management responsibility of NAFIQACEN. This contact will be maintained through regular coordination and information meetings during the project implementation, and through participation of MOFI staff and other relevant stakeholders in workshops and the regional conference, which is planned at the conclusion of the HABViet project.

**Field and Laboratory research.** During the first and second phases of the project, the surveys for potentially harmful microalgae were conducted in more than 50 stations in almost every coastal Provinces of Vietnam. The sampling stations were weekly and monthly visited in 1999 - 2004. All data are stored and analysed in a database, Planktonsys (Bioconsult a/s, DK). Data from these survey were used for the HABViet Guide book (already published), HAB species abundance/distribution in time and space, and would be for many other purposes e.g. basic information for any coastal utilised plan.

Surveys on cyanobacteria in water reservoirs were also carried out during phase II of the project in Ho Chi Minh city. Publications regarding this issue are in editing.

Along with the surveys, HABs species were isolated and bring into cultures at the ION and with the backup at Copenhagen University. Experiments on the cultures were also set up, e.g. growth rate of HABs species in different culture conditions, bivalve feeding biology, life cycle.

Another advanced studies was continued in phase III of the project in 2006 in Cam Ranh Bay and Nha Phu Lagoon for assessment long-term (seasons) and short-term (weeks, days, hours) variation in phytoplankton communities in different waters.

During phase III, a comprehensive survey for benthic dinoflagellates has been conducted along the coast of Vietnam. Benthic species were isolated and used for experiments. Data for these investigations are used for a PhD student at the ION.

### **Capacity building**

- A well equipped phytoplankton research laboratory and a culture collection of harmful microalgae has been established at NIO, HIO, ITB and HUS. This includes an up-grading of the library facilities with a selection of classical and modern literature on phytoplankton and toxic algae.



- Training courses in algal identification and practical monitoring were organized. Additionally, Vietnamese researchers visited and worked at Danish research institutions.
- Two researchers have achieved a MSc degree in phycology and enrolled as PhD students at University of Copenhagen; Three MSc students who participated MSc programme in Hue University also supported by HABViet Phase II, will use samples and information to perform their theses. One student will work with planktonic dinoflagellates, other work with genus *Chaetoceros*, and one student will work with genus *Prorocentrum*.
- One participant is enrolled as PhD student at University of Hanoi. Two scientists from the National Institute of Oceanography-Nhatrang (ION) graduated their PhD degree at Botanical Institute (University of Copenhagen), October 2002.
- Organising a training course in taxonomy and biology of phytoplankton for 11 Vietnamese scientists from different Universities, Institution, and Fishery Agencies in May-June 2003.
- Teaching in the MSc course in summer 2004 at Hue University of Sciences.
- Hosting (supporting) two other PhD students will defend their PhD thesis in winter 2005 at ION.
- Supervising three MSc students from Hue University; One in Dalat University
- Supervisor for PhD student from National University in Ho Chi Minh City; Tay Nguyen University
- Provided two scientists to the IOC E-learning training course on taxonomy of harmful algae held in Hue city as guest lecturers (Dr. Nguyen Ngoc Lam & Dr. Doan Nhu Hai).
- Participated in the HABSEA-portal under UNESCO as editor and using part of information of HABViet.
- Building the unit of phytoplankton laboratories/offices at ION
- Setting up wet laboratory for the feeding biological experiments at ION

## **Publication**

- A bi-lingual (Vietnamese-English) illustrated guide for identification of harmful marine microalgae. Nordic Journal of Botany, Opera Botanica 140, 2003. It is a handbook for both scientists and management personnel, and may provide a scientific-technical basis for identifying high risk areas with respect to contamination of seafood, and in turn to identify areas which should be avoided for future development of a sustainable aquaculture industry.
- Various papers (ca. 50) were published in peer review international and national journals using full or part of HABViet data.

## **Workshop**

- Organising many workshops: 1998, 1999, 2000, 2001, 2003, 2004, 2005, and 2006.
- Organising National Seminar at ION in 2005
- Participated in WS in: Australia, New Zealand, USA, Monaco, Denmark, South Korea, France, Japan, Thailand, China, the Philippines to exchange HABViet scientific results, using part of full HABViet budget.

## **Public education**

- An exhibit called 'From Light to Life' was established at the National Oceanographic Museum in Nha Trang targeted broadly at local fishermen, pupils from elementary schools, and tourists to students from Universities.

- Write three articles and provide information for other two articles to public news papers to warn on the harmful algae.
- Being interviewed by Local and National TV on harmful algae.

## **II-2. Asean –Canada project**

Pilot project: “*Red Tide Monitoring in Khanh Hoa province*”, 1998-1999. Project leader: Dr. Nguyen Tac An, and Ms. Le Lan Huong, ION.

A pilot-scale Red Tide monitoring program undertaken during 1998 and 1999 has provided an enhanced understanding of the prevalence of harmful algal bloom (HAB) organisms in Vietnamese coastal waters. This activity was completed by scientists from the Institute of Oceanography Nha Trang (ION) with technical and financial support from the Canadian International Development Agency (CIDA) ASEAN-Canada Cooperative Program on Marine Science (CPMS-II).

Regular surveys of Nha Trang, Van Phong, and Cam Ranh Bays in Khanh Hoa province over a 15 month period confirmed the presence of harmful algal bloom (HAB) species. Twenty-nine HAB species which are potentially toxic to humans or cause harm to fish and invertebrates were present.

Mouse bioassays were applied on bivalve tissue collected from each of the study areas. Significant seasonal variations in toxicity were observed with the highest toxicity occurring in late summer and autumn. Highest toxicity was recorded in samples from Cam Ranh Bay but lower in samples collected from Nha Trang and Van Phong Bays. Both PSP and ASP were reported.

Synoptic water column measurements (i.e., temperature, salinity, pH, dissolved oxygen, BOD, nutrients, chlorophyll-a, metals) were collected to provide an understanding of environmental conditions associated with HAB events. Among the environmental parameters monitored, temperature was found to be closely correlated with water layers containing high algal densities and nutrient concentrations. Water quality measurements indicated that coastal nutrient enrichment is occurring in the study areas as a result of domestic, industrial and agricultural waste discharges.

Results from the pilot-scale study suggest that continued Red Tide monitoring in Vietnamese coastal marine waters would be beneficial. In particular, regular monitoring of selected areas such as Cam Ranh Bay would serve as an early warning system for HAB events that have the potential to negatively impact aquaculture activities and threaten human health. Based on the success of work completed to date in Khanh Hoa province, it is recommended that a similar monitoring approach and investigative techniques be applied on a larger scale as part of a Red Tide alert network in Vietnam.

## **II-3 The National project KC-09-19 (2004-2005)**

Project title “Investigation and studies on toxic and harmful algae in some coastal marine culture areas and propose solution for prevention and mitigation HABs” (KC-09-19) in 2004-2005. Project leader: Dr. Chu Van Thuoc, IMER. The studies were carried out in Hai Phong, Thai Binh, Thua Thien-Hue, Khanh Hoa, Ben Tre provinces and Ho Chi Minh City. Partners included

The project reported a list of potentially harmful algae including 61 species. 3 species were updated for the list of harmful algae species in Vietnam including *Alexandrium foedum*, *A. tamutum* and *Prorocentrum maculosum*. Some high densities of *Alexandrium* were found in July-August in Do Son, Lang Co and Nha Phu. *A. pseudogoniaulax* blooms in a shrimp pond in Nha Phu in August 2004 with density of  $2.4 \times 10^5$  cells L<sup>-1</sup>. Blooms of *Prorocentrum minimum* was registered in shrimp ponds in Do Son (Hai Phong province), and Lang Co (Thua Thien – Hue

Province). Another species *P. cf. lima* was found in high density ( $5.10^4$  cells  $L^{-1}$ ) in Lang Co (Thua Thien - Hue). Blooms of *Trichodesmium* spp. were recorded in centre and southern central waters from March - September. *Oscillatoria lemmermannii* were present all year round in Binh Dai (Ben Tre Province), reach high density ( $2.10^7$  cells  $L^{-1}$ ) in rainy season from July to September in shrimp pond and canal.

Culture experiments were set up for species of genera *Pseudo-nitzschia*, *Alexandrium*, and *Prorocentrum* to investigate affect of light, temperature, salinity and nutrients on the growth of these species.

Toxins in marine phytoplankton: There were low ASP toxic concentration in phytoplankton samples with present of *Pseudo-nitzschia* species. There was low concentration of PSP toxins in phytoplankton samples from Do Son - Cat Ba where *Alexandrium* species were mainly present. *Pseudo-nitzschia* species isolated species in 2004-2005 were not found to produced toxins. *P. pungens* isolated in the north was found both toxic and non-toxic clones. Toxic clones produce low toxin concentration 0.38 - 0,53pg/cell. *Alexandrium minutum* isolated from shrimp pond in Doson produces mainly GTX4 with minor GTX1, and neoSTX, and trace amount of GTX3, GTX2, and dcSTX. Beside, new gonyautoxin analogue were found. Toxic concentration varied from 3.0 - 13.8 fmol/cell. *A. tamarense* isolated from Cat Ba was not shown to produce toxins.

Phycotoxins in bivalve: Bivalve collected from 7 culture areas were all contained low ASP, PSP and DSP toxins. The toxin concentrations were much lower than tolerable level (Vietnam). However, there were two cases with DSP in blue mussle were as high as twice Vietnamese tolerable level in Cat Ba, 2005. Non intoxicaton were reported at the area during that time.

There was correlation beatween ASP toxin in bivalve and cell density of *Pseudo-nitzschia* in investigated areas while there were not clear beatween PSP and DSP toxins and their relative causative species.

#### II-4. The National Project KC.09.03 (2007-2009)

“Biology and Ecology of HABs, the algal blooming dynamics in south central coast of Vietnam and its effects on marine resources ”

Project leader: Dr. Nguyen Ngoc Lam, ION

Objectives of the project are: 1) to characterise HAB dynamics, 2) to assess effects of Habs on marine resources; and 3) to propose an early waning of HABs in southern central coast and a solution for HABs mitigation. The project is based on already established national networks with strong linkage to national and international **experts/organisations**.

#### II- 5. Other International Organisations

There have been Vietnamese researchers involved in international activities regarding HABs studies: IOC – Copenhagen (training courses, scientific visit, literatures, ... ); IOC-WESTPAC (training courses, scientific visit, literatures, conferences, TTR, ... ); JSPS (Conference, workshop, ...); IAEA (conference, training course, research, ...), ...

#### C- The Current Monitoring Programs

##### **I- National Monitoring on Environment**

The national environmental Monitoring programm was established since 1993 under Ministry of Natural Resouces and Environment, including 18 stations along the coast of Vietnam and other stations in 2 areas offshore (one cruise a year). Harmfull algal blooms were one of the subjects. However, the sampling frequency is rather low, four times a year and it was resently reduced to twice a year.

## **II- Monitoring Program for Bivalve Molluscs Production by NAFIQAVED**

The NAFIQAVED was by appointment of the Ministry of Fisheries responsible for the monitoring programme. Based upon the analytical results of water samples and mussels, NAFIQAVED decides whether fishing areas are declared open, closed, or under intensified monitoring and informs the Service of Fisheries/Fishery Resource Protection Section of the provinces of these decisions by facsimile.

The primary objective of the programme is to protect consumers from toxic shellfish harvesting for exportation. Species involved in the programme including: White clam (*Meretrix lyrata*), Clam (*Meretrix meretrix*), Yellow clam (*Paphia* sp.), Blood clam (*Tegillarca granosa*), Antique ark (*Anadara antiquata*).

Eighteen harvesting areas of bivalve mollusks belong to 8 Provinces/Cities were sampled with sampling frequency for: Harmful algae, and DSP, PSP, ASP toxins in bivalves every second week.

Regulation for potential toxic algal density: *Dinophysis caudata* 500 cells L<sup>-1</sup>; *D. acuminata* 500 cells L<sup>-1</sup>; *Alexandrium* spp. 200 cells L<sup>-1</sup>; *Pseudo-nitzschia* spp. 100.000 cells L<sup>-1</sup>. The safety limits of algal toxins in the shellfish applied by the Vietnamese authorities follow the guidelines given in the EU Council directive No. L268, of 15 July 1991.

During 2001–2005, there were 4 times *Dinophysis caudata* density exceeded warning limits (500 cells/L). The follow actions were taken: Increased sampling frequency for toxicity and potentially toxic species; and additional bivalve samples from previous harvesting in the same area. However, there were no DSP toxins detectable during these high density events of *D. caudata*.

During 2001-2005, there were 5 times DSP toxins detected. The following actions were including closure of harvesting areas with bivalve contaminated DSP toxins; increasing phytoplankton and bivalve sampling; and additional bivalve samples from previous harvesting in the same area.

## **C- HAB issue requiring intergovernmental cooperation**

- It is necessary to have a new management board including representatives from the Vietnamese Academy of Science and Technology, Ministry of Natural Resources and Environment, and NAFIQAVED to cover more efficiency HABs monitoring. This requires some certain assistants from intergovernment organisations (e.g. advising, funding) as well as interaction among the countries in the region (e.g. action plans, method applied, communication).
- The National HABs Project and HABViet project Phase III plan to organize the regional Conference on “HABs and related problems” in Nha Trang city in February 2008. We are calling for partners, sponsors, participants, co-operation and any contribution to strengthen the success of the conference.
- Require the access on satellite data (oceanography and ocean colors).
- Co-operation on HABs in coastal upwelling waters.
- HABs oceanography.
- Increase communication between IOC and Vietnam as well as more linkage to regional activities.
- Confirmation analytical toxins in case of new and unknown toxins in certificated labs (e.g. assistance and/or funding for toxin confirmation).

## **D- Capacity building needs**

- Enhancing human capacity in training and advanced training on HABs studies as well as scientific exchange.
- Enhancing research equipments for key institutions.

ANNEX IV

LIST OF DOCUMENTS

Document code	Title
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**WORKING DOCUMENTS**

IOC/IPHAB-VIII/1 prov.	Provisional Agenda with annotations
IOC/IPHAB-VIII/1 Add. Prov.	Provisional Timetable
IOC/IPHAB-VIII/3 prov.	Executive Summary, Resolutions and Recommendations Results of the HAB programme impacts Assessment conducted during IPHAB-VIII
IOC/IPHAB-VIII/4 prov.	Provisional list of documents
IOC/IPHAB-VIII/5 prov.	Provisional list of participants

**INFORMATION DOCUMENTS**

IOC/IPHAB-VIII/3	Report of the IOC Intergovernmental Panel on Harmful Algal Blooms, Seventh Session, Paris 16-18 March 2005, Executive summary
IOC/IPHAB-VIII/Inf.1	Extract from: Twenty-fourth Session of the IOC Assembly, Paris, 2005.
IOC/IPHAB-VIII/Inf.2	Information on HABP developments 2005-2006
IOC/IPHAB-VIII/Inf.3	Overview of resources and needs: draft HABP Work Plan, 2008-2009
IOC/IPHAB-VIII/Inf.4	Report 2005-2006: IOC-IEO Science and Communication Centre on Harmful Algae, Vigo, Spain
IOC/IPHAB-VIII/Inf.5	Report on IOC/WESTPAC-HAB
IOC/IPHAB-VIII/Inf.6	UNESCO Cross Cutting Project ANCA-FANSA Portal
IOC/IPHAB-VIII/Inf.7	Report of the VII IOC Regional Working Group on Harmful Algal Blooms in South America (FANSA), 21-23 June 2006, Lima, Peru
IOC/IPHAB-VIII/Inf.8	Report of the IOC Regional Group on Harmful Algae of North Africa, HANA
IOC/IPHAB-VIII/Inf.9	Overview of IOC training courses on HAB
IOC/IPHAB-VIII/Inf.10	GEOHAB SSC 2007 and Terms of Reference. Revised ToR's for endorsement by IPHAB-VIII
IOC/IPHAB-VIII/Inf.11	Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) program: Activities 2005-2006
IOC/IPHAB-VIII/Inf.12	ICES/IOC/SCOR Working Group on GEOHAB Implementation in the Baltic 2005, 2006
IOC/IPHAB-VIII/Inf.13	ICES-IOC Working Group on Harmful Algal Bloom Dynamics: Report of the meeting, 4-7 April 2005, Flødeviken, Norway, Report of the meeting 3-6 April 2006, Gdynia, Poland, Executive summary of the meeting 10-13 April 2007, Riga, Lithuania
IOC/IPHAB-VIII/Inf.14	Joint ICES/IOC Intercomparison Workshop on New and Classic Techniques for Estimation of Phytoplankton Abundance (WKNCT)
IOC/IPHAB-VIII/Inf.15	reports of the ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors, 2005, 2006
IOC/IPHAB-VIII/Inf.16	Report on IPHAB task Team on Algal Taxonomy
IOC/IPHAB-VIII/Inf.17	Outline of Harmful Algal Information System and Cooperation with IODE, CoML/OBIS

<b>Document code</b>	<b>Title</b>
IOC/IPHAB-VIII/Inf.18	ChlorOGIN, (Chlorophyll Ocean Global Integrated Network) Report of the Plymouth Chlorophyll Meeting and Workshops
IOC/IPHAB-VIII/Inf.19	Implementation of HAB Monitoring Within the Global Ocean Observing System (GOOS) Strategic Implementation Plan for the Coastal Module
IOC/IPHAB-VIII/Inf.20	General Information
IOC/IPHAB-VIII/Inf.21	Proposal for IOC co-sponsorship of a proposed new SCOR Working group to assess and compare spatial relationship between changing global nutrient exports and loads and the proliferation of major HAB species

#### **OTHER DOCUMENTS**

GEHOAB Report N°. 1	Science plan of the IOC-SCOR Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) Programme
GEOHAB Report N°. 2	Implementation Plan of the IOC-SCOR Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) Programme
GEOHAB Report N°. 3	GEOHAB Core Research project on HAB's in Upwelling Systems
GEOHAB Report N°. 4	GEOHAB Core Research Project on HAB's and Eutrophication
IOC Annual Report N°. 11	IOC Annual Report 2004 (on request)
IOC Annual Report N°. 12	IOC Annual Report 2005 (on request)

ANNEX V

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ANNEX VI

**TERMS OF REFERENCE OF  
THE IOC INTERGOVERNMENTAL PANEL ON HARMFUL ALGAL BLOOMS**

Resolution XVI-4 (SC/MD/97), March 1991)

**INTERGOVERNMENTAL PANEL ON HARMFUL ALGAL BLOOMS**

The Intergovernmental Oceanographic Commission,

**Recalling** that the IOC, at the Fourteenth Session of its Assembly, endorsed the development of the sub-programme on Harmful Algal Blooms, and that the Twenty-third Executive Council, through its Resolution EC-XXIII.1, endorsed the programme development so far,

**Being aware** of the increasing socio-economic risks posed by toxic algae and harmful algal blooms to marine organisms, fisheries, aquaculture, human health and the coastal environment,

**Approves** the formation of an *Ad hoc* Intergovernmental Panel on Harmful Algal Blooms, with the Terms of Reference shown in the Annex hereto;

**Invites** FAO to co-sponsor the *Ad hoc* Panel;

**Invites** Member States which intend to be involved in the implementation of a programme on Harmful Algal Blooms to nominate their representatives for the *Ad hoc* Panel and inform the Secretary IOC accordingly;

**Decides** to review, at the Seventeenth Session of the Assembly, the Terms of Reference of the *Ad hoc* Panel, in conjunction with the Commission's review of the overall organization of the OSLR Programme;

**Instructs** the Secretary to convene the First Session of the *Ad hoc* Panel as soon as possible.

Annex to Resolution XVI-4

**Terms of Reference of the *Ad hoc* Intergovernmental Panel on Harmful Algal Blooms**

**1. FUNCTIONS**

The *Ad hoc* Intergovernmental Panel on Harmful Algal Blooms is established to meet the scientific, managerial, implementation, and resource needs of the Harmful Algal Blooms Programme.

**The Panel will carry out** the following functions:

- 1.1 Review and identify programme requirements;
- 1.2 Promote efficient and cost-effective implementation of the HAB programme and prepare recommendations on this implementation to the Assembly and Executive Council;
- 1.3 Identify the resources necessary to meet HAB programme needs.
- 1.4 Ensure effective interaction and communication with regional intergovernmental (e.g., ICES, ICSEM and GFCM) as well as regional and global non-governmental (e.g.,

SCOR) organizations involved in research on toxic algae and harmful algal blooms; and

- 1.5 Report to the Twenty-fifth Session of the Executive Council and the Seventeenth Session of the Assembly.

## **2. COMPOSITION**

The membership of the *Ad hoc* Panel is open to Member States of IOC (and FAO, if it agrees to co-sponsor the Panel), which have declared to the Secretary IOC their involvement or intention to participate in the development and implementation of the Harmful Algal Bloom Programme on a global, regional, or national scale. The Panel shall include the Chairman of the OSLR Guiding Group of Experts, representatives of IOC regional and other subsidiary bodies, and of other interested international organizations, particularly SCOR. Invitations to participate in Panel activities may be extended to scientific experts at the request of the Panel and with the approval of the Secretary of the IOC.

## **3. ORGANIZATION OF THE SESSIONS**

- 3.1 The Panel will, prior to the closure of each Session, elect from its Members a Chairman who will serve in that capacity until the closure of the next Session.
- 3.2 The Sessions shall, in principle, be arranged without financial costs to IOC. Sessions will be conducted, documentation will be provided, and the report of each session will be prepared in English and in other working languages of the Commission as appropriate and required.
- 3.3 Secretariat support for the Panel will be provided by the Secretary IOC.

ANNEX VII

**IOC HARMFUL ALGAL BLOOM PROGRAMME PLAN**  
**(Revised extract from IOC Workshop Report No. 80)**

PHAB-IV REVISION (1997)

*6.1. EDUCATIONAL PROGRAMME ELEMENTS*

**6.1.1 Information Network**

Goal: To develop, encourage and maintain the flow of information, technology and expertise to scientists, administrators and the general public.

Objectives:

- (i) Produce a regular newsletter for reporting bloom occurrences, recent publications, meetings, new techniques, requests for assistance and general information.
- (ii) Prepare and publish a 2<sup>nd</sup> edition of the IOC manual containing standardized methodology for the study of harmful algae.
- (iii) Prepare identification sheets and reference slides for harmful species, preserved material and video documentation, updated as necessary.
- (iv) Maintain and update as necessary the IOC lists of experts grouped according to areas of expertise.
- (v) Ensure rapid communication of harmful events, new problem species, methodologies and other common information to researchers, administrators and medical personnel.
- (vi) Prepare, distribute and maintain fact sheets on toxin for administrators, the medical community and the general public.
- (vii) Facilitate worldwide distribution of reference books, conference proceedings and equipment.
- (viii) Ensure the distribution of material with respect to public safety and education.

**6.1.2 Training**

Goal: To promote and facilitate the development and implementation of appropriate training programmes in order to distribute the necessary knowledge and expertise on a global basis.

Objectives:

- (i) Facilitate workshops and training programmes on taxonomy, ecology, toxin extraction and analysis, management strategies, public health and safety and mitigation techniques.
- (ii) Promote access to equipment and the extensive training of selected individuals in regions that lack adequate facilities and properly trained personnel for toxin analysis.

## 6.2 SCIENTIFIC PROGRAMME ELEMENTS

### 6.2.1 Ecology and Oceanography

Goal: To understand the population dynamics of harmful algae.

Objectives:

- (i) Develop the necessary understanding of bloom dynamics of harmful algae, which includes the phases of bloom progression (excystment or bloom initiation, exponential growth, aggregation, toxicity, as well as death, grazing, encystment, sinking or dispersal) and the succession of phytoplankton species.
- (ii) Develop numerical models (and eventually reliable predictions) of toxic blooms based on hydrodynamic, chemical and biological principles as well as the unique hydrography, chemistry and plankton composition determined by regional research programmes.
- (iii) Determine the role of nutrients (total amounts and ratios) in the dynamics of harmful algal events; investigate the relative importance of natural versus anthropogenic sources.
- (iv) Elucidate the importance of human activities in the dispersal of certain harmful species (e.g., via ship ballast water; transfer of shellfish stocks).
- (v) Derive quantitative relationships among the biological, physical and chemical parameters with respect to the bloom-forming species that can be used in a local management context through predictive models and management strategies.
- (vi) Determine the ecological role of toxicity in the population dynamics of toxic species and the consequences of toxicity to living resources.
- (vii) Design appropriate experimental and field studies to develop the required understanding of the hydrography, ecology and oceanographic conditions controlling the population dynamics of harmful species.
- (viii) Determine the ecophysiological capabilities of causative species (K,  $v_{max}$ , allelopathic substances, grazer repellent, life-cycle strategies).
- (ix) Establish long-term trend monitoring stations to document changes in phytoplankton species composition and associated physical and chemical variables over decadal time-scales.
- (x) Develop studies on cyst assemblages to document the areal distribution of harmful, cyst-forming species in order to identify risk areas for harmful algal blooms.
- (xi) Encourage analysis of sediments, especially from anoxic basins, that can provide evidence (cysts, frustules, etc.) for the prior occurrence of harmful species in regions where recent introductions are suspected.

### 6.2.2 Taxonomy and Genetics

Goal: To establish the taxonomy and genetics of the causative organisms at the appropriate levels.



Objectives:

- (i) Develop and maintain the capability to recognize, characterize and identify harmful species by morphological criteria, including ultrastructural and phenotypic variability and also by different life stages such as resting cysts.
- (ii) Establish a group to make taxonomic recommendations and to develop identification standards for preparation of manuals, reference materials and training standards.
- (iii) Determine the genetic heterogeneity within species and isolates with respect to mating compatibility and molecular characteristics.
- (iv) Support existing and establish new regional culture collections specializing in harmful species.
- (v) Promote the development of new, rapid, automated identification, discrimination and counting techniques such as, image analysis, flow cytometry and immuno-labelling.
- (vi) Encourage and enable the development of computerized taxonomic data bases of harmful species.
- vii) Organize and conduct intercalibration exercises.

**6.2.3 Toxicology and Toxin Chemistry**

Goal: To determine the physiological and biochemical mechanisms responsible for toxin production and accumulation and to evaluate the effect of phycotoxins on living organisms.

Objectives:

With respect to physiology:

- (i) Establish the biosynthetic pathways of toxin production in algae including defining the role of endo- or exocellular bacteria and viruses.
- (ii) Determine the physiological mechanisms underlying variable toxicity among strains of species or within single strains grown under different conditions.
- (iii) Define the toxin accumulation, chemical conversion and depuration processes in contaminated seafood.
- (iv) Determine the processes of toxin degradation.

With respect to chemistry:

- (v) Isolate, identify and/or elucidate the structure of toxins.
- (vi) Prepare and supply toxin standards and reference materials.
- (vii) Develop new chemical analytical methods for toxins, specifically:
  - 1. alternative assay methods to replace such tests as mouse and other bioassay organisms, while improving the sensitivity, specificity and reproducibility of all methods; and
  - 2. simple field assay kits.

With respect to toxicology:

- (viii) Define the fate and effects of algal toxins in the marine food web.
- (ix) Elucidate mechanisms of toxicity to marine animals.
- (x) Determine the mechanisms responsible for the mass mortalities of fish and other marine organisms caused by toxic substances.
- (xi) Establish pathological indicators to determine toxins responsible for mortalities and other impacts.

### 6.3 OPERATIONAL PROGRAMME ELEMENTS

#### 6.3.1 Resource Protection

Goal: To develop and improve methods to minimize the environmental and economic consequences of Harmful Algae.

Objectives:

- (i) Assist managers in designing, evaluating and improving cost-effective procedures for selecting and protecting aquaculture sites; applying methods for early warning of toxicity and mass mortalities; and developing management strategies.
- (ii) Assist managers in applying scientific results as quickly and effectively as possible to resolve management, mitigation, public safety, public education and public relations problems.
- (iii) Assist managers in developing strategies and procedures for protecting the tourist and amenity value of coastal areas.

#### 6.3.2 Monitoring

Goal: To promote and facilitate the development and implementation of appropriate monitoring programmes.

Objectives:

- (i) Provide a source of information and guidance on design and implementation of monitoring programmes.
- (ii) Interact with, and encourage, long-term regional, national and international monitoring plans and programmes to identify trends and cycles in the frequency of harmful algal blooms, their resulting toxicity for marine life, and suspected causes (e.g., climatological, hydrographical, or nutrient changes).
- (iii) Ensure the compatibility (e.g., techniques, type of data collected) of plankton and toxin monitoring programmes with basic studies of algal bloom dynamics and ecology.

#### 6.3.3 Public Health and Seafood Safety

Goal: To protect public health and ensure seafood quality.

Objectives:

- (i) Facilitate monitoring for toxic species and seafood toxins.
- (ii) Encourage standardization of methods for toxin detection and levels for market closure.
- (iii) Facilitate testing of techniques for the mitigation of noxious blooms: (e.g., forced sedimentation, aeration, sea surface scum collection).
- (iv) Where appropriate, assist with measures to avoid or mitigate harmful events.
- (v) Develop antidotes against seafood toxins.

## ANNEX VIII

### IOC INTERGOVERNMENTAL PANEL ON HARMFUL ALGAL BLOOMS INFORMATION ON DEVELOPMENTS IN THE INTERSESSIONAL PERIOD

#### TABLE OF CONTENTS

PROGRAMME DEVELOPMENT	Page
1. Staffing	
1.1 Staffing of the Programme Office .....	3
1.2 Science and Communication Centres .....	3
2. Regional groups and workshops	
2.1 IOC Regional Work Group on Harmful Algae in South America.....	4
2.2 IOC Regional Work Group on Harmful Algae in the Caribbean.....	4
2.3 IOC/WESTPAC/HAB .....	4
2.4 IOC/HANA Regional Network for North Africa.....	4
EDUCATIONAL ELEMENTS	
3. Information Network	
3.1 Harmful Algae News .....	5
3.2 Directory .....	5
3.3 Regional Directory .....	6
3.4 HAB on Aquatic Cyanobacteria .....	6
3.5 UNESCO monographs on oceanographic methodology .....	6
3.6 Co-sponsorship of conferences related to HAB.....	6
3.7 Provision of literature .....	7
3.8 Harmful Algal Event Database- HAEDAT .....	8
3.9 IOC HAB Internet Site.....	9
4. Training	
4.1 HAB Training Programme: implemented courses .....	9
4.2 HAB Training Programme: planned courses .....	9
SCIENTIFIC ELEMENTS	
5. Oceanography and Ecology	
5.1 ICES-IOC Working Group—WGHABD .....	10
5.2 IOC-SCOR GEOHAB .....	11
5.3 ICES-IOC-SCOR Working Group—WGGIB .....	12
5.4 ICES-IOC-IMO Working Group—WGBOSV .....	12
6. Taxonomy and Genetics	
6.1 Task Team on Algal Taxonomy .....	13
7. Toxicology and Toxin Chemistry	
7.1 Task Team on Aquatic Biotoxins .....	13

## OPERATIONAL ELEMENTS

8.	Monitoring	
8.1	IOC-ICES HAB Monitoring database- MONDAT .....	14
8.2	HAB and the Global Ocean Observing System .....	15
8.3	HABWATCH Monograph .....	16

### Appendice I

An overview of contributions to the IOC for development and implementation of the Harmful Algal Bloom Programme 2005–2006.

### Appendice II

Implementation of IPHAB-VI Resolutions and Recommendations

## PROGRAMME DEVELOPMENT

### 1. Staffing

#### 1.1 Staffing of the Programme Office

The IOC Secretariat has one staff assigned to the HAB Programme. H. Enevoldsen is located at the decentralized Programme Office at the IOC Science and Communication Centre on Harmful Algae at University of Copenhagen, Denmark. The post for the HAB Programme is not a permanent post and is in the period 2005-2007 funded through extra-budgetary contributions from Denmark and the USA combined with 1/3 from IOC Regular Programme in 2006 and 2007. Ms. Virginie Bonnet is the administrative Assistant for the HAB Programme and is located at IOC Headquarters, Paris. There is at present no extra-budgetary contributions committed to maintain a post for HAB for 2008 and onwards.

#### 1.2 HAB Science and Communication Centres

The establishment of HAB Programme activity centres was proposed at the Twenty-fifth Session of the IOC Executive Council (Paris 10-18 March 1992) and the idea was further elaborated at the First Session of IPHAB (23-25 June 1992). At the Seventeenth Session of the IOC Assembly (Paris, 25 February-11 March, 1993), Denmark and Spain offered to host and establish Science and Communication Centres on Harmful Algae. The main purpose of the Centres is to provide the framework for systematic assistance in training and capacity building to developing countries with respect to harmful algae.

The IOC Science and Communication Centre on Harmful Algae in Copenhagen, Denmark, opened in May 1995. The Centre is a decentralized programme Office for the IOC HAB Programme and is staffed by Mr. Henrik Enevoldsen, IOC Project Coordinator, and Associate Professors Drs. Jacob Larsen and Gert Hansen. The Centre is hosted by, and located at, the Institute of Biology with Professor Ø. Moestrup as the focal point at the University. Activities are centred on capacity building in identification of harmful algae and associated services. The Centre is sponsored by DANIDA, the University of Copenhagen, the National Environmental Research Institute, the Fisheries Research Institute and the IOC. The core extra-budgetary support is provided by Danida to the IOC Trust Fund.

Following the decision taken at IPHAB-V, and in view of the formulation of a new work plan for 2003-2007, a panel was composed with the aim of reviewing the activities of the IOC Science and Communication Centre on Harmful Algae in Copenhagen. The reviewers unanimously expressed the judgment that the Centre has been a success, its plans are appropriate and it deserves continued support. The review concluded that plans for 2003-07 were realistic and credible. The reviewers suggested additional activities as well as the expansion of those presently carried out to more countries and regions. Of particular challenge is the role that the Centres can have in organizing international cooperation in HAB research and monitoring, and in providing capacity building in new fields.

As a follow up to recommendations of the review, negotiations were made during 2003 and 2004 with the Danish donors. However, due to changed policy of the Danish government with respect to the UN agencies it has not been possible to augment the support; at the contrary it has been a hard struggle to maintain the present level. Early 2005 Danida committed to co-fund the Centre until end 2007. The continuation of the Centre beyond 2007 will require identification of new extra-budgetary funding. As a follow-up to IPHAB-VI.3 the partnership in the Copenhagen Centre was expanded through formal memoranda of understanding with Alfred Wegener Institute for Polar and Marine Research, the Research Institute Senckenberg, and the Friedrich Schiller University Jena, Germany. The new partnership will provide the platform for implementation of training courses on qualitative and qualitative determination of algal toxins.

The IOC-IEO Science and Communication Centre on Harmful Algae in Vigo, Spain, was established in October 1996, after a document of understanding was signed between IOC and IEO (Instituto Español de Oceanografía). The Centre is located at the Oceanographic Centre in Vigo. The Centre staff is the head, Mrs. Monica Lion, and one assistant, Mrs. Cristina Sexto. The Centre also draws on the scientific staff of the IEO in Vigo under the coordination of Dr. Beatriz Reguera. The Centre provides advice, and scientific and technical assistance on problems related with monitoring and management of harmful algae events, and the characterization of the microalgae and their toxins (taxonomy, toxin content, ecology). Priority is given to the cooperation with Iberoamerican and the Maghrebian research institutions. The Centre is sponsored by the IEO (through the IOC Trust Fund), and IOC. The "Spanish Agency for International Cooperation"(AECI) cosponsors the courses held at the Vigo Centre. The agreement and sponsorship was renewed in March 2002 to continue the activities of the Centre until end of 2006. Spain committed during the XXIII IOC Assembly (June 2005), to continue the Centre in Vigo and a new Memorandum of Understanding is in the process of being signed to renew the activities of the centre until end 2011.

The activities of the two Centres are coordinated and coupled as appropriate, and are intended to be as complementary as possible. Both Denmark and Spain have provided part of the resources for the Centres to the IOC Trust Fund.

The IOC Assembly has expressed its wish to continue the Centres beyond the initial periods through Resolution XX.3.

An executive summary of the 2005-6 Activity Report of the Vigo Centre is available as Document IOC/IPHAB-VIII/Inf.4.

## 2. Regional groups and workshops

### 2.1 IOC Working Group on Harmful Algal Blooms in South America (COI-FANSA)

A detailed report of FANSA activities is given in Document IOC/IPHAB-VIII/Inf.7.

A copy of the FANSA-ANCA Portal Work Plan is attached as Document IOC/IPHAB-VIII/Inf.6

### 2.2 IOC Working Group on Harmful Algal Blooms in the Caribbean (COI-ANCA)

ANCA had no meeting in the period 2005-2006. The Chair of ANCA will provide a report on activities.

### 2.3 IOC/WESTPAC HAB

IOC/WESTPAC-HAB has, through the WESTPAC-HAB Chair Dr. Y. Fukuyo, received support from Japan to conduct capacity building in the WESTPAC region and to provide a species identification service. The support is for a ten-year period starting from 1995. In 2004 WESTPAC/HAB started a training through research project (TTR).

A detailed report of WESTPAC/HAB activities is given in document IOC/IPHAB-VIII/Inf.5.

### 2.4 Harmful Algae of North Africa: HANA , a regional network

The Participants at the "Regional Training Course on Harmful Algae" organised by IOC in cooperation with the AECI, NAUTA, IEO, COPEMED and DANIDA, from 1 to 12 December 2003 at the INSTM, Salammbô, Tunisia, led by Professor Y. Halim resulted in improved cooperation on HAB among the countries along the North African coast. Recalling the serious impacts of this problem on marine resources and on aquaculture, and referring to the desirability of combining efforts and means and of cooperation at the regional scale towards a better management of the HAB problem, the participants formulated the establishment of a network "Harmful Algae of

North Africa ", HANA. This initiative is a follow-up to IPHAB Recommendation IPHAB-VI.1. The HANA group is now operation under the auspices of the IOC HAB Programme as endorsed by IPHAB.

The Chair HANA will give a report of HANA activities 2005-2006.

## EDUCATIONAL ELEMENT

### 3. Information Network

#### 3.1 *HARMFUL ALGAE NEWS* - an IOC newsletter on harmful algae and algal blooms;

Issues No. 28-32 of *Harmful Algae News* have been published in the intersessional period. HAN is published whenever there is sufficient material for an issue. The number of subscribers has stabilized just above 2,000. HAN is produced by the IOC Centres in Vigo and Copenhagen. Subscriptions and back issues are available at <http://ioc.unesco.org/hab/news.htm>

An Editorial Team composed of 13 regional co-editors was established in 1993 in order to support the Editor in his efforts to make HAN a broad newsletter both scientifically and geographically. At IPHAB-III and IV the limited support from the Editorial Team was noted and discussed. Consequently the Team is de facto non functional and has been disbanded. However, one co-editor (Shumway) has committed to actively support the Editor.

#### THE EDITORIAL TEAM FOR THE IOC NEWSLETTER "*HARMFUL ALGAE NEWS*" 2007-2009

EDITOR, Dr. Tim Wyatt, Instituto de Investigaciones Marinas, SPAIN

#### CO-EDITORS:

Dr. Amelia la BARBERA, FONIAP, VENEZUELA

Dr. Laurita BONI, University of Bologna, ITALY

Dr. José Ignacio CARRETO, Instituto Nacional de Investigación y Desarrollo Pesquero, ARGENTINA

Dr. Allan CEMBELLA, NRC, CANADA

Dr. Rhodora AZANZA, University of the Philippines, PHILIPPINES

Dr. Einer DAHL, Institute of Marine Research, NORWAY

Dr. Yasuwo FUKUYO, Asian Natural Environmental Science Center, JAPAN

Ms. Itaf GNINGUE, Centre de Recherches Oceanographiques de Dakar Thiaroye, SENEGAL

Dr. Youssef HALIM, University of Alexandria, EGYPT

Dr. Iddya KARUNASAGAR, University of Agricultural Sciences, INDIA

Dr. Anne-Marie LEGRAND, Institut de Recherches Médicales Louis Malardé, FRENCH POLYNESIA

Dr. Sandra SHUMWAY, Department of Marine Resources, UCONN, USA

#### 3.2 Directory of Experts, HAB-DIR

The Directory has been prepared to assist countries facing toxic and harmful algal bloom emergencies by facilitating rapid access to scientists, fisheries managers, public health officials, and physicians dealing with toxic and harmful algal blooms and their consequences to fisheries, aquaculture, and public health. The second edition of Directory was a joint IOC-NOAA (USA) effort, and was published by the IOC in May 1995. As recommended by IPHAB-III, HAB-DIR became a searchable database at the internet. HAB-DIR is a sub-section of the IOC global directory of experts in marine and freshwater science, the 'Ocean Expert'. HAB-DIR can be edited on-line, and new entries can also be submitted on-line. HAB-DIR is regularly announced at PHYCOTOXINS and in Harmful Algae News and people are encouraged to up-date their information of to join the directory. HAB-DIR is an integrated part of OceanExpert at <http://www.oceanexpert.net/>



### 3.3 Regional Directory of Experts and Data-base

Following the request by the IOC-FANSA Working Group, the UNESCO/ROSTLAC Office in Montevideo has established an IOC-FANSA DATA BASE containing (i) a regional directory of scientists working on phytoplankton and harmful algae problems in South America and (ii) a list of all the scientific publications on phytoplankton and harmful algal blooms available in South America. This product is integrated into the FANSA-ANCA Portal.

### 3.4 Manual on Aquatic Cyanobacteria

A 'Manual on Aquatic Cyanobacteria, a photo guide and a synopsis of their toxicology', by Gertrud Cronberg and Helene Annadotter was published jointly with the International Society for the Study of Harmful Algae (ISSHA). Potentially harmful cyanobacteria occur widespread in the aquatic environment and this manual treats their taxonomy, identification, and toxicology across freshwater, brackish and marine environments. Published August 2006, 110 pages, ISBN 87-990827-0-5, Order at: [www.isssha.org](http://www.isssha.org)

### 3.5 UNESCO monographs on oceanographic methodology:

A new title 'Real-time Coastal Observing Systems for Marine Ecosystem Dynamics and Harmful Algal Blooms: Theory, Instrumentation and Modeling' edited by Marcel Babin, Collin Roesler and John Cullen has been developed.

The proliferation of harmful phytoplankton in marine ecosystems can cause massive fish kills, contaminate seafood with toxins, impact local and regional economies and dramatically affect ecological balance. Real-time observations are essential for effective short-term operational forecasting, but observation and modeling systems are still being developed. This volume offers guidance for developing real-time and near real-time sensing systems for observing and predicting plankton dynamics, including harmful algal blooms, in coastal waters. It explains the underlying theory and discusses current directions in research and monitoring in looking at instrumentation and modeling.

Topics treated include: coastal ecosystems and dynamics of harmful algal blooms; theory and practical applications of in situ and remotely sensed optical detection of microalgal distributions and composition; theory and practical applications of in situ biological and chemical sensors for targeted species and toxin detection; integrated observing systems and platforms for detection; diagnostic and predictive modeling of ecosystems and harmful algal blooms, including data assimilation techniques; observational needs for the public and government; and future directions for research and operations.

This anthology should inform the work of researchers and environmental monitors as well as teachers and trainers concerned with understanding the causes, predicting the occurrences and mitigating the effects of harmful algal blooms in marine ecosystems. Expected release spring 2007.

### 3.6 IOC co-sponsorship of International Conferences related to HAB

The HAB Programme co-sponsored the Twelfth International Conference on Harmful Algae, Copenhagen, Denmark, 4-8 September 2006. The IOC Science and Communication Centre in Copenhagen acted as secretariat for the Conference and the preparations and follow-up to the Conference took up a major part of the Centre activities in 2006. A summary of the Conference is available in Harmful Algae News No. 32 at <http://www.ioc.unesco.org/hab/news.htm>. Proceedings will be published as a joint publication of the International Society for the Study of Harmful algae (ISSHA) and the IOC. Expected release late 2007. Conference web site at <http://www.bi.ku.dk/hab-archive/>

The HAB Programme co-sponsored the the 5th International Conference on Molluscan Shellfish Safety (ICMSS), 14-18 June, 2004, Ireland, [www.icmss04.com](http://www.icmss04.com). The Proceedings are co-published by the IOC. Unfortunately the financial support to the conference was not as first committed due to budget cuts in IOC.

### 3.7 Provision of literature

The provision of HAB related literature to scientist in developing countries has been taken care of by the IOC HAB Centres in Copenhagen, Vigo and through WESTPAC/HAB. The book grants offered in 2005-2006 include the following titles:

- GEOHAB: HABs in eutrophic systems. Glibert, P. (ed.). IOC and SCOR, Paris and Baltimore, 2006
- Manual on aquatic cyanobacteria. A photo guide and a synopsis of their toxicology. Cronberg, G. & Annadotter, H.. (Eds.), ISSHA and IOC of UNESCO, Copenhagen, 2006
- GEOHAB: GEOHAB Core Research Project: HABs in Upwelling Systems. Pitcher, G. et al. (eds.). SCOR and IOC, Baltimore and Paris, 2005
- Harmful Algal Management and Mitigation. Hall, S. et al, APEC, 2004
- Manual on Harmful Marine Microalgae, Hallegraeff, G. et al. (eds.), UNESCO Publishing 2003 and 2004
- Red tides. Okaichi, T. (eds.), Ocean Sciences Research (OSR). Terra Scientific Publishing Company & Kluwer Academic Publisher. Japan, 2003
- Molluscan Shellfish Safety, Villalba A. et al(eds.), Consellería de Pesca e Asuntos Marítimos da Xunta de Galicia and IOC of UNESCO, 2003
- GEOHAB. Global Ecology and Oceanography of Harmful Algal Blooms, Implementation Plan. P. Glibert and G. Pitcher (eds.) SCOR and IOC, 2003
- Proceedings of the Ninth International Conference on Harmful Algae Blooms, G. Hallegraeff *et al.* (eds.), UNESCO, 2002
- LIFEHAB – Life history of microalgal species causing harmful blooms. Garcés, E. et al. (Eds.), Environment and Sustainable Development Programme, European Communities, 2002.
- Floraciones Algas Nocivas en el Cono Sur Americano, E.A. Sar *et al.* (eds.), 2002.
- Monitoring and Management Strategies for Harmful Algal Blooms in Coastal Waters, D. M. Anderson *et a* (eds.) , APEC Report # 201-MR-01.1, APEC Programme and IOC of UNESCO, Technical Series No. 59, Paris, France ,2001
- GEOHAB. Global Ecology and Oceanography of Harmful Algal Blooms, Science Plan. P. Glibert and G. Pitcher (eds.) SCOR and IOC, 2001
- Potentially Harmful Microalgae of the Western Indian Ocean. A Guide based on a preliminary survey. IOC Manuals and Guides No. 41, IOC of UNESCO 2001.
- Technical Guide for Modern Dinoflagellate Cyst Study, Matsuoka, K., and Fukuyo, Y. WESTPAC-HAB/WESTPAC-IOC, 2000
- Algae, Graham, L.E., Wilcox, L.W. Prentice Hall, Upper Saddle River, NJ, 2000
- Toxic Cyanobacteria in Water, Chorus, I., and Bartram, J., WHO, 1999
- Los dinoflagelados del Atlántico Sudoccidental. Balech, E., Ministerio de Agricultura Pesca y Alimentación, Madrid, 1998
- Proceedings of the Seventh International Conference on Toxic Phytoplankton, Yasumoto, T. et al. (eds.), IOC of UNESCO, 1996

- Proceedings of the Eighth International Conference on Harmful Algae, Reguera, B. et al. (eds.), Xunta de Galicia and IOC of UNESCO, 1998
- Biology, Epidemiology and Management of *Pyrodinium* Red Tides. Hallegraeff, G. M. et al. (eds.), ICLARM Conf. Proc. 21, 1989
- The Genus *Alexandrium* Halim, E. Balech, Sherkin Island Marine Station, Cork, Ireland, 1995
- Identifying Marine Phytoplankton, C. Tomas et al. (eds.), Academic Press, USA, 1997
- The Biology of Dinoflagellates, F.J.R. Taylor (ed.), Blackwell Scientific Publications, Oxford, 1987
- Physiological Ecology of Harmful Algal Blooms, D. Anderson et al. (eds.), NATO ASI Series, Springer-Verlag, Bermuda, 1998
- Algal Toxins in Seafood and Drinking Water, I. Falconer (ed.), Academic Press, London, 1993
- Phytoplankton Pigments in Oceanography, S.W. Jeffrey et al. (eds.), UNESCO Publishing, Paris, 1997
- Proceedings of the First International Congress on Toxic Cyanobacteria, Ø. Moestrup et al. (eds.), 1996

### 3.8 Harmful Algal Event Data Base, HAEDAT jointly with ICES and PICES

The ICES-IOC Working Group on Harmful Algal Bloom Dynamics has recorded events related to harmful microalgae on a regular basis since 1987. Since then, a National Report form has been completed by the national representatives in order to organize, on an annual basis, data on harmful algae events in different countries.

Increasing interest in data analysis led to a proposal in 1997 to create a computer data base of these events: the Harmful Algae Event Data Base (HAEDAT). The main purpose of creating HAEDAT was to develop a structure for data storage that allows easy integration of data, efficient search tools, and the possibility of conducting powerful data analysis.

HAEDAT has been available at the IOC web site since October 1999. At first it was based on Microsoft Access, requiring to be downloaded by the user, but following recommendations of the ICES-IOC Working Group on Harmful Algae, HAEDAT has been transferred from this desktop solution to a web-based solution (MySQL/PHP).

The work of transforming HAEDAT into the new software platform has taken considerably longer than anticipated as the database had to be normalised (arranged into tables according to data types) and data had to be harmonised. Furthermore, the requirement that the new platform should allow on-line searches and data upload, as well as a direct coupling between records and maps in a GIS type system, required resources and expertise not immediately available at the IOC Secretariat. Thanks to the extra-budgetary support from the US National Oceanic and Atmospheric Administration, it was possible to contract an external expert to implement the new web-based HAEDAT.

The new version of HAEDAT is now (March 2007) available at <http://www.iode.org/haedat/> and is being tested and edited by the National editors.

There is an open invitation and encouragement to countries and regions to join HAEDAT. In October 2004 the Pacific International Council for Exploration of the Sea (PICES) formally joined HAEDAT and has submitted reports since 2000. The two Latin American IOC regional groups, FANSA and ANCA, have joined HAEDAT and have committed to enter records since 2000. Other countries from the Mediterranean area, such as Italy and Greece, as well as the members of the IOC HANA Network, have specifically been encouraged to join HAEDAT in an attempt to expand HAEDAT and make it the unifying global data base on harmful algal events.

### 3.9 IOC HAB Internet Site

The IOC HAB site at [ioc.unesco.org/hab](http://ioc.unesco.org/hab) contains information on all ongoing activities under the IOC HAB Programme, including various data bases, access to publications, announcements etc. The site had an average of 36 visits/week day in the period June 2002-February 2007 (Netstat). This only includes visitors that entered through the default page. The site was designed in 1995/96 and has for some years been prone for a major revision and redesign. This redesign and revision was initiated with the assistance of Coldrose Ltd consultants during January-March 2007 and the new site is open for review during April and May 2007.

The GEOHAB site ([www.geohab.info](http://www.geohab.info)) is monitored separately and had an average of 9 visits per day in the same period. The sites are maintained by the IOC HAB Centre in Copenhagen, and are updated on daily to weekly basis. The [www.geohab.info](http://www.geohab.info) site is being revised and redesigned by Catherine Brown funded by a grant from the French Space Agency to French CNRS, Villefranche-sur-Mer.

Of the regional groups WESTPAC/HAB has a portal for the South East Asia and FANSA during 2004–2005 established FANSA Portal at <http://www.algasnocivas.net/>. UNESCO is 2006-2007 funding the expansion of the Portal to cover the Caribbean. The expansion of the portal is developed as cooperation between the FANSA and ANCA groups.

HANA established its own homepage in 2005 at <http://www.ioc.unesco.org/hab/HANA/hana.htm>. It is the aim to move this site to a portal platform as soon as finances allow.

## 4. Training

### 4.1 HAB Training and Capacity Building Programme

The HAB Training and Capacity Enhancement Programme, as adopted by IPHAB-VI, is composed of 4 main modules on species identification, toxin chemistry and toxicology, design of monitoring, and management. See Document IOC/IPHAB-VIII/Inf.9 for an overview of courses implemented between 1993 and 2006.

Courses implemented 2005–2007:

- 4.1.1 IOC Training Course on Qualitative and Quantitative Determination of Algal Toxins. Wattenmeerstation Sylt, Alfred Wegener Institut für Polar- und Meeresforschung, List/Sylt, Germany, 22 February to 3 March 2005.
- 4.1.2 Individual specific training stays with a length of one month under the supervision of one expert from a Galician Institution. IOC-IEO Science and Communication Centre on Harmful Algae. Instituto Español de Oceanografía, Vigo, Spain, 2005.
- 4.1.3 Taxonomy of Harmful Microalgae, Faculdade Ciências Universidade Lisboa (Portugal), Facultad de Ciencias Naturales y Museo (Argentina), Fundação Universidade Federal do Rio Grande (Brazil), Instituto de Botânica (Brazil), Instituto Nacional de Investigación y Desarrollo Pesquero (Argentina), Universidade de Taubaté (Brazil), and the IOC Science and Communication Centre on Harmful Algae, University of Copenhagen (Denmark). Co-organised with the Brazilian Phycological Society (Sociedade Brasileira de Ficologia). E-learning March–May 2005, microscope course 16–27 May 2005, University of Sao Paulo, Brazil.
- 4.1.4 IOC-ROPME Regional Training Workshop on Harmful Algae, Iranian National Center for Oceanography, INCO, Tehran, Iran, 22–31 January 2006.

- 4.1.5 VII IOC-AECI-IEO Course on Toxic Microalgae and Marine Biotoxins: Monitoring Programmes on Toxic Phytoplankton and Marine Biotoxins according to European Regulations, Centro Oceanografico de Vigo-IEO, 6–24 February 2006.
- 4.1.6 Biology of Marine Phytoplankton, in country training course at Hue University of Science, 9-17 March 2006; and Taxonomy of Harmful Algae 15–18 May, Hue, Vietnam.
- 4.1.7 Advanced Phytoplankton Course 8, Stazione Zoologica, Anton Dohrn, Naples, Italy, 2–23 April 2005. The IOC HAB Programme contributed through the participation of Jacob Larsen who lectured at the course. Details at <http://www.szn.it/~apc8/>
- 4.1.8 IOC Training Course and Identification Qualification in Harmful Marine Microalgae, IOC Science and Communication Centre on Harmful Algae Copenhagen, University of Copenhagen, Denmark, E-learning May-June, practical course and examination, 10–18 September 2006
- 4.1.9 WESTPAC/HAB Training Through Research Project 2006–2007.
- 4.1.10 VIII IOC-AECI-IEO Course on Toxic Microalgae and Marine Biotoxins: Monitoring Programmes on Toxic Phytoplankton and Marine Biotoxins according to European Regulations, Centro Oceanografico de Vigo-IEO, 7–23 February 2007.
- 4.2 Planned courses:
  - 4.2.1 IX IOC-AECI-IEO Training Course: Identification of Harmful Marine Microalgae. IOC - IEO Science and Communication Centre on Harmful Algae, IEO, Vigo, Spain. E-learning (April-May), Practical Course June 2008.
  - 4.2.2 Individual specific training stays with a length of one month under the supervision of one expert from a Galician Institution.IOC-IEO Science and Communication Centre on Harmful Algae. Instituto Español de Oceanografía, Vigo (Spain), 2007-2008.
  - 4.2.3 IOC Training Course and Identification Qualification in Harmful Marine Microalgae, IOC Science and Communication Centre on Harmful Algae Copenhagen, University of Copenhagen, Denmark, E-learning May-June, practical course and examination, 20–30 August 2007.
  - 4.2.4 WESTPAC/HAB Training Through Research Project 2006–2007.
  - 4.2.5 Regional Course for North Africa (HANA) Casablanca, Morocco, 2–13 July 2007.
  - 4.2.6 IOC-AWI-BMU-BSH-DZMB-FSU Training Course on Qualitative and Quantitative Determination of Algal Toxins, Germany 2007/2008, pending available funding.
  - 4.2.7 Regional Course for the Indian Ocean (India), Central Indian Ocean and Gulf region proposed.
  - 4.2.8 Regional Course for the Black Sea/Aegean Sea (Turkey).

## SCIENTIFIC ELEMENTS

- 5. Oceanography and Ecology
  - 5.1 ICES-IOC Working Group on the Dynamics of Harmful Algal Blooms- WGHABD

The WGHABD (Chair: Dr J. Martins, Canada) The WGHABD met April 2005 in Flødeviken, Norway, hosted at the Institute of Marine Research. The report is included in Document IOC/IPHAB-VIII/Inf.13.

The WGHABD met April 2006 in Gdynia, Poland, hosted at the University of Gdansk. The Report is included in Document IOC/IPHAB-VIII/Inf.13.

A review of the work of WGHABD is to be presented and discussed at IPHAB-VIII.

The WGHABD will meet April 2007 in Riga, Latvia. The Terms of Reference are included in Document IOC/IPHAB-VIII/Inf.13.

Of particular importance in 2005 is the organization of a inter-comparison work shop on 'New and Classic Techniques for the Determination of Numerical Abundance and Bio-volume of HAB-species' to be held at the Kristineberg Marine Biological Station, Sweden in August. See also Godhe et al, 2007 Harmful Algae 6 56-72 included in Document IOC/IPHAB-VIII/Inf.14.

## 5.2 IOC-SCOR International Science Programme on the Global Ecology and Oceanography of Harmful Algal Blooms - GEOHAB

GEOHAB is a plan for co-ordinated scientific research and co-operation to develop international capabilities for assessment, prediction and mitigation. The approach of the GEOHAB Programme is comparative, from the cellular to the ecosystem level. GEOHAB fosters research that is interdisciplinary, focusing on the important interactions among biological, chemical, and physical processes. GEOHAB also fosters research that is multifaceted as the problems are complex and interactions and processes occur on a broad range of scales. Finally, GEOHAB research should be international in scope to encompass the global issues of HAB events.

The efforts of the SCOR-IOC Working Group 97 on the Physiological Ecology of Harmful Algal Blooms resulted in a NATO-SCOR-IOC Advanced Study Institute on the Physiological Ecology of Harmful Algal Blooms, which was held at the Bermuda Biological Station, 27 May–6 June 1996. The deliberations and recommendations of the WG 97, together with the work of the ICES-IOC Working Group on the Dynamics of Harmful Algal Blooms, provided the basis for formulation of Recommendation IPHAB-IV.2 which Recommendation IPHAB-IV.2 instructed the IOC to develop an international science programme on the Global Ecology and Oceanography of Harmful Algal Blooms jointly with an appropriate organization. Partnership in the development of the new programme was agreed upon with the Scientific Committee on Oceanic Research (SCOR).

The initial development of GEOHAB received support from IOC, SCOR, The Maj and Tor Nessling Foundation (Finland), US National Aeronautics and Space Administration, US National Oceanic and Atmospheric Administration, US National Science Foundation, and IFREMER (France).

In 2003-2005 the SSC organised four open science meetings (OSM) to involve the scientific community in the detailed planning of GEOHAB Core Research. For details see the documents listed below.

For the 2005/06 and 2007 composition of the Scientific Steering Committee and its ToR please see Document IOC/IPHAB-VIII/Inf.10.

An activity report for 2005–2006 is available in Document IOC/IPHAB-VIII/Inf.11.

GEOHAB Science Plan, GEOHAB Report No. 1

GEOHAB Implementation Plan, GEOHAB Report No. 2.

GEOHAB Core Research Project: HABs in Upwelling Systems, GEOHAB Report No. 3

GEOHAB Core Research Project: HAB's in Eutrophied Systems, GEOHAB Report No.4.

GEOHAB Core Research Project: HABs in Fjords and Coastal Embayments, GEOHAB Report No. 5 (in prep).

GEOHAB Core Research Project: HABs in Stratified Systems, GEOHAB Report No. 6 (in prep).

### 5.3 ICES/IOC/SCOR Working Group on GEOHAB Implementation in the Baltic Sea

The Group first met as a Study Group in Dublin, Ireland, from 12–13 March 2001 under the chairmanship of Dr K Kononen (Finland), to create a plan for the implementation of GEOHAB in the Baltic Sea, and to plan coordinated multi-ship field experiments in support of GEOHAB in the Baltic. Next meeting of the Study Group was in Stockholm, Sweden, 24 November 2001, where the terms of reference were to (i) continue the planning of GEOHAB implementation in the Baltic, (ii) plan a meeting combined with an open workshop for the spring 2002 to discuss and finally develop the Baltic project, including the co-ordination of field experiments to be implemented 2002-06; (iii) prepare application to the GEOHAB SSC for endorsement of the Baltic project and the planned workshop; (iv) and to estimate the biomass and impacts of the *cyanobacteria* blooms in the Baltic Sea, and assess the ecosystem effects of this. As from 2003 Prof. Markku Viitasalo from the Finnish Marine Institute (markku.viitasalo@fimr.fi) has taken over as chair of the study group.

The Study group met 7-8 April 2005 at Flødevigen Marine Station, Institute of Marine Research, Norway, to report and discuss new findings on HABs and HAB modelling in the Baltic; report observations on 2004 distribution of HABs in the Baltic; prepare the HAEDAT reports for ICES use; update the checklist of the harmful species of the Baltic Sea; compile existing observations on concentrations of nodularin and other HAB toxins in different compartments of the Baltic ecosystem; summarize observed toxicological effects in the Baltic biota; review existing information on long term trends in HABs in the Baltic; continue planning an open sea field study and workshop for summer 2005; review and update the GEOHAB implementation plan for the Baltic.

The Group was in 2005 converted to a longer standing Working Group on GEOHAB Implementation in the Baltic Sea (WGGIB) and met as such 6–7 April in Gdynia, Poland to report and discuss new findings on HABs and HAB modelling in the Baltic; Update the checklist of the harmful species of the Baltic Sea; Estimate the health hazard of cyanobacteria and dinoflagellate toxins to humans and review the concentrations of HAB toxins in the upper trophic levels of the Baltic foodweb; Finalize the proposal for a Cooperative HAB study in the Baltic Sea and agree upon its implementation; Take into account the recommendations of the Workshop on Developing a Framework for Integrated Assessment for the Baltic Sea (WKIAB).

The GEOHAB SSC has been requested to review WGGIB and advice on its further ToR.

The reports of the SGGIB are available as Document IOC/IPHAB-VIII/Inf.12.

### 5.4 ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors

IPHAB-II requested the IPHAB Chair and the Programme Office to further investigate the possibilities and need for interaction with the activities of IMO and ICES. IPHAB-III adopted Recommendation IPHAB-III.3 on a Working Group on Transfer of Phytoplankton by Ballast of Ships. In response to this recommendation a Joint ICES-IOC-IMO Study Group on Ballast Water and Sediments was established. The ICES/IOC/IMO Study Group on Ballast Water and Sediments [SGBWS] was later been renamed the "ICES/IOC/IMO Study Group on Ballast and Other Ship Vectors [SGBOSV] and is now the ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors (WGBOSV).



WGBOSV will in 2005 meet in Norway 14–18 March and in Gdynia, Poland 6–7 April 2007. The Chair as from 2007 is Dr Anders Jelmert, Institute of Marine Research, Norway, E-mail: [anders.jelmert@imr.no](mailto:anders.jelmert@imr.no)

WGBOSV reports are available at <http://www.ices.dk/> and as Document IOC/IPHAB-VIII/Inf.15

The WGBOSV will meet in Dubrovnik, Croatia 19–21 March 2007 to critically review and report on the status of ballast water research with an emphasis on new developments in ballast water treatment technology, risk assessment, ballast water sampling devices, and selection of ballast water exchange zones to contribute to guidelines currently in preparation by IMO; continue its global review of shipping vectors through the participation of representatives from ICES, IMO, IOC, CIESM, BMB and PICES Member States and of invited experts; finalize the ICES Ballast Water Sampling Manual; prepare a draft ICES Code of Best Practice for the Management of Ships Hull Fouling; continue reviewing port sampling protocols with the aim to prepare a draft ICES Code of Best Practice for Port Sampling; consider and respond to the recommendation from ACME to merge in 2008 WGITMO and WGBOSV into a single working group with a broadened mandate for the occurrence and impact of marine invasive and/or pest organisms.

## 6. Taxonomy and Genetics

### 6.1 IPHAB Task Team on Algal Taxonomy

The Task Team was established through Resolution IPHAB-II.1. The Terms of Reference were updated by IPHAB-III, IV, and VI. Chair is Prof. O. Moestrup. The Progress Report will be submitted to IPHAB-VIII. Document IOC/IPHAB-VIII/Inf.16.

## 7. Toxicology and Toxin Chemistry

### 7.1 IPHAB Task Team on Aquatic Biotoxins

The IPHAB Task Team on Biotoxin Regulation was activated after IPHAB-VI and merged with a WHO and FAO initiative to provide scientific advice to the Codex Committee of Fish and Fisheries products (CCFFP). The Chair of the IPHAB Task Team was assigned to chair a joint FAO/IOC/WHO Workshop held in Dublin in April 2003 and subsequently to chair the Joint FAO/IOC/WHO ad hoc Expert Consultation on Biotoxins in Bivalve Molluscs in Oslo that, upon request from the CCFFP, provided scientific advice to the CCFFP to enable the establishment of maximum levels in shellfish for shellfish toxins; methods of analysis for each toxin group; and guidance on monitoring and management of biotoxin forming phytoplankton and bivalve molluscs.

IPHAB-VII decided to let the Task Team continue its work and in particular identify incompatibilities among regulations in various markets; take the initiative to expand the participation in the Task Team (e.g. EC, APEC, US FDA, and relevant experts) as required to assist the Codex Committee on Fish and Fisheries Products (CCFFP) to clarify and include into the CCFFP Standard and Code of Practice for Live Bivalve Molluscs the recommendations contained in the Report of the Joint FAO/IOC/WHO ad hoc Expert Consultation on Biotoxins in Bivalve Molluscs; and in cooperation with the Joint FAO/IOC/WHO executive, complete the background papers to the report of the Joint FAO/IOC/WHO ad hoc Expert Consultation on Biotoxins in Bivalve Molluscs in preparation for publication.

The CCFFP established a working group of CCFFP delegates which convened in Ottawa to address the above Report and report back to the Twenty Eighth Session of CCFFP in Beijing 18–22 September 2006. Many of the recommendations from the Joint FAO/IOC/WHO ad hoc Expert Consultation on Biotoxins in Bivalve Molluscs are now included in the CCFFP proposed



Draft Standard for Live and Raw Bivalve Molluscs and in particular new sections on management and the use of phytoplankton have been included Section 7.2.2.3 of the proposed draft Code of Practice for Fish and Fishery Products.

The Twenty Eighth session of the CCFFP also further addressed the issues raised by the Report of the Joint FAO/IOC/WHO Expert Consultation on Biotoxins in Bivalve Molluscs by forwarding marine biotoxin test methods to the Twenty Eighth Session of the Codex Committee on Methods of Analysis (CCMAS) and sampling, 5–9 March 2007, Budapest. The only method endorsed by CCMAS was the AOAC LC-FL Method 2005.06 for saxitoxins. CCMAS noted that mouse bioassay methods are not specific and are subject to interference so cannot be endorsed as a Type III Method. The CCMAS outcome is a confirmation of the recommendations of the Expert Consultation.

More or less in parallel with the CCFFP and CCMAS, the European Union Community Reference Laboratory on Marine Biotoxins has reviewed the Report of the Joint FAO/IOC/WHO ad hoc Expert Consultation on Biotoxins in Bivalve Molluscs, and in October 2005 convened a Working Group on Test Methods and another on Toxicology and following their reports, requested the European Food Safety Authority (EFSA) to address issues in these areas. EFSA has convened a 17 person Working Group on “Marine Biotoxins” with the mandate “to assess the current EU limits with regard to human health, the methods of analysis for marine biotoxins as established in EU legislation, as well as new and emerging marine biotoxins”. This work is expected to be completed by December 2007.

Rather than recruiting members to the Task Team on Biotoxin Regulation, the IPHAB Task Team Chair lobbied participants involved with the above meetings to ensure that the recommendations of the Joint FAO/IOC/WHO ad hoc Expert Consultation on Biotoxins in Bivalve Molluscs were being incorporated into any revisions of national and international shellfish safety standards.

## OPERATIONAL ELEMENTS

### 8. Monitoring

#### 8.1 IOC-ICES META DATA BASE ON DESIGN AND IMPLEMENTATION OF HAB MONITORING PROGRAMMES: MON-DAT

The MON-DAT meta-data-base contains information on the design and implementation of harmful algae monitoring and management systems from all over the world. MON-DAT include data from countries that have responded to the questionnaire circulated by the Secretariat.

The initial compilation of information was carried out within the ICES-IOC Working Group on the Dynamics of Harmful Algal Blooms, and the establishment of the data-base was made possible through the financial support of the Danish agency for development assistance, DANIDA. The first survey for information on HAB monitoring was made in 1995/96 and a summary of the result was published as IOC Technical Report No. 44. The base was updated in 2000/01.

MON-DAT was planned to have been updated in 2005 but resources did not allow. Update of MON-DAT is postponed until it has been integrated into a new Harmful Algal Event Information System which is a new data base platform initially holding the data of HAE-DAT (see item as to have one comprehensive data source for information on harmful algal events, geographical distribution and descriptions of the monitoring systems that generate the event data.

MON-DAT is unavailable on-line until its integration in to the Harmful Algal Event Information System.

## 8.2 IMPLEMENTATION OF HAB MONITORING WITHIN THE GLOBAL OCEAN OBSERVING SYSTEM (GOOS)

Through Recommendation IPHAB-VI.3 IPHAB acknowledged that the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) is the vehicle for the collection, archiving, distribution and utilization of ocean and meteorological data, and that their Terms of Reference allow for the coastal module of GOOS to include non-physical variables. IPHAB therefore recommended that it cooperate with JCOMM to develop effective systems for the monitoring of harmful species at the appropriate functional level, which would allow detection of changes in marine systems to be made in order to understand and manage coastal ecosystems.

The Strategic Implementation Plan for the Coastal Module of the Global Ocean Observing System has been published at <http://www.ioc-goos.org/>. The vision for the implementation of the coastal module of GOOS is that it will happen through GOOS Regional Alliances [GRA], National GOOS programmes, global elements (e.g. GLOSS, GCRMN,...) and existing global programmes (e.g. LOICZ, GLOBEC, IMBER, GEOHAB). The JCOMM Management Committee is presently discussing how JCOMM can begin global implementation of non-physical variables under GOOS.

JCOMM is proposing as the next step to establish an ad hoc joint JCOMM-POCO Task Team to work in collaboration with GOOS Regional Alliances and National GOOS Programmes (perhaps through a global body of GOOS Regional Alliances and National GOOS Programmes such as the GOOS Regional Forum or its Council) to establish requirements and mechanisms for implementation of the Global Coastal Network [GCN].

JCOMM concluded that it was premature to act until the GRAs have reacted to the draft implementation plan. Also, the variables required by the coastal module of GOOS have not been established firmly yet nor have they been prioritised and a COOP follow-on panel (tentatively named Panel for Coastal Observations - POCO) has not been formed yet. When these actions are taken, it will be feasible for JCOMM to work in collaboration with GRAs and National GOOS programs toward implementation of the GCN.

JCOMM has noted that, as with the global (basin-scale) module of GOOS, the specifications of techniques and protocols for the observations, data management and products should be demonstrated by pilot projects. Such projects might be carried out independently by the GRAs or jointly with JCOMM.

The Scientific Steering Committee for GEOHAB has with a letter in December 2006 opened a dialogue with the GOOS Regional Alliances to address the inclusion of, and approach to, observation systems for harmful algal events and harmful algal occurrences in regional GOOS components.

Referring to this correspondence it was arranged that questions on HAB observations were added to the GOOS national reporting template that is used preparation for the Eight Intergovernmental Panel for GOOS (I-GOOS-VIII). Background information on the exercise is available at: <http://www.ioc-goos.org/content/view/66/48/> and the national reporting template itself is available at: <http://www.ioc-goos.org/igoos8reporting>. The I-GOOS-VIII page is at: <http://www.ioc-goos.org/igoos8>.

This survey will provide the information needed to table the inclusion of HAB observations at the moment as well as the wish in the regions to do so onwards and thus help identify the GRA's where interaction with SSC and or IPHAB is relevant.

Document IOC/IPHAB-VIII/Inf.18 and 19.

### 8.3 HABWATCH

IOC co-sponsored a GEOHAB endorsed 'Workshop on real-time coastal observing systems for ecosystem dynamics and harmful algal blooms', in Villefranche, France, 11–21 June 2003. The proceedings are available via the IOC HAB web site, including recorded oral presentations, posters, and tutorials. Furthermore, the material is now edited into a manuscript for a new title in the UNESCO series, Monographs on oceanographic methodology. The volume is expected to be published first half of 2007.

**APPENDICE I. RESOURCES AVAILABLE TO THE IOC FOR DEVELOPMENT AND IMPLEMENTATION OF THE IOC HARMFUL ALGAL BLOOM PROGRAMME 2005–2006**

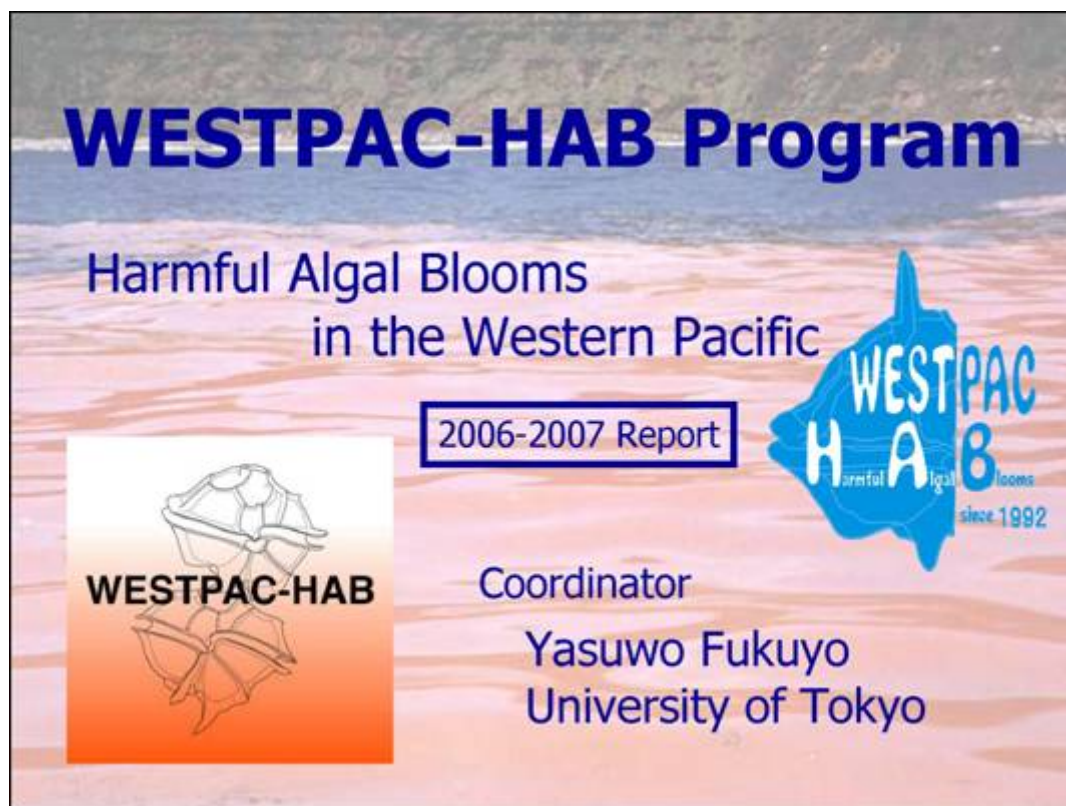
<u>IOC-UNESCO REGULAR PROGRAMME</u>	US Dollars
IOC HAB Programme Regular Budget 2005 (41.000)-2006 (25 .000) (2003-2004 was 124.000)	66.000
IOC Staff	50.000
UNESCO Cross Cutting Project, FANSA-ANCA Portals	24.000
<u>EXTRA-BUDGETARY CONTRIBUTIONS TO THE IOC:</u>	
Denmark: -DANIDA:IOC Science and Communication Centre on Harmful Algae, activities and contribution to cost of one IOC Staff:	300.000
Japan: -WESTPAC/HAB TTR project:	34.000
Spain: -Spanish Institute of Oceanography: Support for the IOC Science and Communication Centre at the Oceanographic Centre in Vigo, Spain 2005- 2006	73.000
USA: Contribution 2005–2006 for implementation of GEOHAB, HAEDAT and CB activities:	109.000
<u>SPONSORSHIP OF ACTIVITIES AND FUNDS ADMINISTERED AT THE SCIENCE AND COMMUNICATION CENTRES:</u>	
Denmark: -DANIDA: Survey of Potentially Harmful Algae in Vietnamese Waters (training through research and provision of equipment) 2002-2004.	609.000
University of Copenhagen: IOC Science and Communication Centre on Harmful Algae, Copenhagen, staff, operation and activities:	121.000
Japan: WESTPAC/HAB Training Courses and TTR:	35.900
Spain: -Spanish Institute of Oceanography: IOC-IEO Science and Communication Centre on Harmful Algae, Vigo, 2 staff, operation and activities:	264.000
-AECI (Spanish Agency for International Cooperation), Scholarships for participants in training activities at Vigo Centre 2005:	26.500
AECI (Spanish Agency for International Cooperation), Scholarships for participants in training activities at Vigo Centre 2006:	36.000
AECI (Spanish Agency for International Cooperation), Scholarships for participants in training activities at Vigo Centre 2007:	36.000
USA: National Science Foundation and NOAA: support for GEOHAB SSC via SCOR	64.000
France: Ifremer support for GEOHAB SSC	5.000
SCOR for GEOHAB	7.500

**APPENDICE I. IMPLEMENTATION OF IPHAB-VII RESOLUTIONS AND RECOMMENDATIONS**

<b>Code</b>	<b>Title</b>	<b>Implementation</b>
<u>Resolution IPHAB-VII.1</u>	Task Team on Algal Taxonomy	<b>Sub items (i) and (ii) implemented, Items (iii)-(vi) partly or not implemented</b>
<u>Resolution IPHAB-VII.2</u>	Task Team on Biotoxin Monitoring, Management and Regulations	<b>Sub items (i) and (ii) not implemented, (iii) implemented.</b>
<u>Resolution IPHAB-VIII.3</u>	Regional HABP Development	<b>Implemented</b>
<u>Resolution IPHAB-VII.4</u>	IPHAB operation regarding GEOHAB	<b>Report on implementation to be given by IPHAB Members</b>
<u>Recommendation IPHAB-VII.1</u>	Development of GEOHAB	<b>Establishment of a GEOHAB IPO not yet successful</b>
<u>Recommendation IPHAB-VII.2</u>	Assessment of the Potential Effect of Tsunami on the Temporal and Spatial Changes in Ciguatera Occurrence	<b>The recommendation was communicated to WHO and positively received and it impacted various information material and documents prepared by WHO. Also communicated to the IOC Tsunami Unit</b>
<u>Recommendation IPHAB-VII.3</u>	Implementation of HAB Monitoring within the Global Ocean Observing System	<b>Implementation initiated</b>
<u>Recommendation IPHAB-VII.4</u>	ICES-IOC-IMO Working Group on Ballast and Other Ship Vectors	<b>Implemented</b>
<u>Recommendation IPHAB-VII.5</u>	HABP Workplan 2006-2007	<b>Implemented as reported in this document and as resources has allowed.</b>
<u>Recommendation IPHAB-VII.6</u>	Operation of the IOC Intergovernmental Panel on Harmful Algal Blooms	<b>Implemented</b>

ANNEX IX

WESTPAC/HAB REPORT



WESTPAC/IOC member countries

About IOC/WESTPAC

Member States and their focal points for IOC/WESTPAC (as of 2005)

Click on the flag for information of their representatives.

 Australia	 Philippines
 China	 Russian Federation
 Fiji	 Samoa
 France	 Singapore
 Indonesia	 Solomon Islands
 Japan	 Thailand
 Korea, DPR	 Tonga
 Rep. of Korea	 United Kingdom
 Malaysia	 United States of America
 New Zealand	 Vietnam



**IOC/WESTPAC Member States (2005)**

- Australia
- China
- Fiji
- France
- Indonesia
- Japan
- Korea D.P.R.
- R.O.f Korea
- Malaysia
- New Zealand
- (/)
- Philippines
- Russia
- Western Samoa
- Singapore
- Solomon Islands
- Thailand
- Tonga
- United Kingdom
- United States
- Vietnam



## Goal:

1. Understand the biological and chemical nature, population dynamics and environmental effects of harmful algae and their bioactive products
2. Prevent ill consequences caused by HABs, through providing scientific knowledge useful for establishment of reliable cost- and load-effective management systems including monitoring and research

## Research on Harmful Algal Blooms

### HABs' recent trend in WESTPAC region

#### 2000-2005

Increase in frequency  
in variety of types  
in distribution and  
in severity

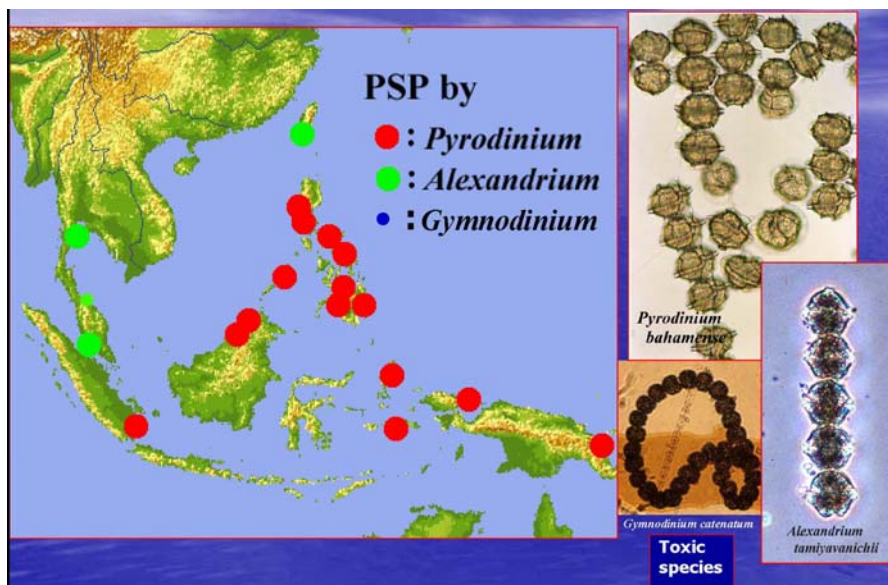
Lack of monitoring system and countermeasure  
against expanding ill consequences

Not enough number of scientists, esp. toxin chemist  
still necessary to develop HAB science

#### 2006-2007

Problems are less serious, in terms of damages  
from the blooms,

Time to grow young peoples for HAB science



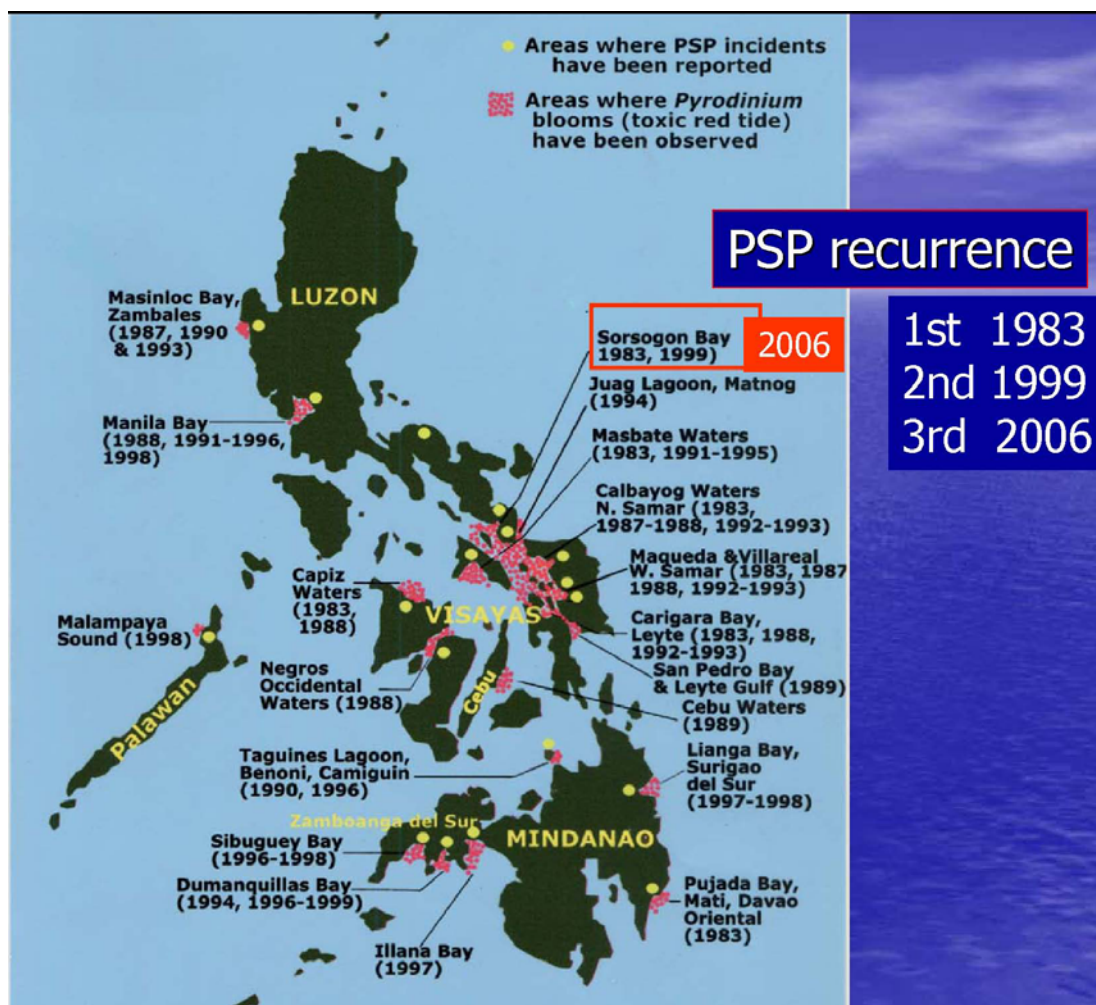
## PSP in western Pacific tropical and subtropical countries





## PSP case number in the Philippines

	case	casualty	1991	80	9	2001	0	0
			1992	269	11	2002	34	3
1983	289	23	1993	282	14	2003	18	3
1984	0	0	1994	58	6	2004	0	0
1985	0	0	1995	121	8	2005	25	1
1986	0	0	1996	157	8	2006	86	9
1987	226	7	1997	92	4	2007		
1988	307	16	1998	181	3	Total	2,267	134
1989	31	7	1999	7	1	Problems are less serious recently.		
1990	14	1	2000	0	0			



## Another WESTPAC concern: Eutrophication Progress gradually in WESTPAC coastal waters, and then possibly large scale blooms of HA

Degradation of coastal environment progresses gradually.

Utilization of coastal waters for aquaculture accelerates eutrophication in water and sediment.

Considering high turn-over rate of nutrients in tropical water environment, criteria to judge eutrophication of water and sediment must be different from those used in temperate countries.

WESTPAC HAB Programme has deep concern on this issue and wish to have cooperation with other programmes/projects to facilitate study and research on it.

### **Activities of WESTPAC-HAB Programme for 2006-07**

1. To establish a network of national focal points and update a WESTPAC-HAB membership list of scientists and managers in the region.  
Leader: Yasuwo Fukuyo (the University of Tokyo, Japan)
2. To organize strategic planning workshops.  
Leader: Y. Fukuyo
3. To implement the WESTPAC-HAB TTR Project.  
Leader: Dr. Rhodora Azanza (University of the Philippines)
4. To further develop the HABSEA Portal to be useful to WESTPAC.  
Leader: Dr. R. Azanza
5. To develop red tide monitoring network on usage of remote sensing.  
Leader: Dr. Joji Ishizaka (Nagasaki University)
6. To publish and distribute HAB reference materials in CD.  
Leader: Y. Fukuyo
7. To disseminate activities of GEOHAB.  
Leader: Dr. Ken Furuya (the University of Tokyo)
8. To seek interaction with other Projects on HAB and interact with the other IOC regional networks or groups on HAB.  
Leader: Y. Fukuyo
9. To develop monitoring research on blooming of toxic benthic microalgae in coastal areas affected by Tsunami.  
Leader: Y. Fukuyo



### Activities of WESTPAC-HAB Programme for 2006-07

1. To establish a network of national focal points and update a WESTPAC-HAB membership list of scientists and managers in the region.  
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Leader: Y. Fukuyo
9. To develop monitoring research on blooming of toxic benthic microalgae in coastal areas affected by Tsunami.  
Leader: Y. Fukuyo

1. To **establish a network** of national focal points and update a WESTPAC-HAB membership list of scientists and managers in the region.

2. Organize **strategic planning workshops**

have not started yet:

But HAB Programme wish to have them at  
WESTPAC Symposium (2008?, Malaysia)  
13th ICHA (November 2008, Hong Kong)

Leader: Y. Fukuyo

No budget required

3. To implement the WESTPAC-HAB TTR Project.  
Leader: Dr. Rhodora Azanza  
(University of the Philippines)

The TTR has three components;

1. Technical standardization exercise /  
Research planning meeting
2. Cooperative field survey / laboratory analysis
3. Presentation of result at scientific meetings and in  
journals

Difference between a Training Course (TC) and TTR

TC: No after-care

To improve TC, Training through Research (TTR) starts.

Not only training, but also research is a part of activity.

Each members must conduct researches  
cooperatively with other members.

Technical standardization is necessary.

Continuous information update is necessary.

Research budget from member efforts.

ORI-HAB from JSPS can support a part of activity.

**TTR RG1:** Cyst Mapping

Leader: Elsa Fugen Furio, Philippines

Cooperative study on horizontal and vertical  
distribution HAB cysts to know their  
geographical expansion history





## TTR RG3: PSP ELISA kit

Leader: S. Sato, Japan; Sub-leader; Dao Viet Ha, Vietnam  
Cooperative study on PSP toxin occurrence in plankton  
and marine organisms using ELISA kits as a monitoring tool





### TTR RG3: PSP ELISA kit

Leader: S. Sato, Japan; Sub-leader; Dao Viet Ha, Vietnam  
Cooperative study on PSP toxin occurrence in plankton and marine organisms using ELISA kits as a monitoring tool



To disseminate activities of GEOHAB.

Leader: Dr. Ken Furuya (the University of Tokyo)

March 2008, Tokyo, coordinated by K. Furuya  
GEOHAB SSC meeting

GEOHAB Asia meeting organized by GEOHAB SSC in  
cooperation with IOC/WESTPAC and PICES  
from WESTPAC region

China, Japan, Korea, Malaysia,  
Philippines, Thailand, Vietnam,

Dr. Furuya is working to establish GEOHAB Asia.



## ANNEX X

### **SEVENTH INTERNATIONAL PANEL ON HARMFUL ALGAL BLOOMS WORKING GROUP ON HARMFUL ALGAL FROM SOUTH AMERICA (FANSA)**

#### SUMMARY REPORT

The 7<sup>th</sup> IOC Regional Science Planning Workshop on Harmful Algal Blooms organized by the Working Group on Harmful Algal Blooms of South America (IOC-FANSA) was held in Lima, Peru, between the 21<sup>st</sup> and 23<sup>rd</sup>, June, 2006, as a continuation of periodical meetings occurring since 1994. The IOC-FANSA meeting was supported by IOC (UNESCO) and hosted by Instituto del Mar del Perú (IMARPE). The local organizer was Dr Sonia Sánchez from IMARPE.

The Workshop was opened by the President of the Board of IMARPE, Rear Admiral (r) Hugo Arévalo Escaró, who welcomed participants and thanked IOC for continued support of scientific and operational analyses of HABs in South America. He was followed by Dr. Leonardo Guzmán, Chairman of IOC—FANSA, who gave a brief overview of the working group, the expectations of previous workshops, and future objectives. The Minister of Production of Perú, Mr. David Lemor Bezdin, emphasized the importance of strengthening regional capacity to face HAB problems associated with serious problems in Public Health, fisheries resources and marine ecosystems.

Twenty six representatives from Argentina (1), Brazil (2), Chile (2), Ecuador (2), Uruguay (2) and Perú (17) attended the WS. Mónica Lion (IOC-IEO Science and Communication Centre on Harmful Algae, Vigo, Spain) acted as IOC observer.

The Workshop consisted of four sessions:

- 1) State of HAB problems within the region and novelties in participant countries;
- 2) State of the scientific knowledge, management of HABs and its effects within the region: comprehension level and operational actions;
- 3) Information networks, training activities, scientific information exchange, local development and actions for public education and information dissemination,
- 4) Workshop recommendations.

Additional time was dedicated to revision of the HAB-FANSA PORTAL ([www.algasnocivas.net](http://www.algasnocivas.net)) by Leonardo Guzmán, Silvia Méndez and Luis Proença, editors of this UNESCO/IOC initiative.

The next IOC FANSA WS will be held in Mar del Plata, Argentina, hosted by the Instituto de Investigación Pesquera (INIDEP).

#### **The Workshop resulted in sixteen recommendations:**

##### Scientific recommendations:

- Encourage cooperation among different experts on shared topics of interest, as in the case of *Alexandrium*, *Pseudo-nitzschia* and *Dinophysis* blooms.
- Explore the feasibility to organize a specific workshop on problems associated with *Alexandrium* in the region, prior to the next IOC FANSA WS.



Recommendations on Capacity building:

- The need for taxonomic training on different taxonomic groups to strengthen monitoring programmes.
- Organize a second UNESCO Knowledge Portal e-Learning Training Course on Taxonomy and Biology of Harmful Marine Microalgae.
- Considering the interest of the Group in the update and improvement of new biotoxin analytical methods, the group supports the continuation of the training courses on Marine Biotoxin Monitoring held at IOC-IEO SCCHA in Vigo.
- Considering the capabilities within some countries in the region, the WG supports the organization of Regional training courses on present official shellfish biotoxin techniques.

Recommendations on International HAB Activities:

- The IOC-FANSA group agrees to revise and complete the available information on HAB thematic maps (HAB-MAPs) prior to its official presentation.
- Contribute with validated data up to 2000, through the focal point of each FANSA country, to upgrade the IOC-ICES-PICES-HAEDAT (once the new electronic format becomes available).
- The IOC-FANSA agrees to invite the IOC-ANCA group to integrate the Latin American HAB portal, to establish mechanisms to favor the integration between the two Latin American WG on HABs, and that for at least one representative of each WG could attend the ANCA/ FANSA meetings.
- The Latino American HAB-Portal should include the scientific and operational capacities available within each FANSA country.
- Members of the IOC-FANSA WG should stimulate other regional researchers to contribute with material and suggestions to the Latin American HAB portal.

Other Recommendations:

- Considering the need of the Official Laboratories of the Region to progress in the accreditation of Marine Toxin Analytical Laboratories (ISO 17025), the WG asked IOC for coordination and support to perform during 2007/2008 an inter-calibration exercise for PSP determination (AOAC, 2000) between the EU Reference Laboratory on Marine Biotoxins and the Official Laboratories of FANSA countries.
- Considering the need of continuous financial support to FANSA activities, the WG suggest that The IOC Executive Secretary should communicate each FANSA country of its capacity to maintain their financial contribution.
- Each national representative should inform its IOC National Focal point about IOC budget restrictions to be presented at the IPHAB Panel.
- Reinforce educational, training and dissemination activities on HABs oriented to different population sectors.
- Developments of issues, and progresses reached in specific topics by each country should be suggested for the preparation of the agenda.

# ANNEX XI

## OVERVIEW OF IOC HAB TRAINING COURSES AND WORKSHOP (Is grab inf 9 at <http://www.ioc.unesco.org/hab/iphaviii.htm>)

### IMPLEMENTED CAPACITY ENHANCEMENT ACTIVITIES 1993–2006

(for overview, complete details not included)

<b>MODULE:</b> <i><b>TAXONOMY OF HARMFUL MARINE MICROPLANKTON</b></i>	<b>LEVEL, no. of part.:</b>	<b>TARGET GROUP/ Region:</b>	<b>WHERE:</b>	<b>WHEN:</b>	<b>NEED IDENTIFIED WHERE:</b>	<b>FUNDING IDENTIFIED: in US \$</b>
<b>Course name:</b> IOC-Danida Training Course on the Taxonomy of Harmful Marine Phytoplankton  <b>Organizer:</b> Prof. O. Moestrup, University of Copenhagen	M.Sc, Ph.D.  (15)	Global,  developing countries	University of Copenhagen, Denmark	16-28 August 1993	HABP Plan, Pilot Course	Danida- IOC-TF: 42K  IOC: 10K  Total: 52K
<b>Course name:</b> IOC-Danida Training Courses on the Taxonomy and Biology of Harmful Marine Microplankton  <b>Organizer:</b> IOC Science and Communication Centre on Harmful Algae, (Moestrup, Larsen, Fukuyo, Matzuoka, Enevoldsen)	Advan. M.Sc Ph.D  (5-18)	Global,  developing countries	University of Copenhagen, Denmark	August  1995 1996 1997 1998 1999 2000 2001 2004	HABP Plan BMTCS WS HAB Survey 1 <sup>st</sup> IOC-Danida Training Course. Survey 1999 IPHAB 2003	Danida- IOC-TF: 50 K/course
<b>Course name:</b> IOC- Training Course and Identification Qualification in Harmful Marine Microalgae	Advan. M.Sc Ph.D	Global,	University of Copenhagen, Denmark	2006. E-learn May-June/ course and examination 10-18 Sep.	HABP Plan IPHAB 2003	Danida- IOC-TF: 20 K/course

<b>Organizer:</b> IOC Science and Communication Centre on Harmful Algae	(5-18)			2007: E-learn May- June/practical course and examination 20- 30 Aug.		
<b>Course name:</b> MAST-ONR-IOC 6 <sup>th</sup> Advanced Phytoplankton Course <b>Organizer:</b> Dr. A. Zingone, Zool. Sta. A. Dorhn, Napoli, Italy	Advan. M.Sc, Ph.D.  (20)	Global, self paying	Zoological Station Anton Dorhn, Napoli, Italy	24 Sep.- 14 Oct. 1995		MAST, ONR
<b>Course name:</b> IOC-SAREC-Danida Training Course on the Taxonomy and Biology of Harmful Marine Microplankton <b>Organizer:</b> IOC Science and Communication Centre on Harmful algae, Cph.(Dr. Larsen), Dr. F.R.J. Taylor. Univ. of British Columbia	Basic M.Sc.  (15)	IOCINCWIO	University of Mauritius	5-14 Feb. 1996	IOCINCWIO -III Implementat ion Plan	IOC: 30K NAI 4K TEMA 6K  SAREC: 20K  Danida: printed material, equipment  Total: 30K
<b>Course name:</b> IOC-IEO-AECI Training Course on Toxic Phytoplankton <b>Organizer:</b> IOC Science and Communication Centre on Harmful Algae, Vigo	M.Sc./ Ph.D.  (12)	Latin America,  developing countries	Centro Oceanográfico de Vigo. Instituto Español de Oceanografía, Vigo, Spain	13-28 Feb 1996	IPHAB	IOC:16K AECI:10K IEO: 10K
<b>Course name:</b> IOC/WESTPAC Training Course on Species Identification of Harmful Microalgae <b>Organizer:</b> Dr. Yasuwo Fukuyo, Asian Natural Environmental Science Center, the University of Tokyo, Tokyo, Japan	M.Sc./ Ph.D,  (10)	WESTPAC	Asian Natural Environmental Science Center, the University of Tokyo, Japan	28 February - 8 March, 1997	WESTPAC- HAB	Funded by Japan

<b>Course name:</b> IOC-FURG-DANIDA Training Course on the Biology and Taxonomy of Harmful Marine Microplankton  <b>Organizer:</b> Dr. Clarisse Odebrecht, University of Rio Grande (FURG); IOC Science and Communication Centre on Harmful Algae, Copenhagen.	M.Sc, Ph.D.  (20)	South America	University of Rio Grande, Rio Grande, Brazil	3-14 March 1997	COI-FANSA	FURG and national Brazilian : 27 K  IOC: 8K WESTPAC/HAB-Japan:4K  DANIDA:10K
<b>Course name:</b> IOC-NorFa Training Course on the Taxonomy and Biology of Harmful Marine Microplankton  <b>Organizer:</b> IOC Science and Communication Centre on Harmful Algae, Copenhagen	Advanced M.Sc./ Ph.D.  (18)	Baltic Sea	Tvärminne Zoological Station, Finland	16-22 Aug. 1997	NorFa	Nordic Research Academy (NorFa):18K  IOC: 2K  Total: 20 K
<b>Course name:</b> IOC/WESTPAC Training Course on Species Identification of Harmful Microalgae  <b>Organizer:</b> Asian Natural Environmental Science Center, the University of Tokyo	M.Sc, Ph.D.  (10)	WESTPAC	Asian Natural Environmental Science Center, the University of Tokyo, Tokyo, Japan	22-30 Aug. 1997	WESTPAC-HAB	Funded by Japan
<b>Course name:</b> IOC-APEC Training Course on the Identification and Monitoring Harmful Marine Microplankton  <b>Organizer:</b> IOC Science and Communication Centre on Harmful Algae, Copenhagen	Basic M.Sc.  (12)	APEC	University of Copenhagen, Denmark	11-19 Oct. 1997	APEC	APEC: 10K IOC: 10K  Self paying participants  Danida: printed material, equipment

<b>Course name:</b> 7th advanced Phytoplankton Course on Taxonomy and Systematics  <b>Organizer:</b> Dr. A. Zingone, Zool. Sta. A. Dohrn, Napoli, Italy	Advan. M.Sc, Ph.D.  (20)	Global, self paying	Stazione Zoologica A. Dohrn di Napoli, Italy	10-30 May 1998		MAST, ONR, IOC-UNESCO
<b>Course name:</b> IOC-NorFa Training Course on the Taxonomy and Biology of Harmful Marine Microplankton  <b>Organizer:</b> IOC Science and Communication Centre on Harmful Algae, Copenhagen	Advanced M.Sc./Ph. D.  (18)	Baltic Sea	Võrtsjärv Limnological Station, Estonia	1-9 Sept. 1998	NorFa	Nordic Research Academy (NorFa):18K  IOC: 2K  Total: 20 K
<b>Course name:</b> IOC-IEO-AECI Training Course on Toxic Microalgae and Marine Phycotoxins  <b>Organizer:</b> IOC Science and Communication Centre on Harmful Algae, Vigo	M.Sc./Ph. D  (12)	Global, developing countries	Centro Oceanográfico de Vigo. Instituto Español de Oceanografía, Vigo, Spain	June 1998 1999 2000 2001	IPHAB	Funded by Spai IOC TF  35K/course
<b>Course name:</b> IOC Distant Learning Course in Harmful Algae for South East Asia.	M.Sc./Ph. D  (18)	SE Asia	Universities of the Philippines, Tokyo, Tasmania, and Copenhagen and the IOC Science and Communication Centre on Harmful Algae Copenhagen,  Final workshop Hue University of Sciences	September-December 2003., 6-13 January 2004	IPHAB	UNESCO Cross Cutting Project: 35K

<b>Course name:</b> IOC Distant Learning Course in Harmful Algae for South East Asia.	M.Sc./ Ph. D  (18)	SE Asia	Universities of the Philippines, Tokyo, Tasmania, and Copenhagen and the IOC Science and Communication Centre on Harmful Algae Copenhagen, Final workshop University of the Philippines, Manila	January-May 2003. 5-12 August 2003	IPHAB	UNESCO Cross Cutting Project: 35K
<b>Course name:</b> Taxonomy of Harmful Microalgae  <b>Organizer:</b> ,Faculdade Ciências Universidade Lisboa (Portugal), Facultad de Ciencias Naturales y Museo (Argentina), Fundação Universidade Federal do Rio Grande (Brazil), Instituto de Botânica (Brazil), Instituto Nacional de Investigación y Desarrollo Pesquero (Argentina), Universidade de Taubaté (Brazil), and the IOC Science and Communication Centre on Harmful Algae, University of Copenhagen (Denmark). Co-organised with the Brazilian Phycological Society(Sociedade Brasileira de Ficologia).	M.Sc./ Ph. D  (18)	South America	University of Sao Paolo, Brazil.	E-learning March-May 2005, microscope course 16-27 May 2005,	UNESCO CCT	UNESCO Cross Cutting Project: 35K
<b>Course name:</b> IOC-ROPME Regional Training Workshop on Harmful Algae, <b>Organizer:</b> IOC Science and Communication Centre on Harmful Algae and INCO	M.Sc./ Ph. D  (16)	Gulf region	Iranian National Center for Oceanography, INCO, Tehran, Iran,	22-31 January 2006	IOCINDIO	IOC: 5 K ROPME 15K~
<b>Course name:</b> Biology of Marine Phytoplankton/ Taxonomy of Harmful Algae in-country Training Course	M.Sc.  (25)	Vietnam,	Hue University of Science, Hue, Vietnam	9-17 March / 15-18 May 2006	HABViet Plan	HABViet / Danida 20 K

<b>MODULE:</b>  <b>TOXIN CHEMISTRY AND TOXICOLOGY</b>	<b>LEVEL</b>  <b>no. of part.:</b>	<b>TARGET GROUP/ Region:</b>	<b>WHERE:</b>	<b>WHEN:</b>	<b>NEED IDENTIFIED WHERE :</b>	<b>FUNDING IDENTIFIED:</b> in US \$
<b>Course name:</b> IOC-UNEP-WHO-FAO Training Course on Qualitative and Quantitative Determination of Algal Toxins  <b>Organizer:</b> Prof. B. Lukas Univ.of Jena,Germany	Advan. M.Sc., Ph.D.  (12)	Mediterranean, global	Friedrich- Schiller University of Jena, Germany	Oct. 1994	HABP Plan BMTc WS HAB Survey	UNEP: 15K IOC: OSLR 5K TEMA 8K  Univ. Jena: equipment + accom. Japan: equipment  Total: 45K
<b>Course name:</b> IOC-UNEP-WHO-FAO-Italy Training Course on Toxin Chemistry and Toxicology related to Harmful Algae  <b>Organizer:</b> Prof. R.D. Loggia, Dr. A. Tubaro	Advan. M.Sc., Ph.D.  (10)	Developing countries, East Med., Black Sea	University of Trieste	3-12 Sep. 1995	HABP Plan BMTc WS HAB Survey	IOC: 8.4K MAP: 1.6K FAO: 7 K Univ. of Trieste: 22K Japan: equipment  Total: 39K
<b>Course name:</b> IOC-AECI-IEO Training Course on Analytical Methods for the Detection of Marine Toxins  <b>Organizer:</b> IOC Science and Communication Centre on Harmful Algae Vigo (Reguera)	Basic M.Sc, Ph.D.  (10)	Latin America	IEO, Vigo, Spain.	25 June-6 July 1997	IOC-FANSA	Funded by Spain IOC TF  36K/course

<b>Course name:</b> IOC-UNEP Training Course on Qualitative and Quantitative Determination of Algal Toxins  <b>Organizer:</b> Prof. B. Lukas University of Jena, Germany	Advan. M.Sc., Ph.D.  (12)	Global	Friedrich- Schiller University of Jena, Germany	2-12 March 1999	HABP Plan BMTc WS HAB Survey	UNEP: ?K  IOC: HAB 8K  Univ. Jena: equipment,  Total: 40K
<b>Course name:</b> IOC Training Course on Phycotoxins <b>Organizer:</b> Dr. Kevin J. James, Director, Ecotoxicology Res. Unit, Chemistry Dept, Cork Inst of Techn., Cork, Ireland	Advan. M.Sc., Ph.D.  (14)	Global	Cork Institute of Technology, Cork, Ireland	1-14 Sep., 2000	IPHAB	CIT: 13,5K <b>IOC: 12,5K requested</b>  EU and WHO subject to application
<b>Course name:</b> IOC Training Course on Qualitative and Quantitative Determination of Algal Toxins  <b>Organizer:</b> Dr. Matthe Elbraechter, Senckenberg Museum, Germany	Advan. M.Sc., Ph.D.  (16)	Global	Wattenmeerstation Sylt, Alfred Wegener Institut für Polar- und Meeresforschung, List/Sylt, Germany	22 February to 3 March 2005	IPHAB	IOC: HAB 7K German partners: 12K  Total: 19K excl airfare for all



<b>MODULE:</b> <b>RISK ASSESSMENT, CONTINGENCY PLANNING AND MANAGEMENT OF HARMFUL ALGAL EVENTS; DESIGN AND IMPLEMENTATION OF MONITORING PROGRAMMES</b>	<b>LEVEL</b>  <b>no of part.:</b>	<b>TARGET GROUP/ Region:</b>	<b>WHERE:</b>	<b>WHEN:</b>	<b>NEED IDENTIFIED WHERE :</b>	<b>FUNDING IDENTIFIED:</b> in US \$
<b>Course name:</b> IOC-Japan Training Workshop on Monitoring of PSP Plankton and Shellfish Toxicity  <b>Organizer:</b> Dr. Y. Fukuyo, Univ. of Tokyo, Dr. M. Kodama, Kitasato Univ	Basic, M.Sc., Ph.D.  (15)	WESTPAC	Kitasato University	17-21 July 1995	HABP Plan BMTC WS HAB Survey WESTPAC WS	IOC: 11K  Japan: 30K  Kitasato Univ: 5K  Total 46K
<b>Course name:</b> IOC-APEC Symposium: Harmful Algal Mmanagement  <b>Organizer:</b> IPHAB Task Team and APEC	Managers , Administrators, Scientists  (40-60)	Global	Subic Bay, Philippines	9-14 May 1999	HABP Plan, BMTC WS,	Danida funds for prep. of WS: 15K  IOC: 15K APEC : remainder 30K
<b>Course name:</b> VI IOC-AECI-IEO Training Course on Toxic Phytoplankton and Marine Phycotoxins: Monitoring programmes on Toxic Phytoplankton and Marine Phycotoxins according to European Union Directives	Advanced  (10)	Latin America	IOC-IEO Science and communication Centre on Harmful Algae. Instituto Español de Oceanografía, Vigo, Spain.	10-26 June, 2002.	IPHAB	25K Spain  TF Spain: 8K AECI: 7K IEO: 10K

<b>MODULE:</b>  <i><b>THEME WORKSHOPS, AND REGIONAL INTERDISCIPLINARY WORKSHOPS</b></i>	<b>LEVEL</b>  <b>no. of part.:</b>	<b>TARGET GROUP/ Region:</b>	<b>WHERE:</b>	<b>WHEN:</b>	<b>NEED IDENTIFIED WHERE :</b>	<b>FUNDING IDENTIFIED : in US \$</b>
<b>Course name:</b> WESTPAC - LIPI - P30 Seminar on HAB  <b>Organizer:</b> Mr. D.J. Praseno, P30 LIPI	Basic, Admin. and Scientists  (30)	WESTPAC	Research and Development Centre for Oceanology, LIPI, Indonesia.	8 Nov. 1993	WESTPAC-II	Japan: 5K Indonesia: 3K  Total: 8K
<b>Course name:</b> WESTPAC - China Workshop on HAB  <b>Organizer:</b> Dr. Qi Yuzao, Jinan University	Basic M.Sc.  (10)	WESTPAC	Guangzhou, China	21-26 Nov. 1993	WESTPAC-II	Japan: 5K China: 3K  Total: 8K
<b>Course name:</b> WESTPAC - PAMS - Thailand Workshop on HAB  <b>Organizer:</b> Dr. R.A. Corrales, Univ. of the Philippines, Dr. A. Marasigan, Univ. of the Phil. in the Visayas.	Basi, admin., tech., scientists  (20)	WESTPAC	Iloilo, Philippines	May 1994	WESTPAC-II	Japan: 3K  Indonesia: 1K  CIDA: ?K
<b>Workshop name:</b> IOC Regional Science Planning Workshop on Harmful Algal Blooms  <b>Organizer:</b> Dr. Silvia Mendez, INAPE, Uruguay	M.Sc., Ph.D.  (22)	Scientists  South America	INAPE, Montevideo, Uruguay	May 1994	IPHAB-II	IOC: MTD 4K  Total: 4K
<b>Workshop name:</b> Second IOC Regional Science Planning Workshop on Harmful Algal Blooms	M.Sc., Ph.D.	Scientists  South America	INIDEP, Mar del Plata, Argentina	Oct. 1995	1 <sup>st</sup> Workshop	IOC: 10K

<b>Organizer:</b> Dr. Jose I. Carreto, INIDEP, Argentina						
<b>Workshop name:</b> Third IOC Regional Science Planning Workshop on Harmful Algal Blooms (COI-FANSA-III)  <b>Organizer:</b> Leonardo Guzman	M.Sc., Ph.D.	Scientists  South America	Instituto Fomen Pesquero, Puenta Aremas, Chile	28-30 July 1997	2 <sup>nd</sup> workshop	IOC
<b>Course name:</b> International Seminar on Red Tides, risks for human health and development  <b>Organizer:</b> Raul Koch	M.Sc., Ph.D.	Scientists  South America	Puerto Varas, Xa Region, Chile	3-5 August 1999	IOC FANSA	Health Ministry, Regional Government, IOC
<b>Course name:</b> Regional S-American Course on HAB, methodologies for marine biotoxins  <b>Organizer:</b> Karim Keisser	M.Sc., Ph.D.	Scientists  South America	Public Health Institute, Santiago, Chile	8-12 November 1999	III IOC FANSA	FURG IOC Ministry of Science and Technology
<b>Course name:</b> IV Regional Working Meeting on Harmful Algae Blooms in S-America (COI/FANSA)  <b>Organizer:</b> Virginia Garcia	M.Sc., Ph.D.	Scientists  South America	FURG, Rio Grande University, Brazil	Jan. 2000	III IOC FANSA	IOC 10 K + local sponsorship
<b>Course name:</b> WESTPAC-LIPI-P30 Red Tide training CourseCanada Training Workshop on Harmful Algae	Basic, M.Sc.  (10)	WESTPAC ASEAN	LIPI, Ambon, Indonesia	13-18 Nov. 1995	WESTPAC-II	IOC:  Japan: 5K  Indonesia 3K

<b>Organizer:</b> Mr. D.P. Praseno, P30 LIPI, Dr. Yasuwo Fukuyo, Univ. Tokyo						
<b>Course name:</b> IOC/WESTPAC In-Country Training Courses:  IOC/WESTPAC-Philippines: Dinoflagellate Identification  IOC/WESTPAC-Vietnam: Phytoplankton Monitoring and Identification in Eastern Indonesia  IOC/WESTPAC-Indonesia: Phytoplankton Monitoring and Identification in Eastern Indonesia  IOC/WESTPAC-Malaysia: Identification of PSP Plankton  <b>Organizer:</b> Asian Natural Environmental Science Center, the University of Tokyo, Tokyo, Japan,	Basic M.Sc.	WESTPAC				
	(9)		BEFAR, Manila, Philippines	6-19 Dec. 1995	WESTAPC-II	Japan 3K BEFAR 10K
	(8)		Inst of Ocean., Haiphong Vietnam	12-15 Nov. 1996	WESTPAC-III	Japan 15K Vietnam 3K
	(15)		Res.andDevelop. Centre for Oceanology, Jakarta, Indonesia	18-22 Nov. 1996	WESTPAC-III	Japan 15K Indonesia 3K
	(15)		Univ.of Malaysia Saba, Kota Kinabalu, Malaysia	9-11 December, 1996	WESTPAC-III	Japan 15K Malaysia 5K
<b>Course name:</b> IOC/WESTPAC In-Country Training Courses:  IOC/WESTPAC-UPV: Red Tide Seminar Workshop  IOC/WESTPAC-PSU: Seminar on HAB  IOC/WESTPAC-UPV: Red Tide Seminar Workshop	Basic M.Sc.	WESTPAC				
	(20)		Univ.Phil.in the Visayas, Philippines	17 May 1996	WESTAPC-II	Japan 5K Phil. 10K
	(20)		P.of Songkla Univ., Hat-Yai, Thailand	12-16 Dec. 1997	WESTPAC-III	Japan 25K Thailand 5K
	(20)		Univ.of the Phil.in Cebu	17-21 Nov. 1998	WESTPAC-III	Japan 35K Philippines 5K

<p>IOC/WESTPAC-Chinese Taipei: Red Tide Seminar Workshop</p> <p>IOC/WESTPAC-Hong Kong: Red Tide Seminar and Training Course</p> <p><b>Organizer:</b> Asian Natural Environmental Science Center, the University of Tokyo, Tokyo, Japan.</p>	(13)		National Taiwan University, Taipei	3-7 April 1999	WESTPAC-III	Japan 5K C. Taipiei 50K
	(20)		Agriculture and Fisheries dept, Hong Kong	6-10 Dec. 1999	request	Japan 5K Hong Kong 50K
<p><b>Course name:</b> IOC/WESTPAC Training Course on PSP Toxin Monitoring</p> <p><b>Organizer:</b> Dr. Y. Fukuyo, Asian Natural Environmental Science Center, University of Tokyo, and Dr. M. Kodama, School of Fisheries Sciences, Kitasato University</p>	M.Sc/ Ph.D.	9	School of Fisheries Sciences, Kitasato University, Iwate, Japan	24-30 August 1998	WESTPAC-HAB	Japan 16K
<p><b>Course name:</b> 5<sup>th</sup> IOC/WESTPAC/HAB Training Course on Ecology and Physiology of Harmful Algae</p> <p><b>Organizer:</b> Asian Natural Environmental Science Center, the University of Tokyo, Tokyo, Japan.</p> <p>The 6th IOC/WESTPAC Training Course on Advanced Techniques on Characterization of Harmful Algal Species</p> <p><b>Organizer:</b> Asian Natural Environmental Science Center, the University of Tokyo, Tokyo, Japan.</p>	M.Sc/ Ph.D.	9	Chulalongkorn University and Burapha University, Thailand	19 – 24 March 2001	WESTPAC/HA B	Japan FiT
	M.Sc/ Ph.D.	9	Manila, Philippines	May 13-18 2002	WESTPAC/HA B	Japan FiT

<p>The 7th IOC/WESTPAC Training Course on Species Identification of Harmful Microalgae,</p> <p><b>Organizer:</b> Asian Natural Environmental Science Center, the University of Tokyo, Tokyo, Japan.</p>	M.Sc/ Ph.D.	9	Sabah, Malaysia	March 17-22, 2003,.	WESTPAC/HA B	Japan FiT, 16K
<p><b>Course name:</b> IOC Training course on HAB for the Caribbean Countries</p> <p><b>Organizer:</b> Arturo Sierra</p>	Basic M.Sc.,  (10)	Caribbean	Mexico. CIBNOR (Centro de Inv. Biologicas del Noroeste)	2001	IOC Rep.of Gov. and Major Subsidiary Bodies No. 67, Dec. 1995	IOC: 10K
<p><b>Course name:</b> IOCEA Workshop on Harmful Algal Blooms</p> <p><b>Organizer:</b> IOC Science and Communication Centre on HAB, Copenhagen</p>	M.Sc/ Ph.D	10	University of Accra, Ghana	29 October 2 November 2001	IPHAB	Danida 10K IOC budget 20K
<p><b>Course name:</b> IOC-NAUTA-COPEMED Course on Identification of Harmful Algal Blooms, INSTM, Tunisia,</p> <p><b>Organizers:</b> Monica Lion, Jacob Larsen, Souad Turki (INSTM)</p>	M.Sc/ Ph.D	11	INSTM, Tunisia	1-10 December 2003	IPHAB	IOC HAB: 1,7K AECI-Nauta: 13,5K IEO: 10,5K Danida TF: 8K FAO-COPEMED:1,5K Total: 35,2K

<b>MODULE:</b>  <i><b>INDIVIDUAL TRAINING</b></i>	<b>LEVEL</b>  <b>no. of part.:</b>	<b>TARGET GROUP/ Region:</b>	<b>WHERE:</b>	<b>WHEN:</b>	<b>NEED IDENTIFIED WHERE :</b>	<b>FUNDING IDENTIFIED:</b> in US \$
IOC-IEO Science and Communication Centre on Harmful Algae. Individual training visits under the supervision of one expert from a Galician Institution.	2002: 2 2003: 1 2004: 5 2005: 10 2006:  Advanced	Latin America and North Africa	Instituto Español de Oceanografía, Vigo (Spain)	2002-2006	IPHAB	Spanish TF 2002: AECl: 2,5 K, IGACl: 2,5 K, IEO: 2 K 2003: AECl: 2,5 K, IEO: 1 K 2004: AECl: 12,5, IEO: 5 K 2005: AECl: 26,5 K
IOC Science and Communication Centre on Harmful Algae. Individual training visits/PhD under the supervision of expert from University of Copenhagen	5  Advanced	Developing countries	Department of Phycology, Institute of Biology, University of Copenhagen, Denmark	2001-2006	IPHAB	Danish TF ~6K/year

## ANNEX XII

### **TERMS OF REFERENCE AND RULES OF OPERATION (AS OF APRIL 2007)**

SCOR/IOC Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB)  
Programme Scientific Steering Committee (SSC)

The Scientific Steering Committee of the GEOHAB Programme will

1. Coordinate and manage GEOHAB Core Research Projects (CRPs) in accordance with the GEOHAB Science and Implementation Plans.
2. Identify gaps in knowledge required to execute CRPs, and encourage targeted research activities to fill those gaps.
3. Review progress on CRPs over time and initiate new CRPs in priority research areas.
4. Foster framework activities to facilitate implementation of GEOHAB, including dissemination and information tools.
5. Establish appropriate data management activities to ensure access to, sharing of, and preservation of GEOHAB data, taking into account the data policies of the sponsors.
6. Promote comparative and interdisciplinary research on harmful algal blooms by providing coordination and communication services to national and regional research groups, encouraging explicit affiliation with GEOHAB via the endorsement process.
7. Collaborate, as appropriate, with intergovernmental organizations and their subgroups (e.g., ICES, PICES, FANSA, ANCA, WESTPAC/HAB, HANA, NOWPAP), as well as related research projects (e.g., GLOBEC, LOICZ, IMBER) and observational systems such as the Global Ocean Observing System and its regional alliances.
8. Report regularly to SCOR, the IOC Intergovernmental Panel on Harmful Algal Blooms (IPHAB), and the global HAB research community on the state of planning and accomplishments of GEOHAB, through annual reports and, as appropriate, the GEOHAB Web site, a GEOHAB Newsletter, *Harmful Algal News*, special sessions at scientific meetings, and other venues.
9. Interact with agency sponsors to stimulate the support of GEOHAB implementation through various mechanisms (e.g., direct support of GEOHAB initiatives and integration of the GEOHAB approach in national programs).

Approved {date} by the SCOR Executive Committee and {date} by the Intergovernmental Panel on Harmful Algal Blooms.

#### Acronyms

ANCA = IOC HAB working group for Central America and Caribbean Sea

FANSA = IOC HAB working group for South America

HANA = IOC HAB working group for North Africa



GLOBEC = Global Ocean Ecosystem Dynamics project

ICES = International Council for the Exploration of the Seas

IMBER = Integrated Marine Biogeochemistry and Ecosystem Research project

IOC = Intergovernmental Oceanographic Commission

LOICZ = Land-Ocean Interactions in the Coastal Zone project

NOWPAP = UNEP Northwest Pacific Action Plan

PICES = North Pacific Marine Sciences Organization

SCOR = Scientific Committee on Oceanic Research

WESTPAC/HAB = IOC Sub-Commission for the Western Pacific HAB Working Group

ANNEX XIII

**TERMS OF REFERENCE 2007**  
**ICES-IOC WORKING GROUP ON HARMFUL ALGAL BLOOM DYNAMICS**

The Working Group will meet in Riga, Latvia, from 10-13 April 2007 to:

- a) review outcome of the WKEUT workshop on Long term data sets and eutrophication held 11–15 September 2006 in Copenhagen;
- b) review progress and analyses that REGNS North Sea Group have done and report on the second REGNS workshop held in Copenhagen from 15 to 19 May 2006;
- c) discuss new findings that pertain to harmful algal bloom dynamics. Bring new findings in phytoplankton population dynamics models to the attention of WGHABD for discussion;
- d) review the on-line format of HAEDAT system and developments made towards developing an integrated system and evaluate the amendments made to update historical submissions and links to mapping. Perform user identification and plan the promotion of the system;
- e) review the structure and composition of the decadal HAE maps for the ICES region with special reference to clarifying the distinction between harmful algal blooms and the harmful affects that are reported on the maps;
- f) collate and assess National reports and update the decadal mapping of harmful algal events for the IOC/ICES harmful algal database, HAE-DAT;
- g) take part in the intersessional work led by PGPYME in developing the mission and draft resolutions for a new Expert Group related to phytoplankton and microbial ecology.

In addition perform a self review under the following topics:

- 1) Were the Terms of Reference properly addressed and completed?
- 2) Is the report clear and understandable?
- 3) Is the science quality adequate?
- 4) Are the conclusions well supported and acceptable?
- 5) Linkages to other topics, or work elsewhere in ICES?
- 6) Is the work suitable for an ICES publication?
- 7) How should the work be continued?
- 8) Other points to note or query?
- 9) Was attendance adequate?
- 10) Was the range of expertise appropriate or adequate?

## ANNEX XIV

### TERMS OF REFERENCE 2007 ICES-IOC-IMO WORKING GROUP ON BALLAST AND OTHER SHIP VECTORS (WGBOSV)

2006/2/ACME04 The ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors (WGBOSV) (Chair: Anders Jelmert\*, Norway) meet in Dubrovnik, Croatia from 19–21 March, 2007 to:

- a) critically review and report on the status of ballast water research with an emphasis on new developments in ballast water treatment technology, risk assessment, ballast water sampling devices, and selection of ballast water exchange zones to contribute to guidelines currently in preparation by IMO;
- b) continue its global review of shipping vectors through the participation of representatives from ICES, IMO, IOC, CIESM, BMB and PICES Member States and of invited experts;
- c) finalize the ICES Ballast Water Sampling Manual;
- d) prepare a draft ICES Code of Best Practice for the Management of Ships Hull Fouling;
- e) continue reviewing port sampling protocols with the aim to prepare a draft ICES Code of Best Practice for Port Sampling;
- f) consider and respond to the recommendation from ACME to merge in 2008 WGITMO and WGBOSV into a single working group with a broadened mandate for the occurrence and impact of marine invasive and/or pest organisms.

WGBOSV will report by 2 April 2007 for the attention of ACME.

Priority:	The current activities of this Group will direct ICES towards issues related to the high priority issue of unintentional species invasions.
Scientific Justification:	<p>a) contributes to the continuing global effort to reduce the risks of the unintentional introduction of aquatic invasive species through the discharge of ballast water.</p> <p>b) Consideration of hull fouling and other non-ballast shipping vectors is of equal importance for species invasion compared to ballast water in some areas. Hull fouling and other non-ballast shipping vectors also need to be considered.</p> <p>c) finalize the ICES Ballast Water Sampling Manual,</p> <p>d) prepare a draft ICES Code of Best Practice for the Management of Ships Hull Fouling taking into account the recommendation from ACME to expand the scope to include all shipping vectors other than ballast water;</p> <p>e) Draft guidelines will be prepared intersessionally and finalised at the meeting.</p> <p>f) These two groups have many members in common and have regularly deemed it beneficial to meet consecutively and in the same location, hence ACME is proposing the 2 groups be merged in 2008. It is also recommended that the mandate of the merged group be expanded to cover the general issue of marine invasive and/or pest organisms. The two groups are asked to consider this recommendation and respond to ACME with any concerns.</p>
Relation to Strategic Plan:	
Resource Requirements:	None required other than those provided by host country and national members.

Participants:	Participation of representatives from ICES Member Countries, IMO, IOC, PICES, CIESM, shipping agencies, and scientists from relevant research groups world-wide.
Secretariat Facilities:	None required
Justification of venue	<p>The WGITMO agreed to hold the meeting in Dubrovnik in response to a request by the observers (Marijana Pecarevic and Josip Mikus) to assist Croatia with raising awareness of the risks of marine introductions in Croatia and to share the scientific knowledge of the EG with local scientists. One justification for holding the meeting in Croatia was to share information from the WITGMO EG with local scientists on potential invaders, risks of invasions, and management or control options. The observers agreed to provide local sponsorship of the WGITMO meeting if it were held in Croatia. The last two meetings were held at ICES countries (Norway and Belgium).</p> <p>There is a value in having meetings in locations where officials may not fully appreciate the risks of invasive species and impacts (economic and ecological) to society, holding the meeting in Dubrovnik, Croatia will benefit Croatia, foster exchange between scientists will benefit ICES and Croatia, and meet other ToR requirements.</p>
Financial:	None required
Linkages to Advisory Committees:	ACME
Linkages to other Committees or Groups:	WGITMO as well as to other related ICES Working Groups, such as Working Group on Harmful Algal Bloom Dynamics (WGHABD), PICES WG15 on Harmful Algal Blooms and the newly established PICES WG21 on biological invasions.
Linkages to other Organisations:	IOC, IMO, PICES, CIESM, BMB

## ANNEX XV

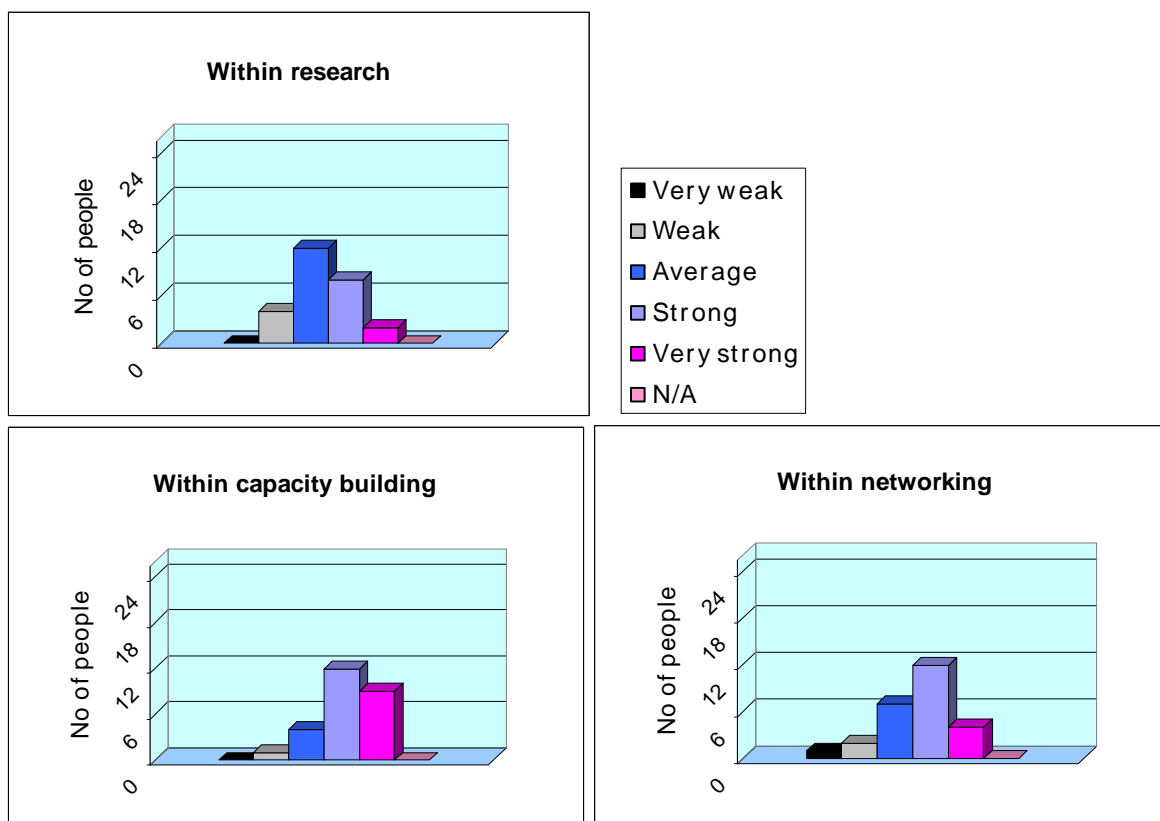
### IPHAB SELF ASSESSMENT 2007

The IOC HAB Programme has existed for 15 years (since 1992) and the IOC wishes to make a broad assessment of how the impact of the Programme is perceived in the broad community working with HAB.

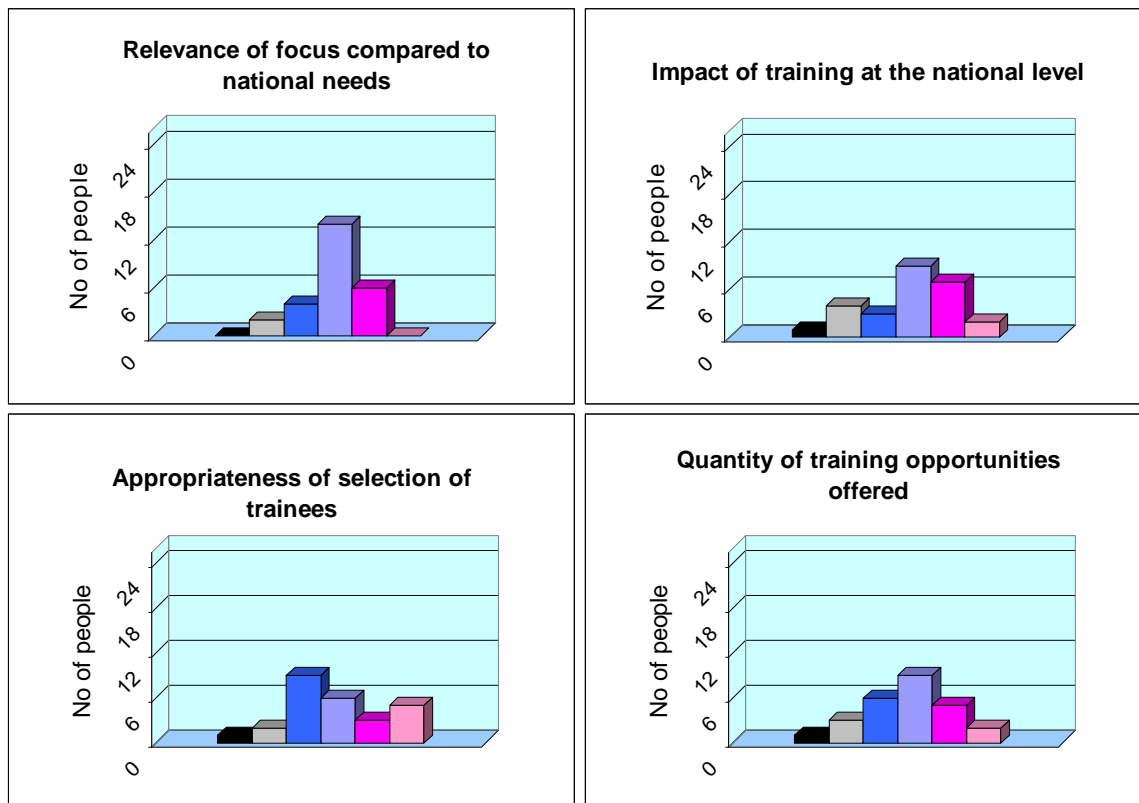
By the 'IOC HAB Programme' we refer to a broad variety of activities including international and regional training courses, GEOHAB, Harmful Algae News, manuals and guides and proceedings published by IOC and UNESCO, the regional networks FANSA, ANCA, WESTPAC/HAB and HANA, the IOC Science and Communication Centres, and the various working groups the Programme has had or has with ICES, SCOR, PICES and IMO, etc.

Your replies to the questions below are important to us and will help guide us in deciding on IOC priorities within HAB in our next Medium Term Plan covering 2008-2013.

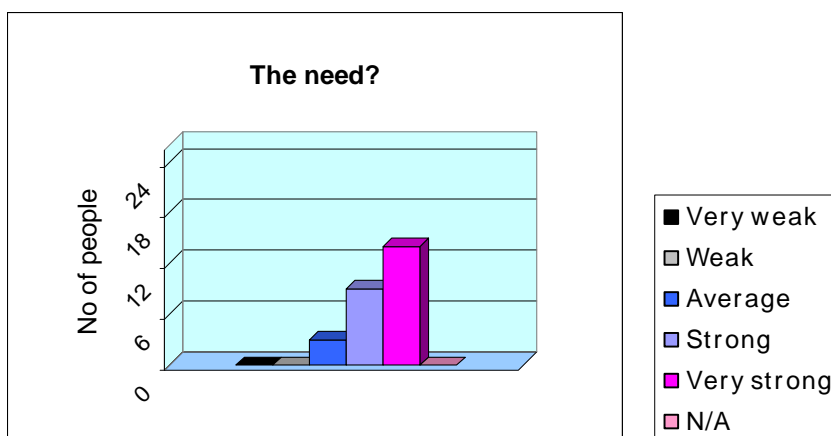
1. How do you perceive the overall impact of IOC activities on HAB on the development of international cooperation within HAB:



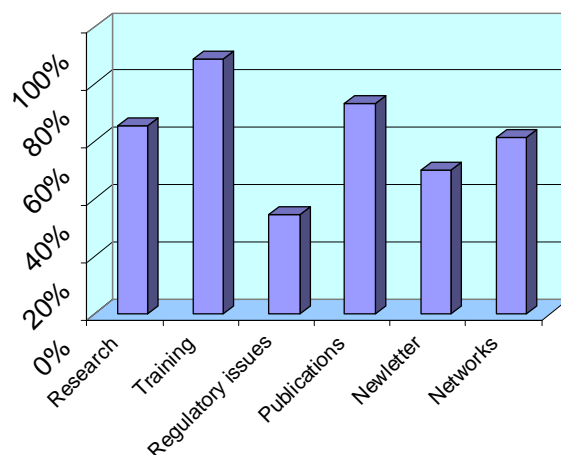
2. Regarding the IOC efforts on training and capacity building in relation to HAB over the past 15 years (IOC international and regional activities at the IOC Science and Communication Centres on HAB in Copenhagen and Vigo and through WESTPAC/HAB, FANSA, ANCA and HANA), how do you perceive:



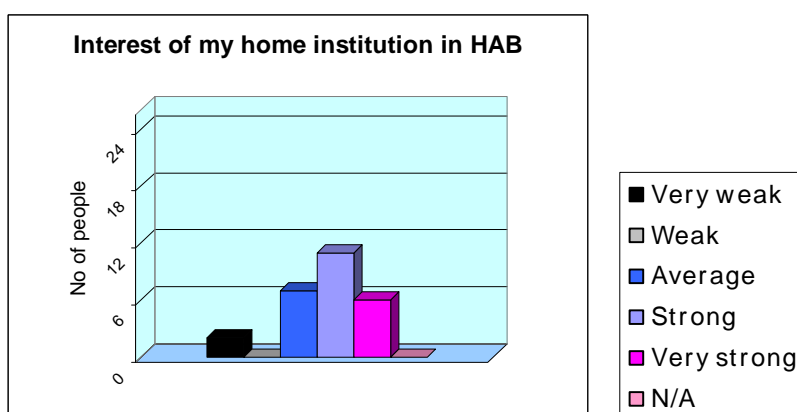
3. How do you perceive the need for IOC involvement in the HAB field in the forthcoming 5-10 years?



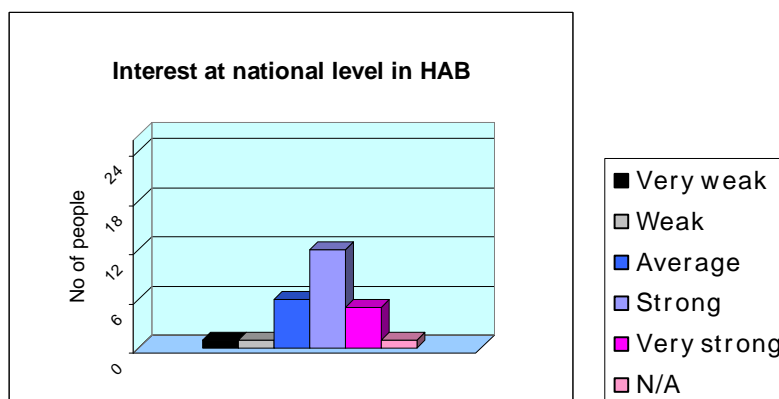
If you perceive the need as medium to high, what are the areas where you perceive the need as most important? (you may tick more than one box):



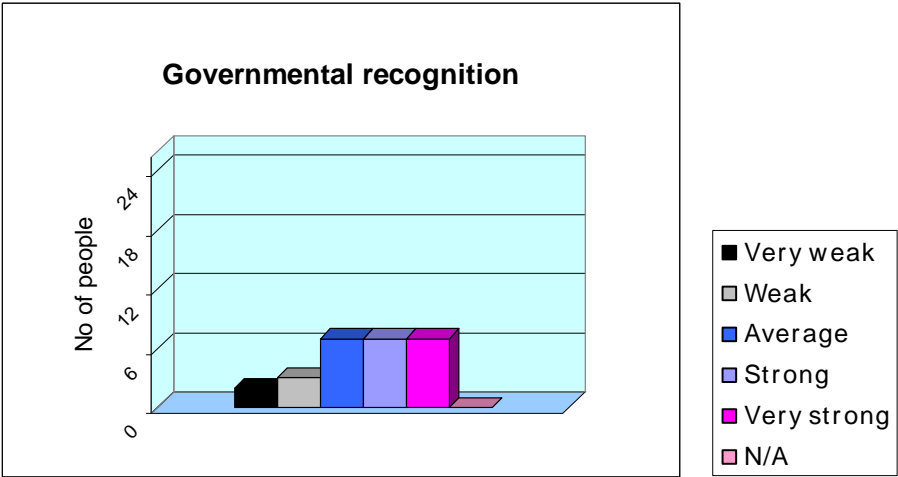
4. Has your involvement in IOC HAB activities influenced the interest or awareness of your home institution in the HAB issue?



5. Has your involvement in IOC HAB activities influenced the interest or awareness at the national level in the HAB issue?



6. Is your membership of IPHAB recognized at governmental level in your Country (government agency, ministry level or are you mandated on their behalf)?





ANNEX XVI

**GLOSSARY OF ACRONYMS AND SPECIAL TERMS**

<b>AOAC</b>	Association of Official Analytical Chemists
<b>APEC</b>	Asia Pacific Economic Cooperation
<b>ASEAN</b>	Association of South East Asian Nations
<b>BCLME</b>	Benguela Current Large Marine Ecosystem
<b>CCFFP</b>	Codex Committee on Fish & Fisheries Products
<b>CFT</b>	Ciguatera Fish Poisoning
<b>COPEMED</b>	Cooperation on Mediterranean Fisheries
<b>DANIDA</b>	Danish International Development Agency
<b>DSP</b>	Diarrhetic Shellfish Poisoning
<b>EPA</b>	Environmental protection Agency
<b>ETI</b>	Expert Centre on Taxonomic Identification
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>DFA</b>	Food and Drug Administration
<b>GEEP</b>	Group of Experts on the Effects of Pollutants
<b>GEF</b>	Global Environment Facility
<b>GEOHAB</b>	Global Ecology and Oceanography of Harmful Algal Blooms
<b>GoMOOS</b>	The Gulf of Marine Ocean Observing Systems
<b>GOHWMS</b>	Global Tsunami & Other Related hazards Early Warning System
<b>GOOS</b>	Global Ocean Observing System
<b>GRS</b>	GOOS Regional Alliances
<b>GSSC</b>	Scientific Steering Of the Global Ocean Observing System
<b>IAEA</b>	International Atomic Energy Agency
<b>ICES</b>	International Council for the Exploration of the Sea
<b>ICOM</b>	International Census of Marine Microbes
<b>ICSEM</b>	International Commission for the Scientific Exploration of the Mediterranean Fisheries
<b>ICSU</b>	International Council of Scientific Unions
<b>IMBER</b>	Integrated Marine Biogeochemistry & Ecosystem Research
<b>IMO</b>	International Maritime Organization
<b>IOC</b>	Intergovernmental Oceanographic Commission
<b>IOCARIBE</b>	IOC Sub-Commission for the Caribbean and Adjacent Regions
<b>IPHAB</b>	Intergovernmental Panel on Harmful Algal Blooms
<b>ISSHA</b>	International Society for the Study of Harmful Algae

<b>JCOMM</b>	Joint WMO-IOC Technical Commission for Oceanography & Marine Meteorology
<b>LOICZ</b>	Land-Ocean Interactions in the Coastal Zone
<b>MAP</b>	Mediterranean Action Plan
<b>NMDIS</b>	National Marine data and Information Service
<b>NMEFC</b>	National marine Environmental Forecast Center
<b>NMEMC</b>	National Marine Environmental Center
<b>NOAA</b>	National Oceanic and Atmospheric Administration
<b>NSOAS</b>	National satellite Ocean Application Services
<b>NSP</b>	Neurotoxic Shellfish Poisoning
<b>PICES</b>	North Pacific Marine Science Organization
<b>PSP</b>	Paralytic Shellfish Poisoning
<b>RCOOSs</b>	Regional Coastal Ocean Observing Systems
<b>ROPME</b>	Regional organization for the protection of marine Environment
<b>SCOR</b>	Scientific Committee on Oceanic Research
<b>TPA</b>	Toxin Producing Algae
<b>UNCED</b>	United Nation Conference on Environment and Development
<b>UNDP</b>	United Nations Development Programme
<b>UNEP</b>	United Nations Environment Programme
<b>UNESCO</b>	United Nations Educational, Scientific and Cultural Organization
<b>WESTPAC</b>	IOC Sub-Commission for the Western Pacific
<b>WHO</b>	World Health Organization

In this Series	Languages
<b>Reports of Governing and Major Subsidiary Bodies</b> , which was initiated at the beginning of 1984, the reports of the following meetings have already been issued:	
1. Eleventh Session of the Working Committee on international Oceanographic Data Exchange	E, F, S, R
2. Seventeenth Session of the Executive Council	E, F, S, R, Ar
3. Fourth Session of the Working Committee for Training, Education and Mutual Assistance	E, F, S, R
4. Fifth Session of the Working Committee for the Global Investigation of Pollution in the Marine Environment	E, F, S, R
5. First Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions	E, F, S
6. Third Session of the <i>ad hoc</i> Task team to Study the Implications, for the Commission, of the UN Convention on the Law of the Sea and the New Ocean Regime	E, F, S, R
7. First Session of the Programme Group on Ocean Processes and Climate	E, F, S, R
8. Eighteenth Session of the Executive Council	E, F, S, R, Ar
9. Thirteenth Session of the Assembly	E, F, S, R, Ar
10. Tenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific	
11. Nineteenth Session of the Executive Council, Paris, 1986	E, F, S, R, Ar
12. Sixth Session of the IOC Scientific Committee for the Global Investigation of Pollution in the Marine Environment	E, F, S
13. Twelfth Session of the IOC Working Committee on International Oceanographic Data Exchange	E, F, S, R
14. Second Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions, Havana, 1986	E, F, S
15. First Session of the IOC Regional Committee for the Central Eastern Atlantic, Praia, 1987	E, F, S
16. Second Session of the IOC Programme Group on Ocean Processes and Climate	E, F, S
17. Twentieth Session of the Executive Council, Paris, 1987	E, F, S, R, Ar
18. Fourteenth Session of the Assembly, Paris, 1987	E, F, S, R, Ar
19. Fifth Session of the IOC Regional Committee for the Southern Ocean	E, F, S, R
20. Eleventh Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Beijing, 1987	E, F, S, R
21. Second Session of the IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Arusha, 1987	E, F
22. Fourth Session of the IOC Regional Committee for the Western Pacific, Bangkok, 1987	E only
23. Twenty-first Session of the Executive Council, Paris, 1988	E, F, S, R
24. Twenty-second Session of the Executive Council, Paris, 1989	E, F, S, R
25. Fifteenth Session of the Assembly, Paris, 1989	E, F, S, R
26. Third Session of the IOC Committee on Ocean Processes and Climate, Paris, 1989	E, F, S, R
27. Twelfth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Novosibirski, 1989	E, F, S, R
28. Third Session of the Sub-Commission for the Caribbean and Adjacent Regions, Caracas, 1989	E, S
29. First Session of the IOC Sub-Commission for the Western Pacific, Hangzhou, 1990	E only
30. Fifth Session of the IOC Regional Committee for the Western Pacific, Hangzhou, 1990	E only
31. Twenty-third Session of the Executive Council, Paris, 1990	E, F, S, R
32. Thirteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, New York, 1990	E only
33. Seventh Session of the IOC Committee for the Global Investigation of Pollution in the Marine Environment, Paris, 1991	E, F, S, R
34. Fifth Session of the IOC Committee for Training, Education and Mutual Assistance in Marine Sciences, Paris, 1991	E, F, S, R
35. Fourth Session of the IOC Committee on Ocean Processes and Climate, Paris, 1991	E, F, S, R
36. Twenty-fourth Session of the Executive Council, Paris, 1991	E, F, S, R
37. Sixteenth Session of the Assembly, Paris, 1991	E, F, S, R, Ar
38. Thirteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Baja California, 1991	E, F, S, R
39. Second Session of the IOC-WMO Intergovernmental WOCE Panel, Paris, 1992	E only
40. Twenty-fifth Session of the Executive Council, Paris, 1992	E, F, S, R
41. Fifth Session of the IOC Committee on Ocean Processes and Climate, Paris, 1992	E, F, S, R
42. Second Session of the IOC Regional Committee for the Central Eastern Atlantic, Lagos, 1990	E, F
43. First Session of the Joint IOC-UNEP Intergovernmental Panel for the Global Investigation of Pollution in the Marine Environment, Paris, 1992	E, F, S, R
44. First Session of the IOC-FAO Intergovernmental Panel on Harmful Algal Blooms, Paris, 1992	E, F, S
45. Fourteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Paris, 1992	E, F, S, R
46. Third Session of the IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Vascoas, 1992	E, F
47. Second Session of the IOC Sub-Commission for the Western Pacific, Bangkok, 1993	E only
48. Fourth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions, Veracruz, 1992	E, S
49. Third Session of the IOC Regional Committee for the Central Eastern Atlantic, Dakar, 1993	E, F
50. First Session of the IOC Committee for the Global Ocean Observing System, Paris, 1993	E, F, S, R
51. Twenty-sixth Session of the Executive Council, Paris, 1993	E, F, S, R
52. Seventeenth Session of the Assembly, Paris, 1993	E, F, S, R
53. Fourteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Tokyo, 1993	E, F, S, R
54. Second Session of the IOC-FAO Intergovernmental Panel on Harmful Algal Blooms, Paris, 1993	E, F, S
55. Twenty-seventh Session of the Executive Council, Paris, 1994	E, F, S, R
56. First Planning Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Melbourne, 1994	E, F, S, R
57. Eighth Session of the IOC-UNEP-IMO Committee for the Global Investigation of Pollution in the Marine Environment, San José, Costa Rica, 1994	E, F, S
58. Twenty-eighth Session of the Executive Council, Paris, 1995	E, F, S, R
59. Eighteenth Session of the Assembly, Paris, 1995	E, F, S, R
60. Second Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 1995	E, F, S, R

61.	Third Session of the IOC-WMO Intergovernmental WOCE Panel, Paris, 1995	E only
62.	Fifteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Papete, 1995	E, F, S, R
63.	Third Session of the IOC-FAO Intergovernmental Panel on Harmful Algal Blooms, Paris, 1995	E, F, S
64.	Fifteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange	E, F, S, R
65.	Second Planning Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 1995	E only
66.	Third Session of the IOC Sub-Commission for the Western Pacific, Tokyo, 1996	E only
67.	Fifth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions, Christ Church, 1995	E, S
68.	Intergovernmental Meeting on the IOC Black Sea Regional Programme in Marine Sciences and Services	E, R
69.	Fourth Session of the IOC Regional Committee for the Central Eastern Atlantic, Las Palmas, 1995	E, F, S
70.	Twenty-ninth Session of the Executive Council, Paris, 1996	E, F, S, R
71.	Sixth Session for the IOC Regional Committee for the Southern Ocean and the First Southern Ocean Forum, Bremerhaven, 1996	E, F, S,
72.	IOC Black Sea Regional Committee, First Session, Varna, 1996	E, R
73.	IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Fourth Session, Mombasa, 1997	E, F
74.	Nineteenth Session of the Assembly, Paris, 1997	E, F, S, R
75.	Third Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 1997	E, F, S, R
76.	Thirtieth Session of the Executive Council, Paris, 1997	E, F, S, R
77.	Second Session of the IOC Regional Committee for the Central Indian Ocean, Goa, 1996	E only
78.	Sixteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Lima, 1997	E, F, S, R
79.	Thirty-first Session of the Executive Council, Paris, 1998	E, F, S, R
80.	Thirty-second Session of the Executive Council, Paris, 1999	E, F, S, R
81.	Second Session of the IOC Black Sea Regional Committee, Istanbul, 1999	E only
82.	Twentieth Session of the Assembly, Paris, 1999	E, F, S, R
83.	Fourth Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 1999	E, F, S, R
84.	Seventeenth Session of the International Coordination Group for the Tsunami Warning System in the Pacific, Seoul, 1999	E, F, S, R
85.	Fourth Session of the IOC Sub-Commission for the Western Pacific, Seoul, 1999	E only
86.	Thirty-third Session of the Executive Council, Paris, 2000	E, F, S, R
87.	Thirty-fourth Session of the Executive Council, Paris, 2001	E, F, S, R
88.	Extraordinary Session of the Executive Council, Paris, 2001	E, F, S, R
89.	Sixth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions, San José, 1999	E only
90.	Twenty-first Session of the Assembly, Paris, 2001	E, F, S, R
91.	Thirty-fifth Session of the Executive Council, Paris, 2002	E, F, S, R
92.	Sixteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Lisbon, 2000	E, F, S, R
93.	Eighteenth Session of the International Coordination Group for the Tsunami Warning System in the Pacific, Cartagena, 2001	E, F, S, R
94.	Fifth Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 2001	E, F, S, R
95.	Seventh Session of the IOC Sub-commission for the Caribbean and Adjacent Regions (IOCARIBE), Mexico, 2002	E, S
96.	Fifth Session of the IOC Sub-Commission for the Western Pacific, Australia, 2002	E only
97.	Thirty-sixth Session of the Executive Council, Paris, 2003	E, F, S, R
98.	Twenty-second Session of the Assembly, Paris, 2003	E, F, S, R
99.	Fifth Session of the IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Kenya, 2002 (* Executive Summary available separately in E, F, S & R)	E*
100.	Sixth Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, St. Petersburg (USA), 2002 (* Executive Summary available separately in E, F, S & R)	E*
101.	Seventeenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Paris, 2003 (* Executive Summary available separately in E, F, S & R)	E*
102.	Sixth Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 2003 (* Executive Summary available separately in E, F, S & R)	E*
103.	Nineteenth Session of the International Coordination Group for the Tsunami Warning System in the Pacific, Wellington, New Zealand, 2003 (* Executive Summary available separately in E, F, S & R)	E*
104.	Third Session of the IOC Regional Committee for the Central Indian Ocean, Tehran, Islamic Republic of Iran, 21-23 February 2000	E only
105.	Thirty-seventh Session of the Executive Council, Paris, 2004	E, F, S, R
106.	Seventh Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 2005 (* Executive Summary available separately in E, F, S & R); and Extraordinary Session, Paris, 20 June 2005	E*
107.	First Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Perth, Australia, 3-5 August 2005	E only
108.	Twentieth Session of the Intergovernmental Coordination Group for the Tsunami Warning System in the Pacific, Viña del Mar, Chile, 3-7 October 2005 (* Executive Summary available separately in E, F, S & R)	E*
109.	Twenty-Third Session of the Assembly, Paris, 21-30 June 2005	E, F, S, R
110.	First Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS), Rome, Italy, 21-22 November 2005	E only
111.	Eighth Session of the IOC Sub-commission for the Caribbean and Adjacent Regions (IOCARIBE), Recife, Brazil, 14-17 April 2004 (* Executive Summary available separately in E, F, S & R)	E*
112.	First Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions (ICG/CARIBE-EWS), Bridgetown, Barbados, 10-12 January 2006	E only
113.	Ninth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE), Cartagena de Indias, Colombia, 19-22 April 2006 (* Executive Summary available separately in E, F, S & R)	E S*

114.	Second Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Hyderabad, India, 14–16 December 2005	E only
115.	Second Session of the WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology, Halifax, Canada, 19–27 September 2005 (Abridged final report with resolutions and recommendations)	E, F, R, S
116.	Sixth Session of the IOC Regional Committee for the Western Indian Ocean (IOCWIO), Maputo, Mozambique, 2–4 November 2005 (* Executive Summary available separately in E, F, S & R)	E*
117.	Fourth Session of the IOC Regional Committee for the Central Indian Ocean, Colombo, Sri Lanka 8–10 December 2005 (* Executive Summary available separately in E, F, S & R)	E*
118.	Thirty-eighth Session of the Executive Council, Paris, 20 June 2005 (Electronic copy only)	E, F, R, S
119.	Thirty-ninth Session of the Executive Council, Paris, 21–28 June 2006	E, F, R, S
120.	Third Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Bali, Indonesia, 31 July–2 August 2006 (*Executive Summary available separately in E,F,S & R)	E*
121.	Second Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS), Nice, France, 22–24 May 2006	E only
122.	Seventh Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, Paris, France, 16–18 March 2005 (* Executive Summary available separately in E, F, S & R)	E*
123.	Fourth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS-IV), Mombasa, Kenya, 30 February-2 March 2007 (* Executive Summary available separately in E, F, S & R)	E*
124.	Nineteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Trieste, Italy, 12–16 March 2007 (* Executive Summary available separately in E, F, S & R)	E*
125.	Third Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, Bonn, Germany, 7–9 February 2007 (* Executive Summary available separately in E, F, S & R)	E*
126.	Second Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Cumaná, Venezuela, 15–19 January 2007 (* Executive Summary available separately in E, F, S & R)	E*
127.	Twenty-first Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, Melbourne, Australia, 3–5 May 2006 (* Executive Summary available separately in E, F, S & R)	E*
128.	Twenty-fourth Session of the Assembly, Paris, 19–28 June 2007	E, F, S, R
129.	Fourth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, Lisbon, Portugal, 21–23 November 2007 (* Executive Summary available separately in E, F, S & R)	E*
130.	Twenty-second Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, Guayaquil, Ecuador, 17–21 September 2007 (* Executive Summary available in E, F, S & R included)	E*
131.	Forty-first Session of the Executive Council, Paris, 24 June–1 July 2008	E, F, R, S
132.	Third Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Panama City, Panama, 12–14 March 2008 (* Executive Summary available separately in E, F, S & R)	E*
133.	Eighth Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, Paris, France, 17–20 April 2007 (* Executive Summary available separately in E, F, S & R)	E*