Intergovernmental Oceanographic Commission

Reports of Governing and Major Subsidiary Bodies

IOC Intergovernmental Panel on Harmful Algal Blooms

Ninth Session

Paris, France
22–24 April 2009

UNESCO

Intergovernmental Oceanographic Commission

Reports of Governing and Major Subsidiary Bodies

IOC Intergovernmental Panel on Harmful Algal Blooms

Ninth Session

Paris, France
22–24 April 2009

UNESCO 2009

IOC/IPHAB-IX/3
Paris, 8 July 2009
English only[1]

[1] An Executive Summary of this report, including the recommendations, is available in French, Spanish and Russian as a separate document (IOC/IPHAB-IX/3s).

TABLE OF CONTENTS

ANNEXES

EXECUTIVE SUMMARY

The Ninth Session of the IOC Intergovernmental Panel on Harmful Algal Blooms (IPHAB) was held at UNESCO Headquarters, Paris, from 22 to 24 April 2009.

The Panel reviewed the actions completed during the intersessional period and noted with satisfaction that continuous progress had been made and that the Recommendations of the Eight Session had been followed up to large extent. The Panel noted with concern the reduced financial support, and stressed that the IOC HAB Programme will only be able to develop and be implemented in 2010-2011 if there is additional extra-budgetary financial support from Member States to fund programme staff and activities. The major achievements reported include: (i) the development of the integrated IPHAB-IODE Harmful Algae Information System; (ii) developments within GEOHAB including the launch of the GEOHAB Research Plans for the Core Research Projects in Stratified Systems and the development of a plan for GEOHAB Asia; (iii) development of the regional activities ANCA, FANSA, HANA; (iv) the implementation of twelve training courses and training-through-research projects; (v) the continued publication of the IOC Harmful Algae News; (vi) results from the ICES-IOC WGHABD; (vii) the IOC co-sponsorship of international HAB conferences; and (viii) provision of HAB literature to developing countries.

The Panel decided on five Resolutions and endorsed three Recommendations. The Resolutions concern (i) revised terms of reference for the IPHAB Task Team on Biotoxin Monitoring, Management and Regulations, (ii) the development of the Harmful Algal Information System; (iii) revised terms of reference for the IPHAB Task Team on Algal Taxonomy; (iv) revised terms of reference for the IPHAB Task Team on HAB Monitoring within the Global Ocean Observing System; and (v) Regional HABP Development. The Session also adopted guiding principles for capacity enhancement with respect to mitigating the effects of harmful algae, a draft strategy for IPHAB, and a focus for activities on the transfer and introduction of HAB species by human activity such as shipping (ballast water).

The Recommendations concern (i) the IPHAB Strategy for assisting the Ocean Science Section in the development of a work plan for integrated coastal research; (ii) a summary of the Resolutions and planned intersessional activities into a Work Plan and budget for the IOC HAB Programme 2010-2011, and (iii) the continuation of the IPHAB and time of the next Session. Dr Leonardo Guzman (Chile) was re-elected as Chairman and Phil Busby (New Zealand) was re-elected as Vice-Chairman.

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 Ninth Session of the Panel was held at IOC UNESCO Headquarters in Paris from 22-24 April 2009. The Session was opened by the Executive Secretary IOC, Dr. Patricio Bernal. The Executive Secretary recalled how the Panel is a broad representation of communities; science, outreach, management, legal aspects, etc, and the challenge for the Panel is to find consensus for a balanced approach to a broad spectrum of potential activities. He welcomed the participation of IAEA, UNEP/GPA and PICES and noted with regret, that FAO and WHO were not attending the Panel despite effort to encourage their participation. The Executive Secretary acknowledged that the Panel oversees many activities and delivers a variety of services. He encouraged the Panel to in particular focus on activities that are closely tied to the intergovernmental role and mandate of the Panel. He particularly acknowledged the achievements of the Panel in stimulating regional efforts and to cooperate closely with the relevant regional organisations. The Executive Secretary underlined the role of IOC in enhancing capabilities of both individuals and institutions and recognised the difficulties to achieve this at a level where it has significant national or regional impact. He stressed the crucial role of the intergovernmental bodies like IPHAB in achieving tangible results in capacity building. The Executive Secretary informed the Panel about the Johannesburg SSD process for a regular assessment of the oceans. Although the implementation has been somewhat delayed, in 2009 will start to look into e.g. how fisheries, HABs etc are managed. He also referred to the UN 'Assessments of Assessments' which is an inventory of what regular assessments of the marine environment are conducted nationally and regionally worldwide. As a next step the UN Assembly will convene a meeting to develop the way forward and eventually the oceans will be under permanent review including social, human and economic factors. He invited the Panel to consider if and how it could contribute to this process including how IPHAB can respond to the profound need for data. He concluded by introducing the new Head of the Ocean Science Section of the IOC Secretariat, Dr Luis Valdes.

3 The Session was attended by representatives from: Brazil, Canada, Chile, Cook Islands, Croatia, Denmark, Greece, Italy, Malaysia, Mexico, Morocco, Namibia, New Zealand, Oman, Peru, Slovenia, Spain, Sweden, Thailand, Tunisia, United Kingdom, United States of America, Uruguay, IAEA, PICES, UNEP, and the International Society for the Study of Harmful Algae (ISSHA). The attendance was the highest to date (Fig. 1). The List of Participants is attached as Annex V hereto.

4 The Chairman, Leonardo Guzman (Chile) 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).

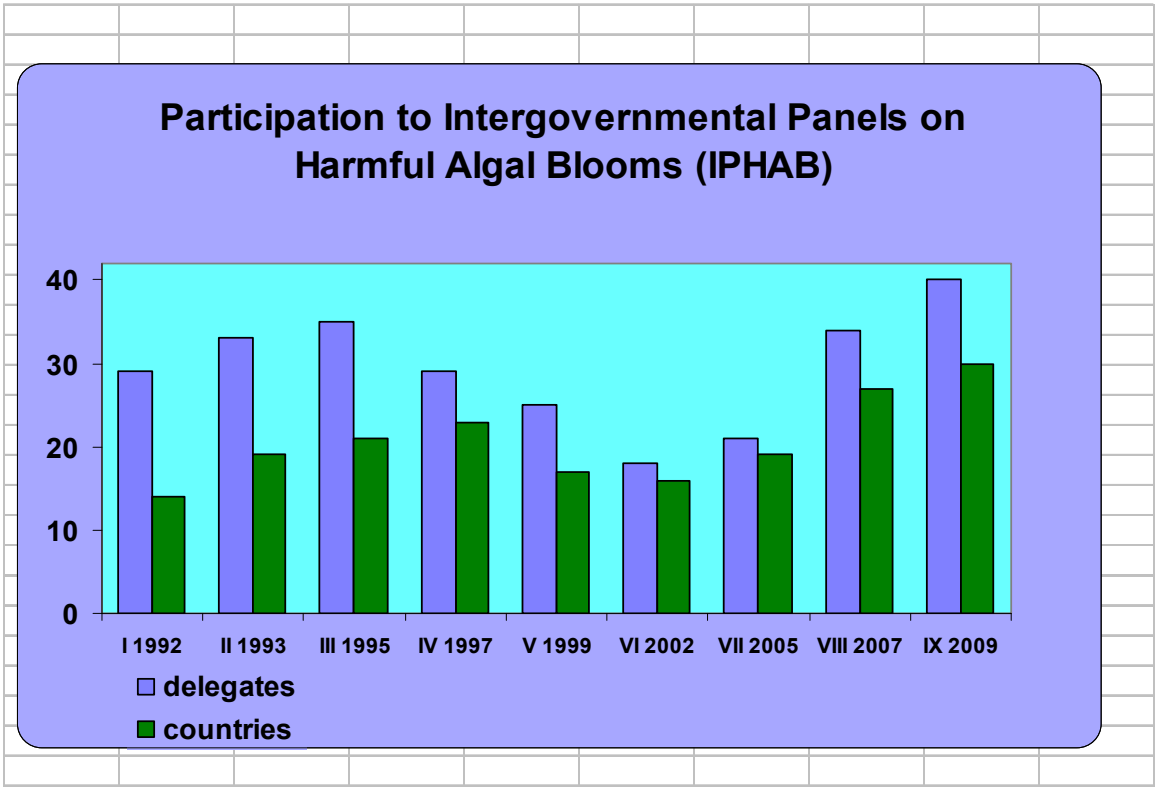


Figure 1. Attendance to IPHAB 1992–2009

5 **The Panel noted** that the Twenty-fourth Session of the IOC Assembly, Paris, 2007 had endorsed all the Recommendations of the Eighth Session of the Panel. The Resolution of the Twenty-fourth Session of the Assembly was introduced.

2. ADMINISTRATIVE ARRANGEMENTS

6 The Agenda for the Session was introduced by the Chairman (Annex I hereto) and adopted. Dr L. Proenca (Brazil) was designated as Rapporteur.

3. THE IPHAB STRATEGY

7 **The Panel decided** through Resolution IPHAB-VIII.1 to formulate a strategy for IPHAB and the HAB Programme. The draft strategy was presented by the Secretariat (H. Enevoldsen).

8 **The Panel reviewed** the draft strategy (attached hereto as Annex XV) **and adopted** it as a working draft that will be further developed and refined before the next session of the Panel.

4. HABP DEVELOPMENTS IN THE INTERSESSIONAL PERIOD

9 During its Ninth Session, **the Panel reviewed** the actions completed during the intersessional period. The detailed report on HAB Progamme developments in the intersessional period is included as Annex VIII hereto.

10 **The Panel noted with satisfaction** that considerable progress had been made and that good progress had been made in implementing the Recommendations of the Eighth Session of the Panel.

5. MAJOR ISSUES REQUIERING INTERGOVERNMENTAL COOPERATION

11 The Session was organized into eight panel discussions: Panel 1 on capacity enhancement was chaired and introduced by B. Reguera (Spain); Panel 2 on the joint IOC-SCOR/GEOHAB Research Programme was introduced and chaired by R. Raine (Ireland); Panel 3 on biotoxin regulations and human health was chaired and introduced by P. Busby (New Zealand); Panel 4 on the Harmful Algal Information System was introduced by H. Enevoldsen (Secretariat) and chaired by A. Zingone (Italy); Panel 5 on HAB observations and their inclusion in GOOS Regional Alliances was chaired by B. Karlson (Sweden), Panel 6 on harmful algal events, coastal zone management and linkages with coastal eutrophication was introduced and chaired by R. Magnien (USA); Panel 7 on harmful algal as invasive species was introduced and chaired by C. McKenzie (Canada); and Panel 8 on formulation and endorsement of regional activities was introduced by the regional Chairs and chaired by L. Proenca (Brazil);

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

13 **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 2010–2011, which is included in Annex II (Rec. IPHAB-IX.2) hereto.

14 A summary of the deliberations made and the decisions taken is given below.

5.1 CAPACITY BUILDING

15 **The Panel recalled** the adoption by the IPHAB-VI of a revised IOC HAB Training and Capacity Enhancement Programme, and noted with satisfaction the number of training courses and workshops on harmful algae that have been successfully implemented, regionally and globally in 2007–2009 (listed in Annex XII).

16 **The Panel expressed its appreciation** of the significant support provided by Denmark, USA (2007), and Spain (2007 and 2008), and strongly encouraged Member States to continue to support IOC capacity enhancing activities.

17 **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.

18 **The Panel welcomed** the participation of IAEA, PICES and UNEP in this session and the opportunity to continue discussions on cooperation in enhancing national capacities to mitigate the effects of harmful algae.

19 The discussion was opened with presentations by IAEA, PICES and IOC on current capacity enhancing activities. Main lessons learned from IOC courses in species identification included the value of the IOC-UNESCO HAB Manual, the value and effectiveness of using distant learning tools as part of the strategy, and the positive feedback following the introducing accreditation (examination) as part of the training course concept. A summary of IAEA and PICES training activities is included as Annex X and XI respectively, and information on IOC activities is summarized in Annex XII.

20 **The Panel welcomed** the reinforced commitment by the IAEA to close cooperation on building capacity for HAB management and mitigation and the recognition by IAEA of the mutual benefits of close cooperation.

21 **The Panel also welcomed** the statement submitted by FAO (Document IOC/IPHAB.VIII.Inf.19) in which FAO welcomes cooperation on capacity building with IOC IPHAB. **The Panel recommended** that the cooperation with FAO is this respect is explored in more detail.

22 **The Panel made** a thorough reassessment of the capacity enhancing activities implemented or fostered by the IOC and partners, and revisited regional priorities.

23 The representatives from the regional groups and networks acknowledged the good results of the IOC-HAB activities on building and enhancing capacity as well as the importance of the regional networks to cooperation and mutual assistance.

24 **The Panel acknowledged** the fundamental role of training in species identification for both monitoring and research and discussed the relevance and priority of increasing focus in the use of molecular methods (e.g. molecular probes). Although the methods may not be ready for routine application they are developing fast and **the Panel encouraged** the inclusion of the potential use of molecular methods in future courses on phytoplankton identification and that the possibility of organising specific workshops on the use of molecular probes in monitoring HAB species should be explored.

25 **The Panel discussed** the value of screening methods for species and toxins to optimise resources and improve response time. **The Panel commended** the PICES HAB Training project for its approach in this respect and for considering the inclusion of screening methods in business plans for HAB monitoring systems. **The Panel also commended** the implementation of an IAEA regional project in the Caribbean region that was focussed on the early detection of PSP and CFP toxins using sensitive radio assays. **The Panel stressed** however, that screening methods need to be validated and approved by the respective national or regional regulatory agencies particularly if used for regulatory monitoring in relation to international trade.

26 The priorities of the regional groups for capacity enhancement activities were revisited and summarize as follows:

27 ANCA (Caribbean): Training course on ciguatera fish poisoning (CFP) and the detection and monitoring of other benthic microalgal toxins. At present there is a profound lack of expertise on the analysis and monitoring of CFP and other benthic microalgal toxins. Ciguatera is endemic in the region; there are hundreds of reports of affected consumers every year, and many more go unrecorded because of a lack of medical awareness and public education.

28 WESTPAC/HAB (Western Pacific): The WESTPAC region would benefit from a training workshop on ciguatera fish poisoning (CFP) and the detection and monitoring of other benthic microalgaltoxins. CFP is a very important issue with regard to fisheries trade for countries in the region. Support should be sought from other agencies (i.e. FAO, WHO).

29 **The Panel noted** that the regional groups and the respective IOC sub-commissions should actively seek support for these activities from other agencies and national sources as IOC cannot be expected to fund them fully.

30 **The Panel encouraged** the planning of courses on CFP and toxins from other benthic microalgae that would allow participation from other countries in which capacity building is required, e.g Indian Ocean countries, not included in any IOC-HAB Regional group.

31 FANSA (South America): As recommended by the Eighth IOC FANSA Workshop, one priority is continued training (using e-learning) on species identification, taxonomy and the biology of harmful marine microalgae, as well as the potential use of molecular probes

and other alternative tools with which to monitor and undertake research on harmful algae. The courses should be organized to make use of local expertise and consideration should be given to provide courses which conclude with an examination and certificates of accreditation.

32 HANA (North Africa): Following the recommendations from the First HANA WS (Casablanca, October 2007), a training course has been proposed on quantitative and qualitative analyses of toxin producing microalgae. There is a continuous need to inform health and fisheries authorities of the benefits of establishing monitoring programmes. This assistance has in particular been requested by group members from Libya, Algeria and Egypt. Support from UNEP-MAP and from FAO (MED-SUD-MED Programme) for training activities should be explored.

33 **The Panel decided** to explore the possibility of interacting and collaborating with the Mediterranean Council for the Exploration of the Sea (CIESM) in capacity building activities with respect to their ongoing programme on invasive species in the Mediterranean Sea.

34 Since the 1970s a series of international advanced phytoplankton courses have been offered, firstly via the University of Oslo with UNESCO support and later via the Zoological Station Anton Dohrn in Naples. This series of courses has received continuous support from IOC and the HAB Programme. The Ninth Advanced Phytoplankton Course –Taxonomy and Systematics (APC9), was held in Naples from 5 to 26 April 2008. APC9 classes were given on all phytoplankton groups, including harmful algae, with the focus on their identification mainly based on morphology. The molecular phylogenetic approach to species classification was also introduced in classes and practical demonstrations.

35 **The Panel acknowledged** that this Course and the previous courses in the series have had a considerable impact in the building of taxonomic expertise in many countries, including the contribution made by attendees of the courses who have gone on to train other people in their respective countries. Therefore, the Panel considered the Advanced Phytoplankton Courses highly relevant to activities related to HABs and to HAB capacity building.

36 **The Panel encouraged** the continuation of this series of courses.

37 **The Panel endorsed** the provision of advanced phytoplankton courses conducted by other agencies and agreed that if such agencies wish, their course can be conducted under the auspices of the IOC and HAB Programme. This would imply assistance with advertisements for courses, training materials and financial support to the extent feasible within the available resources.

38 **The Panel recommended** that the IOC web site be expanded to include a section with quick access to information on who to contact for assistance with HAB problems such as phytoplankton identification, toxin identification and analytical methods.

39 **The Panel adopted** a set of basic principles for capacity enhancement in research and management of harmful algal events. The intent of the guiding principles is to strengthen cooperation and coordination in regional training activities between IOC and other United Nations and/or intergovernmental agencies (i.e. IAEA, UNEP, FAO, PICES, etc) to optimize available funding, and to reduce or eliminate duplication and overlap of activities. The Principles are listed in Annex XIII hereto.

40 **The Panel endorsed** the implementation of a number of proposed capacity building activities 2010–2011 listed in Annex II hereto (annex to Rec. IPHAB-IX.2).

5.2 THE GEOHAB RESEARCH PROGRAMME

41 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.

42 The GEOHAB IPO functions are 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.

43 The Chairman of the IOC-SCOR Scientific Steering Committee (SSC) for GEOHAB, R Raine (Ireland), gave a summary of GEOHAB and reported on GEOHAB developments 2007–2008. The Terms of Reference for the GEOHAB SSC, the List of SSC Members, and the summary of GEOHAB activities and achievements are included in Annex XIV hereto.

44 In his report the Chairman of the SSC addressed the strengths/weaknesses and major challenges of GEOHAB.

45 A major achievement of GEOHAB has been the production of the series of five GEOHAB reports, which include the Science and Implementation Plans and three CRP reports. Two further reports are close to the review stage. These reports lay a very strong foundation for the organization and framework of future HAB research as well as list key questions which need to be addressed. Demand for the Science Plan, which has been heavy enough to require a further printing run of 2,000 copies, is witness to the value of these state-of-the-art reports.

46 Despite the delays in implementation of the CRP in Fjords and Coastal Bays and the production of a report, it is generally acknowledged that this project has most potential for linking with HAB projects on a global scale. At the SSC meeting in 2008 actions have been taken to speed up progress within this CRP.

47 The biggest challenge to GEOHAB lies in succeeding to link related HAB research projects on a global scale. The reasons for limited success have been discussed at recent SSC meetings, and several actions have been taken to improve this. Among these are a major overhaul of the GEOHAB web site, and a simplification of the endorsement procedure which links projects together and to GEOHAB. The benefits of linking to GEOHAB were seen by the research community as obscure, and outreach activities have attempted to overcome this problem, particularly as there is uncertainty within the community as to the funding capability of GEOHAB. It is for these reasons that GEOHAB has been more successful linking projects at regional/national level than on the global stage. However, the level of interaction between GEOHAB and regional consortia such as FANSA, HANA, ANCA, and WESTPAC/HAB has been at a low level and there is significant room for improvement here. A strong link between GEOHAB and the IOC Working Group on HAB Dynamics is also desirable.

48 In 2006/2007 it was observed within the SSC that the level of visibility of GEOHAB within the research community was not strong. To the most part this was due to the implementation of the CRPs, as there was a natural gap between the highly successful Open Science Meetings within the CRPs and the publication of respective reports. To this end,

effort has gone into improving publicity outlets (e.g. website, posters, brochures, stalls at conferences) to maintain the visibility of the GEOHAB programme.

49 With respect to resource requirements for 2010–2011 the Chairman of the SSC emphasised that the lack of an IPO for GEOHAB has affected the rate of progress of the project, particularly with framework activities. GEOHAB implementation has progressed in all aspects of the Science Plan, although an IPO would have substantially facilitated the process. He also acknowledged the efforts of the IOC and SCOR secretariats with their assistance in this regard.

50 For scientific actions, the GEOHAB SSC encourages regional actions such as GEOHAB Asia. A group of regional scientist will review the forthcoming plan for GEOHAB Asia in depth before publication. It is expected that the GEOHAB Asia Plan will lay a solid foundation for co-operative studies in the region.

51 Under discussion within the GEOHAB SSC has been the development of a new CRP devoted to the growing problem of benthic epi-benthic toxic HABs. It is acknowledged that this problem is of an extremely large, global scale, outstripping the combined effects of other toxic HABs. The current high level of interest in this topic world-wide means that such a CRP would be timely and well attended. However, a substantial proportion of the financial resources of GEOHAB have been committed to the Modelling Workshop (2009). When this is coupled with an end-date to the current GEOHAB of 2013, foreseen by SCOR, i.e. 10 years after the production of the Implementation Plan, it would most likely restrict this action to an Open Science Meeting in 2011 (earliest), with additional funding sought.

52 The Chairman of the SSC concluded by recalling that GEOHAB is not a provider of funds for research. Often, therefore, the promotion of collaborative research involves assistance with the sourcing of funds to facilitate activity. Having drafted the Science Plan and identified key questions within the CRP reports, an additional function of GEOHAB SSC would be to improve funding levels through the identification of new channels which can be resourced to achieve GEOHAB goals. Currently, the most obvious sources are science funding agencies in the US and Europe, and it is recognised that both sources contain avenues of funding which transcend national/regional boundaries.

53 However, in many instances the kinds of resources available are restricted through the actual work, science or action plan of the funding agency. Thus a possible role of GEOHAB would be, benefitting through links with IPHAB, to seek routes whereby regional or national collaborative actions can be stimulated. An example has already been achieved through the stimulation of HAB studies in Viet Nam from resources made available under a development programme in Denmark. Similar opportunities should be sought for elsewhere in Asia and other continents.

54 **The Panel gratefully acknowledged** the extra budgetary support provided via IOC and SCOR for GEOHAB activities.

55 **The Panel expressed its appreciation** of the work of the GEOHAB SSC and in particular the advanced in developing the GEOHAB Core Research Projects.

56 **The Panel welcomed** the activities targeted at developing regional GEOHAB initiatives, and noted that linkages between projects within regions through GEOHAB endorsements had not been as successful as originally hoped, but that there have been significant improvements facilitating this.

57 **The Panel recommended** the continued and strengthened focus on the relationship between GEOHAB and both global and regional activities. GEOHAB, through its Science Plan, Implementation Plan and CRP reports provides a framework on which regional alliances are able to build their efforts. The relationship between GEOHAB and the regional

groups such as FANSA, HANA, ANCA, WESTPAC/HAB and ICES-IOC WGHABD should be strengthened, while recognizing that GEOHAB research has to be rooted in and driven by national institutions.

58 **The Panel took note** of the end of GEOHAB in 2013 foreseen by SCOR and requests the SSC to present to IPHAB-X a plan for the period 2011–2013 and an assessment of activities with potential to continue.

5.3 BIOTOXIN REGULATIONS AND HUMAN HEALTH

59 **The Panel recalled** its Resolution IPHAB-VI.2 where the Panel established a Task Team to address incompatibilities among biotoxin regulations in major markets and the subsequent updates of the Terms of Reference by IPHAB-VI and VIII as well as the merger during 2004–2006 into a 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).

60 **The Panel reviewed** the Task Team report presented by the Chairman of the Task Team P. Busby (New Zealand) and **noted with concern** that the Report of the Joint FAO/IOC/WHO *ad hoc* Expert Consultation on Biotoxins in Bivalve Molluscs had not been finalised for publication.

61 While acknowledging the that the Task Team had not fully fulfilled its Terms of Reference, it was also acknowledged that an impediment to this was the fact that the finalisation and publication of the background papers of the Expert Consultation is in the hands of FAO and that none of the editors has been involved in the finalization of the background papers. There was concern that the papers prepared in 2004 might be partly outdated and needs to be updated.

62 **The Panel noted** that the CCFFP decided not to include recommendations of the Expert Consultation in its revision of guidelines, e.g. how to handle new toxins. This gives problems in some countries e.g. Australia. Had the response of the Expert Consultation been included this might have been avoided. One implication is that some regulators ignore the problem (new toxins) and this may be fatal.

63 **The Panel was informed** that the European Commission has requested the European Food Safety Authority (EFSA) to address nine marine biotoxin matters and in doing so to consider the report of the Expert Consultation. When EFSA has completed the review and produced a Scientific Opinion on each matter —94 Scientific Opinions have been published so far— the Commission will consider the need to amend marine biotoxin requirements in its regulations.

64 **The Panel reiterated** is request for assistance from the IOC Secretariat and Assembly to strengthen the formal relationship between IOC/IPHAB and FAO and between IOC/IPHAB and WHO.

65 To continue to address the issue of biotoxins and human health systematically and to identify it as a key issue for IPHAB, to communicate to FAO and WHO, and for IPHAB to stay informed and provide overview, **the Panel decided** on revised Terms of Reference for the Task Team. **The Panel adopted** Resolution IPHAB-IX.1.

5.4 THE HARMFUL ALGAE INFORMATION SYSTEM

66 This topic was introduced by a presentation by the Secretariat (H. Enevoldsen), of the plan for the development of an integrated Harmful Algae Information System (HAIS) as requested by IPHAB-VIII through Resolution IPHAB-VIII.5. The Plan is available at

www.ioc.unesco.org/hab. 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.

67 **The Panel welcomed** the development of the plan and the broad partnerships established or proposed.

68 **The Panel requested** the Chairpersons of regional HAB groups to pursue the sharing of data in the Harmful Algal Event Data Base (HAEDAT). It was recognized that e.g. ANCA and FANSA have been introduced to HAEDAT and encouraged to participate, but that further effort is required to ensure data sharing.

69 **The Panel commended** PICES for it successful efforts to commit its Member States in data sharing through HAEDAT.

70 The IAEA offered to encourage sharing of data with HAEDAT through IAEA projects.

71 Namibia stated that it is ready for submission of data to HAEDAT.

72 **The Panel recommended** that the feasibility of incorporating real time data into HAIS should be evaluated. However, it was acknowledged that real time data would be difficult for many agencies to provide as there is typically time lags (often several months) before data are public. It was also recommended that HAIS should include information on molecular probes and other technological tools for identification. This information could be added to the taxonomic reference list. It was recognised however, that at present time there is no mechanism to establish and maintain this extra data layer.

73 **The Panel noted with regret** that the Directory of Experts is not up to date and needs to be updated, i.e. specific HAB fields to be accessible and searchable and that this has not been functional for a while.

74 The taxonomic backbone of HAIS is the IOC Taxonomic Reference List of Toxic Microalgae. IPHAB-VIII endorsed the expansion of the reference list and its integration into the World Register of Marine Organisms (WoRMS). The new list was presented and demonstrated by Ø. Moestrup (Denmark).

75 The Reference List is maintained and developed by The IPHAB Task Team on Algal Taxonomy (Resolution IPHAB-VIII.5).

76 **The Panel reaffirmed** the strong need in the international research and management community for a reference list on potentially harmful algae, and **decided** to continue the Task Team with revised Terms of Reference.

77 **The Panel adopted** Resolution IPHAB-IX.3.

78 **The Panel concluded by adopting** also Resolution IPHAB-IX.2 regarding endorsement of the Harmful Algae Information System Plan to be implemented in cooperation with IODE.

5.5 HAB OBSERVATIONS AND THEIR INCLUSION IN GOOS REGIONAL ALLIANCES

79 **The Panel recalled previous** recommendations and resolutions in relation to operational observation of HABs as a constituent of the Coastal Ocean Observations Modules of The Global Ocean Observing System (GOOS) (IPHAB-V.3, IPHAB-VI.3 and IPHAB-VII.3, and IPHAB-VIII2), and how, 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.

80 The agenda item was introduced by a presentation by B. Karlsson (Sweden) of the work of the IPHAB Task Team on Implementation of HAB Monitoring within the Global Ocean Observing System (Resolution IPHAB-VIII.2). The primary output was a document specifying the requirements for the routine observation and monitoring of HAB species.

81 **The Panel reviewed** the document and found it to fulfill the need identified at IPHAB-VIII.

82 **The Panel reiterated** that HAB observations should be integrated in GOOS, not a separate system, and that there are examples (e.g. Brazil) where this is the already being practices.

83 **The Panel endorsed** the 'IOC-IPHAB recommended procedures for automated and semi-automated HAB-monitoring and forecasting within the Global Ocean Observing System'. The document is attached hereto as Annex XVI. The recommended procedures will be communicated to GOOS partners, in particular to the Panel for Integrated Coastal Observations (PICO), a technical subcommittee of the GOOS Scientific Steering Committee.

84 **The Panel recognized** that many countries do not have the capability or resources to match the requirements listed in the recommended procedures and there may be reluctance on the part of government to upgrade monitoring because of the costs.

85 **The Panel reiterated** the instructions of IPHAB-VIII for the Scientific Steering Committee of GEOHAB to collaborate with the GSSC in the development of joint GEOHAB-GOOS pilot projects with the goal of establishing operational HAB observing systems regionally, and to establish 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).

86 **The Panel decided** to continue the IPHAB Task Team on HAB Observations and Forecasting Systems and revised its terms of reference.

87 **The Panel adopted** Resolution IPHAB-IX.4.

5.6 HARMFUL ALGAL EVENTS, COASTAL ZONE MANAGEMENT AND LINKAGES WITH COASTAL EUTROPHICATION

88 R. Magnien (USA) introduced the subject. Nutrient enrichment has degraded estuarine and coastal marine waters worldwide, and has been linked to the increased prevalence of harmful algal blooms (HABs) that can cause serious ecological, economic, and human health impacts. Yet, this linkage currently lacks a firm, quantitative foundation.

89 D. Osborn (UNEP/GPA) introduced the UNEP General Plan of Action (GPA) and the new Global Partnership on Nutrient Management (GPNM) (see Annex XVII hereto) and underlined that IPHAB activities can be a valuable contribution to the GPNM. He noted the linkage between nutrient loading and some types of harmful algal events and that the UNEP/GPA is looking into what the GPA can do to address the issues and to link its activities with both those of the GPNM and IPHAB.

90 The Panel took note of the recommendations of the IOC Advisory Group for the Ocean Sciences Section, the IOC Medium-Term Strategy and GLOBAL NEWS and GEOHAB outline for intersection of several IOC programmes under the theme: Linking Nutrient Sources to Coastal Ecosystem Effects and Management. The goal of this intersection of several IOC programmes is to develop quantitative relationships between

nutrient sources and controlling factors in watersheds and their effects on coastal systems, and then apply these quantitative relationships to inform development and implementation of policies to improve coastal water quality.

91 **The Panel reviewed** the draft plan (the report from the workshop – "Coastal Eutrophication: Linking Nutrient Sources to Coastal Ecosystem Effects and Management" held on 2–4 February 2009) for the integrative activity, and noted the complexities of the human effects on ecosystems services and that the occurrence of harmful algae blooms is one of several possible undesirable outcomes of the human driven eutrophication process;

92 There was broad recognition in the Panel of the relevance of this new initiative to the GEOHAB science theme on the link between HABs and Eutrophication, the SCOR/LOICZ Workgroup 132 on the examination of the relationship between nutrient loading and HAB occurrence (2008–2010), the UNEP/GPA for the Protection of the Marine Environment from Land-Based Activities, and the newly established Global Partnership on Nutrient Management. It was also recalled that GOOS has been investigating the opportunities to measure parameters of relevance to coastal management such as harmful algal blooms and that the UN Assessment of Assessments of the marine environment will soon be available to assist in the prioritization of integrated research topics and regions of concern for the IOC. It was also recognizing that the UN has mandated an Integrated Coastal Area Management (ICAM) approach and IOC has made major commitment to ICAM.

93 **The Panel decided** to be fully engaged in the development of an IOC Integrated Research Strategy **and adopted** Recommendation IPHAB-IX.1.

5.7 HARMFUL ALGAE AS INVASIVE SPECIES

94 C. McKenzie (Canada) introduced the topic and summarized the activities and achievements of the ICES-IOC-IMO Working Group on Ballast and Other Ship Vectors (WGBOSV). She noted with regret that the group had not submitted its reports from 2007 and 2008. She recalled that the Panel through Recommendation IPHAB-VII.4 had requested the WGBOSV to actively contribute to the process of developing the IMO guidelines for implementation of the IMO Ballast Water Convention.

95 **The Panel reviewed** the WGBOSV 2009 (Washington D.C, 9–11 March 2009) Terms of Reference and the resulting draft ballast water sampling manual. The terms of reference were to: (i) critical review and report on the status of shipping vector 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; (ii) make a global review of shipping vectors through the participation of representatives from ICES, IMO, IOC, PICES; (iii) comment on the final draft of the ICES Code of Best Practice for handling Hull Fouling on Vessels; (iv) review draft ballast water sampling and port survey methodology Code of Practice; and (v) provide data on how climate change may alter distribution of alien introduced species and shipping operations.

96 To more accurately assess the achievements and focus of the Working Group on Ballast of Ships and other Vectors (WGBOSV) the panel requests that the reports from previous WGBOSV be submitted and also request that the WG Chairperson attend IPHAB-X to report on achievements, focus and future activities.

97 **The Panel decided** to review at IPHAB-X the achievement of the WG and advice on its future direction.

98 **The Panel endorsed** the co-sponsorship of the Working Group for 2010–2011 and urged IOC to ensure representation at the meetings of the WGBOSV.

99 **The Panel recognized** the difficulty of identifying an “invasive” phytoplankter or even providing lists of native phytoplankters so that future invasive species could be identified. **The Panel also recognized** that a list of harmful phytoplankton that could potentially be transported or introduced by ballast water is extensive and that it is complex or not possible to predict the likelihood of an introduced species becoming established in a new region.

100 **The Panel concluded by acknowledging** that there is a need to develop advice on the phytoplankters most likely to be successful as invasive species, the size of inoculums and conditions that would result in an invasive species. The risk of an invasive species having a negative impact on ecosystem health or the human uses of the ecosystem is determined by the combination of the probability of a species being introduced, its survival and spread, and impact. Therefore, priority should be given during the review to those phytoplankton species that are known to be or have a high probability of transport by ballast water, high survival (cysts/spore formation) and high ecological or economic impact. The intent is thus to be able to assess risk associated with incoming ballast water that has not been exchanged. The list would be a watch list or an indication of high risk waters where specific HAB species are known to occur and cause problems. A top ten or twenty of high risk phytoplankton species that would not be world-wide, but region or climate-zone specific.

101 **The Panel requested** IOC and ICES to request the WGHABD, in collaboration with WGBOSV, to consider this matter and in particular to determine whether: (i) it was possible to identify species of phytoplankton, especially HAB species (and their characteristics) which are more likely to be successful as invasive species, and have significant potential ecological or economic impact; (ii) there are particular characteristics of coastal waters which favour the establishment of invasive phytoplankters.

5.8 OBJECTIVES FOR REGIONAL IOC HAB GROUPS

102 **The Panel took note** of the results and reports under the regional components of the HAB Programme, IOC/FANSA (South America), and IOCARIBE/ANCA (Caribbean), and HANA (North Africa). No report was submitted by WESTPAC/HAB (Western Pacific).

103 The discussion session Chairman, L. Proença (Brazil) presented the report of HANA on behalf of the HANA Chairman, Prof. Y. Halim (Egypt) who could not attend. A summary of achievements is included in Annex VIII hereto. Twenty four experts from Egypt, Tunisia, Algeria and Morocco met from 18 to 20 October 2007 in Casablanca, Morocco, together with eight guests, to discuss HAB problems in the HANA region. As no representatives from Mauritania and Libya were present, the organizers agreed to specifically urge the participation of all countries of the region at the next meeting. The group recommended that all countries of the region should establish a monitoring and management programme for phytoplankton, phytotoxins and the quality of the environment and give regional priority to develop coordinated regional research under the auspices of GEOHAB. The second IOC/HANA workshop is planned for 2009 in Egypt. For 2010–2011 HANA is planning a third workshop in 2011.

104 The Chairman of COI/ANCA, José Luis Peña-Manjarrez (Mexico), gave a summary of ANCA activities since its establishment in Cuba in 1998. He noted that the main activity during the 4th meeting of ANCA Working Group, St. Andres, Colombia, 2007, was to review the advances in the region since the 2005 meeting in Cumana, and to develop jointly with FANSA the HAB section of the PortalOceanico. The achievements, recommendations and work plans of ANCA are summarized in Annex VIII hereto. The main outstanding issues include: the need to increase the participation of IOCARIBE Member States in ANCA meetings; to make governmental authorities from each Member State aware of the importance of implementing microalgae monitoring programmes and of the impact of harmful algae on public health and socioeconomic activities. In its Work Plan for 2010–2011, the focus of ANCA will be on improving the capacity in the Caribbean countries for HAB research

and monitoring (see also section 5.1). The Chairman of ANCA advised that the 5th ANCA-IOCARIBE meeting will be held in Mexico in 2010.

105 The Chairman of COI/FANSA, L. Proença (Brazil), gave a summary of achievements and proposed future activities (included in Annex IX hereto). FANSA has met regularly since 1994 and this has been very rewarding. It has for example, provided the basis for approaching the HAB problem at a regional level. He also noted the increase in the scientific, managerial and educational capacities in the participating countries. In this sense, an inter-calibration exercise conducted by FANSA in 2007–2008 provided an important comparison and basis for discussion on the procedures for HAB monitoring in each country. The results were encouraging and the FANSA group wish to run a second exercise on lipophylic toxins. This exercise will help each country work towards ISO 17025 accreditation.

106 The FANSA Chairman also presented the present state of the Algas Nocivas Portal and pointed to the need to establish an appropriate domain for it. The lack of technical IT back-up from UNESCO/DIT at Headquarters in Paris prevents its further development.

107 In the absence of a report from WESTPAC/HAB **the Panel recalled** the substantial achievements in enhancing capacity through training courses and training through research projects funded by Japan.

108 **The Panel took note** of expressions of concern by Panel Members about the future operation of the group, its membership, the mechanisms for choosing the chairperson, and the interaction with IPHAB.

109 **The Panel urge** the Secretariat and WESTPAC to secure clear guidance on membership of WESTPAC/HAB and to ensure an open and transparent process of election of the Chairperson at regular intervals.

110 **The Panel noted** that over the last two decades problems related to harmful algae along the coasts of the Mediterranean Sea areas have become clearly evident. In addition, a new event has been associated with species of the epi-benthic microalgal *genus Ostreopsis*. The scientific community and managers in different countries are facing this new problem with very scarce or null coordination of monitoring and assessment.

111 **The Panel noted** that CIESM, the Mediterranean Scientific Commission, has played an important role over the years in coordinating the scientific activity in the area. The Panel considered the possibility of HANA embracing the Northern Mediterranean at some of its meetings or thematic workshops to address issues of interest to the entire Mediterranean.

112 **The Panel requested** the Secretariat to contact CIESM to investigate the feasibility of a joint regional workshop and possibly a joint CIESM-IOC regional group on harmful algae.

113 As the first Pacific Island country to participate in IPHAB, the Cook Islands outlined the problems that Pacific Island Countries and Territories (PICTs) face with HABs (see Annex XVII hereto). The region is severely affected by ciguatera and mussel contamination with biotoxins. PICTs are heavily reliant on seafood as a source of protein, consuming over 200 kg of seafood/capita/year. Species implicated in HABs in the PICTs include *Gambierdiscus toxicus*, *Prorocentrum lima*, *Phaeocystis sp.* and cyanobacteria. Of these, ciguatera is by far the greatest HAB problem in the PICTs affecting Pacific Island health, economy, livelihoods and food security. The PICT region has the highest incidence of ciguatera in the world ranging in each country from 1/1,000 to 20/1,000 cases. Recent activity in the region has lead to the establishment of a Pacific regional steering committee to develop an action plan with regards to ciguatera in the PICT region coordinated by the Secretariat for the Pacific Community.

114 **The Panel acknowledged with concern** the problems the Pacific Islands Countries and Territories (PICT) face with HABs, and in particular the serious problem of ciguatera fish poisoning.

115 **The Panel highlighted** the importance of working group participants trying to encourage countries to input data into the HAEDAT database and also **urged** all IPHAB member countries to consider putting data into HAEDAT. The urge to participate was extended not only to countries integrating the working groups but all.

116 **The Panel reiterated** its recognition of the need for regional groups and networks on harmful algae in different areas of the world, **welcomed** proposals for new regional networks, **and re-confirmed** the strategy of pursuing co-sponsorship of regional groups with relevant regional organizations.

117 **The Panel expressed its appreciation** of the resources made available to regional activities by Spain and stressed that efforts must be made to improve and reinforce the intra- and inter-regional scientific activities of regional groups while at the same time highlighting the economical and social benefits of their activities. This includes the need to encourage government representatives at the next IOC Assembly to identify possible participants to regional groups and support their participation.

118 **The Panel concluded the item by expressing appreciation** to the IOC Secretariat for the support to the regional activities, and noted that the efforts of the regional groups are important to both scientific and managerial advances as well as the integration within the regions.

119 **The Panel endorsed** the proposed regional activities of ANCA, FANSA, and HANA for 2010–2011 and integrated them into the Work Plan (see Recommendation IPHAB-IX.3 and its Annex 1). The priorities of WESTPAC/HAB will be included in the work plan according to availability of resources

120 **The Panel adopted** Resolution IPHAB-IX.5.

6. HAB PROGRAMME WORKPLAN 2010–2011

6.1. STAFFING AND BUDGET OF THE HAB PROGRAMME

121 **The Panel took note** of the significant decline in extra-budgetary resources (see Annex VIII).

122 **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 regarding funds for IOC staff for the HAB Programme ended in 2007.

123 **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.

124 **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.

6.2. IOC SCIENCE AND COMMUNICATION CENTRES ON HARMFUL ALGAE

125 **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 (IOC-XVII Assembly, 1993, 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.

126 **The Panel recognized** the strengths and additional resources made available by having a decentralized Programme Office, and that the decentralized programme office is essential for the Commission to implement the HAB Programme.

127 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 Centres.

128 **The Panel noted with appreciation** the present commitment of Spain until 2011.

129 **The Panel noted with concern** the fatal impact that the termination of support from Denmark will have on the capacity to implement the IPHAB Work Plan and on the sustainability of the decentralized Programme Office at University of Copenhagen.

130 **The Panel urged** the Danish sponsoring organizations to continue to seek renewed commitment.

6.3 WORKPLAN 2010–2011

131 **The Panel summarized** the priorities and needs for the next intersessional period and **recommended** a work plan for the period 2010–2011 as indicated in Annex II hereto. **The Panel adopted** Recommendation IPHAB-IX.2.

7. OPERATION OF THE IOC INTERGOVERNMENTAL PANEL ON HAB

132 **The Panel decided** to continue its intersessional activities under the co-ordination of the Chairman L. Guzman (Chile) who was re-elected, and P. Busby (New Zealand) was re-elected Vice-Chairman.

133 **The Panel and the Secretariat expressed their gratitude** to L. Guzman and P. Busby for their wise and competent chairing of the Panel.

134 **The Panel stressed the importance** of the attendance of the Chairpersons of regional IOC HAB groups at IPHAB sessions, and **urged** the Secretariat to ensure their participation for the Tenth Session of the Panel.

135 **The Panel recommended** that the Tenth Session be announced to Member States no less than 12 months in advance.

136 **The Panel adopted** Recommendation IPHAB-IX.3. **The Panel requested** the Chairman to present an Executive Summary, Resolutions and Recommendations to the Twenty-fifth Session of the IOC Assembly, June 2009.

ANNEX I

AGENDA

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

3.1 SUMMARY DESCRIPTION

3.2 THE IPHAB STRATEGY AND A HIGH-LEVEL SUMMARY OF MAJOR IPHAB ACCOMPLISHMENTS. FOLLOW-UP TO IPHAB-VIII DECISION ON A STRATEGY FOR IPHAB AND THE HAB PROGRAMME.

4. HABP DEVELOPMENTS IN THE INTERSESSIONAL PERIOD:

4.1 CHAIR IPHAB AND TECHNICAL SECRETARY´S SUMMARY REPORT ON ACTIVITIES AND IMPLEMENTATION OF IPHAB-VIII DECISIONS

5. 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, end 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 Beatriz Reguera.
Panel 2. The GEOHAB Research Programme: Assessment of advances in GEOHAB implementation and identification of IPHAB assistance required in implementation; Chaired by Robin Raine (Ireland)
Panel 3. Biotoxin Regulation and Human Health: Identification of priorities 2010-2011 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 (New Zealand)
Panel 4. The Harmful Algae Information System and the International Ocean Data Exchange: Status and priorities 2009-2013 for the integrated IOC/IPHAB-IODE Harmful Algae Information system (HAIS) Included herein how to strengthen mechanisms for data submission and an assessment of the needs among governments and their agencies for inclusion of additional data; Chaired by Adriana Zingone (Italy).

Panel 5. HAB observations and their inclusion in GOOS Regional Alliances: IPHAB has a Task Team to act as the focal and coordination point of the IPHAB regarding interaction with

the Global Ocean Observing System (GOOS), the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), and the IOC Ocean Related Hazards Early Warning System with respect to HAB observations, forecasting and warning systems. IPHAB will assess progress and actions to be taken. Chaired by Bengt Karlson (Sweden)

Panel 6. Harmful algal events, coastal zone management and linkages with coastal eutrophication: IOC has activities on coastal zone management and ecological modelling of coastal ecosystems in relation to nutrient loading. HAB management and prevention is closely related to these broader areas of concern. IPHAB will discuss how it can promote the inclusion of HAB management and mitigation strategies in broader coastal zone management and planning. Chaired by Rob Magnien (USA).

Panel 7. Harmful algae as invasive species: The ICES-IOC-IMO Working Group on Ballast of Ships and other Vectors (WGBOSV) reports to IPHAB. IPHAB will assess achievements and focus. IPHAB will discuss HABs and broader Aquatic Invasive Species issues in the context of marine research and management - specifically i) integrated coast area management including monitoring and mitigation as well as introduction issues, ii) climate change and iii) capacity building. Chaired by Cynthia McKenzie (Canada).

Panel 8. 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 Luis Proenca (Brazil) and regional chairs

6. OTHER RELEVANT ITEMS

The Panel will discuss any other proposal for activities.

7. RECOMMENDATIONS OF THE IPHAB, OVERVIEW OF RESOURCES AND NEEDS - WORKPLAN 2010-2011

8. OPERATION OF THE IPHAB

9. ELECTION OF CHAIR AND VICECHAIR

7 ANY OTHER BUSINESS

10. ADOPTION OF EXECUTIVE SUMMARY AND RESOLUTIONS/RECOMMENDATIONS

11. CLOSURE

NOTE: Panel Members are invited to present their **national priorities** for international cooperation under each relevant agenda item and thereby contribute to consensus regarding an IPHAB Work Plan 2010–2011.

ANNEX II

ADOPTED RESOLUTIONS AND RECOMMENDATIONS

Code	Title
	Resolutions
Resolution IPHAB-IX.1	Task Team on Biotoxin Monitoring, Management and Regulations
Resolution IPHAB-IX.2	Development of the Harmful Algal Information System
Resolution IPHAB-IX.3	Task Team on Algal Taxonomy
Resolution IPHAB-IX.4	Task Team on HAB Monitoring within the Global Ocean Observing System
Resolution IPHAB-IX.5	Regional HABP Development
	Recommendations
Recommendation IPHAB-IX.1	Visualising the IPHAB Strategy for Assisting the Ocean Science Section in the Development of a Workplan for Integrated Coastal Research
Recommendation IPHAB-IX.2	HABP Work Plan 2010–2011
Recommendation IPHAB-XI.3	Operation of the IOC Intergovernmental Panel on Harmful Algal Blooms

Resolution IPHAB-IX.1

TASK TEAM ON BIOTOXIN MONITORING, MANAGEMENT AND REGULATIONS

The IOC Intergovernmental Panel on Harmful Algal Blooms,

Recalling Resolution IPHAB-VIII.3;

Noting the communication by the IOC secretariat during the intersessional period between the IPHAB and FAO and between IPHAB and WHO to strengthen formal relationships and the positive response from FAO;

Recalling the result of the IPHAB-VII Task Team on Biotoxin Regulations as a result of its merger with the FAO/IOC/WHO Task ad hoc Expert Consultation on Biotoxins in Bivalve Molluscs and the resultant use of the Report of the Expert Consultation by CODEX Fish and Fisher Products Committee and the European Food Safety Authority;

Noting the advice received from FAO at IPHAB-IX that the FAO has decided to edit and publish the background papers to the Expert Consultation;

Recalling that many aspects of IPHAB contribute to minimising the effect of HABs on human health and international trade of seafood;

Decides to continue with the Task team on Biotoxin monitoring management and Regulation with the following Terms of Reference;

(i) ensure coordination with FAO in the editing and publishing of the background papers to the Summary Report of the Joint FAO/IOC/WHO *ad hoc* Expert Consultation on Biotoxins in Bivalve Molluscs, Oslo, 2004. This will include reviewing the need to update the background papers;

(ii) promote the inclusion of the recommendations of the Expert Consultation into the CODEX Fish and Fishery Products Committee Standard and Code of Practice for Bivalve Molluscs;

(iii) report to IPHAB-X on international activities in marine biotoxin monitoring management and regulation during the intersessional period;

(iv) coordinate with and advise the Task Team on the Harmful Algal Information System regarding the use of toxin names and the inclusion of background data on toxins.

Invites FAO and WHO to be members of the Task Team as equal partners;

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;

Decides also that the Task Team will be composed by P. Busby (New Zealand) Chair, B. Currie (Namibia), H. Taleb (Morocco) and V.L. Trainer (PICES, USA). The Task Team may be expanded as required to fulfil the Terms of Reference;

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 intersessional period to the Chair IPHAB prior to IPHAB-X.

Resolution IPHAB-IX.2

DEVELOPMENT OF THE 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 the biogeography of harmful species and occurrence of harmful algal events, current taxonomic names of harmful algae 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 Harmful Algal Event Data Base (HAEDAT), IOC Taxonomic Reference List of Toxic Plankton Algae; IOC-ICES Monitoring System Data Base (MONDAT), IOC-ISSHA HAB Bio-geographical Data Base (HABMAP), 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);

Recalling Resolution IPHAB-VIII.5 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;

Recalling Recommendation IODE-XIX.1 through which the IODE Committee endorses the IOC Harmful Algal Event Information System as a joint IPHAB-IODE activity;

Having reviewed the Plan for a Harmful Algal Information System prepared by the Joint IPHAB/IODE Task Team on the development of the Harmful Algal Information System, **endorses** the Plan and its priorities;

Commends the efforts of PICES to engage its member countries in HAEDAT;

Requests the regional HAB groups and networks ANCA FANSA, HANA, and WESTPAC/HAB, and their respective IOC sub-commissions and regional committees, to include as a permanent Term of Reference the collation and submission of harmful algal event summary data to HAEDAT;

Invite the Regional Organisation for the Protection of the Marine Environment (ROPME) to participate in HAEDAT;

Invites IOC National Committees to identify the appropriate institution, and IODE National Oceanographic Data Centres (NODCs), not contributing so far, to participate in the Harmful Algae Information System, in particular HAEDAT;

Requests the HAB Programme Office to identify and assess barriers to the sharing of data, and to interact with ISSHA, IAEA, ICES, and PICES and other relevant organisations to encourage the completion of HAEDAT in terms of both number of contributing member states and collation of data;

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

(i) guide and advise on the further development and implementation of the system;

(ii) assist in identifying the resources required to develop the system.

(iii) seek advice from the IPHAB Task Team on Algal Taxonomy and Biotoxin Regulation in relation to the updating of existing material and the preparation of new material on HAB species, biotoxin names and associated syndromes to be included in HAIS;

Decides also that the Task Team will have the following membership; Jennifer Martins, Chair ((ICES, Fisheries and Oceans Canada); Jim Ammerman (Rutgers University, USA), Catherine Belin (Ifremer, France), Edward Vanden Berghe (Executive Director, Ocean Biogeographic Information System OBIS), Živana Nincevic Gladan (Institute of Oceanography and Fisheries, Croatia), Richard Gowen (AFBI Headquarters, UK), Francisco Hernandez (VLIZ, Belgium), Antoine Huguet (IFREMER, France), Seppo Kaitala (Finnish Institute of Marine Research), Sergey Konovalov ((IODE), Marine Hydrophysical Institute, Ukraine), Jacob Larsen (University of Copenhagen, Denmark), Silvia M. Méndez ((FANSA) DINARA, Uruguay), Øjvind Moestrup ((Chair IPHAB TT), University of Copenhagen, Denmark), David J Patterson (WHOI, EoL, USA), Vera L. Trainer ((PICES), NOAA, USA), Adriana Zingone ((ISSHA) Stazione Zoologica 'A. Dohrn', Italy), a representative of WoRMS, and the Chair IODE GE-BICH. 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 IODE, and that it will work by correspondence and/or meet upon request by the IOC secretariat, and provide a progress report including an updated work plan for the intersessional period to the Chair IPHAB and IODE prior to IPHAB-X.

Resolution IPHAB-IX.3

TASK TEAM ON ALGAL TAXONOMY

The IOC Intergovernmental Panel on Harmful Algal Blooms,

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

Acknowledging the valuable sources of information on the taxonomy and 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 undertaking regulatory monitoring;

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

Acknowledging the progress made by the Task Team in publishing and updating of the IOC Taxonomic Reference List of Toxic Plankton Algae as an integrated element of the World Register of Marine Organisms;

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) verify the Reference List and suggest modifications to it;

(ii) actively interact in the development of the Harmful Algal Information System; identify editors within or outside the task team who will be responsible for maintaining, completing and updating the list of toxic algal species in marine and brackish waters, including illustrations showing diagnostic features of each species or reference to such illustrations or links to such illustrations; the list will include a description of species and genera or links to such descriptions.

Decides also that the Task Team will be composed by Ø. Moestrup (Denmark) Chair, R. Akselman (Argentina), N. Lundholm (Denmark), Y. Halim (Egypt), M. Elbraechter (Germany), M. Hoppenrath (Germany), A. Zingone (Italy), S. Fraga (Spain), G. Cronberg (Sweden), L.N Nguyen (Vietnam). 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, and provide a progress report including a work plan for the intersessional period to the Chair IPHAB prior to IPHAB-X.

Resolution IPHAB-IX.4

TASK TEAM ON HAB OBSERVATIONS AND FORECASTING SYSTEMS WITHIN THE GLOBAL OCEAN OBSERVING SYSTEM

The IOC Intergovernmental Panel on Harmful Algal Blooms,

Recalling Resolution IPHAB-VIII.2 on 'Implementation of HAB Monitoring within the Global Ocean Observing System;

Recognizing the need to maximise the operational effectiveness of regulatory monitoring of HABs and 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 HABs and their impacts is a high priority;

Recognising the need to incorporate data on 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 several elements are essential for HAB observation and prediction systems but that the diversity of HAB species and coastal marine ecosystems requires that observational networks and predictive models need to be tailored for a specific HAB species in a particular coastal environment;

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

Reiterates the instructions of IPHAB-VIII for the Scientific Steering Committee of GEOHAB:

(i) to 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) to establish 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);

Decides to continue the 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, in particular with the Panel for Integrated Coastal Observations (PICO);

(ii) together with PICO suggest HAB-related products from automated observation and forecasting systems in selected GOOS Regional Alliances (GRA's) and if possible make these available through the IOC-HAB Programme web site;

(iii) keep informed, and solicit 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, P. Gentien (France), Robin Raine (Chair GEOHAB SSC, Ireland) Chair of the IOC-SCOR GEOHAB SSC, Stewart Bernard (South Africa), Milton Campbell (Brazil), Steve Groom (United Kingdom), Liam Fernand (United Kingdom), Seppo Kaitala (Finland), Raphe Kudela (USA), Thomas C. Malone (USA) and PICO, Tetsuo Yanagi (Japan), Susan Blackburn (Australia) pending accept of invitation; Joji Ishizaka (Japan) pending accept of invitation, Gemita Pizarro (Chile) pending accept of invitation. The Task Team may be expanded as required to fulfil the Terms of Reference;

Invites members of the GRA's to take active part in the Task Team;

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-X.

Resolution IPHAB-IX.5

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 ANCA, FANSA, and HANA;

Acknowledging that the integrative processes among participating countries is important to set collaborative work on science, monitoring, managing and educational activities provided by Regional Working Groups;

Acknowledging that regional working group enhance the collaborative process and that they are an important basis for sustainable integrative development;

Taking note of the different practices in the selection of membership of the regional HAB groups and the selection of chairs;

Encouraging a practice of open invitations to member state of the regions to participate and for the groups to elect or re-elect their chairs at two-year intervals;

Recall the impediment to WESTPAC/HAB expressed at IPHAB-VIII 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;

Reiterates the requests for the assistance of the IOC Secretariat and WESTPAC to clarify the operation of WESTPAC/HAB within the combined framework of IPHAB and IOC/WESTPAC;

Endorses the proposed work plans of ANCA, FANSA and HANA for 2010-2011 subject to availability of funding, and the continuation of the groups to in particular:

(i) stimulate the development of both inter- and intra-regional science projects and their funding via intergovernmental financial sources;

(ii) promote and enhance the organization of regional training courses on taxonomy and marine biotoxins, including new technologies and where possible use local capabilities to strengthen inter-group interaction;

(iii) encourage the countries within the regional groups to provide information to the HAEDAT, MONDAT and HABMAP databases through their representatives in the groups;

(iv) ensure the continuation of the Algas Nocivas Portal edition under a UNESCO domain;

(v) continue inter-calibration exercises within the group and/or joining international exercises. The FANSA group has identified the needs for as DSP and lipophilic toxins in the FANSA region with the support of Community Laboratory reference and the Vigo IOC Center.

Notes that the priorities of WESTPAC/HAB were not presented to the Panel;

Acknowledging with concern the problems the Pacific Islands Countries and Territories (PICT) face with HABs;

Noting in particular the serious problem of ciguatera fish poisoning in PICT,

Recognizing the limited resources of PICT;

Noting the recommendations from the Pacific regional workshop on Ciguatera and Related Biotoxins 27-31 October 2008, Noumea, New Caledonia;

Expresses its full support for PICT to:

(i) set up coordinated and collaborative research on ciguatera and other HABs between various research institutes and the PICT;

(ii) seek funds to assist with training and capacity building to set up and implement an HAB monitoring system and a database for recording fish poisoning cases through health and fisheries departments in PICT;

Recognizing the establishment of a Pacific Regional Steering Committee on Ciguatera and its valuable role in developing an action plan with regards to ciguatera in the Pacific in consultation with PICT governments;

Acknowledging the Secretariat of the Pacific Community (SPC) as the coordinator of regional efforts in coordinated and collaborative research on ciguatera in liaison with PICT government administrations;

Welcomes the participation of the PICT region in IPHAB activities and **invites** the Pacific Regional Steering Committee on Ciguatera to affiliate to IPHAB as a regional group/network;

Request that the regional Chairs maintain contact and coordinate activities when feasible and appropriate;

Supports the establishment of new regional HAB groups or networks where there is a request for this;

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

Recommendation IPHAB-IX.1

ASSISTING THE OCEAN SCIENCE SECTION IN THE DEVELOPMENT OF A WORKPLAN FOR INTEGRATED COASTAL RESEARCH

The IOC Intergovernmental Panel on Harmful Algal Blooms,

Recalling that the 41st Session IOC Executive Council encouraged further development of a workplan for integrated coastal research and elaboration of funding requirements for an initial workshop and to present this to the 25th Session of the IOC Assembly in 2009;

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

(i) Advisory Group for the IOC Ocean Sciences Section and its advice to give priority to the integration and inter-relationship of presently distinct elements and to recognize coastal research as a primary element;

(ii) IOC Medium-Term Strategy 2008-2013 and the decision therein to develop integrated coastal research on direct human influences on coastal ocean functioning and ecosystem health;

Noting the complexities of the human effects on ecosystems services and that the occurrence of harmful algae blooms is one of several possible undesirable outcomes of the human driven eutrophication process;

Recognising:

(i) the GEOHAB science theme on the link between HABs and Eutrophication;

(ii) the SCOR/LOICZ Workgroup 132 on the examination of the relationship between nutrient loading and HAB occurrence (2008–2010);

(iii) the report from the workshop - "Coastal Eutrophication: Linking Nutrient Sources to Coastal Ecosystem Effects and Management" held 2–4 February 2009;

(iv) the UNEP GPA for the Protection of the Marine Environment from Land-Based Activities, and the newly established Global Partnership on Nutrient Management;

Recalling that GOOS has been investigating the opportunities to measure parameters of relevance to coastal management such as harmful algal blooms;

Recognizing the Assessment of Assessments that will soon be available to assist in the prioritization of integrated research topics and regions of concern for the IOC to address;

Further recognizing that the UN has mandated an Integrated Coastal Area Management (ICAM) approach and IOC has made major commitment to ICAM;

Notes that IPHAB-IX decided to be fully engaged in the development of an Integrated Research Strategy;

Recommends that the proposed workplan of the 22–23 February Workshop on "Coastal Eutrophication: Linking Nutrient Sources to Coastal Ecosystem Effects and Management" be broadened to be more inclusive of the issues and concerns of the various intergovernmental bodies and science programs referenced below and be inclusive of a broader suite of quantitative tools linking nutrient sources to ecosystem impacts so as to be more relevant to assisting in management decisions of member states at the regional to local scale;

Recommends that the IOC Secretariat lead the development of an inclusive framework for action and budget on Integrated Coastal Research that is responsive to the IOC Executive Council direction, for presentation to the 2009 IOC Assembly and that is inclusive, at a minimum, of the following international intergovernmental agencies and science programs: IOC/IPHAB and its GEOHAB, IOC/ICAM, IOC/GOOS, UNEP/GPA, International Human Dimensions Programme (IGBP), FAO/Aquaculture, WHO, IGBP/LOICZ, SCOR/WG 132, and INI.

Further Recommends that a workshop as part of the further development and implementation of an Integrated Research Strategy, be convened to link and coordinate the many intergovernmental bodies and science programs that would advance our understanding of both current and predicted impacts of nutrient loads from watersheds and other sources on ecosystem services and formulate policy responses and management strategies.

Recommendation IPHAB-IX.2

HABP WORKPLAN 2010–2011

The IOC Intergovernmental Panel on Harmful Algal Blooms,

Referring to the deliberations of its Ninth Session and the priorities identified prior to the session by ANCA, FANSA, and HANA;

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

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

Recommendation IPHAB-IX.3

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-IX.2

IOC HAB PROGRAMME WORKPLAN 2010–2011
(Main activities and funding identified as of 1 May 2009 only)

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

ACTIVITY:	**ORGANIZER/ RESPONSIBLE**	**TARGET GROUP/ Region:**	**WHERE:**	**WHEN:**	**FUNDING IDENTIFIED:** In USD 1,000 IOC Ex Bud		FUNDING REQUIRED TOTAL: **In USD 1,000**	**AUTHORITY & REMARKS**
OPERATION & SERVICES								
IOC SCC HA & HAB Programme Office *Included the activities and services in this workplan implemented by the Centre and required to justify a decentralized PO.*	IOC/H. Enevoldsen	Global	Cph	2010-2011	0	Denmark requested	2 x 100 and in kind by host	IPHAB-IX
IOC SCC HA	IOC/M. Lion	Latin America & North Africa	Vigo	2010-2011	0	2 x 7 IOC TF/Spain and in kind	2 x 7 and in kind	IPHAB-IX
PUBLICATIONS								
HAB Programme Strategic document	IOC	Global	HQ / SCC HA	2009	0	0	5	IPHAB-VIII
Harmful Algae News	T. Wyatt (Spain), Editor	Global	HQ / SCC HA	2010-2011	2 x 2	0	2 x 2	IPHAB-IX
GEOHAB CRP Plan: GEOHAB Asia Science Plan	K. Furuya (Japan)	Global	HQ with SCOR	2009/10	0	3	3	IPHAB-IX
GEOHAB CRP Plan: HAB's in Fjords and Coastal Embayments	S. Roi (Canada)	Global	HQ with SCOR	2009/108	0	3	3	IPHAB-VIII
IOC Manuals and Guides: Manual on Plankton Analysis	B. Karlson (Sweden)	Global	HQ, possibly with ICES	2009/10	0	3	3	IPHAB-VIII

ACTIVITY:	**ORGANIZER/ RESPONSIBLE**	**TARGET GROUP/ Region:**	**WHERE:**	**WHEN:**	**FUNDING IDENTIFIED:** In USD 1,000 IOC Ex Bud		FUNDING REQUIRED TOTAL: **In USD 1,000**	**AUTHORITY & REMARKS**
COSPONSORSHIP OF CONFERENCES								
XIVth ICHA	ISSHA	Develop. Country.	Crete, Greece	2010	0	5	Unknown	IPHAB-IX
TRAVEL								
IOC Staff	H. Enevoldsen	-		Yearly	2 x 2K	2 x 5	2 x 10	IPHAB-IX
Chair IPHAB Travel	L. Guzman (Chile)	-		Yearly	2 x 2K	0	2 x 2	IPHAB-IX
SCIENTIFIC ELEMENTS								
GEOHAB SSC	IOC/SCOR	Global	-	-	2 x 20K (incl publication)	2 x 50 via SCOR	2 x 120	Agreement with SCOR
ICES-IOC WGHABD	J. Silke (Ireland)	Develop. Country		Yearly	0	0	4	IPHAB-IX
ICES/IOC/IMO WGBOSV	A. Jelmert (Norway)	Global		Yearly	0	0	4	IPHAB-IX
Harmful Algal Information System development	HABP-IODE	Global	-	2010-2011	0	0	100	IPHAB-IX and IODE-XX
REGIONAL GROUPS								
Regional Working Group on Harmful Algal Blooms in South America (IOC FANSA)	L. Proenca (Brazil)	S-America	Chile	2010	0	7	10	IPHAB-IX
Publication of a regional review of HAB occurrences and associated impacts.	FANSA Group,	FANSA	NA	2011	0	0	5	IPHAB-IX
Regional Working Group on Harmful Algal Blooms in the Caribbean (IOC ANCA) including a 3-day scientific workshop.	JL Peña Manjarrez (Mexico)	Mexico	To be decided	2010	0	5	10	IOCARIBE and IPHAB-IX
Regional Group on Harmful Algal Blooms in the Western Pacific: WESTPAC-HAB	To be decided	WESTPAC	To be decided	To be decided	0	0	10	IPHAB-IX and WESTPAC-7

ACTIVITY:	**ORGANIZER/ RESPONSIBLE**	**TARGET GROUP/ Region:**	**WHERE:**	**WHEN:**	**FUNDING IDENTIFIED:** In USD 1,000 IOC Ex Bud		FUNDING REQUIRED TOTAL: **In USD 1,000**	**AUTHORITY & REMARKS**
Regional Working Group on Harmful Algal Blooms in North Africa (IOC HANA)	Y. Halim (Egypt)	North Africa	To be decided	2011	0	7	10	IPHAB-IX
Regional Network for the Gulf Region	To be explored with ROPME	Gulf	To be decided	To be decided	0	0	unknown	IPHAB-VIII
CAPACITY ENHANCEMENT								
IOC Training Course on Identification and Qualification in Harmful Marine Microalgae	IOC SCC HA CPH	Global, Develop. Country	Uni. of Copenhagen, Denmark	2010 and 2011	0	sought	2 x 50 If grants are to be provided	IPHAB-IX
IOC-IEO-AECI Training Courses	IOC SCC HA Vigo	Latin America, and North Africa Develop. Country	Instituto Español de Oceanografía, Vigo, Spain	2010 and 2011	0	2 x 36 IOC TF/Spain 2 x 10 IEO	2 x 46	IPHAB-IX
IOC Training Course on Qualitative and Quantitative Determination of Algal Toxins	A. Cembella/ B. Luckas (Germany)	Global, Develop. Country	Germany, AWI	?	0	German partners and IOC TF	40	IPHAB-VIII
Regional Training Course on Taxonomy and Ecology of Harmful Marine Microalgae (E-learning)	t.b.d.	HANA	To decided	2011	0	0	15	IPHAB-IX
Regional Training Course on Taxonomy and Ecology of Harmful Marine Microalgae (E-learning)	t.b.d.	FANSA	t.b.d.	2010/ 2011	0	0	15	IPHAB-IX

ACTIVITY:	**ORGANIZER/ RESPONSIBLE**	**TARGET GROUP/ Region:**	**WHERE:**	**WHEN:**	**FUNDING IDENTIFIED:** In USD 1,000 IOC Ex Bud		FUNDING REQUIRED TOTAL: **In USD 1,000**	**AUTHORITY & REMARKS**
Reestablishment of the ANCA-FANSA portal Algas Nocivas	Portal Editors	ANCA/FANSA	ROSTLAC	2010-2011	0	0	unknown	IPHAB-IX
Intercalibration exercise of DSP and other lipophilic toxin determination between EU-CRL and the NRLs of the Region which have alredy implemented ISO norm 17025	t.b.d.	FANSA	In country	2010/11	0	0	5	IPHAB-IX

Identified funding (2010–2011): US$ 70,000 from IOC Regular Programme (draft 35 C/5)

US$ 80,000 from expected extra-budgetary resources

US$ ~500,000 to be identified from extra-budgetary resources.

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. Emphasis is put on the prevention of new invasions and the mitigation of harmful established invaders. The federal department of Fisheries and Oceans (DFO) is engaged in a partnership with 13 universities in a national research network, the Canadian Aquatic Invasive Species Network (CAISN) 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.

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

The Canadian Aquatic Invasive Species Network (CAISN) is a national group of specialists created with the goal of predicting and preventing new aquatic invasive species (AIS) from entering Canada, determining factors that affect successful colonization by AIS, and modeling the invasion process for both potential and existing AIS. CAISN studies increase understanding of the invasion process, train personnel to prevent future invasions and minimize spread of AIS already established in our lakes and coastal marine ecosystems. The research objectives for CAISN are directed at three theme areas: vectors and pathways, factors affecting establishment success and risk assessment modeling.

In the last two years, several risk assessments have been completed, particularly relating to ballast water exchange zones in the Newfoundland and Labrador region and the Canadian Arctic region. Several projects with CAISN 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.

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.

Canada continues to provide data on harmful events and biogeography of harmful species to the IOC/IPHAB–IODE Harmful Information system (HAIS) and Harmful algal event database (HAEDAT).

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 10th Canadian Workshop on Harmful Marine Algae was held in Mont Joli, Quebec, May 9-11, 2007 and included a special session on innovative toxin detection techniques and a special session on freshwater harmful microalgal or cyanobacteria blooms in Canadian lakes.

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.

To increase capacity in phytoplankton expertise several representatives of Canada have participated in IOC endorsed training programs including the IOC Training course on identification and qualifications in harmful marine microalgae in Denmark and the 9th Advanced Phytoplankton training course in Naples.

B. CROATIA

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". This program is performed in compliance with the EU shellfish hygiene directive 91/492/EEC and funded by the Croatian Ministry of agriculture, fisheries and rural development. The National Reference Laboratory for investigation of marine biotoxins and identification and enumeration of toxic algal species is the Laboratory of plankton and shellfish toxicity, Institute for Oceanography and Fisheries, Split, Croatia. In 2008 this Laboratory achieved accreditation (in compliance with 91/492/EC) under ISO 17025 for the identification and enumeration of toxic phytoplankton species and the detection of shellfish toxins (PSP, DSP, YTX, 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 are performed on mussels *(Mytilus galloprovincialis*) and minor part on *Pecten jacobeus* and *Ostrea edulis.*

During 2008 and 2009 Laboratory of plankton of IOF carried out intercalibration for biotoxin identifications with Referent laboratories in Italy and Spain. Laboratory working group for phytoplankton has harmonized methods for the sampling, identification and enumeration of toxic phytoplankton species between regional laboratories (Slovenia, Italia).

The largest part of the shellfish toxicity events in Croatia has been associated to DSP shellfish toxicity. DSP toxin profiles showed that OA and yessotoxin are the main DSP toxins in Croatian waters. In the northern Adriatic DSP shellfish toxicity has been associated to proliferation of *Dinophysis* species, particularly to the summer and autumn proliferation of *D. forthii and D. caudata.* Closure of the shellfish harvesting areas in the northern Adriatic was mainly provoked by presence of OA in shellfish flash.

The largest part of DSP shellfish toxicity in the middle and south Adriatic was provoked by yessotoxin. The presence and high cell densities of *Lingulodinium polyedrum* during DSP toxicity events has indicated to the involvement of this species in yessotoxin appearance. In some occasions yessotoxins was detected also in absence of this species. The largest problems with DSP toxicity in eastern Adriatic waters were recorded in 2005, 2006 and 2008.

In Croatian waters PSP shellfish toxicity was recorded for the first time in March 2009 (Northern Adriatic). This event was associated with occurrence of *Alexandrium minutum* but in very small abundance (2×10^2 cells L^{-1}). At the same time tunicates (*Microcosmus sulcatus*) have been positive on PSP mouse bioassay repeatedly.

The major part of HAB research activities in Croatia are conducted through the national program "Systematic Research of the Adriatic Sea as a Base for Sustainable Development of the Republic of Croatia" and program is funded by the Government of Croatia. This interdisciplinary program includes a large number of physical, chemical, biological and fishery research activities, as well as regular meteorological and oceanographic measuring. Research activities focusing on harmful algal blooms problem include basic research on bloom development, persistence and termination, as well as food web.

The research project "Ecological research of toxic phytoplankton and shellfish toxicity" is funded by the Croatian Ministry of Science, Education and Sports. Through this project Laboratory of plankton and shellfish toxicity of IOF has obtained LC-MS/MS and initiated study of examining the correlation between the presence and abundance of potential toxic species in the water column and toxin concentrations in shellfish flesh. During the last seven years, a large number of scientific reports and scientific paper related to problem of HAB species and biotoxins has been published.

Main Croatian priorities are:

- Stronger collaboration between all Adriatic countries and creation of Adriatic network for exchange of information of toxic species and shellfish toxicity

- Education of new experts in monitoring activities trough continued training courses (taxonomic training and training for LC-MS/MS biotoxins detection) with the goal of extending the HAB monitoring along the whole eastern Adriatic coast

- Research on toxic bloom dynamics and on the response of HAB species to environmental factors

- Application of Liquid Chromatography Mass Spectrometry (LC-MS/MS) methods for the detection of shellfish toxins

C. GREECE

HABS Events

In Greece, the major persistent impacts of HAB events have been associated to proliferation of *Dinophysis* species.The most serious diarrheic shellfish poisoning (DSP) outbreak, associated with a *Dinophysis cf. acuminata* bloom (maximum abundance: 8×10^4 cells l^{-1}) was firstly observed in January 2000 in Thermaikos Gulf, a major shellfish cultivation area in Greece (90% of total shellfish production). The outbreak lasted until March 2000, resulting in great economical losses in the shellfish industry due to closing of bivalve mussel production zones. Since then, this organism constantly appears during the winter-spring period and its maximum abundance (6.1×10^5 cells l^{-1}) was noted in February 2004. *Noctiluca* bloom often coincides or follows, as well as, the diatom *Pseudo-nitzschia* does.

Recently, during March-April 2009, a new serious economic problem arose from the sudden massive mortalities of aquaculture and wild fish in the estuary of Sperchios river (western Maliakos Gulf, Central Aegean Sea), that are being associated with the toxic species *Chatonella sp*. This phenomenon was observed soon after an episodic rainfall event during the fertilizer application period (January-February).

A winter bloom dominated by *Pseudo-nitzschia calliantha*, a potential domoic acid producer, is reported for the first time in the Aegean Sea, in a semi-enclosed embayment (Kalloni Gulf) surrounded by agricultural land and drained by intermittent rivers. Abundances of this species in the inner part of the Gulf during February 2005 were extremely high (max 1.1×10^7 cells l^{-1}). The species *Alexandrium insuetum* was also found in considerable cell numbers (maximum: 1.4×10^5 cells l^{-1}) during the bloom, reaching up to 40% of the total biovolume. These blooms demonstrate an evident cause - effect relationship between nutrient inflows originating from agricultural activities in the watershed and the development of a potential HAB. *Pseudo-nitzschia cf. pungens* is constantly found in samples from Thermaikos Gulf and it reached bloom concentrations in Amvrakikos Gulf in 2008.

The epiphytic *Prorocentrum* species, *P. borbonicum* and *P. Levis* found at the North Aegean coastline during 2005 constitute new records for the Mediterranean Sea. Toxicological properties of *Prorocentrum* species were examined by means of protein phosphatase 2A inhibition assay and/or *Artemia* bioassay. Results concerning toxicity of "*Prorocentrum lima* complex" (up to 1.3×10^5 cells g^{-1} fresh weight of macrophyte (fwm) on *Cymodocea nodosa*) constitute new information for the Mediterranean Sea, pointing out their potential role as diarrhetic shellfish poisoning (DSP) toxins producers.

The toxic benthic dinoflagellate assemblage comprising species of the genera *Ostreopsis (Ostreopsis ovata, Ostreopsis cf. siamensis and Coolia cf. monotis* were recorded along the North Aegean coasts during late summer and autumn periods of 2004, 2005 and 2006 reaching high abundances epiphytically on macroalgae (e.g. *Ostreopsis* sp. 1.6×10^5 cells gr^{-1} wwa). The toxicity of *Ostreopsis* species from cultures and field populations were examined by both mouse bioassay (MBA) and hemolysis neutralization assay (HNA).

The toxic dinoflagellate *Alexandrium minutum* that reached cell densities up to 2.5×10^5 cells l^{-1} in April 2003 in Pagassitikos Gulf (Central Aegean Sea) was also recorded during the last years in other Greek gulfs without forming blooms.

Research projects

Research activities focusing on harmful algal blooms problem are conducted at research centers and universities through monitoring projects mainly funded by national sources. Research includes HAB species taxonomy, physiology, ecology and toxins' methods to detect marine biotoxins. Targeted investigations, related to toxic phytoplankton species and shellfish toxicity events are carried in the frame of harmful algae national monitoring programs conducted in a wide network of fixed points at the main fishing and shellfish growing areas of Greece as well as ecological protection areas, recreation resorts and HABs frequently occurrence areas. Most projects have 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.

At the period 2007-09, some of the research programmes for environmental monitoringof phytoplankton (including HABs) of the Institute of Oceanography, Hellenic Centre for Marine Research are the following:

- Study of inner Saronikos ecosystem, under the influence of Psittalia sewage treatment plant. (Funding: Company of water supply and sewerage)
- Monitoring program for the evaluation of the quality of Messiniakos Gulf and the western coast of Messinia during 2006-2010. (Funding: Prefecture of Messinia)
- Monitoring the quality of the marine environment of the Gulf of Thessaloniki. (Funding: Ministry of Environment)
- Study of short- and mid-term effects of the pollution cased from the accident of the ship "SEA DIAMOND" in Santorini Bay. (Funding: Ministry of Mercantile Marine)
- Study of the annual and biological cycles of plankton in a coastal area. (Funding: UNEP)
- Study of environmental conditions in Pagasitikos Gulf. (Funding: Golfing Developments)
- Monitoring the quality of the marine environment affected by the outfalls of the wastewater treatment plants in Paros Island. (Funding: Environmental Management)
- Mapping of Environmental Conditions and Parameters in the Antikyra Bay. (Funding: PECHINEY)
- Development of electrochemical immunosensors for the detection of toxins present during harmful algae blooms. (Funding: 75% from European Social Fund and 25% by National Funds).

At the Department of Botany, Aristotle University of Thessaloniki, Greece, the Project "Harmful Algae Monitoring Programme in Greek coastal waters" runs since 2000 and is funded mainly by national sources (Prefectures).The monitoring schedule covers 8 mussel

(*M. galloprovincialis*) culture and bivalve molluscs fishing areas at the coastal areas of the Aegean Sea and 1 area in the Ionian Sea.

Mussels are examined for three categories of toxins, DSP, PSP and ASP by either mouse bioassay and/or HPLC method in compliance of the Decisions 2002/225/EC, 2002/226/EC, which are an amendment of Council Directive 91/492/EEC. The majority of the examined mussels belong to *Mytilus galloprovincialis.* The National Reference Laboratory of Marine Biotoxins, Ministry of Agricultural Development and Foods, Thessaloniki, Greece is the main Laboratory of marine Biotoxins and operates since 1993 in compliance of the above Decisions. A 100% of the shellfish fishing or shellfish cultures are inspected from 15 provinces of the country, of which about 65% from Thermaikos Gulf. Moreover, the Hellenic Centre for Marine Research administers chemical analyses using Liquid Chromatography Mass spectroscopy (LC-MS) for the analyses of okadaic acid, and DTX:s and domoic acid.

Research on phytoplankton (including HABs) is also carried out in other universities (e.g. University of Aegean, Department of Marine Sciences, Lesvos Island, Greece), as well as other research institutes.

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

Capacity building

- A culture collection of some harmful microalgae has been established at HCMR, Athens and at the Department of Botany, Thessaloniki.
- 2 young scientists participated in the "Marine Genomics Europe" course on "Plankton bloom dynamics – New insights from molecular and genomic tools" in Bremerhaven, Germany (June 2008).
- Ph.D. students are supported via monitoring projects

Priorities

At the last IPHAB IOC meeting (Paris 2007), Greece proposed the following priorities:

- 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

The majority of these priorities for the period 2007-09 was achieved through national and EU cooperation.

Greek priorities for 2010–2011 are:

- Continuation of national HAB species and phycotoxin monitoring by extending it in time and space
- Participation of young scientists in training courses for identification of toxic species and shellfish toxins
- Participation of young scientists in training courses of new methodologies (e.g. molecular biology, genetic diversity, biosensors)
- Application of new methodologies for identification of toxic species and shellfish toxins
- Strengthening the collaboration among universities, research laboratories, social, economic and public services (e.g. port and/or prefectures authorities) in order to achieve a significant progress in research and management of HAB problems that would not be possible if similar studies were undertaken independently (e.g. coordination of research, input to solutions/decisions)
- Exchange of information on toxic species and shellfish toxins with other countries
- Establishment of data bank of HAB events

D. NAMIBIA

HAB monitoring

HAB monitoring in Namibia has been driven in the last five years by the developing shellfish mariculture industry. A national shellfish sanitation programme was initiated through the BCLME programme in 2004 and is running routinely. This programme, set to satisfy EU and US/FDA standards, is presently in draft regulations under the Namibian Aquaculture Act (2002).

Phytoplanktons are monitored daily from the shore and every two weeks from all farmed areas.

Regulatory biotoxin testing for PSP, DSP and ASP is carried out on commercial shellfish. A major step forward was the opening of national biotoxin and microbiology laboratories in Walvis Bay by the regulatory authority for fishery and aquaculture products in Namibia, the National Standards Institute NSI, to serve the mariculture industry, These laboratories are presently going through the necessary validation procedures before they can run independently from the only other biotoxin laboratory in the southern Africa region (the CSIR laboratory in Cape Town, South Africa). The establishment of Namibian regulatory labs will play a major role in getting test turnover-times acceptable to the EU and US.

HAB Impacts

Until the end of 2007, HAB problems were not a concern in Namibia. Few toxic problems had been experienced in the preceding years. However in 2008 the situation changed with major impacts from HABs, both from biotoxin problems from the lipophillic (DSP) group (see fig. 1), and from inshore “crashes” of non-toxic high-density dinoflaggellate blooms leading to anoxic conditions. The problems appeared to be associated with changes in natural climatic environmental conditions:

Over the last decade the wind system driving upwelling along the Namibian coastal section of the Benguela upwelling system has slackened, with increased slack periods and

an increase in onshore (westerly) wind, resulting in marked stratification periods, and buildup of blooms inshore. This trend intensified in the summer of 2008 to produce continual heavy algal blooms next to the coast. Calm weather conditions led to bloom "crashes" with ensuing anoxic conditions disastrous to both the farmed shellfish as well as the indigenous littoral fauna.

Whilst these high density blooms were mostly non-toxic, toxic problems also presented during 2008. In the south of the country (Lüderitz region) an *Alexandrium catenella* bloom caused shellfish to test positive for PSP in April-May 2008. DSP-positive shellfish along the whole central coast resulted in shellfish closures intermittently throughout the year. The DSP-positive tests have continued into 2009 (fig. 1). Additionally the frequent occurrence of *Karlodinium* in the coastal waters over the last two years is suspected of causing mortalities of farmed oysters.

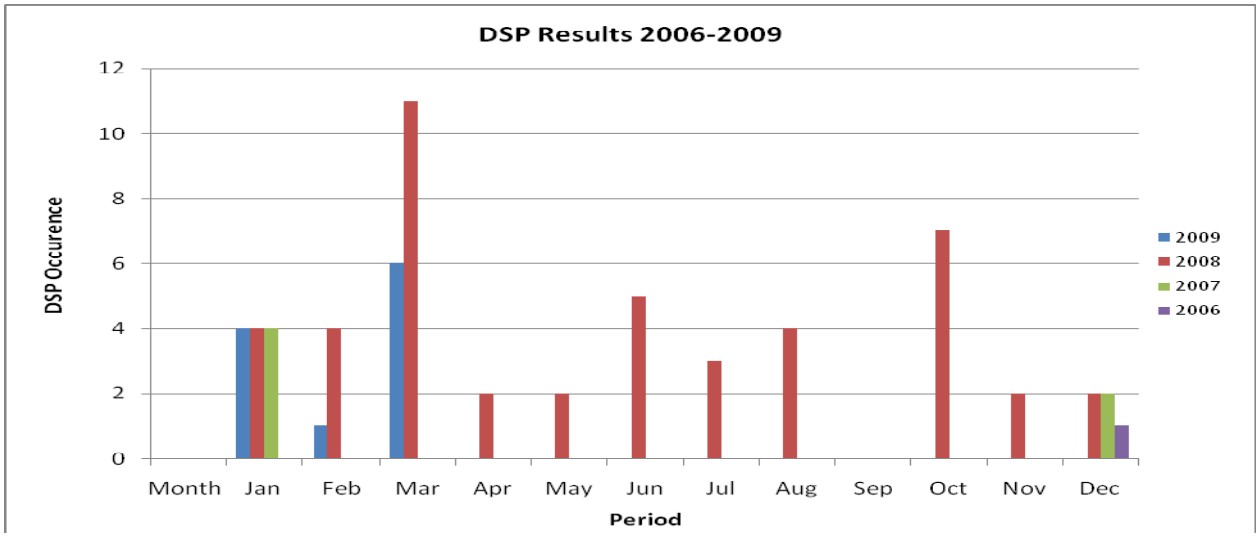


Fig. 1: Incidence of DSP (mouse testing) in farmed oysters

Although a regular HAB-monitoring programme has not been running for long in Namibia, the HAB events of 2008 came as a shock, as no similar impacts had been experienced in the last 15 years. It is suspected that these changes are symptomatic of the changing oceanographic/climatic environment. However some sort of early warning system is desirable and urgent for the mariculture industry. HAB problems were previously considered insignificant as the shellfish industry developed, but now count as a major factor affecting success.

Outlook

HAB monitoring to date has revealed several priority areas for research. Capacity within Namibia is limited to comprehensively tackle the many leading research questions, and therefore potential research partners are being sought.

Priority research aspects include:

- Karlodinium veneficum (=Gymnodinium galatheanum) dynamics, to understand the impact of this species in Namibian waters. The Spanish-Namibian Co-operation Programme is hoped to partner Namibia on this topic.
- Intensified monitoring of DSP toxins in shellfish, with LC-MS analyses of DSP-positive (mouse test) shellfish samples, in order to profile the causative toxins. Possibly Spanish and German collaboration will be sought for collaboration.
- PSP occurrence in Namibian coastal waters (phytoplankton, shellfish, other organisms) using the RBA method through the IAEA RAF 7007 project.

- Pseudo-nitzschia species: possible ecosystem effects from the heavy blooms along the Namibian coast.
- Persistent PSP occurrence in farmed abalone: investigation of the source and persistence of this problem.

E. PACIFIC ISLANDS

The Pacific Islands community is characterized by multiple cultures among small populations on hundreds of islands scattered over vast distances across the ocean. The total land area makes up only 2% of the total area of the Pacific Ocean (Rapaport, 1999:367). Twenty two Pacific Island countries and territories[2] manage over 29 million square kilometers of ocean (Rapaport, 1999:367), equivalent to the combined area of Canada, China and the USA.

Harmful Algae Blooms (HABs) have a long history in the Pacific Islands, with reports of this problem recorded by Fernandez da Queiros in 1606 and Captain James Cook in 1776. Some of the species which have been implicated in Pacific Islands HABs include the ciguatera-causing dinoflagellates such as *Gambierdiscus toxicus,* the benthic algae *Prorocentrum lima,* the nuisance algae *Phaeocystis sp.* and the cyanobacteria *Lyngbya majuscula*. Look up official names for these in the UNESCO database.

Of these, ciguatera is by far the greatest HAB problem in the Pacific Islands affecting Pacific Island health, economy, livelihoods and food security. Pacific Islanders are one of the highest consumers of seafood in the world with consumption of over 200kg/capita/annum of seafood (Rapaport, 1999:366). However due to the increasing incidence of ciguatera, a study on one island showed that 71% of people are no longer eating local reef fish due to concerns about ciguatera fish poisoning (Hajkowicz and Petero, 2005:37). Indeed the South Pacific region has the highest incidence of ciguatera in the world with 3400 to 4700 cases recorded per year most likely representing only 10-20% of the actual number of cases (Laurent et al, 2005:14).

The result is an increased reliance on pelagic fish and a less healthy diet of imported canned fish and red meat. This new diet combined with a reduction in inshore fishing activity contributes to the problem of poor diet and reduced levels of physical activity noted amongst Pacific Islanders in recent research (SPC, 2002:9). Ciguatera fish poisoning is an additional burden on health care systems in the Pacific Islands.

Ciguatera fish poisoning also has an economic impact on Pacific Island countries. A survey of patients in French Polynesia found that losses in productive working days through sick leave amounted to US$1 million/year (Bagnis, 1992). In addition, the live reef fish trade was severely impacted in the country of Kiribati when people in Hong Kong contracted ciguatera from fish allegedly imported from Kiribati. The incident resulted in a total closure of the trade in Kiribati and a loss in income for several fishermen (Laurent et al, 2005:15).

Another incident that had a serious impact on health and the economy in the country of the Cook Islands is likely to have been caused by an HAB. Between November 2003 and May 2004 Rarotonga experienced an “irritant syndrome” characterized by a painful burning sensation in the nose, sore, watery eyes, breathing difficulties, skin itchiness/rash and throat irritation. The syndrome resulted in school closures and cancellations in tourist

[2] American Samoa, Cook Islands, Fiji, French Polynesia, FSM, Guam, Kiribati, Marshall Islands, Northern Mariana Islands, Nauru, New Caledonia, Niue, Palau, Papua New Guinea, Pitcairn Island, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, Wallis & Futuna.

accommodation bookings. Research during and after the syndrome indicated that an aerosol of the cyanobacteria *Lyngbya majuscula* may have been a possible cause (Evans, 2008). Reports of shellfish poisoning allegedly due to other species of dinoflagellate and cyanobacteria have been reported in the Cook Islands, New Caledonia and French Polynesia (Skinner, 2009; Laurent et al, 2008)

The outcomes of a "Ciguatera and Related Biotoxins" workshop that was jointly organized by the Secretariat for the Pacific Community (SPC)[3], the Institute for Research and Development and the Pasteur Institute of New Caledonia and held in Noumea, New Caledonia 27-31 October 2008 indicated that Pacific Islands Countries and Territories (PICTs) face an increasing incidence in ciguatera and related biotoxins. The workshop recommended that:

1. Coordinated and collaborative research be set up on ciguatera between the various research institutes and the Pacific Islands Countries and Territories

2. SPC be the coordinator of this regional effort in liaison with each PICT government administration

3. Partnerships with the following institutes be fostered :
   - The Institute Louis Malardé, French Polynesia
   - The Institute Pasteur, New Caledonia
   - The Institute de Recherche pour le Développement, New Caledonia
   - The Institute Cawthron, New Zealand
   - The University of Queensland, Australia
   - The FDA Gulf Coast Seafood Laboratory, United States of America
   - The NOAA Hollings Marine Laboratory, United States of America

4. The establishment and the efforts of a steering committee which would be responsible for the development of an action plan with regards to ciguatera in the Pacific, in consultation with the PIVTs governments be supported. This Committee would include:
   - Marie-Yasmine BOTTEIN (NOAA Hollings Marine Laboratory, USA)
   - Mireille CHINAIN (Louis Malardé Institute, Papeete, French Polynesia)
   - Robert DICKEY (Food and Drug Adminstration, USA)
   - Jacqueline EVANS (Ministry of Health, Rarotonga, Cook Islands)
   - Patrick HOLLAND (Cawthron Institute, New Zealand)
   - Dominique LAURENT (Institute for Research and Development-Toulouse, France)
   - Richard LEWIS (University of Queensland, Australia)
   - Jordi MOLGO (C.N.R.S., Gif sur Yvette, France)
   - Serge PAUILLAC (Pasteur Institute, New Caledonia)
   - Being YEETING (Secretariat of the Pacific Community)

5. Funding mechanisms be sought to assist countries in training and capacity building to set up and implement a monitoring/control system and to set up a database for recording fish poisoning cases through health and fisheries departments

6. The possibility of creating a regional reference Center on ciguatera and marine biotoxins, with the aim of facilitating and enabling exchanges between PICTs be explored. This Center will also be able to conduct research on ciguatera, analyse fish and algae samples (in order to identify toxins and other biotoxins) and maintain a database on these toxins in the Pacific for reference.

[3] SPC was previously the South Pacific Commission, a Pacific regional organization currently with a membership of 22 Pacific Island countries and territories plus Australia, France, New Zealand and the United States of America

7. That SPC take these outcomes of the conference and present them to the Pacific Head of Fisheries Meeting in 2009 to seek support and endorsement for a co-ordinated regional effort.

8. The recommendations received endorsement at the 6th SPC Heads of Fisheries Meeting in New Caledonia in February this year.

Bagnis, R. 1992. *Ciguatera in French Polynesian islands: of coral fish and men.* Bulletin de la Societe Pathologique Exotique 85:412-414.

Evans, J. 2008. *Lyngbya majuscula (Microcoleus lyngbyaceus)* as a possible cause of the Irritant Syndrome in Rarotonga, Cook Islands. Ciguatera and Related Biotoxins Workshop, Noumea, New Caledonia, 27-31 October 2008. Secretariat for the Pacific Community, Noumea.

Hajkowicz, S and Okotai, P. 2005. *An Economic Valuation of Watershed Pollution in Rarotonga, Cook Islands.* CSIRO Sustainable Ecosystems, Brisbane.

Laurent, D. Yeeting, B. Labrosse, P. Gaudechoux, J. 2005. *Ciguatera: a field reference guide.* Secretariat of the Pacific Community, Noumea.

Laurent, D. Kerbrat, A. Darius, T. Peyraud-Thomas, C. Mejean, A. Molgo, J. Llewellyn, L. Tandeau de Marsac, N. Lewis, R. Golubic, S. Pauillac, S. Chinain, M. 2008. *A new ecotoxicological phenomenon related to marine benthic Oscillatoriales (cyanobacteria) blooms.* Ciguatera and Related Biotoxins Workshop, Noumea, New Caledonia, 27-31 October 2008. Secretariat for the Pacific Community, Noumea.

Rapaport, M 1999. *The Pacific Islands Environment and Society.* Bess Press, Honolulu.

SPC, 2002. *Obesity in the Pacific: Too Big to Ignore.* Secretariat for the Pacific Community, Noumea.

Skinner, M. Lewis, R. Johnstone, R. Turua, T. Evans, J. Shaw, G. 2009 A Harmful Algae Bloom (Prorocentrum gillespii), Ciguatera, Nutrients and a case of DSP, from Muri lagoon, Rarotonga, Cook Islands. Poster presentation 11th Pacific Science Inter-Congress 2009

F. SLOVENIA

Harmful algae in Slovenian waters fall into 3 categories: red tide species (e.g. blooms of *Noctiluca scintillans*), toxic species of which DSP is the only syndrome periodically registered till now and species related to nuisance phenomenon such as gelatinous macroaggregates, which appeared for the last time in summer 2004.

PSP and ASP are uncommon although species of *Alexandrium* and *Pseudo-nitzschia* (mainly *P. calliantha*) occur regularly, especially the latter in high numbers during autumn blooms. In autumn 2007 *Ostreopsis* cf. *ovata* was identified and isolated for the first time from benthic macroalgae.

While the second type of HAB is regularly monitored (toxins and phytoplankton) in compliance with EU and national regulations, the first and the third types address mainly eutrophication, trophic interactions along the food chain, organic matter cycling and other environmental issues.

In view of these facts Slovenia supports the following activities that embrace research (national projects and international collaboration), monitoring and capacity building:

- Submission of the NEMO'S project [Network for the environmental management of climate changes risks] in the frame of EU programme MED in March 2009. The proposal was launched after harmful events related to *Ostreopsis* blooms in Italian waters in 2004 and 2005, as well as due to the first records of the species in the northern Adriatic. If approved it will provide governance methods and operative tools to fight environmental, socioeconomic and health risks and damages on coasts caused by biological pollution (toxic algae and other dangerous species) due to climate changes.
- Proposal for a project aiming to establish a network of Adriatic ports, which will allow exchanging information obtained through the monitoring of ballast waters and of sea water in ports. Application will be submitted to the call in spring/summer 2009 in the frame of EU IPA Adriatic Cross-Border Cooperation Programme. Partners from different Adriatic research institutes and ports' authorities will join the project.
- Activities in the filed of observing system: since these are one of the national priorities also in the IOC-GOOS program the national IOC-HAB program could only benefit from it. Information of the status of the waters in the real-time are provided from oceanographic buoys not only in the Slovenian coastal waters but in the larger northern Adriatic area, which in past suffered from eutrophication events having severe consequences on the ecosystem (red tides, bottom oxygen depletion) and harmful - nuisance events (copious gelatinous aggregates) with economic loss in tourism in fishery besides ecosystem perturbation. These observations are most useful to monitor high-biomass harmful blooms: their spatial coverage and time evolution.
- A lot of effort has been dedicated to the study of mucous aggregates in past and present in various national projects and through international cooperation: EU project (4^{th} framework programme), INTERREG projects Slovenia-Italia in the period 1998-2006 and several bilateral scientific cooperation between Slovenia and Croatia, Italy or US that are still running.
- Capacity building: in the academic year 2007/08 a new graduate joint study programme Marine biology between universities and research institutes from Italy and Slovenia initiated and the course Marine resources and coastal zone management comprises, among others, also HAB issues.
- Training: Slovenia supports participation of a post-doc student to the GEOHAB Modelling workshop this June in Ireland.

G. SWEDEN

Background

The Harmful Algal Bloom (HAB)-problems for the waters surrounding Sweden are very different for the Baltic and the Skagerrak-Kattegat areas. In the brackish water of the Baltic blooms of cyanobacteria, e.g. the toxic species *Nodularia spumigena,* is the major problem while in the waters with higher salinities in the Skagerrak and the Kattegat fish killing species and species that produce toxins that accumulate in filter feeders (mussels) is the major concern. Commercial farming and harvesting of wild mussels and oysters is restricted to the Skagerrak coast at present.

National priorities

A priority for Sweden is that international integrated observing systems of HABs are created in the Baltic and in the Kattegat-Skagerrak-North Sea areas. Data sharing in near

real time is important and can be accomplished through further development of existing systems in the Baltic Operational Oceanographic System (BOOS) and in the North West Shelf Operational Oceanographic System (NOOS).

The ctenophore, *Mnemiopsis leidyi*, was observed in the Skagerrak, the Kattegat and in the southern Baltic Proper in 2007 and 2008. In the northern Baltic proper and in the Bothnian Sea the ctenophore *Mertensia ovum* was observed. These two gelatinous zooplankton species are supposedly introduced species and there is concern about effects on the ecosystem, especially in the Baltic where ctenophores have not been part of the ecosystem earlier. There have also been speculations about a connection between low abundances of *Dinophysis* spp. and the occurrence of the new ctenophores in the Skagerrak the last few years. *Mertensia ovum* was previously misidentified as *Mnemiopsis leidyi.*

Harmful algal blooms in the seas surrounding Sweden in 2007 and 2008

HABs in the Skagerrak and the Kattegat

No major harmful algal blooms occurred in the area in 2007-2008. The diatom *Chaetoceros concavicornis*, known from the West coast of North America, was observed in high abundances for the first time in 2007. It was abundant from September to the end of the year and it was also observed in 2008. Its spines have negative effects on the gills of fish but no harmful effects were noted in Sweden.

The dinoflagellate *Peridinium quenquecorne* was common in the area in early summer in 2007. This is the first observation of high abundances of this species in the area. It is suspected that a case of swimmers rash near Gothenburg in June was connected to high abundance of the organism.

In April 2008 cf *Alexandrium tamarense* occurred at several locations along the Swedish Skagerrak coast and the northern part of the Swedish Kattegat coast. Abundances up to 4700 cells per litre were recorded. Simultaneously Paralytic Shellfish toxins above regulatory levels were recorded in blue mussels (*Mytlilus edulis*) by the Swedish National Food Administration and some mussel harvesting areas were closed.

Dinophysis spp., a dinoflagellate genus with representatives producing Diarrhetic Shellfish Toxins (DST) was observed during most of 2007 and 2008 but in abundances lower than usual. In 2007 DST above the regulatory limit of 160 mg per 100 g of mussel meat occurred in blue mussels at a few locations along the Swedish West coast in January-February and in July-August. In 2008 DST were not recorded at levels above the regulatory limit in blue mussels.

Pseudo-nitzschia spp., a diatom genus producing domoic acid causing amnesic shellfish poisoning, occurred in abundances up to 800 000 cells l^{-1} in 2008 but no amnesic shellfish toxins were observed in shellfish.

Other potentially harmful algae observed include *Pseudochattonella farcimen, Akashiwo sanguinea, Karenia mikimotoi, Procentrum minimum* and *Karlodinium veneficium.* No harmful effects from these species were reported from Swedish waters.

The Baltic proper

The potentially harmful flagellate *Chrysochromulina* cf. *polylepis* was observed in bloom abundances (max ca 5 000 000 cells per litre) in a large part of the Baltic proper during winter 2007-8 and spring 2008. No harmful effects were reported. Surface accumulations of cyanobacteria were minor in 2007 but in 2008 these were observed in a large part of the Baltic proper in July. At the end of the month beaches were affected in the Kalmar Sound area. The toxin producing species *Nodularia spumigena* was found in the

water together with non toxic *Aphanizomenon* sp. and *Anabaena* sp. No toxin analyses were carried out.

The Bothnian bay

In 2007 no large surface accumulations of cyanobacteria were observed. Surface accumulations of cyanobacteria were observed from satellite in the Bothnian Sea in July and August 2008. These off shore blooms did not reach the Swedish coast. In October 2008 local blooms of cyanobacteria occurred along the Swedish coast of the Bothnian Sea. In one site the composition of the bloom was confirmed to consist of *Nodularia spumigena Aphanizomenon* sp. and *Anabaena* sp. In a few places the public noticed what they thought was turquoise paint spilled on stony beaches. This is a common phenomenon and actually consists of dry cyanobacteria.

H. THAILAND

Bloom categories in Thai waters

The first report of plankton bloom in Thailand was in 1952, in the upper Gulf of Thailand, while the actual research started in 1974. The blooms have occurred regularly but toxic species were rarely found. At present, algal blooms in Thai waters are reported directly to DMCR and distributed to all relevant institutions. Blooms information is collected at PMBC.

In the Gulf of Thailand, phytoplankton bloom happened regularly especially in the upper gulf area where blooms always found almost all year round. Blooms in the eastern coast of the gulf occurred mostly during June and September, while blooms in the western part of the gulf mostly occurred during September and February. The common bloom species in the Gulf of Thailand are *Noctiluca scintillans*, *Ceratium furca* , and *Oscillatoria erythraeum*.

In the Andaman Sea, in general, there is no bloom, only in 2007 when frequent blooms occurred during January-April mainly caused by *Ceratium furca* and some by *Noctiluca scintillans*, *Oscillatoria erythraeum*, and *Chaetoceros socialis*.

Institutions involved

In the old days, the Department of Fisheries (DOF) was in charge of all researches dealing with this matter. Later, the Pollution Control Department (PCD) involved more in terms of researches, monitoring, database, and capacity building, where continuous activities were carried out and a number of publications were released to public. Besides, researchers and lecturers from various universities always are the important resources in all research and co-operative activities.

Since late 2002, Department of Marine and Coastal Resources (DMCR) was established under a new Ministry of National Resources and Environment, and the job on red tide phenomena was then transferred to DMCR, having Phuket Marine Biological Center (PMBC) and its 4 other centers as the main research institutes on both the Andaman Sea coast of Thailand and the Gulf of Thailand. Unfortunately, the staffs in charge of phytoplankton study are those all new recruited, so the first need during the first few years was to educate them in various aspects of phytoplankton study, which were very well assisted by the available experts in the countries.

DMCR/PMBC activities on algal bloom/study

At present, there are a number of projects run by PMBC and the 4 centers.

1. Monitoring program: Coastal monitoring program was set in 2006 as routine sampling of water quality and watch on phytoplankton bloom along the coastal area of all 14 coastal provinces on the Andaman Sea coast and the Gulf of Thailand. The monitors are performed either bi-annually, bi-monthly, or more frequent, up to the problem of each area. Local communities are invited to participate in the regular monitoring program, at least to report the bloom in their areas. Database on the monitoring data is now in progress and will soon be linked to the DMCR website.
2. Community studies: Apart from the monitor, studies on phytoplankton communities in the coastal ecosystems are still continuously conducted as we have not yet got a complete species list for our waters.
3. Ballast water from ships moored at the Bangkok harbor is monitored for possible invasive species.
4. Capacity building:
   - Arrange in-house trainings on sampling techniques for general phytoplankton and specifically for watched phytoplankton species, taxonomy of common bloom and toxic species in Thai waters.
   - Encourage staff to attend workshops, conferences, trainings, arranged by other institutions, and if possible to the regional and international level.
5. Institutional cooperation: During 2008-2009, there is a cooperative project with Thailand Institute for Nuclear Technology (TINT) and International Atomic Energy Agency (IAEA) on “Paralytic Shellfish Poisoning (PSP) Patterns in the Gulf of Thailand”.

Other Institutional activities

Apart from DMCR/PMBC, there are various research topics conducted under a number of universities, both by national funding and also some from individual cooperative research project. The universities those are active in marine plankton studies are Chulalongkorn University in Bangkok, Kasetsart University in Bangkok, Burapha University in Chon Buri, and Prince of Songkhla University in Songkhla. Department of Fisheries (Fish Inspection and Quality Control Division) is also active particularly in the screening process of marine product quality especially in mussel and fish meat.

Since 2000, the “Algal and Plankton Society of Thailand” was established with its objectives to develop research methods/directions to be applicable for and respond the need of the country. The society arranges bi-annual conferences and trainings, where researchers, students, and public have opportunity to share their information and experiences. This society is much stronger these days but, unfortunately, the marine plankton group is still relatively small.

Capacity building needs

There is still a strong need of training in species identification, basically in terms of morphological study, and also in the molecular level. Another need is to be educated in the forecasting/early warning system for the bloom, especially in the Gulf of Thailand. Lack of funding is a major obstacle for Thai researchers to participate regional/international trainings/workshops. Cooperative project is another possibility to have our staff learning by doing, along with experts from other countries.

I. UNITED KINGDOM

The United Kingdom continues to monitor coastal waters for the presence of toxin producing species of phytoplankton and shellfish tissue for a range of toxins in compliance with European Union Regulation 854/2004. Monitoring is undertaken on a regional basis and this is the way the findings for 2008 are presented.

England and Wales

In 2008 a total of 1072 samples were collected from 53 production areas. *Alexandrium* spp. occurred less frequently than in 2007, being recorded from 25 of the 53 sampled areas. They only occurred in 74 of the 1072 samples collected (about half of the number of positive samples recorded in 2007). Highest concentrations (1.7×10^6 cells L^{-1}) were found during August in the River Yealm (Devon), where it persisted from May to September. *Alexandrium* spp. was found in samples from the Salcombe Estuary, Devon, from April - September with a maximum concentration of 0.5×10^6 cells L^{-1} in July. *Alexandrium spp*. were found much less frequently than previously in samples collected from the Fal Estuary and sampling was terminated at Weymouth Inner Harbour (as this is not a production area) but has been a site from which high densities of *Alexandrium* spp. have been recorded in the past. PSP toxins were only found on three occasions (in mussel flesh) in 2008, all at Holy Island (NE coast of England) at the end of May/ early June. *Alexandrium* spp did not coincide with PSP toxins being found on any occasion this year.

Dinophysis spp. were found in low concentrations on 23 occasions, but only breached action levels once at each of four sites in Devon and Cornwall. Sampling at Blyth (Northumberland) was terminated as there is no shellfish harvesting in that area but it was a site where *Dinophysis* spp. had been regularly found in the past. Elsewhere, *Dinophysis* spp. were found to occur infrequently and always at low concentrations. *Prorocentrum lima* (DSP) was found on ten occasions with only four breaches of action levels, (once in the Fleet Lagoon, Dorset and three times at separate sites in the Thames Estuary). DSP toxins were recorded on four occasions in samples of cockles from Three Rivers (twice) and Burry Inlet, South Wales and once in a sample of Pacific Oysters from the Fleet Lagoon.

Pseudo-nitzschia spp were found in most of the sampled areas in 2008 and were more widespread and persistent than in 2007. They breached the 'investigative' level (50,000 cells L^{-1}) on three occasions but breached the action level (0.15×10^6 cells L^{-1}) 14 times during May - June 2008. ASP toxins were not found in any shellfish flesh samples in 2008.

Northern Ireland

In 2008, forty sites were sampled routinely on a fortnightly basis from N. Ireland sea loughs. *Alexandrium* spp were recorded in 1.6 % of samples. The maximum cell abundance (80 cells L^{-1}) was recorded in a sample from Belfast Lough on the 14th April. No PSP toxins were detected in shellfish in 2008.

Dinophysis spp were present in water samples throughout the year (January – December). The maximum abundance (600 cells L^{-1}) was recorded in a sample collected from Dundrum Bay in mid August. The most abundant species was *D. acuminata* with only small numbers of *D. acuta*, *D. norvegica* and *D. rotundata* counted. Cells of *Prorocentrum lima* were present in 2.3% of samples with a maximum abundance of 80 cells l^{-1} recorded in a sample from Lough Foyle in August. Approximately 11% of Lough Foyle samples contained this epiphytic species. No DSP toxins were detected in shellfish sampled during the year.

Pseudo-nitzschia spp. were present in 72.1% of samples and reached a maximum concentration of 0.46×10^5 cells L^{-1}) in a sample from Dundrum Bay in mid August. Toxicity

due to domoic acid was confined to samples of scallops (*Pecten maximus*) from Strangford Lough.

One incident of phytoplankton causing water discolouration was reported during 2008. This was in Belfast Lough in mid October. A sample collected on the 14th October contained 0.17 x 10^6 cells L^{-1} of the ciliate *Myrionecta rubra*.

Scotland

Alexandrium spp were observed less frequently in 2008 compared with previous years. The largest blooms recorded during 2008 were all observed at the same location in southwest Shetland over a period of approximately four months, with peaks in May, June and August, the maximum being 1,440 cells L^{-1} in mid June. Low levels of PSP toxicity were frequently reported throughout the period from March through to October at numerous sites, although *Alexandrium* cell counts were below detection levels in the water samples. A low density bloom of 160 cells L^{-1} occurred in the Dornoch Firth in May 2008 and was associated with elevated levels of PSP toxicity in shellfish (detected by bioassay).

Dinophysis spp were first observed in concentrations likely to be harmful at Loch Eishort (Isle of Skye) in May 2008, where a density of180 cells L^{-1} was recorded. Blooms above the threshold level (100 cells L^{-1}) were observed in north Argyll (Lochs Creran and Melfort) in mid September. The largest bloom occurred in Loch Roag (Western Isles) in early June, with a density of 2,220 cells L^{-1}. Other blooms were recorded from the north west: 1,080 cell L^{-1} in Loch Laxford in late July; 840 cell L^{-1} in Loch Ewe in mid August; and from Argyll: 600 cell L^{-1} in Loch Striven in early July. Both the Loch Laxford and Loch Striven blooms had associated DSP toxicity. However, DSP positive results in shellfish did not always coincide with an elevated *Dinophysis* cell count.

Pseudo-nitzschia spp were first recorded on the Scottish west coast (Isle of Skye and Sutherland) and around Shetland in early April. Similarly to 2007, dense *Pseudo-nitzschia* concentrations were mostly absent in southwest Scotland and southern Argyll during 2008, although relatively less dense blooms appearing in Loch Striven in August and West Loch Tarbert in October did have some associated toxicity. The largest recorded *Pseudo-nitzschia* bloom was observed in NE Shetland in early June, with a cell density of > 2.8 x 10^6 cells L^1. An unusual bloom of *P. subpacifica* was observed in Shetland in August. Bloom duration was generally between three to five weeks over the summer months, although at two sites in Shetland (Ronas Voe and Clift Sound), *Pseudo-nitzschia* was observed at potentially harmful cell concentrations for a period of over 12 weeks from mid June to mid September. Toxic *Pseudo-nitzschia* species were present in north Argyll in July and September and around Shetland in August. *Pseudo-nitzschia* concentrations of approx. 70,000 cells L^{-1} recorded in the Western Isles in early September resulted in ASP toxicity above permitted levels in shellfish.

Prorocentrum minimum was frequently observed at Scottish monitoring sites during 2008, with blooms above background level first noted in Shetland, Orkney and the Isle of Skye in April. The largest recorded bloom occurred in Loch Roag in early June, with a density of >4 x 10^6 cells L^{-1}. Maximum cell density of *Prorocentrum lima* reached 340 cells.l^{-1} in Colonsay in mid June. *Protoceratium reticulatum* was recorded on 13 occasions during 2008. Cell concentrations of 40 cells L^{-1} were observed in samples from Orkney and Shetland during April. *Lingulodinium polyedrum* was observed at only one monitoring site in 2008, as in 2007 (West Loch Tarbert, Argyll). Maximum cell density reached 180 cells L^{-1} in early September. *Protoperidinium crassipes* was observed infrequently at sites in Argyll and Shetland, with a maximum cell density reaching 100 cell L^{-1} in Loch Fyne (Argyll) in mid September. Large blooms of *Karenia mikimotoi* were not observed during 2008. Cell densities were at their greatest in late August, with a maximum concentration of 0.14 x 10^6

cell L^{-1} recorded in Loch Stockinish (east coast - Harris). This bloom was first noted around St. Kilda in early August. *Karenia* cell counts were at their maximum around Shetland in late September.

J. URUGUAY

Monitoring Programme

The Uruguayan coast is often affected by toxic blooms. The National Direction for Aquatic Resources (DINARA) established a national monitoring programme for toxin producing algae and accumulated toxins in fisheries resources. Samples are taken weekly for both phytoplankton and toxin analysis at five fixed coastal stations. Other areas for exploitation of bivalve mollusks off the coast are monitored with the same methodology during the harvest period. Phytoplankton is monitored using the Uthermöhl counting method and qualitative samples are taken using 20 µm mesh net. Paralytic Shellfish Toxins (PST) are quantified using mouse bioassay, method 959.08 from AOAC (1995), Diarrhetic Shellfish Toxins (DST) are detected using mouse bioassay for lipofilic toxins; domoic Acid is quantified using HPLC according to method 991.26 from AOAC (1995). Principal toxin-producing species are *Alexandrium tamarense, Gymnodinium catenatum, Dinophysis acuminata, D. caudata, D. tripos, D. rotundata* and *Pseudonitzschia multiseries.*

In freshwater bodies, several municipalities have cyanobacteria monitoring programmes and microcystins are analyzed using an ELISA immunoassay.

Uruguay participated in the intercalibration interlaboratory exercise on *D. acuminata* cell enumeration, by the Uthermöhl Method, involving 62 researchers from 13 countries, organized by the Xunta de Galicia (Spain). Satisfactory results were obtained (Acta IX Reunión Iberica 2007).

In September 2008, Uruguay participated with similar good results at the intercalibration exercise for PSP determination by mouse bioassay, organized by the Communitarian Reference Laboratory for Marine Biotoxins (CRLMB), with the collaboration of the IOC-IEO Vigo Scientific Communication Center on Harmful Algae.

According to the normative ISO/IEC 17025/2000, Uruguay is making important progress for marine biotoxin detection implementation, in order to shortly attain accreditation of sanitary control techniques for marine biotoxins.

Education and information:

Distribution material was recently created for secondary students and professors concerning harmful algal blooms. General information is distributed during events in affected areas. Simultaneously with the issue of a harvest ban, mass communication media is used to inform the population of the closures; prefectures cooperate by contacting fisherman and marine products shops to prevent intoxication.

From initial discussions, Uruguay actively participated in the creation and implementation of the FANSA Portal, and considers the need to continue editing its contents into one IOC domain.

Research

Uruguay is participating in a Technical Cooperation Programme 2009 – 2011, supported via the International Organization of Atomic Energy (OIEA) ARCAL Regional

Project (RLA2007049). It addresses the design and implementation of an early alert and toxins evaluation program for harmful algal blooms in the region.

Additionally, Uruguay encourages cooperation among experts from South America on topics of common interest such as the ecology and toxicology of the main toxic species affecting the region.

K. UNITED STATES OF AMERICA

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, 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. Diarrhetic shellfish poisoning (DSP) has historically not been a problem in the U.S., but a large *Dinophysis* sp. bloom in Texas in 2008 led to harvesting closures and product recalls. A recent discovery is that more than half of all marine mammal mortalities in U.S. waters are now attributed to marine biotoxins. Improved techniques and increased sampling of animal tissues may account for this apparent increase, but the lack of earlier data makes it impossible to determine if this also represents an expansion of the problem.

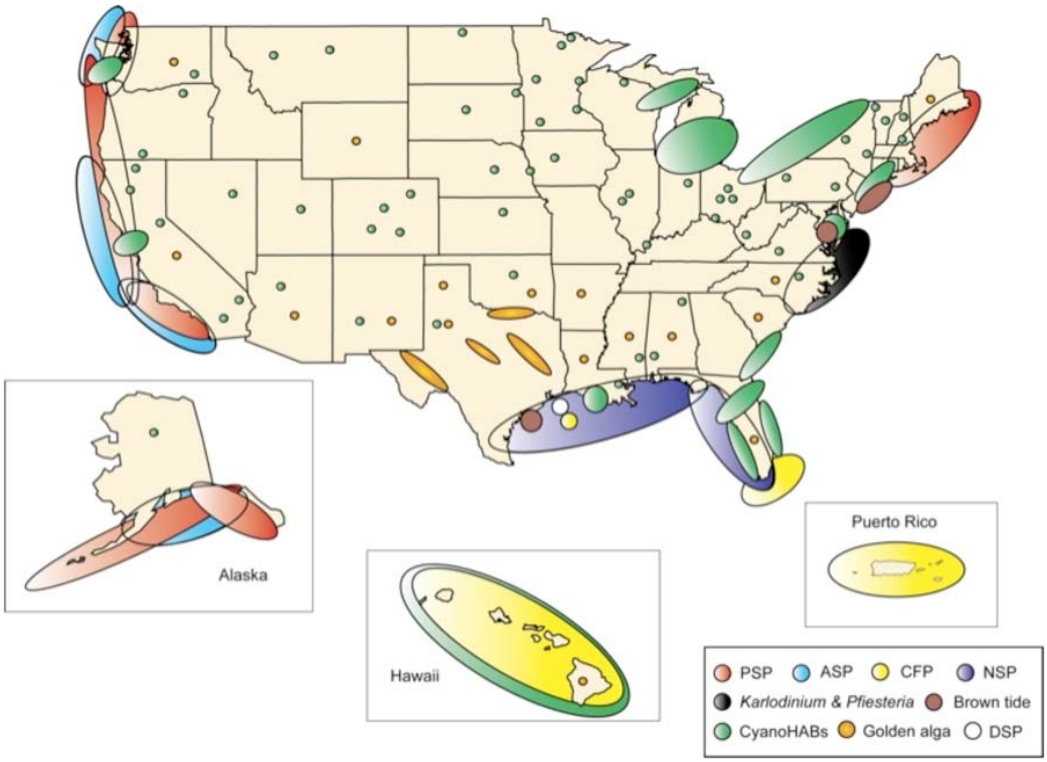


Figure 1. Distribution of major HAB syndromes and events in the U.S. Source: U. S. National Office for Marine Biotoxins and HABs, Woods Hole, MA.

Another development in recent years is the absence of significant apparent impact from *Pfiesteria* spp. 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 Programs and Activities

The national commitment to management and research of HABs through new understanding of their causes, and development of 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 Dec. 2004 (HABHRCA 2004, http://www.cop.noaa.gov/stressors/extremeevents/hab/habhrca/). Besides authorizing the research and response programs listed below, HABHRCA 2004 called for four HAB reports.

1. *Prediction and Response Report* (Jewett et al., 2007)
2. *HAB Management and Response Report* (Jewett et al., 2008)
3. *Scientific Assessment of Freshwater Algal Blooms* (Lopez et al., 2008)
4. *Scientific Assessment of Marine Algal Blooms* (Lopez et al., 2008)

These reports have been completed and are available at: http://www.cop.noaa.gov/stressors/extremeevents/hab/habhrca/Report Plans.html. Together they provide a blueprint for future U.S. HAB management, research and response programs. HABHRCA 2004 is due to be reauthorized by the U.S. Congress in 2009.

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, http://www.cop.noaa.gov/stressors/extremeevents/hab/current/fact-ecohab.html), one of the two national HAB Programs. This Program, established in 1997, led by NOAA and authorized by HABHRCA, has provided competitive research to over 117 projects (11of them regional studies) with almost US$88.6 million (1996 through 2011 commitments) contributed by NOAA, EPA, NSF, ONR, and NASA. There are 4 regional studies in progress now (Pacific Northwest *Pseudo-nitzchia* 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:

- improve understanding of HABs leading to predictive models that can be used for forecasting and prevention
- track trophic transfer of toxins and determine impact of toxins on higher trophic levels
- develop new methods, especially automated sensors
- focus on newly emerging problems.

NOAA also manages the second of two major national HAB Programs, Monitoring and Event Response for Harmful Algal Blooms (MERHAB, http://www.cop.noaa.gov/stressors/extremeevents/hab/current/fact-merhab.html). It has provided US$28.8 million (1998 through 2010 commitments) for 27 projects, including 10 regional projects and 17 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. Past and present 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 oversees a modest Event Response Program (http://www.cop.noaa.gov/stressors/extremeevents/hab/current/fact-ev_resp.html) through which states can request Federal assistance for immediate response to HAB events that exceed normal response capabilities. Event Response funding also allows local managers

and researchers to take advantage of the unique opportunity for research that such events provide. In 2007-2008 seven requests were granted for event response funds, totalling $70,000. Events included *Karlodinium* in Alabama, *Dinophysis* off of Texas, multiple requests concerning *Alexandrium fundyense* in the Gulf of Maine, and multiple requests about *Cochlodinium* in the Chesapeake Bay.

Two major Federal initiatives for "Oceans and Human Health" (OHH) began in 2004, one by NSF and NIEHS (National Institute for Environmental Health Sciences) (http://www.whoi.edu/science/cohh/), and the other by NOAA (http://www.eol.ucar.edu/projects/ohhi/). The NSF and NIEHS program established four national academic "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.

Some oceanographic HAB research is conducted through non-specific internal and/or external funding programs of NOAA, FDA, NIEHS, and NSF. Findings on basic HAB ecology/oceanography and toxin/cell identification and assay development, are rapidly incorporated into the expanding Federal-State partnered monitoring programs described below. The NSF focus is on the many aspects of species-specific dynamics of plankton, macroalgal populations, and species succession that contribute to bloom formation, maintenance and demise. NSF's interest is in increasing our understanding of the direct and indirect causes of HABs in our coastal regions and their ecological consequences through research on the physiological and ecological basis for bloom formation, the physical and chemical attributes of coastal oceans that facilitate them, the population attributes of bloom species, and the long-term consequences of ecosystem changes.

Intertwined with federal programs addressing HABs are extensive outreach and synthesis activities involving managers, scientists, NGOs, Congress and other stakeholders. An early example of this was the original *National HAB Plan* (Anderson et al., 1993) that was recently revised - *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. For the socioeconomic recommendations, 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 above and major regional workshops that include identification of priority research in those areas; examples of these are contained in the following paragraph.

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 was prepared, and a dedicated issue of *Harmful Algae* (Vol. 8, #4) has now been published. A West Coast Regional HAB Summit was held February 10-12, 2009, which endorsed the vision of the West Coast Governors' Agreement (WCGA) of a West Coast regional harmful algal bloom (HAB) monitoring, alert and response network and forecasting system: http://www.cop.noaa.gov/stressors/extremeevents/hab/current/HAB_Summit09/west_coast_summit_post.html. Seizing on the opportunities of new and emerging technologies, the monitoring network and forecasting system will provide advanced early warning of HABs,

minimize fishery closures, protect the economy of coastal communities, mitigate the impacts to marine life and continue to protect public health. The next step will be to incorporate outcomes from the workshop into a plan for implementing the monitoring network and forecasting system, and present that plan to the WCGA.

In addition to the efforts of the aforementioned agencies, a NOAA-supported *National Office of Biotoxins and Harmful Algae* has been established at the Woods Hole Oceanographic Institution to serve as a national resource for dissemination of information and coordination of outreach and synthesis activities. This National Office also serves as a focal point for many of the interactions between U.S. and international researchers, works closely with the IOC Intergovernmental Panel on HABs, 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 4th National HAB meeting was held October 29–November 1, 2007 in Woods Hole, MA, hosted by the U.S. National HAB Office and supported by NOAA. More than 250 participants attended the meeting, which provides a unique opportunity for U.S. scientists to communicate and exchange research results. The 5th Symposium on Harmful Algae in the U.S. is scheduled for Nov. 15-19, 2009 in Ocean Shores, WA: http://www.whoi.edu/habsymposia/.

The U.S. Integrated Ocean Observing System (IOOS) is the coastal component of the Global Earth Observing System for the U.S., and is comprised of 17 government agencies and 11 regional associations. The integration, management, and analysis of key variables for the development of a harmful algal bloom forecasting system is one of 4 focus areas of IOOS. It is through the IOOS Regional Associations that HAB technology can be transitioned from research to operations. The Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS) 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. The Environmental Sensor Processor (ESP) technology is being implemented with support from ECOHAB, MERHAB and US GEO – EPA funding to assist the transition into use within NERACOOS. Other regional efforts include the Southern California Coastal Ocean Observing System (SCCOOS) project support the southern California beach water quality management community including issues related to HABs as well as efforts by the Central California Coastal Ocean Observing System (CenCOOS) to develop web-based HAB data synthesis capabilities in near real-time.

Much of the "front lines" work on protecting public health from HAB toxins occurs through state monitoring of shellfish and shellfish waters, including measurements of accumulated toxins in fisheries resources. The needs of these shellfish managers are regularly incorporated into federal research priorities and there has been significant progress in developing new capabilities for monitoring HABs and responding to HAB events that are being transitioned to operational use by a variety of end-users, including federal and state agencies, and the shellfish industry. The coordinated efforts described above result in a comprehensive National research capability for HABs, toxins, and human health that is linked to management agencies and industries that are on the front lines of preventing, controlling, and mitigating the impacts of HABs.

International Activities

The U.S. remains very active in international HAB activities. Fundamental to this is the general support of the U.S. through the IOC and SCOR partnership (NOAA and NSF) to support activities such as GEOHAB planning, development of international HAB data bases, support for international meetings and capacity building.

The U.S. participates in numerous working groups and sections, such as those by ICES/IOC (Harmful Algal Bloom Dynamics Working Group) and PICES (Harmful Algal Bloom Section), and sends high-level delegations to the IPHAB panels. U.S. support is expected to continue for international GEOHAB efforts through funding by NSF and NOAA. Both agencies are among the sponsors of the June 15-19, 2009 GEOHAB Modeling Workshop in Ireland In addition, NOAA has provided support for the further development of the Harmful Algal Event Data Base (HAEDAT – now known as HAIS) maintained by ICES and IOC.

Many U.S. scientists and centers also maintain bi-lateral research cooperation with scientists from many other countries. NOAA's research centers in Seattle, WA, (Northwest Fisheries Science Center), in Charleston, SC (Coastal Environmental Health and Biomolecular Research), and in Beaufort, NC (Center for Coastal Fisheries and Habitat Research) have continued to assist foreign countries with toxin assays and HAB identification. NOAA Seattle helps lead a PICES initiative to build HAB research capacity in developing nations through training classes in toxin screening tools, phytoplankton identification, and database management. The initial training class was held in Manila in January 2009, and focused on assisting the Bureau of Fisheries and Aquatic Resources, the agency that manages HAB events in the Philippines. NOAA Charleston is leading an effort to validate a method of HAB toxin analysis called the receptor binding assay (RBA) with the Association of Analytical Communities (AOAC). The RBA is a promising candidate to replace the mouse bioassay. An AOAC international collaborative trial including 14 labs from around the world is set to begin this year. NOAA Charleston also continues to support work of the International Atomic Energy Agency (IAEA) to transfer capabilities to run the RBA assay to developing nations in Southeast Asia, Africa and the Caribbean to help mitigate the human illness known as paralytic shellfish poisoning (PSP). Caribbean region efforts initiated this year will also develop strategies for implementing the RBA for ciguatera fish poisoning (CFP) toxins.

NOAA has also regularly supported international HAB meetings including meeting and student travel support for the 12th International Conference on Harmful Algae Copenhagen in 2006 and the 13th International Conference on Harmful Algae in Hong Kong 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). A special issue of Harmful Algae (Vol. 8, #1), summarizes the role of eutrophication in HAB events.

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) **Program coordination**. The IOC HAB Program, led by the IOC Science and Communication Center in Copenhagen, has had an extraordinary impact on the development of HAB monitoring and management programs worldwide. Funding for these offices is threatened, however, and this bodes ill for the future of our program. We urge all IOC Member States with HAB problems to provide support for these program coordination activities, either financially, or though the support of their delegations at the IOC Assembly, when HAB budget issues are discussed.

2) **Capacity building and training.** We note that the IOC Science and Communication Centers 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.

3) **The newsletter,** *Harmful Algae News*, is an excellent communication tool, and should be continued.

4) **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 and expand upon these activities. The U.S. does not presently participate in many of these regional groups, but is interested in increasing participation where it might be helpful to do so.

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, are 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, now known as HAIS) 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, the Regional Coastal Ocean Observing Systems (RCOOSs) of IOOS provide local-scale data and information to address issues that are important to the stakeholders in a particular region, including HABs. In the Gulf of Mexico, the Gulf of Mexico Coastal Ocean Observing System (GCOOS) has held a series of stakeholder and technical workshops to develop a Harmful Algal Bloom Integrated Observing System. An initial meeting between the U.S. and Mexico on HAB monitoring in the Gulf of Mexico has already taken place. 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.

References

Anderson, D.M., Galloway, S.B., Joseph, J.D. 1993. Marine Biotoxins and Harmful Algae: A National Plan. Woods Hole Oceanographic Institution Tech. Rep., WHOI 93-02, Woods Hole, MA. 43 pp. http://www.whoi.edu/redtide/nationplan/s-kplan/s-kcontents.html

Bauer, M., ed. 2006. Harmful Algal Research and Response: A Human Dimensions Strategy, National Office for Marine Biotoxins and Harmful Algal Blooms, Woods Hole Oceanographic Institution, Woods Hole, MA, 58 pp. http://coastalscience.noaa.gov/stressors/extremeevents/hab/HDstrategy.pdf

GEOHAB, 2006. Global Ecology and Oceanography of Harmful Algal Blooms, Harmful Algal Blooms in Eutrophic Systems. P. Glibert (ed.). IOC and SCOR, Paris and Baltimore, 74 pp. http://ioc.unesco.org/hab/FINAL_GEOHAB_Eutro_corrected.pdf

HARRNESS, 2005. Harmful Algal Research and Response: A National Environmental Science Strategy 2005-2015. Ramsdell, J.S., D.M. Anderson, and P.M. Glibert (Eds), Ecological Society of America, Washington, D.C., 96 pp. http://www.esa.org/HARRNESS/harrnessReport10032005.pdf

Jewett, E.B., Lopez, C.B., Dortch, Q., Etheridge, S.M*., 2007. National Assessment of Efforts to Predict and Respond to Harmful algal Blooms in U.S. Waters*. Interim Report. Interagency Working Group on Harmful Algal Blooms, Hypoxia, and Human Health of the Joint Subcommittee on Ocean Science and Technology. Washington, D.C. http://www.cop.noaa.gov/stressors/extremeevents/hab/habhrca/Predict_Resp_IntRpt_0107.pdf

Jewett, E.B., Lopez, C.B., Dortch, Q., Etheridge, S.M., Backer, L.C., 2008. *Harmful Algal Bloom Management and Response: Assessment and Plan*. Interagency Working Group on Harmful Algal Blooms, Hypoxia and Human Health of the Joint Subcommittee on Ocean Science and Technology. Washington, DC, 76 pp. http://entiat.nos.noaa.gov/stressors/extremeevents/hab/habhrca/HABMngmt_resp_9_08.pdf

Lopez, C.B., E.B. Jewett, Q. Dortch, D. Garrison, 2008. *Scientific Assessment of Marine HABs*. Interagency Working Group on Harmful Algal Blooms, Hypoxia and Human Health of the Joint Subcommittee on Ocean Science and Technology. Washington, DC., 62 pp. http://www.cop.noaa.gov/stressors/extremeevents/hab/habhrca/assess_12-08.pdf

Lopez, C.B., Jewett, E.B., Dortch, Q., Walton, B.T., Hudnell, H.K., 2008. *Scientific Assessment of Freshwater HABs*. Interagency Working Group on Harmful Algal Blooms, Hypoxia and Human Health of the Joint Subcommittee on Ocean Science and Technology. Washington, DC, 65 pp. http://www.cop.noaa.gov/stressors/extremeevents/hab/habhrca/FreshwaterReport_final_2008.pdf

ANNEX IV

LIST OF WORKING DOCUMENTS

Document code	Title
WORKING DOCUMENTS	
IOC/IPHAB-IX/1 prov.	Provisional Agenda with annotations
IOC/IPHAB-IX/1 Add. Prov.	Provisional Timetabl
IOC/IPHAB-IX/3prov.	Executive Summary, Resolutions and Recommendations
Summary Report	
IOC/IPHAB-IX/4 prov.	Provisional List of Documents
IOC/IPHAB-IX/5 prov.	Provisional List of Participants
INFORMATION DOCUMENTS	
IOC/IPHAB-IV/3 Annex IV	Terms of Reference of IPHAB
IOC/IPHAB-VIIII/3	Report of the IOC Intergovernmental Panel on Harmful Algal Blooms, Eighth Session, Paris, 19-22 April 2007 Executive summary in French, Spanish, Russian. Includes results of the HAB Programme Impacts Assessment conducted during IPHAB-VIII
IOC/IPHAB-IX/Inf.1	Extract re IPHAB-VIII from: Twenty-fifth Session of the IOC Assembly, Paris, 2007
IOC/IPHAB-IX/Inf.2	Information on HABP developments 2007-2008
IOC/IPHAB-IX/Inf.3	Overview of resources and needs: Draft HABP Work Plan, 2010-2011
IOC/IPHAB-IX/Inf.4	DRAFT IPHAB Strategy
IOC/IPHAB-IX/Inf.5	Report on IOC/WESTPAC-HAB
IOC/IPHAB-IX/Inf.6	Integrated Coastal Research: NEWS2USE
IOC/IPHAB-IX/Inf.7	Report of the VII IOC Regional Working Group on Harmful Algal Blooms in South America (FANSA)
IOC/IPHAB-IX/Inf.8	Report of the IOC Regional Group on Harmful Algae of North Africa, HANA
IOC/IPHAB-IX/Inf.9	Overview of IOC training courses on HAB
IOC/IPHAB-IX/Inf.10	GEOHAB SSC Terms of Reference and Members 2009

Document Number	Title
IOC/IPHAB-IXI/Inf.11	Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) Program: Report 2007-2009 and activities 2010-2011 GEOHAB Asia OSM
IOC/IPHAB-IXI/Inf.12	Programme of GEOHAB Modelling Workshop
IOC/IPHAB-IX/Inf.13	ICES-IOC Working Group on Harmful Algal Bloom Dynamics: Report of the meeting 10-13 April 2007, Riga, Lithuania; Report of the meeting 10-14 April 2008, Galway, Ireland; Executive summary of the meeting 31 March-2 April 2009, Huelva, Spain
IOC/IPHAB-IX/Inf.14	Report on IPHAB Task Team on HAB Observation Systems: Implementation of HAB Monitoring Within the Global Ocean Observing System (GOOS); Strategic Implementation Plan for the Coastal Module of the Global Ocean Observing System
IOC/IPHAB-IX/Inf.15	Reports of the ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors, 2007, 2008, 2009
IOC/IPHAB-IX/Inf.16	Global Partnership on Nutrient Management, Information Brief
IOC/IPHAB-IX/Inf.17	Report on Joint IPHAB/IODE Task Team on the development of the Harmful Algal Information System (HAIS)
IOC/IPHAB-IX/Inf.18	HAB Activities of the International Atomic Energy Agency (IAEA)
IOC/IPHAB-VIII/Inf.19	FAO Activities in the Area of Shellfish Safety and Biotoxins Joint FAO/WHO/IOC activities to provide scientific advice on marine biotoxins, Marine Pollution Bulletin 52 (2006) 1735–1745:
IOC/IPHAB-IX/Inf.20	General Information
IOC/IPHAB-IX/Inf.21	List of Hotels for IPHAB-IX
Other documents	
GEOHAB Report No. 1	Science Plan of the IOC-SCOR Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) Programme
GEOHAB Report No. 2	Implementation Plan of the IOC-SCOR Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) Programme
GEOHAB Report No. 3	GEOHAB Core Research Project on HAB's in Upwelling Systems
GEOHAB Report No. 4	GEOHAB Core Research Project on HAB's and Eutrophication
IOC Annual Report No. 7	IOC Annual Report 2007 (on request)

ANNEX V

LIST OF PARTICIPANTS

MEMBER STATES

BRAZIL

Maria Elena Campos Baeta Neves
Instituto de Estudos do mar Almirante Pulo Moreira
Rua Kyoto, 253 Praia dos anjos
Arrabal do Cabo - RJ-Brasil
Phone: 55 22 2622-9015
Fax: 55 22 2622-9093
E-mail: baetaneves@uol.com.br

Luis Antonio de Oliveira Proença
CTTMar-Universidade do Vale do Itajaí
C. Postal 360
Itajaí, SC - 88301-970
Tel.: +55 47 3417713
Fax: +55 47 3417633
E-mail: luis.proenca@univali.br

CANADA

Cynthia McKenzie
Research Scientist-Science Branch
Fisheries and Oceans Canada
Northwest Atlantic Fisheries Centre
St. John's, NL A1C 5X1
Tel: 709-772-6984
Fax: 709-772-5315
E-mail: Cynthia.McKenzie@dfo-mpo.gc.ca

CHILE

Leonardo Guzmán (Chair)
División de Investigación en Acuicultura
Instituto de Fomento Pesquero
Bammaceda 252 Puerto Montt
Tel: 56-65-342299
Fax: 56-61-211424
Email: lguzman@ifop.cl

COOK ISLANDS

Jacqui Evans
Health Planner (sanitation)
Ministry of health
PO Box 109 Rarotonga
Tel: 682-29-110
E-mail: j.evans@health.gov.ck

CROATIA

Ivona Marasovic, Director
Institute of Oceanography and Fisheries
Setaliste Ivana Mestrovica 63
CRO-2100 Split
POB500
Tel: 385-21-408-002
Fax: 385-21-358-650
E-mail: marasovic@izor.hr

DENMARK

Øjvind Moestrup
Department of Biology
University of Copenhagen
Oster Farimagsgade 2D
DK-1353 Copenhagen K
Tel.: +45 35 32 22 90
Fax: +45 35 32 23 21
E-mail: moestrup@bio.ku.dk

GREECE

Olympia Gotsis-Skretas
Research Director
Hellenic Center for Marine Research
Institute of Oceanography
P.O.Box 712
19013 Anavyssos
Attika
Email: ogotsis@ath.hcmr.gr

ITALY

Adriana Zingone
Statione Zoologica Anton. Dohrn
Villa Communale
80121 Naples
Tel: +39 081 5833295
Fax: +39 081 7641355
E-mail: Adriana.zingone@szn.it

MALAYSIA

Shahruddin Yusof
Principal Assistant Secretary
National Oceanography Directorate
Ministry of Science, Technology and Innovation
Level 6, Block C4, Complex C,
Federal Government Administrative Centre,
62662 Putrajaya,
Tel: +603-88858204
Fax: +603-88893008
E-mail: shahyu@mosti.gov.my

Gires Usup
Marine Science Programme,
Faculty of Science and Technology,
Universiti Kebangsaan Malaysia,
43600 Bangi, Selangor
Tel: +603-89213207
Fax: +603-89253357
E-mail: giresusup@yahoo.com

MEXICO

José Luis Peña Manjarrez
Centro de Estudios Technologicos del Mar en Ensada, Km 6.5 Carretera
Ensenada-Tijuana Codigo Postal 22860
Ensenada Baja California, México
Tel: +646-1744522, 1755111
E-mail: jopema01@yahoo.com.mx;
jopema@sep.gob.mx

MOROCCO

Btissam Ennaffah
Institut National de Recherche Halieutique
Station du RESL-INRH
24250 Oualidia - Province El Jadida
Tel.: +212 23366037
Fax.: +212 23366901
E-mail: ennaffah@yahoo.fr

Abdelghani Chafik
Chef de département de la qualité et salubrité du milieu marin
Institut National de Recherche Halieutique,
INRH, Station du RSSL
24250 Oualidia, Province d'El Jadida

NAMIBIA

Bronwen Currie
Chief Biologist
Directorate of Aquaculture
Ministry of Fisheries and Marine Resources
P.O. Box 912
Swakopmund
Tel +264 64 4101000
Fax +264 64 404385
E-mail bcurrie@mfmr.gov.na

NEW ZEALAND

Phil Busby (Vice-chair)
New Zealand Food Safety Authority
68-86 Jervois Quay
PO Box 2835
Wellington
Tel: +64 4 463 2500
E-mail: Phil.Busby@nzfsa.govt.nz

OMAN

Saud Bin Salem Bin Zaher Albousaidi
Marine Environment
Ministry of Fishery of Resources
Sultanate of Oman
E-mail: saud.salim@yahoo.com

PERU

Alfredo Picasso
UNESCO Permanent Delegation
1 rue Miollis
75015 Paris
Tel: +33-1-45682931/32
Fax: +33-1-45682920
E-mail: dl.peru@unesco.org

SLOVENIA

Patricija Mozetic
National Institute of Biology
Marine Biology Station
Fornaće 41, SI-6330 Piran
Tel: +386-5-67-129-14
Fax: +386-5-67-129-02
E-mail:mozetic@mbss.org

SPAIN

Beatriz Reguera
Instituto Español de Oceanografía
Centro Oceanográfico de Vigo
Aptdo. 1552
36280 Vigo
Tel: +34 986492111
Fax: +34 986498626
E-mail: beatriz.reguera@vi.ieo.es

SWEDEN

Bengt Karlson
Swedish Meteorological and Hydrological Institute
Svenkäll felts g.15
42671 Vöstra Frölunda
Tel: +463-17518958
Fax: +463-17518980
E-mail: bengt.karlson@smhi.se

THAILAND

Suree Satapoomin
Senior Marine Biologist
Phuket Marine Biological Center
PoBox 60, Phuket 83000
Tel: 66-76-391128
Fax: 66-76-391127
E-mail: suree.ss@gmail.com

TUNISIA

Asma Hamza
Institut National Scientifique et de la
Technologie de La Mer – INSTM
Centre de Sfax
3029 Sfax
Tel: + 216 74 497117
Fax: + 216 74 497989
E-mail: asma.hamza@instm.rnrt.t

UNITED KINGDOM OF GREAT BRITAIN & NORTHERN IRELAND

Dr. Richard Gowen
AFBI Headquarters
Newforge Lane
Belfast
BT9 5PX
Northern Ireland
United Kingdom
AFBI Fax: +44 (0)28 90 255035
AFBI Headquarters: +44 (0)28 90 255689
E-mail: Richard.Gowen@afbini.gov.uk

UNITED STATES OF AMERICA

Robert E. Magnien
Center for Sponsored Coastal Ocean
Research and Coastal Ocean Program
National Centers for Coastal Ocean Science
National Ocean Service, NOAA
Tel.: +1 301 713-3338 x159
Fax.: +1 301 713-4044
E-mail: rob.magnien@noaa.gov

Donald Anderson
Biology Department
Woods Hole Oceanographic Institution
Woods Hole, MA 02543
Tel.: +1 508 457 2000 ext. 2351
Fax: +1 508 457 2027
E-mail: danderson@whoi.edu

Phillip Taylor
Head, Ocean section
Division of Ocean Sciences
National Science Foundation
4201 Wilson Blvd. Suite 725
Arlington,VA 22230
Tel.: +1 703 306 15 87
Fax: +1 703 306 03 90
E-mail: prtaylor@nsf.gov

Robert Howarth
David R. Atkinson Professor of Ecology
Cornell University, Ithaca, NY 14953, USA
Chair, International SCOPE Biofuels Project

URUGUAY

Silvia Méndez Calicchio
Dirección Nacional de Recursos Acuáticos
Ministerio de Ganaderia, Agricultura y Pesca
Lab Fitoplancton
Constituyente 1497, 11200 Montevideo
Uruguay
Tel: 598-2-4004689 ext 136
Fax: 598-2-4013216
E-mail: smendez@dinara.gub.uy

ORGANIZATIONS

IAEA

Florence Boisson
Marine Environment Laboratories
International Atomic Energy Agency
4 Quai Antoine Ier
MC 98000 Monaco
Tel: 377-97-97-72-64
Fax: 377-97-97-72-73
E-mail: F.Boisson@aiea.org

Maria Betti
Directeur
Laboratoires de l'Environnement marin
Département des Sciences et des Applications
Nucléaires
4 Quai Antoine Ier
MC 98000 Monaco
Tel: 377-97-97-72-79
Fax: 377-97-97-72-75
E-mail: m.betti@iaea.org

GEOHAB SSC

Robin Raine,
The Martin Ryan Institute,
National University of Ireland, Galway,
Galway, Ireland.
Tel: +353 (0)91 492271 (DDI)
Fax: +353 (0)91 525005
E-mail: robin.raine@nuigalway.ie

PICES

Vera L. Trainer
National Oceanic and Atmospheric
Administration
Northwest Fisheries Science Center
2725 Montlake Blvd. East
Seattle, Washington 98112, USA
Tel: 206-860-6788
Fax: 206-860-3335
Email: Vera.L.Trainer@noaa.gov

Charles G. Trick
North Campus Building. Room 402
Department of Biology
The University of Western Ontario, London,
Ontario N6A 5B7, Canada
Tel: 519-661-3899
Fax: 519-661-3935
Email: trick@uwo.ca

UNEP

David Osborn
Coordinator
GPA Coordination Unit
Division of Environmental Policy
Implementation
United Nations Environment Programme
P.O. Box 30552 (00100)
Nairobi, Kenya
Ph. +254 20 762 5721
Fax. +254 20 762 4249
Email: david.osborn@unep.org

IOC SECRETARIAT

Henrik Oksfeldt Enevoldsen
IPHAB Technical Secretary
IOC Science and Communication Centre on
Harmful Algae
University of Copenhagen
Oster Farimagsgade 2D
DK-1353 Copenhagen K
Tel.: +45 33 13 44 46
Fax: +45 33 13 44 47
E-mail: h.enevoldsen@unesco.org

Jacob Larsen
IOC Science and Communication Centre on
Harmful Algae University of Copenhagen
Øster Farimagsgade 2D
1353, Copenhagen.
Denmark
E-mail: jacobl@bio.ku.dk

Luis Valdés
Head, Ocean Science Section
1 rue Miollis
75015 Paris
Tel: 33-1-45-68-40-11
Fax: 33-1-45-68-58-12
E-mail: jl.valdes@unesco.org

IPHAB Members not attending the session

COLOMBIA

Ernesto Mancera
Instituto de Investigaciones Tropicales -
INTROPIC, Universidad del Magdalena,
Carrera 32 Nº 22-08, Santa Marta
Tel.: / Fax: + (57)(5)4382048
E-mail: emancera@hotmail.com;
emancera@universia.net.co

EGYPT

Wagdi Labib Guirguis
Head of Classification and Diversity of
Aquaculture Laboratory
Ministry of Scientific research
The National Institute of Oceanography &
Fisheries (NIOF)
101 Kasr El-Ainy St., Cairo, Egypt
Tel/Fax: 202-7921341
E-mail: niof@hotmail.com

FRANCE

Patrick Gentien
Head of Programme "Health in the Ocean"
IFREMER- Centre de Brest
DYNECO
Pointe du Diable
BP 70, 29280 Plouzane
Tel: 33-2 98 22 42 04 (4204)
Fax: 33-2 98 22 45 48
E-mail: patrick.gentien@ifremer.fr

INDIA

A.C. Anil
National Institute of Oceanography
H.O. Dona Paula
Goa 403 004

ITALY

Erika Magaletti
ICRAM - Central Institute for Marine Research
Via di Casalotti, 300 - 00166 Roma
Tel.: +39 06 61570484
Fax: +39 06 61561906
E-mail: e.magaletti@icram.org

IRAN (Islamic Rep of)

Peyman Eghtesadi
Iranian National Center for Oceanography
#9, Etemadzadeh Ave., West Fatemi St
Tehran
Tel: +9821 6944873-6
Email: haeri@inco.ac.ir

Mohammad Sedigh Mortazavi
Fisheries Organization
Email: ir.fisheries.mail@ict

Hosein Negarestan
Fisheries Organization
Email: ir.fisheries.mail@ict

NIGERIA

Unyimadu John Paul
Nigerian Institute for Oceanography
and Marine Research
Victoria Island, PMB 12729, Lagos
P.O. Box 74304
Victoria Island, Lagos
Tel.: 08023033439
Fax:01-685252, 01-2694642
E-mail: jpcnu@yahoo.com

NORWAY

Francisco Rey
Institute of Marine Research
Nodnesgatan 50
P.B. 1870 Nordnes
N-5024 Bergen
Tel.: +47 55 238500
Fax: +47 55 238531
E-mail: pancho@IMR.no

PAKISTAN

M. Rabbani
National Institute of Oceanography
St-47, Block-1,
Clifton, Karachi
Tel.: + 92 21 9251172-78
Fax: + 92 21 9251179
E-mail: niopk@cubexs.net.pk

Tariq Khan
National Institute of Oceanography
St-47, Block-1,
Clifton, Karachi
Tel.: + 92 21 9251172-78
Fax: + 92 21 9251179
E-mail: tariqmak@yahoo.com

Hina Saeed Baig
National Institute of Oceanography
St-47, Block-1,
Clifton, Karachi
Tel.: + 92 21 9251172-78
Fax: + 92 21 9251179
E-mail: ahbaig@cyber.net.pk

PHILIPPINES

Rhodora V. Azanza
Marine Science Institute
University of the Philippines
Diliman
Quezon City 1101
Tel: (63) 2 98 96 76 to 79, local 7414
Fax: (63) 2 921 59 67
E-mail: rhod@upmsi.ph

ROMANIA

Laura Boicenco
CIER – Mare Nostrum
Str. Mircea cel Batran 57, Bl. MV2, Sc. C, Et. 7,
Ap. 89,
900658 Constanta
Tel./Fax: +40-241-612.422
E-mail:laura_boicenco@cier.ro

SAUDI ARABIA

Salim M Alharbi
Faculty of Marine Studies in King Abdulaziz
University
P.O. Box 80207 Jeddah 21589
Kingdom Of Saudi Arabia
Tel: 966-02-6952384
Fax: 966-02-6401747

Hisham Khamis
Faculty of Marine Studies in King Abdulaziz
University
P.O. Box 80207 Jeddah 21589
Kingdom Of Saudi Arabia
Tel: 966-02-6952384
Fax: 966-02-6401747

SEYCHELLES

Rondolph Payet
Managing Director
Seychelles Fishing Authority
P.O.Box 449
Victoria
E-mail: management@sfa.sc

TOGO

Therese Edorh
Faculty of Science
University of Lome
B.P. 1621 Lomé
Togo

TURKEY

Süleyman Ülger
Expert
Ministry of Agriculture and Rural Affairs
Turkey

VIET NAM

Nguyen Ngoc Lam
Department of Marine Plankton (DMP)
Institute of Oceanography,
Cau Da 01, Vinh Nguyen, Nhatrang
Tel: +84 58 590 476 222 Cell phone: 84 905
111 824
Fax. +84 58 590 591
E-mail: habviet@dng.vnn.vn

GEO

Sebastien Miazza
Biodiversity Expert
Group on Earth Observations (GEO)
7 bis avenue de la Paix
Case postale 2300
CH-1211 Geneva 2
Switzerland
Tel: +41-22-730-82-74
Fax: +41-22-730-85-20
E-mail: smiazza@geosec.org

WHO

J Bartram
Coordinator
Water, Sanitation and Health
WHO
CH-1211 Geneva 27
SWITZERLAND
Tel: 41-22 791 21 11
Fax: 41 22 791 31 11

ANNEX VI

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

RESOLUTION XVI-4

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**)

IPHAB-IV REVISION

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 2nd 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, vmax, 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

INFORMATION ON DEVELOPMENTS IN THE INTERSESSIONAL PERIOD

TABLE OF CONTENTS

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 2008-2009 funded through extra-budgetary contributions and savings. There is at present (2009- onwards) no extra-budgetary contributions committed to maintain a post for HAB. Ms. Virginie Bonnet is the administrative Assistant for the HAB Programme and is located at IOC Headquarters, Paris.

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 as support office for GEOHAB (jointly with the SCOR secretariat) and is staffed by Mr. Henrik Enevoldsen, IOC Project Coordinator, and Associate Professor Dr. Jacob Larsen. Dr. Gert Hansen was affiliated to the Centre until mid 2008 where he took up the position as Curator of the Scandinavian Culture Collection of Algae and Protozoa. The Centre is hosted by, and located at, the Department 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. 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 partnership is intended to provide the platform for implementation of training courses on qualitative and quantitative determination of algal toxins.

The Centre was until end 2007 sponsored by DANIDA, University of Copenhagen, the National Environmental Research Institute, the Fisheries Research Instituteand the IOC. As from January 2008 the Danida commitment expired, the National Environmental Research Institute and the Fisheries Research Institute ceased as government institutions and merged into each their university, and the Department of Biology, University of Copenhagen is the remaining sponsor and host. Negotiations are ongoing with Danida regarding renewed support and with the Ministry of Food, The Danish Veterinary and Food Administration, regarding partnershipThe continuation of the Centre beyond 31 December 2009 will require renewed Danish funding. Clarification of this will be made during second half of 2009 where Denmark decides on the distribution of it extra-budgetary contribution for 2010.

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 in particular assists with the implementation of training courses, the development of HAEDAT, the back-up for the regional networks HANA, ANCA and FANSA, and the production of Harmful Algae News. 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 through Resolution XX.3.

2. REGIONAL GROUPS AND WORKSHOPS

2.1 IOC WORKING GROUP ON HARMFUL ALGAL BLOOMS IN SOUTH AMERICA (COI-FANSA)

The FANSA group first meet in June, 1994 in Montevideo (Uruguay) and subsequently in Mar del Plata, Argentina (1995), Punta Arenas, Chile (1997), Rio Grande, Brazil (2000), Montevideo, Uruguay (2001), Guayaquil, Ecuador (2003) and Lima, Peru (2006). The last workshop occurred in Mar del Plata Argentina at the Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP), chaired by Dr. Jose Carreto. In this Workshop participated official representatives Argentina (2), Brazil (1), Chile (2), Ecuador (2), Peru (2) and Uruguay (2) as well as Monica Lion representing the IOC. In addition, a high number of Argentinean specialists of INIDEP and of other national institutions and of the Maritime Provinces of Argentina, participated.

The activities 2007-2009 were based on the recommendations of FANSA VII (Lima Peru, 2006).

In collaboration with the IOC Science and Communication Centre on Harmful Algae (Vigo, Spain) and coordinated by the European Community Reference Laboratory on Marine Biotoxins (Vigo, Spain), reference laboratories in four countries in the region (Uruguay, Argentina, Chile and Peru) joined an European Union exercise. The PSP intercalibration exercise by mouse bioassay (AOAC 959.08 protocol) was satisfactory and strengthened the operational development in the region as orientated the participating countries to achieve the fulfilment of ISO norm 17.025.

The oceanographic characteristic of the FANSA region is complex, including two major oceans, climate ranging from polar to equatorial characteristics and several short and meso scale environmental features. To have the information as a region, a synthesis of the impact of the occurrence of DSP, ASP, PSP, emergent toxins and causative organisms was presented during the VIII Workshop. After discussion, it was recognized that there are several issues with potential for collaboration among participating countries to address the problem on a regional scale, in particular regarding the ecology and toxicology of the main toxin producing species.

From 11-30 November 2007 third IOC-FANSA HAB training course was held as the

'International Advanced Course on Harmful Marine Algae' in Mar del Plata Argentina, with support from IOC, El Consejo Federal Pesquero, La Comisión de Investigaciones Científicas de la Prov. de Bs. As., La Secretaría de Política Ambiental de la Prov. de Bs. As., la Subsecretaría de Actividades Pesqueras de la Prov. de Bs. As., La Secretaría de Pesca de la Prov. de Chubut, y el Proyecto PNUD ARG O2/O18. The course was held at two institutions, at the la Plata University in La Plata and the Instituto Nacional de Investigaciones Pesqueras in Mar del Plata. It was coordinated by Dr. Martha Ferrario and Dr. José Carreto. The course was given by experts from the region, Spain and Denmark, and was attended by 20 students from the region.

Since Dr. Leonardo Guzmán, Chile had been in office for two consecutive terms (eight years) there was consensus on electing a new chairman for the FANSA Working Group. Dr L. Guzmán was thanked for his long service as FANSA Chairman. Appointment of Dr. Luis Proença, Brazil, in this position for the next four-year term was unanimously approved.

It was agreed that the next meeting should be held in Chile in 2010. For that reason Dr. Leonardo Guzmán was suggested as its organizer. He accepted the commitment. FANSA is dependent on the IOC partial financing of its meetings, and FANSA has requested the IOC to co-finance the next IOC-FANSA Workshop. All FANSA members will in parallel seek national funding and commitment.

FANSA recommendations and priorities 2010-2011:

1. To promote cooperative work among FANSA researchers, optimizing and taking advantage of each country's resources and capacities.
2. To support, among the countries of the region, the integrated development of studies on these phenomena according to the guidelines and methods of the GEOHAB science plan.
3. To endorse the preparation of a special review publication, to be considered as a reference framework for future studies, with the available information on biology and toxicology of the main toxic algae species.
4. To stimulate the effort to develop studies on potentially toxic species and emergent toxins, in order to minimize the harmful effects of unexpected events.
5. To establish a mechanism to obtain from the Community Reference Laboratory on Marine Biotoxins in Vigo, updated information on trial protocols or analyses, reference material suppliers and any other useful information for our regional laboratories to apply equivalent methodologies.
6. To carry out new exercises on official intercalibration techniques and methods to evaluate marine toxins in shellfish, such as the exercise recently developed with the Community Reference Laboratory for Marine Biotoxins in Vigo.
7. To promote the organization of intercalibration exercises in order to determine marine biotoxins among all the regional laboratories which would want to implement or are applying ISO 17025 accreditation norm.
8. To improve the currently available information on marine toxins introducing HPLC-MS methods to detect lipophilic toxins and incorporate to the monitoring system other potentially harmful taxons, such as Alexandrium ostenfeldii and Prorocentrum reticulatum.
9. To continue with the specific courses on phytoplankton and marine biotoxins organized by the IOC centers, including basic training and updates on emerging issues.
10. To promote the implementation of internships deploying the regional capacities to identify harmful phytoplankton, detect and quantify marine toxins, and design and

implement monitoring programs.

11. It is recommended to continue with the organization of courses making use of the regional capacities.

12. It is considered essential to continue with training activities in order to increase certainty on the identification of harmful taxons and on the detection and evaluation of marine toxins in shellfish. Member countries are invited to assess their competence and capacity to develop this type of actions using their regional resources and capacities.

13. It is suggested that FANSA Group would continue editing the “Portal de Algas nocivas” in the “Portal Oceánico” until the “Algasnocivas.net” domain is activated under the auspices of IOC. Once the portal is settled according to the defined terms, the ANCA Group participation will be re-evaluated.

14. To support actions aimed at: 1) increasing public education; 2) incorporating harmful algae blooms and their effects in formal education; and 3) training specific groups responsible for key concepts.

15. To contribute to the development of HAEDAT and MONDAT databases with information provided by the national focal points and keep their constant update.

16. To support the development of the HAIS information system through the contribution and quality control of the information entered in the different databases.

17. To promote the dissemination of the results obtained and edited from the HAB-MAP project in the region among the scientific community.

18. To update the HAB-MAP database and recommend its coordination by experts respectively designated by each member country.

2.2 IOC WORKING GROUP ON HARMFUL ALGAL BLOOMS IN THE CARIBBEAN (COI-ANCA)

The main objective of ANCA is to improve the understanding of harmful algal blooms (HABs) in the Caribbean region and adjacent areas and the ability of national authorities to manage with the impacts. ANCA works to increase international cooperation, taking advantage of the existent knowledge in the region, to train researchers in countries where HABs knowledge is less advanced. To examine the advances of the group and to plan future activities, ANCA has organized workshops in Cuba 1998, Costa Rica 2002, Venezuela 2003 and Colombia 2007.

The IV ANCA-IOCARIBE Regional Science Planning Workshop on Harmful Algal Blooms was held in San Andres, Island – Colombia, from 22 to 24 May, 2007 with attendees from Barbados (1), Brazil (1), Colombia (26), Cuba (1), Dominica (1), Guatemala (1), México (3), Panamá (1), and Venezuela (1). Dr. Monica Lion assisted representing the IOC. The aim of the meeting was to examine the advances of the Group, discuss and develop the terms of reference established during the Third Meeting of ANCA in Cumana, Venezuela, 16 to 18, July, 2003, and to plan future activities. The workshop was sponsored by the Instituto de Estudios Caribeños, Universidad Nacional de Colombia, Caribbean Headquarters, and received financial support from the IOC and Universidad Nacional de Colombia. As in previous meeting, the participants actively exchange knowledge of the different regions, had a fruitful discussion, and concluded with general agreements related to regional activities on HAB.

It was re-confirmed that significant intra-regional differences exist in expertise and management capacity. Some countries experience difficulties to maintain their expertise and monitoring programs, and only operate when severe events of toxicity occur. Other countries have been able to overcome budget constraints and, with difficulties, maintain effective monitoring in some areas. It is necessary to motivate governments to develop regional

monitoring programs. In general, the subject has not been considered a priority by governments yet. The participants highlighted the limitations of national control programs to comply with international regulations, noting that in most countries, aquaculture was not extensively developed as the majority of seafood products are from fisheries. Advances in research and communication actions were also reviewed and future developments in these areas were discussed.

Consensus was reached on the following:

1. There is a necessity for better understanding and prevention of cyanobacterial blooms in the region, and ANCA recommends that each country develop research programs to identify the main factors associated with cyanobacteria blooms in coastal areas.
2. Each country is encouraged to develop oceanographic studies (CTD profiles, surface currents, general circulation patterns) and meteorological data in their relevant geographical areas and to promote an integrated physical and biological approach to understanding HAB events in the region.
3. ANCA will take part in the activities of the OCEAN Portal, Portal Algas Nocivas component, and work together with the FANSA group to develop a Latin American Portal on Harmful Algae. ANCA strongly recommends that each country contributes to the development of the ANCA portal by sending information to the Portal Editors.
4. It is recommended that the experts of the region collaborate with the national authorities in the region to maintain and improve the existing monitoring activities to provide a safeguard to public health and to minimize the impact of HABs.
5. National/local authorities must be aware about the importance of monitoring programs for microalgae as well as for the environmental factors associated to their occurrences. Also, they should have knowledge of the presence of toxins on the marine products and the socioeconomic impact of HAB issues.

Other intersessional activities includes the editing and distribution of the results of the IOC Regional Science Planning Workshop on Harmful Algal Blooms in IOCARIBE – ANCA-IV, held in San Andres Isla, Colombia (Ed. Ernesto Mancera, Instituto de Estudios Caribeños, Universidad Nacional de Colombia). Gustavo Arencibia Carballo, Cuba, prepared a report of about ciguatera intoxications in Cuba and submitted it to Harmful Algal News. México organized two national meetings (La Paz, B.C.S., 2005 and Ensenada, B.C., 2007) to analyze the HAB problem in the five oceanographic environments of the country coastal area (North Pacific, South Pacific, Golfo de California, Golfo de México and Caribbean Sea). The third national meeting will be held at Acapulco, Guerrero, from November 9th to 11th of 2009.

Future expected activities of ANCA relate to the OCEAN Portal (Portal Algas Nocivas) which need to be reactivated (regional maps, report of events), it is necessary to motivate the national representatives to send their information.

ANCA propose three regional workshops to address the HAB research priorities in the area: (i) the Ciguatera phenomena needs special attention to improve the analytical methods for the detection of the toxins, and a non-expensive method is required in order to protect the public health of the region; (ii) the *Pyrodinium bahamense* blooms and related phyto-toxins in the central Pacific need to be focused in different scenarios (hydrology of the region, phyto-toxins monitoring and methodology, north-ward extension of this species); and (iii) the *Gymnodinium catenatum* blooms and related phyto-toxins needs to be addressed in order to standardize their analyses. Activities associated with HAB dispersion trough ballast water in the region must be also be addressed.

To organize the V workshop of the ANCA-IOCARIBE work group it is necessary to obtain financial support from the IOC. Actually México is analyzing the possibility to get some complimentary resources to support this workshop for 2010.

2.3 IOC/WESTPAC HAB

IOC/WESTPAC-HAB is chaired by Chair Dr. Y. Fukuyo (Japan). IPHAB-IX did not receive a summary report of WESTPAC/HAB activities and priorities. However, a status report submitted after IPHAB-IX is included separately as Annex IX to this report

2.4 HARMFUL ALGAE OF NORTH AFRICA: HANA , A REGIONAL NETWORK

The First IOC/HANA Workshop was held in Casablanca, Morocco, 18-20 October 2007. Twenty four experts from Egypt, Tunisia, Algeria and Morocco met together with eight guests, to discuss HAB problems in the HANA region. The workshop programme was conceived with more than one objective in mind. It consisted of reports and scientific presentations, invited lectures and round tables. The scientific presentations reflected the considerable work presently carried out by young and more advanced scientists on potentially harmful microalgae in the region. They also provide a picture of the state of the marine environment regarding these issues. This is particularly obvious where economically important bivalve resources are under threat, namely in Morocco and Tunisia, the only two countries of the region where an institutionalized monitoring programme is in place.

In Morocco, seven sites are monitored on both the Mediterranean and Atlantic facades of the country. Of the diverse potentially harmful species recorded some are of more concern than others: Alexandrium minutum (Nador lagoon, Mediterranean) causing PSP contamination, Lingulodinium polyedra (Abda Doukkala, Atlantic) contaminating shellfish with DSP, three Pseudonitzschia spp (coastal Atlantic waters).Work is initiated on the Dinoflagllate cysts and their possible implication in the outbreak of toxic blooms (Walidia lagoon). In Tunisia, toxic blooms lead to heavy fish mortality in the Gulf of Gabes in 1995, inciting the authorities to launch a monitoring programme in shellfish areas. Most of the toxicity episodes in the last six years appear to be due to Karenia selliformis, though Alexandrium minutum, Coolia monotis, Karlodinium veneficum and Prorocentrum minimum also occur. Investigation of epiphytic microalgae on Posidonia oceanica leaves is just beginning. Of practical importance are the attempts to assess the rate of detoxification in clams. Algeria did not report any toxicity episodes although fifteen potentially harmful species occur. High biomass blooms of the Dinoflagellate Lepidodinium chlorophorum, the diatom Cyclotella meneghiniana and the coccolithophore Holococcolithophora sphaeroidea developed in Algiers harbour in 2003 and of Scrippsiella trochoidea along the coast in 2006. Although no formal monitoring programme is in place in Egypt, the Eastern Harbour and the neighbouring coastal embayments were continuously monitored for red tides and heavy blooms, although irregularly. Heavy fish kills accompanied the last bloom of A.minutum in 1994. Since then, the species became insignificant, replaced by other potentially harmful species such as Chattonella spp, Prorocentrum triestinum, P.minimum, Pseudonitzschia spp. In a new development, survey of epiphytic microalgae along the coast revealed benthic blooms of Ostreopsis spp and Oscillatoria spp.

A variety of issues were dealt with by the six invited lecturers: Phytoplankton strategies (Tim Wyatt), The HAEDAT data base of IOC (Monica Lion), Monitoring and management of phytoplankton and phytotoxins (Catherine Belin), Biology, Ecology and Oceanography of Dinophysis spp. (Beatriz Reguera), Occurrence of freshwater harmful cyanobacteria blooms in North Africa (B.Oudra), Proposed project for cooperation between HANA and the IOC Science and Communication Center on Harmful Algae, Copenhagen (J. Larsen). Three round tables were held respectively at the end of each day. They were devoted to a free discussion of: the research priorities (Chair: B. Reguera), the monitoring and management priorities (Chair C.Belin) and to HANA business (Chair: Y Halim)

Recommendations of the workshop:

1. All countries of the region should launch a monitoring and management programme for phytoplankton, phytotoxins and the quality of the environment.
2. Research problems that should be given priority in an organized research programme inspired by GEOHAB for the region are: (i) better understanding of the ecological conditions that lead to bloom development of HAB species; (ii) taxonomic, toxicological and molecular biology tools for characterization of the main HAB species in the region.
3. A training course on taxonomy of harmful algae and on monitoring is held soon in the region.
4. Selected experts from the HANA region should be trained for toxin analysis at IFREMER, France.
5. Biotoxin experts from the HANA region should be represented in the IPHAB Task Team on Biotoxin regulation.
6. A link to HAEDAT should be added to the HANA web site and HANA data be introduced to HAEDAT.
7. HANA web site be updated and completed regarding the directory, the list of publications and the list of species.
8. As no representatives from Mauritania and Libya were present, the organizers are urged to insure the participation of all countries of the region to the next meetings.
9. Presentations in French language must be accompanied by slides in English.
10. A second IOC / HANA workshop should be convened in 2009. The invitation of the Egyptian participants to convene the workshop meeting at the Department of Oceanography, Faculty of Science in Alexandria, Egypt, was agreed.
11. Extra budgetary funding should be sought to allow more participants from the region to attend the next workshop.

During the third round table, the participants elected the bureau of HANA for the next two years. As HANA Chair was elected Youssef Halim (Egypt), as HANA Vice-Chair Hamid Taleb (Morocco) and as National Coordinators: Amany Ismael for Egypt, Hassina Illoul for Algeria, Asma Hamza for Tunisia, and Chafik Abdelghany for Morocco.

At the end of the meeting the HANA community agreed unanimously that the workshop had been both successful and stimulating.

Activities in the HANA Region 2007-2009 included publication of about 30 papers which have been added to the HANA data base.

Planned Activities 2010-2012 includes:

1. Workshops: The second HANA workshop is to be convened in November 2009. A third workshop is previewed for 2011.

2. Capacity building: Training Courses in the region and/or training of selected scientists in relevant institutions abroad:
   a. Taxonomy of HAB species-at two levels.
   b. Molecular biology techniques for taxonomic purpose.
   c. Techniques for toxin analysis at IFREMER, France.

3. Research and Monitoring: Initiation of a cooperative Research and Monitoring programme inspired from GEOHAB for the countries of the region.

3. EDUCATIONAL ELEMENTS - INFORMATION NETWORK

3.1 *HARMFUL ALGAE NEWS* - AN IOC NEWSLETTER ON HARMFUL ALGAE AND ALGAL BLOOMS

Issues Nos. 33-38 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 HAN relies on the dedicated and longstanding efforts of the Editor, Dr. Timothy Wyatt, Instituto de Investigaciones Marinas, Spain. A reader survey is planned for 2009 to assess if a majority of the readers maintain a preference for a printed version of HAN.

3.2 IOC HAB INTERNET SITE

Most Popular Items	Created	Hits
What are Harmful Algae?	2007-07-12 14:46:00	5071
Training Courses	2007-07-12 14:52:03	5823
Harmful Algae News	2007-07-12 15:05:18	4176
Publications	2007-08-20 19:15:17	3417
Activities	2007-06-14 10:02:06	3338
About the Harmful Algal Bloom Programme	2007-07-12 14:46:59	2269
Contact Us	2007-07-12 14:47:42	2095
Harmful Algal Information System - HAIS	2007-07-12 14:53:43	2085

The GEOHAB site (www.geohab.info) was designed by Catherine Brown funded by a grant from the French Space Agency to French CNRS, Villefranche-sur-Mer. The GEOHAB site is monitored separately and had an average of 9 visits per day in the same period.

Most Popular Items	Created	Hits
GEOHAB Documents	2007-02-13 14:16:10	2720
Mission and Strategy	2007-02-12 14:07:01	2487
Scientific Steering Committee	2007-01-22 16:29:45	2294
Invitation to Participate	2007-02-16 11:55:46	1890
Key Questions	2007-03-26 15:38:22	1718
Goal and Programme Elements	2007-01-22 14:35:28	1681
Single Cell Detection	2007-03-27 14:13:18	1677
Molecular approaches (incl. toxins)	2007-03-27 13:57:58	1655
Others	2007-03-27 14:14:18	1618
Instruments	2007-03-27 14:00:51	1610

The sites are maintained by the IOC HAB Centre with technical back-up by the IOC IODE Programme Office in Oostende, Belgium. Both sites allow for multiple editors. The GEOHAB SSC has co-editors for the GEOHAB site and HANA has a web site editor for the HANA site.

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

3.3 HARMFUL ALGAL INFORMATION SYSTEM - HAIS

IPHAB-VIII in 2007 through Resolution IPHAB-VIII.5 endorsed the development of an integrated Harmful Algal Information System (HAIS) in cooperation with the IOC International Ocean Data Information and Exchange Programme (IODE).

Thanks to extra-budgetary support from the US National Oceanic and Atmospheric Administration (NOAA) and the Government of Flanders (Belgium), it was possible to organize a workshop 8-9 January 2008, Oostende, Belgium, where the Joint IPHAB/IODE Task Team on the Development of the Harmful Algal Information System developed the description and work plan for HAIS.

HAIS will provide an integrated platform for the Harmful Algae Event Data Base (HAEDAT), the database on HAB monitoring Systems (MONDAT) the IOC Taxonomic Reference List, The Directory of Experts (HABDIR), biogeographic data (HABMAP), and possibly epidemiological data. The elements of HAIS currently available are located at http://www.iode.org/haedat/.

The HAIS Plan is available as document IOC/IPHAB-IX/Inf.17

3.4 IOC CO-SPONSORSHIP OF INTERNATIONAL CONFERENCES RELATED TO HAB

The HAB Programme co-sponsored the Thirteenth International Conference on Harmful Algae, Hong Kong, China, 3-7 November 2008. A summary of the Conference is available in Harmful Algae News No. 38 at http://www.ioc-unesco.org/hab. Proceedings will be published as a joint publication of the International Society for the Study of Harmful algae (ISSHA) and the IOC. Conference web site at http://www.hab2008.hk

3.5 UNESCO MONOGRAPHS ON OCEANOGRAPHIC METHODOLOGY:

The title ‘Real-time Coastal Observing Systems for Marine Ecosystem Dynamics and Harmful Algal Blooms: Theory, Instrumentation and Modelling’ edited by Marcel Babin, Collin Roesler and John Cullen was released June 2008.

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 modelling.

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 modelling of ecosystems and harmful algal blooms, including data assimilation techniques; observational needs for the public and government; and future directions for research and operations.

3.6 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. As many of the titles list below are now available on-line the Centres have experienced a dramatic decline in the requests for hard copies. The book grants offered in 2007-2008 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, Hallegreaff, 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 Algales 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

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-IX/Inf.9 for an overview of courses implemented between 1993 and 2009. A total of 657 people were trained, hereof 274 males and 386 females.

Courses and training implemented 2007-2009:

4.1.1. 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.

4.1.2. 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.

4.1.3. X 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 2009.

4.1.4. Advanced Phytoplankton Course 9, Stazione Zoologica, Anton Dohrn, Naples, Italy, 5-26 April 2008. The IOC HAB Programme contributed through the participation of Jacob Larsen who lectured at the course.

4.1.5. 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 2007

4.1.6. 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 18-28 August 2008

4.1.7. 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 11-21 August 2009

4.1.8. Regional Training Course: Advanced Phytoplankton Course on Harmful Marine Microalgae. Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata

(UNLP) and Instituto Nacional de Investigaciones Pesqueras (INIDEP), Argentina, and IOC, 19-30 November 2007.

4.1.9. FAO/SIDA International Workshop on Safety of Shellfish From Harmful Algae and Biotoxins. Mangalore, India, 21-25 January 2008. The IOC HAB Programme contributed through the participation of Jacob Larsen who lectured at the course.

4.1.10. IOC Regional Course for North Africa (HANA) Casablanca, Morocco, 5-11 January 2007.

4.1.11. WESTPAC/HAB Training through Research Project 2006-2007 (See WESTPAC/HAB Report for details).

4.1.12. BCLME Regional Training Course on Harmful Algae, Swakopmund, Namibia, 22 January – 2 February 2007. The IOC HAB Programme contributed through the participation of Jacob Larsen who lectured at the course.

4.1.13. IAEA Regional Training Course on Harmful Algae, Cape Town, 7- 10 May 2007. The IOC HAB Programme contributed through the participation of Jacob Larsen who lectured at the course.

4.2 PLANNED COURSES:

4.2.1. XI Curso COI-AECID-IEO sobre Taxonomía de Fitoplancton Nocivo**:** Identification of Harmful Marine Microalgae. IOC - IEO Science and Communication Centre on Harmful Algae, IEO, Vigo, Spain. E-learning (April-May), Practical Course June 2010.

4.2.2. 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 August 2010.

4.2.3. XI Curso COI-AECID-IEO sobre Taxonomía de Fitoplancton Nocivo: Identification of Harmful Marine Microalgae. IOC - IEO Science and Communication Centre on Harmful Algae, IEO, Vigo, Spain. E-learning (April-May), Practical Course June 2011.

4.2.4. 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 August 2011.

4.2.5. IOC-AWI-BMU-BSH-DZMB-FSU Training Course on Qualitative and Quantitative Determination of Algal Toxins, Germany 200?, pending available funding.

4.2.6. Regional Course for the Indian Ocean (India), Central Indian Ocean and Gulf region proposed.

4.2.7. Regional Course for the Black Sea/Aegean Sea (Turkey) proposed.

5. SCIENTIFIC ELEMENTS - ECOLOGY AND OCEANOGRAPHY

5.1 ICES-IOC Working Group on the Dynamics of Harmful Algal Blooms- WGHABD

The WGHABD (Chair: Dr Joe Silke, Ireland) met April 2007 in Riga, Latvia, April 2008 in Galway, Ireland, and April 2009 in Huelva, Spain. The reports are available as Document IOC/IPHAB-IX/Inf.13.

The main joint activities are HAEDAT and review of scientific issue relevant to GEOHAB. IPHAB can formulate tasks / terms of reference for WGHABD.

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).

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

GEOHAB actions fall into the two broad categories of research and framework activities.

During 2007-2009 most effort under the research category has been the implementation of four Core Research Projects (CRPs) which have progressed to varying degrees. The CRP least implemented is that on Coastal Bays and Fjords, for which the CRP report has only now just been circulated within the GEOHAB SSC. The Stratified Environment CRP has been implemented through transnational collaborative research, but this has been mainly at the European level since the transatlantic synergies possible were through the NSF-EU Scientific Initiative. Only one linked project, on equipment and technological development, was funded in the US. This activity was carried out before final publication of the CRP report in October 2008.

The CRP on Upwelling Systems has developed well, with the project organized under a number of themes, to which funded research projects have been linked. This CRP is now at the stage that 6 review articles will be published in a single issue volume. The future direction of this CRP is uncertain.

The CRP on Eutrophication, progresses well with publication of the CRP report in 2006, committee meetings at transnational conferences and workshops, taking an initiative to criticize and prevent the dumping of nitrogen in the sea for carbon credits and publication of a

special issue of Harmful Algae. A second Open Science meeting is scheduled for October 2009.

GEOHAB continues to promote HAB activities at regional/national level and targeted research. Success has been achieved in linking with national programmes such as CEOHAB, promoting joint cruises and collaborative programmes and projects. An attempt at regional action has been GEOHAB Asia

Actions with framework activities have involved participation on the IPHAB-GOOS Task Team on Observations and with the International Ocean Colour Co-ordination Group. Most resources over the past two years in both man-months and cost have been in the organization of a Workshop on Modelling the Biological and Physical Interactions which Promote HABs. This workshop will be held in Galway in June 2009 and will involve over 80 participants.

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 Stratified Systems, GEOHAB Report No. 5 .
GEOHAB Core Research Project: HABs in Fjords and Coastal Embayments, GEOHAB Report No. 6 (in prep).

5.3 ICES/IOC/SCOR WORKING GROUP ON GEOHAB IMPLEMENTATION IN THE BALTIC SEA

Based upon a review by the GEOHAB SSC, IPHAB-VIII recommended the termination of the WG. The recommendation was followed and instead ICES decided to include in the Terms of Reference for the WGHBD an item on the Baltic.

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 met in 2007 in Dubrovnik, Croatia, in 2008 in Copenhagen, Denmark and in 2009 in Washington DC, USA, under the chairmanship of Dr. Anders Jelmert, Institute of Marine Research, Norway, Email: anders.jelmert@imr.no.

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

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, VI, and VIII. Chair is Prof. O. Moestrup. The Progress Report will be submitted to IPHAB-IX. Document IOC/IPHAB-IX/Inf.17. (HAIS)

7. TOXICOLOGY AND TOXIN CHEMISTRY

7.1 IPHAB TASK TEAM ON AQUATIC BIOTOXINS

There have been 2 key developments in the area of human health and biotoxin regulation during the intersessional period.

Firstly, as reported at IPHAB VIII, the European Food Safety Authority (EFSA), at the request of the European Commission, are assessing the current limits and methods of analysis for marine biotoxins in light of the publication of the report of the Joint FAO/IOC/WHO ad hoc Expert Consultation on Biotoxins in Bivalve Molluscs (Oslo, September 26-30 2004).So far, EFSA have published on 3 of the 9 opinions requested by the Commission – on okadaic acid, azaspiracid and yessotoxin. Each of these scientific opinions has recommended significant changes to the regulatory level of the respective toxin groups and commented on the suitability of methods. Currently the Commission plans to wait until all the scientific opinions are published and then determine changes to its regulations. Examples of the significance of changes recommended by EFSA are the recommendations that the regulatory level for okadaic acid change from 0.16 to .045 mg OA equivalents/kg and the regulatory level for yessotoxin change from 1 mg/kg to 3.75 mg YTX eq/kg shellfish flesh. The scientific opinions are available from the EFSA website.

Secondly, as reported by FAO at this session, FAO is currently preparing for publication the background papers prepared by the three Working Groups (toxicology, management and analytical methods) for the Joint FAO/IOC/WHO ad hoc Expert Consultation on Biotoxins in Bivalve Molluscs (Oslo, 26-30 September 2004). It is important that this publication include the replies by the Expert Consultation to each of the questions posed by the CODEX Committee on Fish and Fishery Products (CCFFP), as the CCFFP have omitted from their draft Code of Practice the advice provided by the Expert Consultation to the CCFFP on management of ‘new toxins’ and ‘newly discovered analogues of existing toxins’. Such advice may have assisted decision-making with the recent detection of pinnatoxins in bivalve molluscs, which, without evidence of illness, resulted in production area closures and became an issue for a shellfish industry and its regulators due to a lack of internationally recognised guidance.

While there has been no formal activity by the Task Team during the intersessional period, informal lobbying, presentations and encouragement to participate in AOAC official method collaborations, Quasimeme international proficiency trials for marine biotoxins and IOC training courses continues.

8. OPERATIONAL ELEMENTS - 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 a new data base platform is 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 was 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 provided 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.

IPHAB-VIII established a 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 Ocean Related Hazards Early Warning System 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 solicit input from, the regional IOC HAB networks in relation to development within GOOS and its GRA's of HAB observation, forecasting and warning systems;

(iv) facilitate establishment of operational HAB observing systems regionally.

A progress report is available as Document IOC/IPHAB-IX/Inf.14.

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 edited into a manuscript for a new title in the UNESCO series, Monographs on oceanographic methodology, 'Real-time Coastal Observing Systems for Marine Ecosystem Dynamics and Harmful Algal Blooms; Theory, Instrumentation and Modelling'. The volume was finally released in June 2008.

APPENDICE I

Resources available to the IOC for development and implementation of the IOC Harmful Algal Bloom Programme

This is not an actual account (for this see doc IOC/EC-XLI/2 Annex 2 regarding 2007 and for 2008 the equivalent document which will be available for the IOC Assembly June 2009).

2007–2008

IOC-UNESCO REGULAR PROGRAMME	US Dollars
IOC HAB Programme Regular Budget 2007-2008	50.000
IOC Staff	100.000
EXTRA-BUDGETARY CONTRIBUTIONS TO THE IOC:	
Denmark: -DANIDA:IOC Science and Communication Centre on Harmful Algae, activities and contribution to cost of one IOC Staff, 2007:	98.000
Spain: -Spanish Institute of Oceanography: Support for the IOC Science and Communication Centre at the Oceanographic Centre in Vigo, Spain 2007-2008	81.000
USA (SD and NOAA): Contribution 2007 for implementation of GEOHAB, HAEDAT and CB activities):	70.000
SPONSORSHIP OF ACTIVITIES AND FUNDS ADMINISTERED AT THE SCIENCE AND COMMUNICATION CENTRES:	
Denmark: -DANIDA: Training through research and provision of equipment	210.000
University of Copenhagen: IOC Science and Communication Centre on Harmful Algae, Copenhagen, staff, operation and activities:	125.000
Spain: -Spanish Institute of Oceanography: IOC-IEO Science and Communication Centre on Harmful Algae, Vigo, 2 staff, operation and activities:	282.500
-AECID (Spanish Agency for International Cooperation & Development), Scholarships for participants in training activities at Vigo Centre 2007:	36.000
-AECID (Spanish Agency for International Cooperation & Development), Scholarships for participants in training activities at Vigo Centre 2008:	36.000

Budget 2009

IOC-UNESCO REGULAR PROGRAMME	US Dollars
IOC HAB Programme Regular Budget	25.000
IOC Staff	50.000
EXTRA-BUDGETARY CONTRIBUTIONS TO THE IOC:	
Spain: -Spanish Institute of Oceanography: Support for the IOC Science and Communication Centre at the Oceanographic Centre in Vigo, Spain	40.000
SPONSORSHIP OF ACTIVITIES AND FUNDS ADMINISTERED AT THE SCIENCE AND COMMUNICATION CENTRES:	
Denmark: -DANIDA: Training through research and provision of equipment	50.000
University of Copenhagen: IOC Science and Communication Centre on Harmful Algae, Copenhagen, staff, operation and activities:	65.000
Spain: -Spanish Institute of Oceanography: IOC-IEO Science and Communication Centre on Harmful Algae, Vigo, 2 staff, operation and activities:	143.500
-AECID (Spanish Agency for International Cooperation & Development), Scholarships for participants in training activities at Vigo Centre:	37.250

GEOHAB Funds 2007-2009

Income	2007	2008	2009
Carry-over from previous year (NSF grant)	$23.755,00	$23.161,23	$51.390,75
NSF (through SCOR)	$10.000,00	$40.000,00	$40.000,00
IOC	$29.000,00	$20.000,00	$20.000,00
IFREMER (to promote GEOHAB Europe)	17000 euros		
CNES	10000 euros		
SCOR Support for LDC Travel	$5.000,00		??
NOAA Funding for Eutrophication CRP (through IOC)	$16.000,00	$16.000,00	
Total	$83.755,00	$99.161,23	$111.390,75

APPENDICE II

Implementation of IPHAB-VIII Resolutions and Recommendations

Code	Title	Implementation
Resolution IPHAB-VIII.1	Visualising the IPHAB Strategy for Assisting Member States in the Mitigation of Harmful Algal Events	Draft presented to IPHAB-IX
Resolution IPHAB-VIII.2	Implementation of HAB Monitoring within the Global Ocean Observing System	Partly implemented. Results to be presented to IPHAB-IX
Resolution IPHAB-VIII.3	Task Team on Biotoxin Monitoring, Management and Regulations	Partly implemented.
Resolution IPHAB-VIII.4	Regional HABP Development	Implemented except assessing the feasibility, and potential for cooperation with the relevant regional organizations, in the establishment of regional HAB networks in the Gulf and the Southern African regions. No follow-up by concerned Member States.
Resolution IPHAB-VIII.5	Development of a Harmful Algal Information System	Draft Plan presented to IPHAB-IX
Resolution IPHAB-VIII.6	Task Team on Algal Taxonomy	Partly implemented, work in progress.
Recommendation IPHAB-VIII.1	HABP Workplan 2008-2009	Implemented within the available resources
Recommendation IPHAB-VIII.2	Operation of the IOC Intergovernmental Panel on Harmful Algal Blooms	Implemented

ANNEX IX

REPORT ON IOC/WESTPAC-HAB PROGRESS (2006–2007) AND FUTURE WORKPLAN (2008–2010)

Project name:
Harmful Algal Blooms in the Western Pacific (WESTPAC/HAB)

Project Leader (Chairperson) and Project Steering Group (as of 28 May 2008)
Project leader: Yasuwo Fukuyo (The University of Tokyo, Japan)
Project Steering Group

- Australia Kezong Yin
- China Mingyuan Zhu, Zongling Wang
- Indonesia Hikmah Thoha
- Japan Yasuwo Fukuyo, Mitsunori Iwataki
- Malaysia Normawaty Mohd Noor, Yong Ai Hua
- Philippines Rhodora Azanza, Elsa Furio
- Thailand: Thaithaworn Lirdvitayaprasit
- Viet Nam Bui Hong Long, Dao Viet Han

Objectives:

1. To 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

Terms of Reference of the Project Steering Group

1. Composition

The Project Steering Group shall consist of all member states of WESTPAC interested to participate. Each Country, through its IOC National Focal Point shall designate one or two members with HAB expertise. Once the Project Leader is identified by IOC Sub-Commission for the Western Pacific, he/she shall sever as the Chairperson of this Steering Group. The Group is encouraged to conduct the work through correspondence. However, they shall meet if needed at the expense of the participating countries as far as possible. Other participants may be invited as observer if deemed necessary.

2. Functions

The Project Steering Committee is established to meet the scientific, managerial, implementation, and resource needs of the WESTPAC- Harmful Algal Blooms Project.

The Group will carry out the following functions:

1.1 Review and identify project requirements;

1.2 Promote efficient and cost-effective implementation of the WESTPAC Project and prepare recommendations on this implementation to the IOC Sub-Commission for the Western Pacific and the IOC's Intergovernmental Panel for HAB;

1.3 Identify the resources necessary to meet HAB project needs;

1.4 Ensure effective interaction and communication with WESTPAC and IOC' Intergovernmental Panel on HAB, as well as other regional intergovernmental (NOWPAP, PEMSEA, PICES) and non-governmental (e.g., SCOR) organizations involved in research on toxic algae and harmful algal blooms; and

1.5 Report to the IOC Sub-Commission for the Western Pacific and IOC's Intergovernmental Panel on HAB.

Activities carried out during last intersessional period (2006–2007) and expenditure (in cash and in kind, which source)

1. Organize strategic planning workshops; Held by ca. 40 participants from Japan and 5 ASEAN scientists in August 2007 in conjunction with JSPS-LIPI Workshop in Yokyakarta, Indonesia (no cost, as it is held by participants came to JSPS-LIPI meeting); held by participation of 48 peoples during 7th WESTPAC Symposium in May 2008 in Kota Kinabalu, Malaysia (no cost, as it is held by participants came to the Symposium) (Minutes attached as annex)
2. Three Research Group Activities of Training through Research (TTR) Project (TTR1: Cyst Mapping); Conducted 2nd cooperative field survey in Luzon, Philippines, in November 2005(using financial support 15K USD from JSPS, Japan); Conduct 3rd cooperative field survey inHalmahera, Indonesia in May 2006 (using financial support 15K USD from JSPS, Japan) (TTR2: Characterization of HA); Held a project formulation meeting at UKM Bangi Selangor, Malaysia in May 2006 (using IOC support 18K USD from JFiT) (TTR3: ELISA for PSP Monitoring); Held a project formulation meeting at NIO Nha Trang, Vietnam, in August, 2006 (using IOC support 17K USD from JFiT)
3. HABSEA PORTAL: Not carried out because of lack of funding
4. Red Tide Monitoring using Satellite Imagery; Not carried out independently because of lack of funding; Sought cooperation with NOWPAP
5. Dissemination of CDs and Publications; Carried out using the chance of TTR activity meeting (no cost)
6. Establishment of a network of national focal points; Not carried out because of lack of funding; Waited for establishment of WESTPAC whole policy and system
7. GEOHAB information dissemination; Carried out through correspondence; Held a international meeting in NIO Nha Trang, Vietnam, in February 2007 (no cost from WESTPAC)
8. Interaction with other projects on HAB; Sought cooperation with NOWPAP/UNEP and PICES
9. Development of HAB Monitoring in Tsunami Affected Area; Not carried out because of lack of funding

Problems encounted
Seeking budget is always problem. Wish to express thanks to WESTPAC office for its kind cooperation.

Actions required by the 7th Intergovernmental Session
Endorsement of this report.
Endorsement of TOR of WESTPAC/HAB (attached)

Proposed workplan and budget (May 2008-2010)

Project	Activities				Funding Required (possible sources indicated)	Participation	Remark
	Activities	Objectives	Expected outputs	Data and place			
HAB	1. HAB strategic meeting	discussion and decision of its activity plan		During 8th WESTPAC Symposium	3K for room (by leader)	50 participants from WESTPAC	
	2. Establishment of regional network	dissemination of information, announcements, etc.		Intersession	No cost		
	3. Provision of coordination for the Asia GEOHAB project	Establishment of AsiaGEOHAB		One day during 3-7 November	20K (IOC)	70 participants from WESTPAC	
	4. Strategic meeting for TTR project	Capacity building		1 week in each year in 2009 and 2010	20K (IOC) in each meeting	10 participants from WESTPAC	
	5. HABSEA Portal	Establishment of web site for information dissemination		Intersessional	20K (IOC)		
	6. interaction with other Projects	Activation of HAB projects		Intersessional	No cost		
	7. Harmful Algal Event Data-base	Information dissimination		Intersessional	No cost (through interaction with other organization		

7th IOC WESTPAC International Scientific Symposium 2008, Kota Kinabalu, Malaysia
Harmful Algal Bloom Workshop
Extract of minutes:

I. Overview/ Background

- Dr. Fukuyo, chairman of the IOC WEST PAC HAB Program, officially opened the workshop at 10am and presented a brief background on the organization of IOCWESTPAC in relation to the IOC UNESCO. The IOC WESTPAC HAB Program in relation to the International IOC HAB Program was also explained.

- He emphasized that the IOC does not provide research funds and only platforms and guidelines for the development of relevant programs and the establishment of communications among member countries can be provided.

HAB Steering Group members

- Nominees at WESTPAC HABS workshop
  - Australia: Kezong Yin
  - China: Mingyuan Zhu, Zongling Wang
  - Indonesia: Hikmah Thoha
  - Japan: Yasuwo Fukuyo, Mitsunori Iwataki
  - Malaysia: Normawaty Mohd Noor, Yong Ai Hua
  - Philippines: Rhodora Azanza, Elsa Furio
  - Thailand: Thaithaworn Lirdvitayaprasit
  - Viet Nam: Bui Hong Long, Dao Viet Ha

Review of WESTPAC/HAB Activities
HABSEA

- Development of HABSEA Portal to be useful to WESTPAC (Dr. Azanza)
- Not carried out because of lack of funding, Members present did not object to the suggestion of Dr. Fukuyo to continue this activity if funds are available.

Remote Sensing

- Development of monitoring network on usage of remote sensing (Dr. IShizaka)
- It is also not carried out because of lack of funding

Distribution of HAB reference materials

- Publication and distribution of HAB reference (Dr. Fukuyo)
- materials in CD
- Prepared CD includes the IOC manual

GEOHAB Activity (Dr. Furuya)

- 1st Asian GEOHAB meeting-- March 2007 in Tokyo, Japan
- 2nd GEOHAB meeting January 2008, Nha Trang, Vietnam
- Asian GEOHAB website: http://www.obsvlfr.fr/LOV/OMT/GEOHAB/index.php?option=com_content&task=view&id=86&Itemid=122
- Scientific goal
  - Improve prediction of HABs by determining the ecological and oceanography mechanisms underlying their population dynamics integrating bio, chem. and physical studies supported by enhanced observation and modeling system
- Programme Strategy
  - Comparative: cellular to ecosystem level
  - Interdisciplinary
  - Multifaceted

  - International
- CORE Projects
  - HABs in upwelling system
  - HABs in eutrophic system
  - HABs in stratified systems
  - HABs in fjords and coastal embayments
- Asian GEOHAB—collective term
- 1st meeting—presentation of country and regional HABs research project
- 2nd meeting: focused in identifying research questions. Scientific discussion (urea dumping in SCS)
- 3rd meeting- is scheduled to be held in Hong Kong International HAB conference—proceed with discussion
  - Comments for 3rd meeting: More focused discussion and brainstorming, define the frame of ASIAN GEOHAB
- Subjects for Asian GEOHAB:
  - Expansion of *Cochlodinium* red tides
  - Eutrophication and adaptive strategy of HAB species---intends to support reasonable and national activities

Review of the WESTPAC HAB "Training through Research" Project (TTR)

Dr. R. Azanza (chairman of the TTR project) gave a brief background on the project; The TTR was officially established in 2005 with the end in view of building capacity of the HAB scientists at the region particularly those in South East Asia. The research cooperation would also train young HAB scientists in planning and undertaking research through the active collaboration with more senior HAB scientists. Joint authorship of scientific papers can be realized in this project.

1. TTR Project 1 Dinoflagellate Cyst Mapping at the SEA Region (Elsa Furio)

This project was officially started in 2005 and was funded by ORI, Univ. of Tokyo and JSPS. Cooperative sampling and analysis of samples and data for cysts /sediments from the Philippines, Malaysia and Indonesia have been completed.

Results have been presented in International conferences and published with multiple authorships in two scientific journals. Another paper is coming out and there is a plan to prepare an atlas of cysts in the area. Lack of funds however prevented them in continuing the sampling in Vietnam and Thailand. Standardization of techniques was done in Nagaski University with DR. Matsuoka as the cooperating expert.

2. TTR Project 2(Characterization of HAB Species (Gires Usup)

This TTR was started in 2006 and the first meeting was held at the University Sans Malaysia.
Conceptualized by Dr. Fukuyo, the project aims to phylogenetically analyze and describe major HAB in the region using conventional and molecular techniques. The high number of researchers and the variety of interest and capacity of participating countries/members became a difficulty in having a joint research. However, individual countries like Malaysia have published papers on the topic.

3. TTR Project 3 Development of ELISA Detection of PSP (Dr. Sato)

This project was started in 2006 and the initial training was held at the Nha Trang Oceanographic Institute in Vietnam. The ELISA Kit for PSP detection was developed by the Kitasato University which owns all the rights to the kit. The Daiichi Chemical Company in

Japan partly funded the Elisa development but another company is being considered for the next phase which would involve further validation of the ELISA.

Terms of Reference

The body approved the following terms of reference for WESTPAC/HAB:

General Terms of Reference:

1. WESTPAC/HAB is established by the IOC Sub-Commission for the Western Pacific (WESTPAC), as the regional mechanism for implementing the IOC Harmful Algal Bloom Programme as adopted by the IOC Assembly through Resolution XVII-2 and with specific priorities and tasks as decided by WESTPAC.
2. WESTPAC will assign the tasks of Chair and steering committee for each period between WESTPAC Sessions or as required. A chair and the steering committee members can be assigned for successive periods. The Terms of Reference for the Steering Committee will be prepared elsewhere.
3. The Chair of WESTPAC/HAB will report its activity to WESTPAC and the IOC Intergovernmental Panel on Harmful Algal Blooms, and through the IOC Secretariat to other relevant IOC Governing and advisory bodies.
4. The Chair and the steering committee will with support of the IOC Secretariat organize WESTPAC/HAB strategic planning workshops as required and feasible in order to develop and implement the Programme.
5. Participation in WESTPAC/HAB strategic planning workshops is open to scientist and managers in WESTPAC. The WESTPAC/HAB executives may together with the secretariat also select a number of participants for full or partial support among individuals who have expressed their interest.
6. The Chair may invite other experts in the WESTPAC region to take on responsibility for specific activities.

Specific Terms of Reference for the period 2008-2010:

1. Conduct IOC/WESTPAC/HAB strategic meeting in conjunction with the WESTPAC Symposium for discussion and decision of its activity plan
2. Establish a WESTPAC/HAB regional network for dissemination of information, announcements, etc. regarding regional HAB activities
3. Provide a coordination for the Asia GEOHAB project
4. Further continue capacity building like TTR project on HAB study with more priority to topics related to Asia GEOHAB focal subjects
5. Further develop HABSEA Portal; and
6. Seek interaction with other Projects on HAB implemented by other international organization and interact with the other IOC regional networks or groups on HAB:
7. Work towards the establishment of a network of national experts for collation of reports on HAB events to be entered into the IOC-ICES-PICES Harmful Algal Event Data-base, HAE-DAT;

ANNEX X

INFORMATION ON IAEA CAPACITY BUILDING ON HAB

Assistance to Member States to address impacts of harmful algal toxins

In response to the growing interest expressed by its Member States in mitigating and managing Harmful Algal Blooms, the International Atomic Energy Agency has enlarged its activities to address impacts of HABs through the following actions:

- Cost-effective technologies involving isotopic compounds were selected for technology transfer and capacity building after careful comparison with non-nuclear techniques.
- The Philippines Nuclear Research Institute was awarded the status of IAEA Collaborating Centre for HABs (with a significant participation of the Marine Science Institute) to develop research on the transfer of PSP toxins in the food chain in collaboration with the IAEA Marine Environment Laboratories in Monaco (MEL).
- An international Coordinated Research Project managed by MEL was developed on the applications of isotopic techniques to the study of HABs toxins bioaccumulation and food chain transfer in mollusks and their natural consumers, to support risk management decision-making in relation to assessment of their suitability for human consumption.

A- Isotopic technologies transferred to IAEA Member States

• Quantification of PSP, ASP and CFP toxins in phytoplankton, shellfish and fish

The Mouse Bioassay (MBA) is the certified method widely used as the basis for warning subsistence consumers and for prohibiting trade in contaminated shellfish products. While it is simple and robust, the method is non-specific, with poor precision (± 20%), low sensitivity and limited sample throughput. Moreover, the use of live animals for product testing is prohibited in many countries and will be discontinued in others. Reliable, rapid, sensitive and accurate assays for toxins are a requirement for any legal regulatory framework. The Receptor Binding Assay is a simple, sensitive (nM range) and high throughput method, based on radio-labeled toxin, for detecting and quantifying neurotoxins in phytoplankton, shellfish and fish. It can be used for the early warning of HABs toxicity.

• Dating of Sediment Cores combined with Cyst Analysis

There is a need for understanding further the influence of natural and anthropogenic causes of HABs. The dating of modern and fossils cysts in sediment cores helps to establish HAB chronologies and to correlate them with physico-chemical parameters and/or climatic changes.

B- Current Technical Cooperation projects

The IAEA Marine Environment Laboratories ensures the coordination, the networking and the technical support for three national projects (Chile, El Salvador & Thailand), two regional projects in Africa and in Central America/Caribbean/Latin America and an inter-regional project. The IAEA assistance is provided through capacity building and human resources development. The main activities are the transfer of the two radio-isotopic techniques in the regions (expert missions and training), the certification process for the Receptor Binding Assay to be recognized as an official method for PSP determination, by the Association of Official Analytical Chemists (AOAC), the secured supply of necessary radiolabelled toxins and the publication of a manual on RBA protocols for PSP and CFP toxins.

The IAEA Marine Environment Laboratories has established collaborations with IOC-UNESCO and FAO to reinforce its programs on seafood safety and human health impact.

ANNEX XI

INFORMATION ON PICES CAPACITY BUILDING ON HAB

PICES Harmful Algal Bloom International Seafood Safety Project

This project accepts a "community research partnership" approach that will ensure that regional contributions will impact positively the seafood safety of developing countries. An inclusive and sustainable model for the implementation of the PICES-led initiative to meets the following criteria regardless of the geographical locale:

1. Initiation and implementation at the community level. Our project contributes to established community research needs and creates a research partnership.

2. Sustainable participation at the local and regional levels and ideally be seen as a realistic career path for either community workers or regional scientists.

3. Engagement of participants in cross-disciplinary research and management groups. Through cross-fertilization, individuals gain a balanced perspective on both the value of the project and of their contribution.

4. Building of partnerships with stakeholder involvement. We need to build partnerships and trust for extended interactions and commitments. Continued education and knowledge translation are essential for the proper capacity building.

Our investment into creating the proper framework for the implementation of the PICES-led initiative was a major accomplishment that will pay dividends in our success. Without this investment of detailed analysis we risk a non-sustainable effort. We now have a plan in place that will embrace community partnerships leading to sustainable success.

With our philosophy, aims and evidence-based criteria established, the HAB International Seafood Safety Project investigated the possibility of partnerships with agencies and individuals active in complementary programs in the geographical areas. We evaluated the integration of our program into established regional collaborations. This was done through extensive discussions with active participants.

During year 1 of this project, we observed a HAB Training Workshop at the Tokyo University of Marine Science and Technology. We then achieved a regional presence by presenting our PICES-led program at the 2nd Annual Asian GEOHAB meeting in Nha Trang, Vietnam. There, Dr. Trainer gave a presentation on the PICES Seafood Safety Project and the three collaborators communicated with Global Ecology and Oceanography of Harmful Algal Bloom (GEOHAB) members on possible candidate countries and institutions of interest. A visit to the Philippines in May 2008 with the Director and the Head of the Unit from the Bureau of Fisheries and Aquatic Resources (BFAR, Sandy Arcamo) and the University of the Philippines (Rhodora Azanza) organized the collaborative research/monitoring needs, identified laboratory needs and evaluated the appropriate stakeholders for the upcoming (Year 2) training sessions. Associate with this workshop preparation, we attended the Western Pacific HAB Network (Westpac) conference in Kota Kinabalu, Malaysia in order to listen to the speakers and also attend the HAB Workshop led by Dr. Yasuwo Fukuyo (Westpac chair, Japan). Dr. Trainer gave a presentation on the concept of the PICES project at this HAB Workshop. She presented the idea behind the project (develop sustainable seafood safety projects in developing Nations) in order to initiate powerful discussions with any other interested countries.

We achieved a higher-level of recognition by engaging the Intergovernmental Oceanographic Commission (IOC) in a country evaluation. A letter to the IOC was then drafted, which requested assistance from the IOC in contacting IOC member countries via a questionnaire regarding their interest in participating in the Seafood Safety Project. This questionnaire asked countries to detail their research and monitoring needs pertaining to HABs and seafood safety. Countries included (but were not exclusive of) were Chile, Indonesia, Malaysia, Mexico, Peru, Philippines, Vietnam, Chile, Costa Rica, Ecuador, Panama, and Guatemala. Information received is being used in determining which country to target for training class/workshops in following years. Results of this exercise enabled our PICES group to select countries that meet our PICES community training philosophy. As partners with IOC we also have gained access to the training classes, and international education/technology transfer activities.

We achieved through our country self-assessment forms an evaluation of the realistic needs of success for specific countries. We can now design worships and training sessions are designed to build capacity within specific countries. For the newly designed workshops and demonstrations we have purchased equipment and supplies for a Seafood Safety Traveling Field Kit for the detection and monitoring of HAB toxins, harmful algal species, and associated environmental (a biotic) parameters, which will be used in subsequent years.

In project year 2, we held a training class in Manila, Philippines. This 1st class of the PICES International HAB program was highly successful. The Philippines appears to be a perfect match to the criteria used for country selection in the PICES HAB International Program including:

1. the need for training
2. the magnitude of the HAB problem
3. the likelihood of sustainability

There were 11 participants from the BFAR Central lab and 3 from the BFAR Regional and Local Governmental Labs during first 2 ½ days' training on toxin screening methods. There were a total of 33 participants during the 4 days of comprehensive training for all participants on phytoplankton identification and toxin screening methods. The quality of teaching and the students' understanding of concepts were assessed through 2 quizzes and 1 class questionnaire. It was determined after our conversations with BFAR personnel during our visit in May 2008 and through subsequent e-mail and telephone contact that the greatest need in the Philippines was for:

1. training in screening tools for toxin detection due to the periodic lack of mice for the mouse bioassay, the standard regulatory method for testing shellfish for paralytic shellfish poisoning (PSP) toxins
2. a review of phytoplankton identification, with specific focus on harmful species in the Philippines
3. an introduction to relational and online databases

A notebook was provided to all participants that included an agenda, a summary of HAB syndromes in humans, phytoplankton key, individual micrographs of HAB species of concern in the Philippines, and handouts on toxin detection methods including the Jellett PSP test and Abraxis ELISA. BFAR Central lab personnel also received a list of supplies including purchasing information and description of the AOAC and ISSC approval of the Jellett rapid test for PSP toxin screening.

Over the next year, the Abraxis Enzyme-Linked Immunosorbent Assay (ELISA) and Jellett test strips will be evaluated by Central Lab personnel. Monthly communications via Skype among PICES investigators and Philippine scientists will assure timely progress, we anticipate a follow up visit to the Philippines in 2010.

We have begun our communications regarding the country of focus for the next training class in Latin America. We will optimize our choice of country fulfilling the project guidelines through a conversation with Dr. Leonardo Guzman, the chair of the International Panel on Harmful Algal Blooms (IPHAB) and a member of HAB-FANSA (the IOC-HAB working group for South America) and Jose Luis Pena Manjarrez, ANCA chair (IOC HAB working group for Central America and Caribbean Sea) at the IPHAB conference in Paris from 22-25 April 2009. Based on our discussions and meetings with these individuals representing central and South America, and through assessment of IOC questionnaires, Guatemala is one of the countries with the strongest needs that is not already receiving assistance from other programs. The International Atomic Energy Authority (IAEA) already has planned to give widespread training classes throughout Central and South America in 2009-2010. In the interest of not replicating efforts in these countries, Guatemala is also a logical choice as it is not currently receiving assistance from IAEA. This decision is also based on our IOC supported questionnaire that was submitted from Leonel Carrillo Ovalle, from the Laboratorio de Investigación Aplicada Centro de Estudios del Mar y Acuicultura, Universidad de San Carlos de Guatemala. His response to the questionnaire fulfills our guidelines of need, sustainability and desire of host country for PICES project training.

ANNEX XII

OVERVIEW OF IOC HAB TRAINING COURSES AND WORKSHOPS

IMPLEMENTED CAPACITY ENHANCEMENT ACTIVITES 1993–2009

For overview, complete details not included. Includes course implemented by IOC, jointly with partners or by partners with IOC contributions

MODULE: ***TAXONOMY OF HARMFUL MARINE MICROPLANKTON***	**LEVEL, no. of part.:**	**TARGET GROUP/ Region:**	**WHERE:**	**WHEN:**	**NEED IDENTIFIED WHERE:**	**FUNDING IDENTIFIED:** in US $
Course name: IOC-Danida Training Course on the Taxonomy of Harmful Marine Phytoplankton **Organizer:** 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
Course name: IOC-Danida Training Courses on the Taxonomy and Biology of Harmful Marine Microplankton **Organizer:** IOC Science and Communication Centre on Harmful Algae, (Moestrup, Larsen,Fukuyo, Matzuoka,Enevoldsen	Advan. M.Sc Ph.D 15-18	Global, developing countries	University of Copenhagen, Denmark	August 1995 1996 1997 1998 1999 2000 2001 2004	HABP Plan BMTC WS HAB Survey 1st IOC-Danida Training Course. Survey 1999 IPHAB 2003	Danida- IOC-TF: 50 K/course

Course name: IOC- Training Course and Identification Qualification in Harmful Marine Microalgae **Organizer:** IOC Science and Communication Centre on Harmful Algae	Advan. M.Sc Ph.D 15-18	Global, self paying	University of Copenhagen, Denmark	E-learn May-June/ Course and examination on August: 2006 2007 2008 2009	HABP Plan IPHAB 2003	2006:Danida-IOC-TF: 20 K/course
Course name: IOC-AECI-IEO Training Course: Identification of Harmful Marine Microalgae **Organizer:** 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	E-learn May-June/ Course and examination on June 2008 2009	IPHAB	Funded by Spain IOC TF 35K/course
Course name: Advanced Phytoplankton Course **Organizer:** Dr. A. Zingone, Zool. Sta. A. Dorhn, Napoli, Italy	Advan. M.Sc, Ph.D. 20	Global, self paying	Zoological Station Anton Dorhn, Napoli, Italy	(6^{th}) 24 Sep.- 14 Oct. 1995 (7^{th}) 10-30 May 1998 (8^{th}) 2-23 April 2005. (9^{th}) 5-26 April 2008		MAST, ONR, IOC

Course name: Regional Training Course: Advanced Phytoplankton Course on Harmful Marine Microalgae. **Organizer:** Marta Ferrario, Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata (UNLP) and Instituto Nacional de Investigaciones Pesqueras (INIDEP), Argentina	Advan. M.Sc, Ph.D. 13	FANSA	Universidad Nacional de La Plata, Argentina	19-30 Nov 2007	FANSA	Self funded, IOC
Course name: IOC-SAREC-Danida Training Course on the Taxonomy and Biology of Harmful Marine Microplankton **Organizer:** 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 Implementation Plan	IOC: 30K NAI 4K TEMA 6K SAREC: 20K Danida: printed material, equipment Total: 30K
Course name: IOC-IEO-AECI Training Course on Toxic Phytoplankton **Organizer:** 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

Course name: IOC/WESTPAC Training Course on Species Identification of Harmful Microalgae **Organizer:** 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, Tokyo, Japan	28 February - 8 March, 1997	WESTPAC-HAB	Funded by Japan
Course name: IOC-FURG-DANIDA Training Course on the Biology and Taxonomy of Harmful Marine Microplankton **Organizer:** Dr. Clarisse Odebrecht, Ubiversity of Rio Grande (FURG); IOC Science and Commiunication 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 Brazillian : 27 K IOC: 8K WESTPAC/HAB-Japan:4K DANIDA:10K

Course name: IOC-NorFa Training Course on the Taxonomy and Biology of Harmful Marine Microplankton **Organizer:** 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
Course name: IOC/WESTPAC Training Course on Species Identification of Harmful Microalgae **Organizer:** 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
Course name: IOC-APEC Training Course on the Indentification and Monitoring Harmful Marine Microplankton **Organizer:** 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

Course name: IOC-NorFa Training Course on the Taxonomy and Biology of Harmful Marine Microplankton **Organizer:** IOC Science and Communication Centre on Harmful Algae, Copenhagen	Advanced M.Sc./Ph. D. 18	Baltic Sea	Vörtsjärv Limnological Station, Estonia	1-9 Sept. 1998	NorFa	Nordic Research Academy (NorFa):18K IOC: 2K Total: 20 K
Course name: 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
Course name: 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 Com. 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

Course name: Taxonomy of Harmful Microalgae **Organizer:** ,Faculdade Ciências Universidade Lisboa (Portugal), Facultad de Ciencias Naturales y Museo (Argentina), Fundaçãoo 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
Course name: IOC-ROPME Regional Training Workshop on Harmful Algae, **Organizer:** 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~

Course name: Biology of Marine Phytoplankton/ Taxonomy of Harmful Algae in-country Training Course **Organizer:** Hue University of Science, HABViet	M.Sc. 25	Vietnam,	Hue University of Science, Hue, Vietnam	9-17 March / 15-18 May 2006	HABViet Plan	HABViet / Danida 20 K
Course name: IOC Regional Course for North Africa (HANA) **Organizer:** Btissam Ennaffah			Casablanca, Morocco,	5-11 January 2007		
Course name: IAEA Regional Training Course on Harmful Algae **Organizer:** IAEA	Basic 9	Angola, Namibia, South Africa	Cape Town, South Africa	7- 10 May 2007	IAEA	Unknown
Course name: BCLME Regional Training Course on Harmful Algae **Organizer:** BCLME	Intermediate 14	Benguela region	Swakopmund, Namibia	22 January – 2 February 2007	BCLME	Unknown

MODULE: ***TOXIN CHEMISTRY AND TOXICOLOGY***	**LEVEL** **no. of part.:**	**TARGET GROUP/ Region:**	**WHERE:**	**WHEN:**	**NEED IDENTIFIED WHERE :**	**FUNDING IDENTIFIED:** in US $
Course name: IOC-UNEP-WHO-FAO Training Course on Qualitative and Quantitative Determination of Algal Toxins **Organizer:** 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
Course name: IOC-UNEP-WHO-FAO-Italy Training Course on Toxin Chemistry and Toxicology related to Harmful Algae **Organizer:** 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
Course name: IOC-AECI-IEO Training Course on Analytical Methods for the Detaection of Marine Toxins **Organizer:** 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

Course name: IOC-UNEP Training Course on Qualitative and Quantitative Determination of Algal Toxins **Organizer:** 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
Course name: IOC Training Course on Phycotoxins **Organizer**: 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 **IOC: 12,5K requested** EU and WHO subject to application
Course name: IOC Training Course on Qualitative and Quantitative Determination of Algal Toxins **Organizer:** Dr. Matlte Elbraechter, Senckenberg Museum, Germany	Advan. M.Sc., Ph.D. 16	Global	Wattenmeerstatio n 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

MODULE: ***RISK ASSESSMENT, CONTINGENCY PLANNING AND MANAGEMENT OF HARMFUL ALGAL EVENTS***; ***DESIGN AND IMPLEMENTATION OF MONITORING PROGRAMMES***	**LEVEL** **no of part.:**	**TARGET GROUP/ Region:**	**WHERE:**	**WHEN:**	**NEED IDENTIFIED WHERE :**	**FUNDING IDENTIFIED:** in US $
Course name: FAO/SIDA International Workshop on Safety of Shellfish From Harmful Algae and Biotoxins **Organizer:** IOC Science and Communication Centre on Harmful Algae, Vigo	Intermed iate 20	Asia	Mangalore, India	21-25 January 2008	FAO	unknown
Course name: 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 **Organizer:** IOC Science and Communication Centre on Harmful Algae, Vigo	Advance d 10	Latin America	IOC-IEO Science and communication Centre on Harmful Algae. Instituto Español de Oceanografía, Vigo, Spain.	10-26 June, 2002. 2006 2007	IPHAB	25K Spain TF Spain: 8K AECI: 7K IEO: 10K

Course name: IOC-IEO-AECI Training Course on Toxic Microalgae and Marine Phycotoxins **Organizer:** 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 Spain IOC TF 35K/course
Course name: IOC-APEC Symposium: Harmful Algal Mmanagement **Organizer:** 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
Course name: IOC-Japan Training Workshop on Monitoring of PSP Plankton and Shellfish Toxicity **Organizer:** 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

MODULE: ***THEME WORKSHOPS, AND REGIONAL INTERDISCIPLINARY WORKSHOPS***	**LEVEL** **no. of part.:**	**TARGET GROUP/ Region:**	**WHERE:**	**WHEN:**	**NEED IDENTIFIED WHERE :**	**FUNDING IDENTIFIED:** in US $
Course name: WESTPAC - LIPI - P30 Seminar on HAB **Organizer:** 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
Course name: WESTPAC - China Workshop on HAB **Organizer:** Dr. Qi Yuzao, Jinan University	Basic M.Sc. 10	WESTPAC	Guangzhou, China	21-26 Nov. 1993	WESTPAC-II	Japan: 5K China: 3K Total: 8K
Course name: WESTPAC - PAMS - Thailand Workshop on HAB **Organizer:** 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

Workshop name: IOC Regional Science Planning Workshop on Harmful Algal Blooms **Organizer:** 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
Workshop name: Second IOC Regional Science Planning Workshop on Harmful Algal Blooms **Organizer:** Dr. Jose I. Carreto, INIDEP, Argentina	M.Sc., Ph.D.	Scientists South America	INIDEP, Mar del Plata, Argentina	Oct. 1995	1st Workshop	IOC: 10K
Workshop name: Third IOC Regional Science Planning Workshop on Harmful Algal Blooms (COI-FANSA-III) **Organizer:** Leonardo Guzman	M.Sc., Ph.D.	Scientists South America	Instituto Fomen Pesquero, Puenta Aremas, Chile	28-30 July 1997	2nd workshop	IOC
Course name: International Seminar on Red Tides, risks for human health and development **Organizer:** 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

Course name: Regional S-American Course on HAB, metodologies for marine biotoxins **Organizer:** 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 Sciemce and Technology
Course name: IV Regional Working Meeting on Harmful Algae Blooms in S-America (COI/FANSA) **Organizer:** Virginia Garcia	M.Sc., Ph.D.	Scientists South America	FURG, Rio Grande University, Brazil	Jan. 2000	III IOC FANSA	IOC 10 K + local sponsorship
Course name: WESTPAC-LIPI-P30 Red Tide training CourseCanada Training Workshop on Harmful Algae **Organizer:** Mr. D.P. Praseno, P30 LIPI, Dr. Yasuwo Fukuyo, Univ. Tokyo	Basic, M.Sc. 10	WESTPAC ASEAN	LIPI, Ambon, Indonesia	13-18 Nov. 1995	WESTPAC-II	IOC: Japan: 5K Indonesia 3K

Course name: IOC/WESTPAC In-Country Training Courses:	Basic M.Sc.	WESTPAC				
IOC/WESTPAC-Philippines : Dinoflagellate Identification	9	-	BEFAR, Manila, Philippines	6-19 Dec. 1995 12-15 Nov. 1996	WESTAPC-II	Japan 3K BEFAR 10K
IOC/WESTPAC-Vietnam: Phytoplankton Monitoring and Identification in Eastern Indonesia	8	-	Inst of Ocean., Haiphong Vietnam	18-22 Nov. 1996	WESTPAC-III	Japan 15K Vietnam 3K
IOC/WESTPAC-Indonesia: Phytoplankton Monitoring and Identification in Eastern Indonesia	15	-	Res.andDevelop. Centre for Oceanology, Jakarta, Indonesia	9-11 December, 1996	WESTPAC-III	Japan 15K Indonesia 3K
IOC/WESTPAC-Malaysia:Identification of PSP Plankton	15	-	Univ.of Malaysia Saba, Kota Kinabalu, Malaysia		WESTPAC-III	Japan 15K Malaysia 5K
Organizer: Asian Natural Environmental Science Center, the University of Tokyo, Tokyo, Japan,						

Course name: 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 IOC/WESTPAC-Chinese Taipei: Red Tide Seminar Workshop IOC/WESTPAC-Hong Kong: Red Tide Seminar and Training Course **Organizer:** Asian Natural Environmental Science Center, the University of Tokyo, Tokyo, Japan.	Basic M.Sc. 20 20 20 13 20	WESTPAC - - - - -	Univ.Phil.in the Visayas, Philippines P.of Songkla Univ., Hat-Yai, Thailand Univ.of the Phil.in Cebu National Taiwan University, Taipei Agriculture and Fisheries dept, Hong Kong	17 May 1996 12-16 Dec. 1997 17-21 Nov. 1998 3-7 April 1999 6-10 Dec, 1999	WESTAPC-II WESTPAC-III WESTPAC-III WESTPAC-III request	Japan 5K Phil. 10K Japan 25K Thailand 5K Japan 35K Philippines 5K Japan 5K C. Taipiei 50K Japan 5K Hong Kong 50K

IOC/WESTPAC Training Course on PSP Toxin Monitoring Organizer: Dr. Y. Fukuyo, Asian Natural Environmental Science Center,University of Tokyo, and Dr. M. Kodama, School of Fisheries Sciences, Kitasato University	M.Sc/ Ph.D.	9	School of Fisheries Sciences, Kitasato University, Iwate, Japan	24-30 August 1998,	WESTPAC-HAB	Japan 16K
5th IOC/WESTPAC/HAB Training Course on Ecology and Physiology of Harmful Algae **Organizer:** Asian Natural Environmental Science Center, the University of Tokyo, Tokyo, Japan.	M.Sc/ Ph.D.	9	Chulalongkorn University and Burapha Unviersity, Thailand	19 – 24 March 2001	WESTPAC/HAB	Japan FiT
The 6th IOC/WESTPAC Training Course on Advanced Techniques on Characterization of Harmful Algal Species **Organizer:** Asian Natural Environmental Science Center, the University of Tokyo, Tokyo, Japan.	M.Sc/ Ph.D.	9	Manila, Philippines	May 13-18 2002	WESTPAC/HAB	Japan FiT

The 7th IOC/WESTPAC Training Course on Species Identification of Harmful Microalgae, **Organizer:** Asian Natural Environmental Science Center, the University of Tokyo, Tokyo, Japan.	M.Sc/ Ph.D.	9	Sabah, Malaysia	March 17-22, 2003,.	WESTPAC/HAB	Japan FiT, 16K
IOC Training course on HAB for the Caribbean Countries **Organizer:** Arturo Sierra	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
IOCEA Workshop on Harmful Algal Blooms Organizer: IOC Science and Communication Centre on HAB, Copenhagen	M.Sc/ Ph.D	10	University of Accra, Ghana	29 October 2 November 2001	IPHAB	Danida 10K IOC budget 20K
Course name: IOC-NAUTA-COPEMED Course on Identification of Harmful Algal Blooms, INSTM, Tunisia, **Organizers: Monica Lion, Jacob Larsen, Souad Turki (INSTM)**	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

MODULE: ***INDIVIDUAL TRAINING***	**LEVEL** **no. of part.:**	**TARGET GROUP/ Region:**	**WHERE:**	**WHEN:**	**NEED IDENTIFIED WHERE :**	**FUNDING IDENTIFIED:** 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: AECI: 2,5 K, IGACI: 2,5 K, IEO: 2 K 2003: AECI: 2,5 K, IEO: 1 K 2004: AECI: 12,5, IEO: 5 K 2005: AECI: 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

386 females

Country	Trainees No
ALBANIA	3
ALGERIA	2
ANGOLA	7
ARGENTINA	23
AUSTRALIA	9
AUSTRIA	1
BAHRAIN	2
BANGLADESH	4
BELGIUM	2
BENIN	1
BRAZIL	24
BULGARY	1
CAMEROON	2
CANADA	5
CHILE	41
CHINA	22
COLOMBIA	8
COSTA RICA	5
CROATIA	5
CUBA	9
DENMARK	11
ECUADOR	7
EGYPT	6
EL SALVADOR	2
ESTONIA	5
FIJI	1
FINLAND	3
FRANCE	4
FRENCH POLYNESIA	1
GEORGIA	1
GERMANY	3
GHANA	7
GREECE	6
GUATEMALA	9
GUINEA	1
HAITI	2
HOLLAND	2
HONDURAS	1
HONG KONG	5
ICELAND	1
INDIA	3
INDONESIA	13
IRAN	10
IRELAND	4
ISRAEL	2
ITALY	10
JAMAICA	1
JAPAN	1
KENYA	6
KUWAIT	4
LATVIA	2
LEBANON	1
LITHUANIA	1

Country	Trainees No
MADAGASCAR	2
MALAYSIA	22
MAURITANIA	1
MAURITIUS	6
MEXICO	17
MOROCCO	12
NAMIBIA	12
NETHERLANDS	2
NEW ZEALAND	9
NIGERIA	6
NORTH KOREA	2
NORWAY	10
OMAN	3
PAKISTAN	1
Panamá	1
Papua New Guinea	1
PERU	16
PHILIPPINES	21
POLAND	1
PORTUGAL	7
PUERTO RICO	2
QATAR	3
ROMANIA	4
RUSSIA	12
Santa Margarita	1
SAUDI ARABIA	1
Senegal	1
Sierra Leone	1
SINGAPORE	3
SLOVENIA	2
SOUTH AFRICA	5
SOUTH KOREA	16
SPAIN	20
SWEDEN	10
SYRIA	1
TAIWAN	2
TANZANIA	3
THAILAND	28
TOGO	1
TRINIDAD & TOBAGO	1
TUNISIA	10
TURKEY	4
UNITED ARAB EMIRATES	1
UNITED KINGDOM	11
URUGUAY	5
USA	16
VENEZUELA	7
VIETNAM	21
ZIMBABWE	1

ANNEX XIII

PRINCIPLES FOR CAPACITY ENHANCEMENT IN RESEARCH ON AND MANAGEMENT OF HARMFUL ALGAL EVENTS

The following principles are drafted to guide the development, coordination and implementation of a broad variety of international, regional and in-country capacity enhancing activities in relation to harmful algae and phycotoxins, and the associated impacts on sea food safety, public health, aquaculture, fisheries, tourism, drinking water, environmental impacts etc. (HA).

I. HA capacity enhancement is focussed and addresses the prioritised needs of the governments and institutions of the trainees. [The implication of this principle is that with limited resources, capacity enhancement cannot and should not address every need].

II. All capacity HA enhancing interventions are imbedded in the larger mandate to promote international cooperation on protection of the marine environment and preservation of human life and property in the ocean and coastal areas and work towards sustainable development.

III. HA capacity enhancement is based on the concept of "Community-based, participatory action research" which requires that the HA trainers offer services only at the request of the host community and that the services are created as a collaboration between the HA trainers and the stakeholders. In most cases this would involve communities that require assistance in sustainable resource management or resource capacity building, rather than new research avenues for the HA trainers. Thus the program and activity of the HA trainers must be structured in such a way that the target group acquires a clear realisation that they have the sole responsibility for their own capacity-building and a high probability of a sustained program after the contribution of the HA training activities cease to be requested. This means that they will:

    a. Identify areas for collaboration.

    b. Seek partners through clearer enunciation of the requirements,

    c. Review and reconstruct the terms of reference through stakeholder consultation, and

    d. Seek funds to co-finance the capacity enhancement in a business mode – (that is, return a product that is beneficial to the public).

IV. HA capacity enhancement interventions are structured and have enduring long-term impacts. This requires contributions that lead to sustainable, community-based management and research. The ultimate goal is to achieve independence of the community from the HA training group.

V. HA capacity enhancement focuses on developing management, operational and research capabilities.

VI. HA capacity enhancement is approached in a holistic, community participation manner. Depending on the type of intervention, decision-makers, directors of institutes, scientists, technicians, and the public are involved. The community has the final ownership of the outcome of the activities.

VII. Interventions are seen and treated as investments. Therefore, the executing agency will maintain appropriate contact with strategic partners, collaborating institutions, key decision makers, sponsors/funding organisations, thought leaders in relevant scientific disciplines, and participants.

VIII. HA capacity enhancement will optimise limited resources and reduce/eliminate duplication and overlap. This will include liaising closely with other agencies that also provide capacity enhancement services to improve coordination and increase efficiency.

Different agencies are invited to share information on their list of trainees. IOC database of HAB capacity building is offered for consultation at any time to inquire about whether individuals have received previous training, where and when.

ANNEX XIV

GEOHAB: TERMS OF REFERENCE MEMBERSHIP OF THE GEOHAB SCIENTIFIC STEERING COMMITTEE

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).

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

The SSC is chaired by:
Robin Raine, The Martin Ryan Institute, National University of Ireland

Vice-chair:
Raphael Kudela (USA)

Scientific Steering Committee Members:
Icarus Allan (UK)
Elisa Berdalet (Spain)
Stewart Bernard (South Africa)
Liam Fernand (UK)
Ken Furuya (Japan) Ex officio for GEOHAB Asia
Leonardo Guzman (Chile) Ex officio member from IOC IPHAB
Dennis McGillicuddy (USA)
Susanne Roy (Canada)
Ming-Jiang Zhou (China-Beijing)

Core Research Project Committee Members:
Allan Cembella (Germany)
Patricia Glibert (USA)
Wolfgang Fennel (Germany)
Patrick Gentien (France)
Grant Pitcher (South Africa)

Modelling Workshop 2009 Organizing Committee:
Dennis McGillicuddy (USA)
Wolfgang Fennel (Germany)
Marcel Babin (France)
Marine Lévy (France)

ANNEX XV

DRAFT IPHAB STRATEGY

A Strategy for enhanced Global Management OF HABs

The IOC Intergovernmental Panel on Harmful Algal Blooms (IPHAB) is a global partnership of decision makers, policy makers, managers, scientists, international organisations and NGOs to address the problem of harmful microalgae. The IOC IPHAB was established in 1991 as the organizational framework for the Partnership.

Why a strategy?

With this strategy for enhanced global management of harmful algal events the IOC of UNESCO wish to visualise the need for and benefits to governments of international cooperation in research, data products, and uniform food safety HAB standards to facilitate international trade and capacity building. We also wish to engage and commit stakeholders to take active part in and contribute to the activities. Without such engagement and contribution at the scientific, financial and governmental level such international cooperation cannot succeed.

Vision and goal

The vision of IPHAB is a global international network of national authorities and institutions involved with sea food safety, statutory monitoring of harmful algae & toxins and HAB research, with capacity to adequately manage and mitigate the affects of harmful algae.

The overall goal of the IOC Harmful Algal Bloom Programme is to foster the effective management of, and scientific research on, Harmful Algal Blooms (HABs) in order to understand their causes, predict their occurrences, and mitigate their effects.

What are Harmful Microalgae?

Phytoplankton blooms, micro-algal blooms, toxic algae, red tides and harmful algae are all terms for naturally occurring phenomena. About three hundred species of micro-algae are reported to form mass occurrences, so called 'blooms', and nearly one fourth of these species are known to produce toxins. These events are referred to by the generic term, 'Harmful Algal Blooms' (HAB), recognising that, because a wide range of organisms is involved and some species have toxic effects at low cell densities, not all HABs are 'algal' and not all occur as 'blooms'

What are the negative effects of Harmful Algae?

- Fish kills and contaminated seafood
- Toxic effects on humans
- Aesthetic problems affecting tourism
- Marine ecosystem impact
- Technical barriers to seafood trade

Occurrences of harmful microalgae in marine or brackish waters can cause fish kills, contaminate seafood with toxins, and alter ecosystems in ways that humans perceive as harmful. A broad classification of harmful algae distinguishes two groups of organisms: the toxin producers, which can contaminate seafood or kill other organisms, and the high-

biomass producers, which can cause anoxia and indiscriminate destruction of marine life after reaching dense concentrations. Some HABs have characteristics of both. Although HABs are natural and occurred long before human activities began to transform coastal ecosystems, reporting from affected regions on economic losses and intoxication of humans demonstrates that there has been a significant increase in the impacts of HABs over the last few decades and that the HAB problem is now widespread, and serious. However, the harmful effects extend beyond direct economic losses and impacts on human health. When HABs contaminate or destroy coastal resources, the functioning of coastal ecosystems is impaired, the livelihoods of local residents are threatened and the sustenance of human populations is compromised.

Some algal toxins are extremely potent and may be several times more toxic than, for example, cobra venom, and more than a thousand times more toxic than cyanide. At least six human syndromes are presently recognized to be caused by consumption of seafood which is contaminated with algal toxins:

- Amnesic Shellfish Poisoning - ASP
- Ciguatera Fish Poisoning - CFP
- Diarrhetic Shellfish Poisoning - DSP
- Neurotoxic Shellfish Poisoning - NSP
- Paralytic Shellfish Poisoning - PSP
- Azaspiracid Poisoning - AZP

Some of these syndromes can be fatal. There is currently no international record of the number of incidents of human intoxication caused by contaminated seafood. Many cases and even fatalities are thought to pass undiagnosed and hence unreported in the official statistics. In addition to posing serious health risks to consumers of seafood, some microalgae may have devastating effects on fish and other marine organisms, both in the wild and in aquaculture. Species of microalgae belonging to different taxonomic groups can produce toxins which damage fish gills by haemolytic effects. This has resulted in extensive fish kills with major economic losses. Additional losses may be inferred due to loss of confidence in seafood products by consumers. In coastal areas where tourism is important to the local or national economy, the loss of aesthetic quality due to microalgae proliferations may have severe impacts. HAB species are also of concern as potential invasive species when transported with ballast of ships or aquaculture stocks.

HABs in the broader context

The IOC addresses the issue of harmful algae and their effects in the broader context of marine research and management.

Integrated coastal area management and nutrient loading to the coastal environment

Improved understanding of population dynamics of harmful marine microalgae, modelling capabilities of harmful marine microalgal events, as well as improved capability to model and link global patterns of nutrient input to coastal ecosystem effects in Large Marine Ecosystems, contributes to the overall goal of the IOC to achieve healthier ocean ecosystems and sustainable coastal and ocean environments by means of development and diffusion of scientific research, better information and procedures on which policies can be based.

Global observing systems

The Intergovernmental Panel on HAB works closely with the Intergovernmental Panel for the Global Ocean Observing System (GOOS) on the inclusion of HAB observations in Coastal GOOS and through proactive interaction with the Regional Alliances of GOOS on strengthened HAB monitoring and management.

Climate change

With regard to the impact of climate change on the marine ecosystem, the IOC-SCOR Global Ecology and Oceanography Programme (GEOHAB) facilitates basic research in the factors that control HAB events and are thus giving answers to how the occurrence of HAB may change as climate change influence fundamental controlling factors from e.g. temperature, Ph, nutrient access, to hydrography.

Food safety

Through a Task Team on Marine Biotoxins, the IOC interacts with sister UN agencies FAO and WHO in the area of food safety to provide guidance on marine biotoxin test methods, toxicology and management. Enhancing capacity to monitor and manage HABs is a precondition to seafood safety and is offered via training opportunities, manuals and guides for national agencies responsible for regulatory control of marine biotoxins and seafood safety.

How is IOC IPHAB assisting Member States?

The IOC is working with the issue of harmful algae in the context of coastal management, protection of public health, wild and farmed fish and shellfish resource protection, livelihood of coastal populations, tourism, eutrophication, and climate change.

In 1992, IOC established a programme with the overall goal of assisting member states in mitigating the effects of harmful algae. This was in recognition that no single country held the expertise to understand the mechanisms underlying the occurrence of harmful algae and that to build own capacity for research and management many countries need to develop collaborative links.

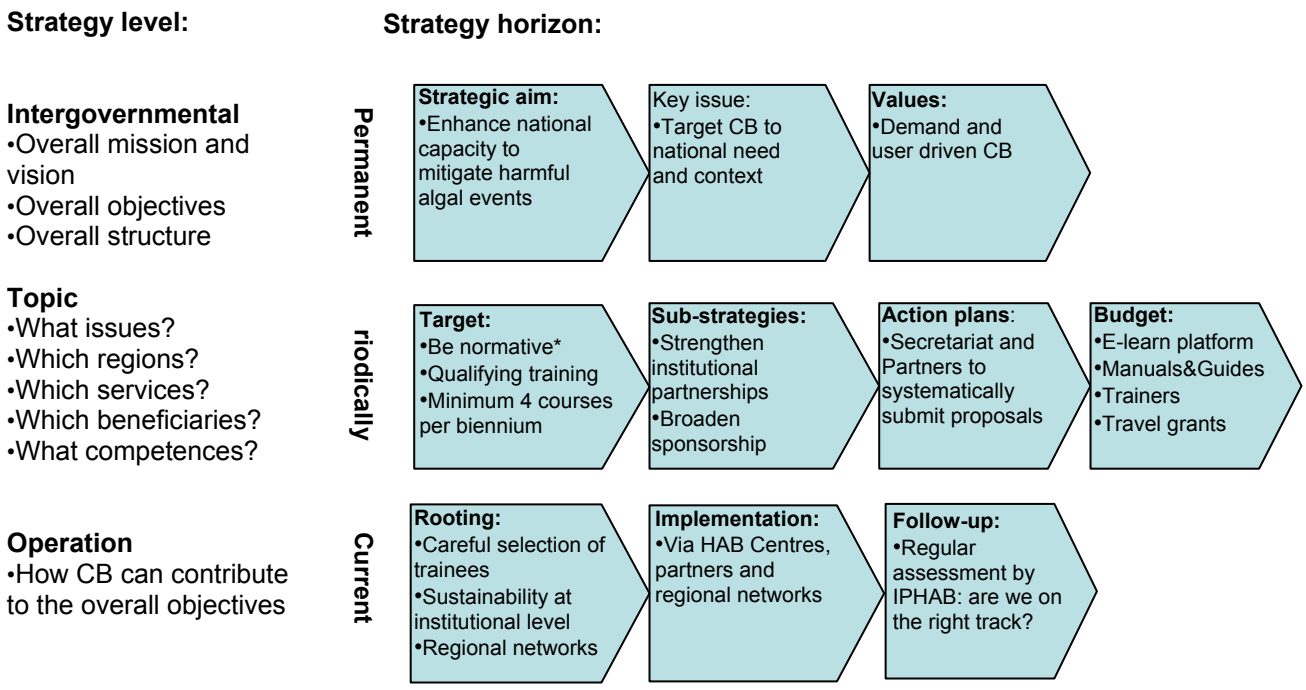
The Programme is supervised and guided by the IOC Intergovernmental Panel on Harmful Algal Blooms (IPHAB). The IPHAB is composed of IOC Member State representatives and identifies priorities and resources for the implementation of the Programme.

Within the Medium Term Strategy of the IOC for 2008-2013 and the overall trans-disciplinary Harmful Algal Bloom Programme Plan, the IPHAB focuses on four priorities:

- Training, capacity building and networks for enhanced knowledge and mitigation
- International cooperative research on bloom dynamics, modelling and forecasting
- An authoritative integrated harmful algal information system

The IOC HAB Programme operates in close cooperation with national institutions and relevant organizations, in particular the Scientific Committee on Oceanic Research (SCOR) the International Council for Exploration of the Sea (ICES), and the North Pacific Marine Science Organization (PICES).

HAB TRAINING, CAPACITY BUILDING AND NETWORK STRATEGY – levels and horizons



The over all plan, with vision, objectives, topics and operation, for HAB training capacity building and networks is described in the 'HAB Training and Capacity Enhancement Programme' as adopted by IPHAB-VI. The Programme is composed of 4 main modules on species identification, toxin chemistry and toxicology, design of monitoring, and management.

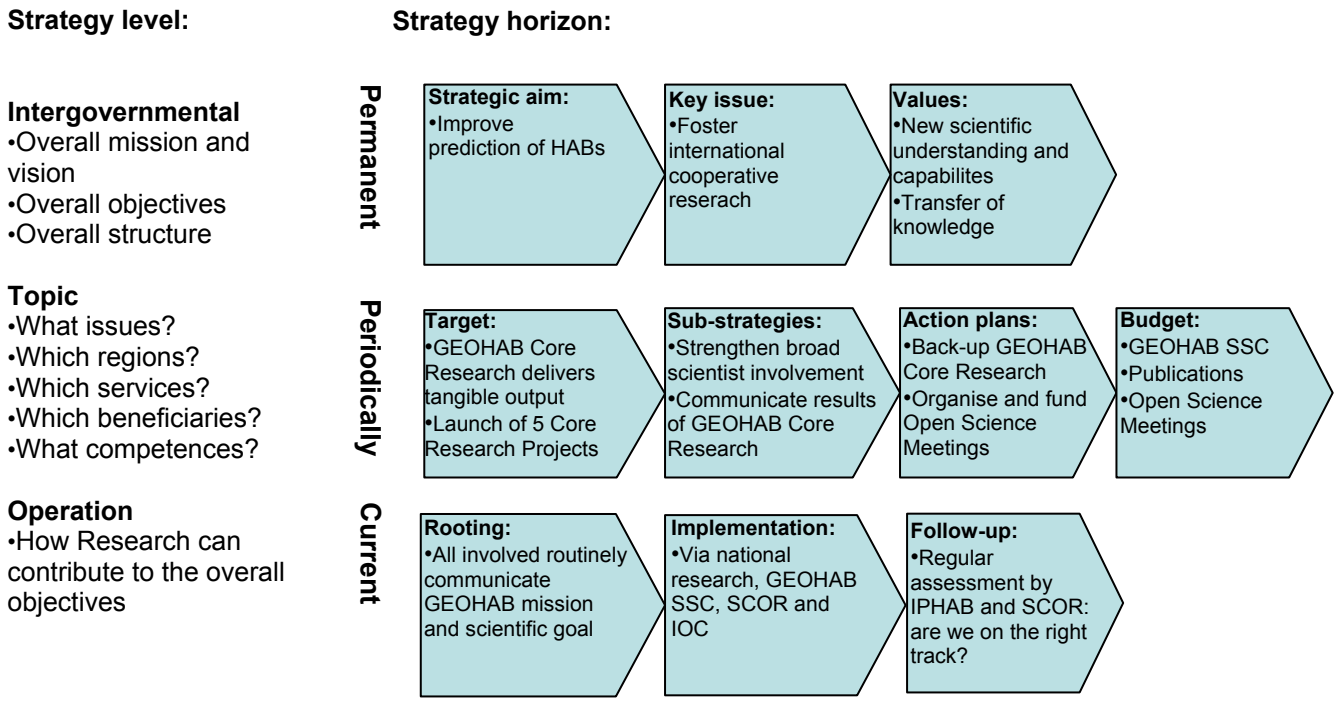
Explanatory notes to strategic model:

Strategic aim: What will we do for Member States?
Key issue: What do we have to be good at?
Values: What should characterize our work?

Target: What is most important to achieve in the period?
*Normative: Set standards and or procedures for relevant HAB training; develop concepts, manuals, guides.
Sub-strategies: How do we reach targets, what actions do we take?
Action Plans: What shall we do, who and when?
Budget: How will we spend the money?

Rooting: How to achieve understanding for and ownership of strategy?
Implementation: How to do it?
Follow-up: Are we on the right track?

INTERNATIONAL COOPERATIVE HAB RESEARCH STRATEGY – levels and horizons



The over all plan, with vision, mission, objectives, topics and operation, for international cooperative research on HAB is described in the Science and Implementation Plans for the SCOR-IOC Global Ecology and Oceanography of Harmful Algal Blooms Programme GEOHAB (www.geohab.info). The GEOHAB Programme is composed of 5 programme elements on upwelling systems, eutrophication, stratified systems and fjords & coastal embayments, and is implemented through a number of Core Research Projects.

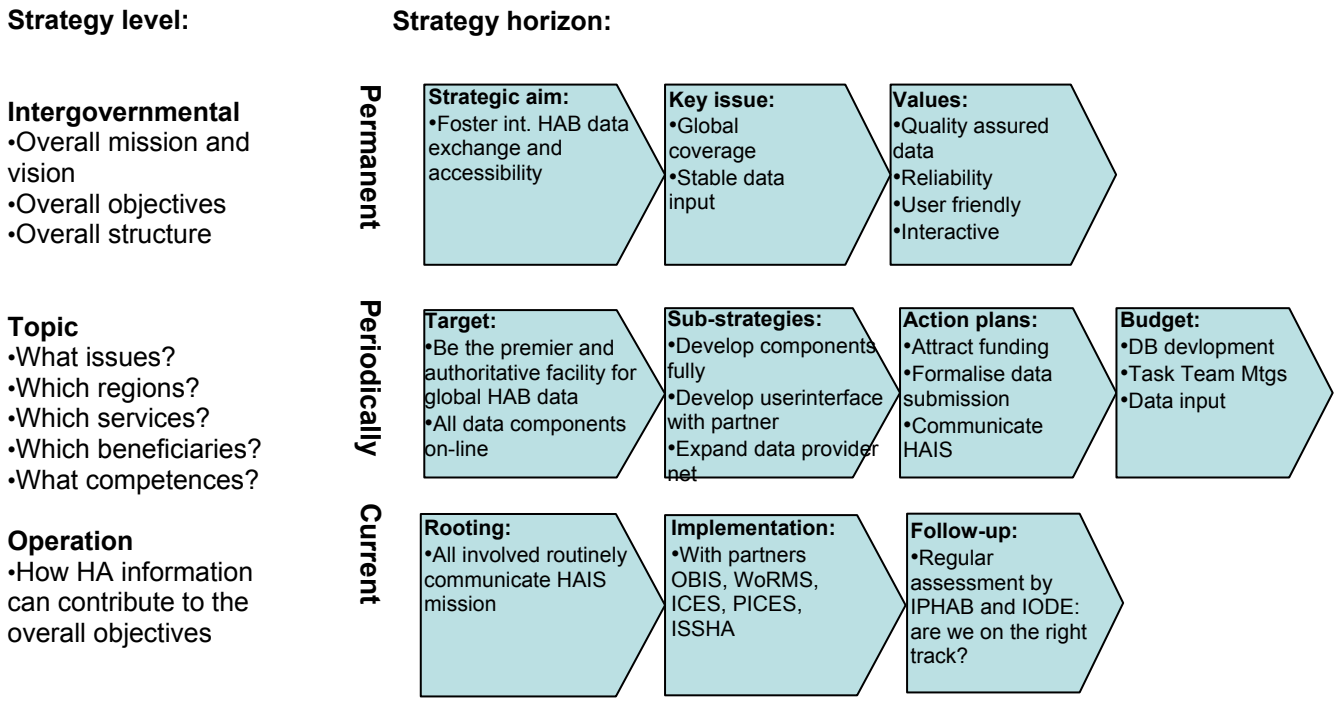
Explanatory notes to strategic model:

Strategic aim: What will we do for Member States?
Key issue: What do we have to be good at?
Values: What should characterize our work?

Target: What is most important to achieve in the period?
Sub-strategies: How do we reach targets, what actions do we take?
Action Plans: What shall we do, who and when?
Budget: How will we spend the money?

Rooting: How to achieve understanding for and ownership of strategy?
Implementation: How to do it?
Follow-up: Are we on the right track?

Harmful Algal Information Strategy– levels and horizons



The over all strategy, with vision, objectives, topics and operation, for an authoritative integrated harmful algal information system is described in the Plan for the IPHAB-IODE Harmful Algal Information System (HAIS). The HAIS system is composed of 5 data elements on HAB species biogeography, HAB events, HAB species taxonomy, HAB monitoring practices, and a HAB expertise roster.

Explanatory notes to strategic model:

Strategic aim: What will we do for Member States?
Key issue: What do we have to be good at?
Values: What should characterize our work?

Target: What is most important to achieve in the period?
Sub-strategies: How do we reach targets, what actions do we take?
Action Plans: What shall we do, who and when?
Budget: How will we spend the money?

Rooting: How to achieve understanding for and ownership of strategy?
Implementation: How to do it?
Follow-up: Are we on the right track?

Beneficiaries and stakeholders

The immediate beneficiaries of the activities of the programme are

- institutions with regulatory responsibilities in relation to seafood safety, biotoxin monitoring, human or ecosystem health, or environmental monitoring;
- institutions and industries implementing HAB and biotoxin monitoring;
- research teams working on the dynamics, modelling and forecasting of harmful algal events
- the individual decision maker, manager, scientist or specialist benefiting from information, data and networks activities.

The enhanced capacity of these immediate beneficiaries contributes to the capability of economies, governments and fishery, seafood trade, tourism etc industry to manage and mitigate the effects of harmful algae.

The true stakeholders in international cooperation on harmful algae are thus a broad section of society that depend on, or interact with, marine resources and the marine environment.

Ownership and contributions

The IOC strives to ensure governmental and institutional ownership of the activities initiated and coordinated by the IOC and of the concerted action in and among Member States and individual stakeholders. Such ownership and the associated engagement and contribution are essential for successful international cooperation. Examples of how various stakeholders contribute are:

Stakeholder	**Can contribute and benefit by:**
Governments	• participation in IPHAB • financial support • in-kind sponsorship and hosting of activities • dissemination of IOC information and news to national institutions and private sector
Institutions	• Involvement, funding and participation in research programmes, working groups, regional networks and support to their staff for participating actively. • Financial support to specific activities. • in-kind sponsorship and hosting of activities • provide viewpoints and feedback on IOC activities to their Governments (IOC National Committees)

Stakeholder	Can contribute and benefit by:
Private sector	• Partnerships in implementation of capacity building and research activities • Sponsorship of activities in return for visibility and acknowledgement
Research teams	• Collaboration in research programmes, working groups, regional networks
Individual scientists, experts, managers	• Actively participate in working groups, research programme, workshops, networks, subscribe to Harmful Algae News and provide feedback inside their organisations and to their leaders about IOC cooperation and activities

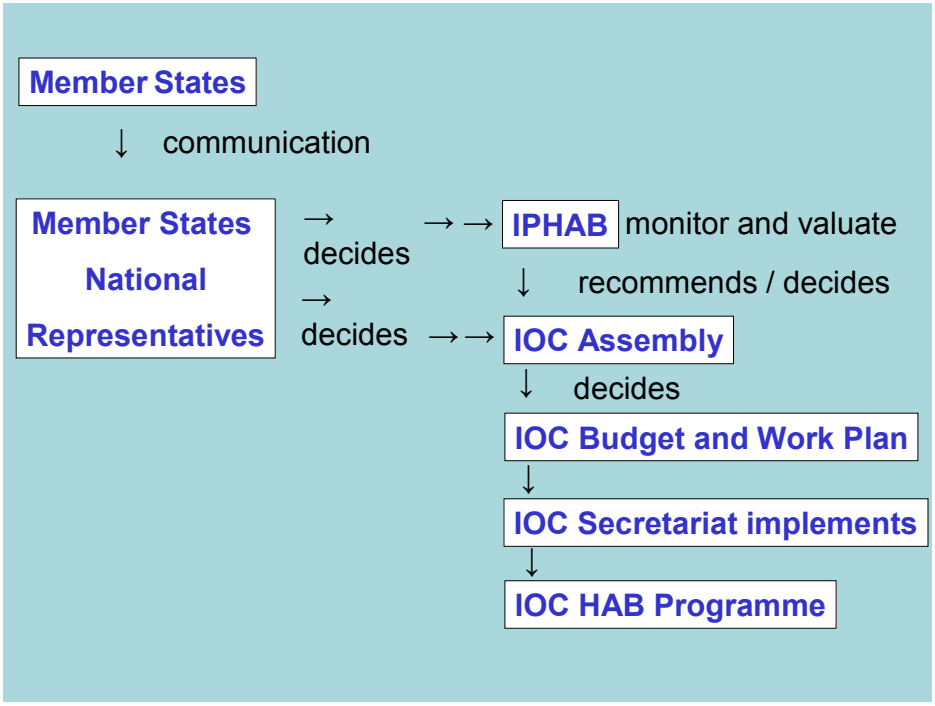
Implementation strategy: science and communication centre and regional networks

The IOC is implementing its HAB activities through an IOC Science and Communication Centre on Harmful Algae. The Centre is composed of a main unit hosted at University of Copenhagen, Denmark, and a complementary unit hosted at the Spanish Institute of Oceanography in Vigo. The Centre also consists of a consortium of national institutions that have committed to take on responsibility for and contribute to, the implementation of the activities. In this way, IOC Member States actively contribute to international cooperation and at the same time achieve a deep rooting of the IOC programme at the institutional level. An equally important mechanism for implementation and concerted action is the IOC regional networks and working groups on harmful algae established in the Caribbean, South America, Western Pacific, North Africa and North Atlantic.

Metrics of impact assessment

The achievements of the IOC HAB Programme are reviewed and valuated every second year by the IOC Intergovernmental Panel on HAB. The Panel assess needs, decide on priorities and identify funding or funding opportunities.

At a higher level the achievements are assessed by the IOC Assembly every second year and as a part of IOC achievements by the UNESCO General Conference every second year. This assessment and the feed back from Member Sates are taken as an indication of the impact of activities at the national level. Particular attention is given to the effects that the accomplishments have had in e.g. facilitating international trade, monitoring practices, focus of national and regional research agendas, and the extend to which concerted action among Member States has occurred.



Achivements and planned deliverables

Training, Capacity Building and Networks

Acheivements:

The IOC has jointly with national institutional partners trained more than 600 individuals from countries all over the world who need to enhance their capabilities to monitor and manage harmful algal events. In particular the IOC offers international training courses in harmful algal identification and toxicity testing. The courses are delivered by experts from leading research institutions world wide. The courses are open to applications from all qualified individuals, but priority is given to those charged with HAB monitoring and management in developing countries. The Courses have become recognised as a form of qualification in some Member Sates and since 2006 the courses in identification are upon passed examination giving certification in identification.

To facilitate knowledge exchange and regional cooperation, the IOC has established networks of professionals in five IOC regions which focus on training, expert assistance, exchange of information, planning of coordinating activities, inter-calibration as well as cooperative research projects.

- ANCA: Grupo COI sobre Algas Nocivas en el Caribe
- FANSA: Grupo COI sobre Floraciones de Algas Nocivas en Sudamerica
- HANA: The IOC North African Network on Harmful Algal Blooms.
- WESTPAC/HAB: Western Pacific Working Group on HAB
- WGHABD: Joint ICES-IOC Working Group on HAB Dynamic

As part of a global network support the IOC publish a newsletter HARMFUL ALGAE NEWS. It reports HAB events around the globe, ongoing research activities, training courses and workshops, publications and relevant announcements. The printed version of the newsletter has more than 2000 subscribers and is free of charge. Harmful Algae News and subscription requests are also available on the IOC HAB website.

The IOC and UNESCO has published and co-published a number of comprehensive manuals and guides to research and management of harmful algae. The 'Manual on Harmful Microalgae' in the series UNESCO Monographs on Oceanographic Methodology is a comprehensive manual on methodologies, identification, toxicity and toxin analysis, monitoring and management of harmful algae. In the same series is a Monograph on "Real-time Coastal Observing Systems for Marine Ecosystem Dynamics and Harmful Algal Blooms: Theory, Instrumentation and Modelling".

Planned deliverables 2008-2013:

The priorities for 2008-2013 are to further develop the series of training courses and to match course content with the needs of research and management institutions in Member States. The platform is extensive use of e-learning and the partner agreements with a number of national institutions with internationally recognised expertise in HAB. The IOC Science and Communication Centres on HAB will continue to facilitate and implement cooperative research projects to enhance research capacity in developing countries.

The regional networks are self driven, and their continuity depends on the initiative of the participating institutions. IOC will strive to provide seed funding for activities.

Manuals and guides will be developed to serve the needs of international research programmes as well as to fill gaps in relation to emerging technologies and application of these to research and routine monitoring for resource protection and/or as part of larger marine observation systems.

Acheivements and planned deliverables

Cooperative Research and Scientific Working Groups

Achivements:

GEOHAB is a joint IOC-SCOR international science programme on the Global Ecology and Oceanography of Harmful Algal Blooms. It is a programme designed to coordinate research and cooperation to develop international capabilities for assessment, prediction and mitigation of harmful algal events. The mission of GEOHAB is to foster international cooperative research on HABs in ecosystems sharing common features to facilitate the comparison of the key species involved and the oceanographic processes that influence their population dynamics.

The scientific goal of GEOHAB is to improve prediction of HABs by determining the ecological and oceanographic mechanisms underlying the population dynamics of harmful algae, integrating biological, chemical and physical studies which are supported by enhanced observation and modelling systems. Thus, the key problem is to understand the critical features and mechanisms underlying the population dynamics of HAB species in a variety of oceanographic regimes. This understanding can be used as a basis for monitoring and predicting the occurrence, movement, toxicity, and environmental effects of HABs. In turn, monitoring and prediction are essential for management and mitigation of HABs.

The ICES-IOC Working Group on Harmful Algal Bloom Dynamics has been established to focus on the physical, chemical and biological interactions associated with harmful algal blooms, and provides technical advice to ICES and IOC e.g. upon request from IPHAB. The Group also collects and assesses national HAB event reports, maps HAB events and summarises the information in the harmful algae event database on a regional, temporal and species basis.

The IOC is jointly with ICES and IMO improving the knowledgebase for control of harmful organisms and pathogens in ballast water. The ICES-IOC-IMO Working Group on Ballast of Ships and other Vectors critically reviews and reports 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. Also, the group continuously review shipping vectors, prepares a Ballast Water Sampling Manual and works on a draft Code of Best Practice for the Management of Ships Hull Fouling and a Code of Best Practice for Port Sampling.

Planned deliverables 2008-2013:

GEOHAB is in the period of implementation and delivery of results. The GEOHAB Scientific Steering Committee will implement the GEOHAB Core Research Projects, organise framework activities for both Core research and GEOHAB affiliated national research, and will synthesise research results.

IOC will continue to co-sponsor the ICES-IOC Working Group on Harmful Algal Bloom Dynamics as a mechanism to review critical research issues, as a feed back mechanism for GEOHAB and to compile data for the Harmful Algae Information System.

The IOC will continue to cosponsor the ICES-IOC-IMO Working Group on Ballast of Ships and other Vectors until finalisation of the draft manuals and codes of practice, expectedly by the entry into force of the IMO Ballast Water Convention.

Acheivements and planned deliverables

Data products for research and management

Achivements:

A data base has been established on harmful algal events as an on-line system in cooperation with the International Council for the Exploration of the Sea (ICES) and the North Pacific Marine Science Organisation (PICES) and is gradually being expanded to cover the entire globe. It provides a structure for data storage that allows easy integration of data, efficient search tools, and the possibility of conducting data analysis. Another data compilation is a meta-database with information on the design and implementation of harmful algae monitoring and management systems from all over the world, and there is an on-line international directory of experts in harmful algae and their effects on fisheries and public health. As the common backbone for the data products is the IOC Taxonomic Reference List of Toxic Plankton Algae.

Planned deliverables 2008–2013:

With respect to data products work will be initiated in 2008 to integrate and expand the existing data products into a Harmful Algae Information System (HAIS). This system will be developed as a joint activity with the International Oceanographic Data exchange Programme (IODE) of the IOC and in partnership with ICES, PICES, ISSHA, and OBIS.

ANNEX XVI

IOC-IPHAB RECOMMENDED PROCEDURES FOR AUTOMATED AND SEMI-AUTOMATED HAB-MONITORING AND FORECASTING WITHIN THE GLOBAL OCEAN OBSERVING SYSTEM

IOC-IPHAB recommended procedures for automated and semi-automated HAB-monitoring and forecasting within the Global Ocean Observing System

About this document

At the VIIIth meeting of the International Panel on Harmful Algal Blooms, Intergovernmental Oceanographic Commission in Paris, France, a resolution about *Implementation of HAB monitoring within the Global Ocean Observing System* was made (resolution IPHAB-VIII.2). This was accepted by the IOC in 2007. The present document constitute the advice from the *IPHAB Task Team on HAB Observations and Forecasting Systems* to the *Global Ocean Observing System,* in particular to the Panel for Integrated Coastal Observations (PICO), a technical subcommittee of the GOOS Scientific Steering Committee.

Version history

Draft 1 of document
Distributed at the IOC-ICES-WGHABD in Galway, Ireland, 10-13 March, 2008

Draft 2 of document
Distributed at the GEOHAB SSC meeting in Annapolis, Maryland, USA, 10 April 2008

Draft 3b of document
Distributed to the *IPHAB Task Team on HAB Observations and Forecasting Systems* and the *IOC/ICES-WGHABD* 9 April 2009
Prepared by Bengt Karlson after advice from participants of the meeting of the ICES/IOC Working Group on Harmful Algal Bloom Dynamics, Punta Umbria, Spain, 30 March – 3 April, 2009

Version 1
20 April, 2009
Prepared by Bengt Karlson after advice from Task Team members.
Presented at IPHAB IX 23 April, 2009

Version 1.1 (this document)
Updated by Bengt Karlson after advice from IPHAB
Accepted by IPHAB IX 24 April, 2009

Contact information

Bengt Karlson (chair of Task Team)
Swedish Meteorological and Hydrological Institute
Research & Development, Oceanography
Sven Källfelts gata 15
SE-426 71 Västra Frölunda
Sweden
E-mail: bengt.karlson@smhi.se
Phone: +46 (0)31 751 8958
Fax: +46 (0)31 751 8980
Cell phone: +46 (0)733-46 76 74

IOC-IPHAB recommended procedures for automated and semi-automated HAB-monitoring and forecasting within the Global Ocean Observing System

Operational requirements

The procedures included are those that may produce results in near real time. A common definition for real time data is data that is accessible within 1 hour after measurement. This applies to many but not all methods included in this document. Data made available within 24 hours of measurement or later may also be useful for operational HAB observations and forecasts within the Global Ocean Observing System.

Acronyms and definitions

Adaptive sampling - an example of adaptive sampling is when water sampling is automatically triggered by a signal of high night-timechlorophyll fluorescence indicating a high biomass of algae.

GEOHAB = The Global Ecology and Oceanography of Harmful Algal Blooms, a SCOR/IPHAB programme

GOOS = The IOC programme Global Ocean Observing System

HAB = Harmful Algal Bloom

ICES = International Council for the Exploration of the Seas (North Atlantic)

IOC HAB Programme = The IOC Harmful Algal Bloom Programme

PICO = Panel for Integrated Coastal Observations, a technical subcommittee of the GOOS Scientific Steering Committee.

SCOR = Scientific Committee on Oceanic Research

WGHABD = ICES/IOC Working Group on Harmful Algal Bloom Dynamics

Harmful Algal Blooms

Most algal blooms are natural phenomena and cause no harm and indeed the growth of phytoplankton is the base of the major part of the marine food web. However, some algae are harmful and Harmful Algal Blooms (HABs) are of concern since they may affect human health, fisheries and aquaculture as well as large parts of marine ecosystems. Harmful algae include species that produce toxins that may accumulate through the food web starting with filter feeders (e.g. mussels). Fish killing species and species causing nuisance blooms (e.g. foam on beaches) are also included in the term harmful algae. Harmful effects of blooms of microalgae such as hypoxia due to eutrophication or upwelling resulting in high algal growth is also included. Some HABs have direct effects (clogging of filters) on industries such as desalination plants. It should be noted that most harmful algae only constitute a small part of the total phytoplankton biomass while they may still cause harm. A few hundred cells per litre of sea water may be enough to cause lethal toxicity in shellfish. The term low biomass blooms are used for these types of HABs in this document. Other harmful algae grow to high densities (e.g. several hundred thousand cells per litre or more) and the term high biomass blooms is used for these HABs. It should be noted that chlorophyll, which is a proxy for total phytoplankton biomass, is not an indicator for the presence of harmful algae.

Automated HAB-observations

Only some HABs can be monitored using automated techniques

There is value in monitoring for HAB species occurrence as well as for HAB-toxins/metabolites.

High biomass HABs with properties detectable using automated techniques (e.g. optical signatures) are good examples of cell detection. the following are examples of HABs that may be detected using optical signatures:
A) Blooms of some filamentous cyanobacteria, e.g. *nodularia spumigena* in the Baltic Sea
B) Blooms of the fish killing dinoflagellate *karenia mikimotoi* (e.g. in UK waters)
C) Blooms of the dinoflagellate *karenia brevis*, that form toxic blooms in the gulf of Mexico.

Low biomass HABs can be detected in rare cases with optical techniques (e.g. automated image analyses of morphologically distinct species) but other less distinct forms require molecular techniques for cell detection.

Algal toxins can be measured in plankton or water samples using new analytical techniques, some of which are being miniaturised and automated.

Instruments for automated *in situ* cell and toxin detection are still under development and thus are not available commercially, although this will change within a few years.

The observing system should be designed to detect the HAB species that occur within a given region. No single system will work in all areas.

The observing system should be designed with sufficient spatial (horizontal and vertical) resolution to capture the time-space evolution of habs and associated environmental conditions. This can best be accomplished with scientists who know the local oceanographic conditions such as stratification, currents, etc.

A combination of automated *in situ* measurements, remote sensing, automated sampling and adaptive sampling from research vessels is recommended for most circumstances.

Some HAB detecting systems require significant power and bandwidth. These will require cabled configurations and/or special hardware installations. in time these instruments will be miniaturized and easier to deploy but it is essential to deploy such instruments on test platforms at an early stage.

Some HABs develop in “hot spots” and in these cases HAB observing systems can be positioned there instead of attempting to achieve full areal coverage.

***In situ* systems**

***In situ* systems include:**
Sensors on buoys

Sensors on permanent structures, e.g. piles, wind mill masts, oil platforms and bridges

Sensors on AUV, autonomous underwater vehicles (gliders and powered vehicles)

Sensors on drifting profilers, e.g. Argo-type floats

Towed sensors, e.g. undulating oceanographic recorders

Sensors in flow-through systems on research vessels, voluntary observing ships (VOS), ships of opportunity etc. These systems, often called FerryBox-systems, only sample near surface water while many HABs are found deeper down.

Minimum set of parameters

Phytoplankton biomass proxy, i.e. night-time chlorophyll fluorescence

Turbidity

Salinity

Temperature

Specific HAB sensor if available (based on e.g. specific optical signature, molecular techniques or *in situ* flow cytometers with optical image analysis)

Sensors should be distributed in depth according to the local occurrence of HAB'S.
In areas where HABs occur in sub surface layers sensors should be mounted on depth profiling platforms

Depth resolution for depth profiling platforms should be 25 cm or better, so as to be able to detect HABs aggregated in fine structures (fine layers).

Sampling frequency should be adapted to the spatial and temporal HAB-distribution in the area, if the HAB-species often occur in hot spots these should be monitored with greater temporal resolution.
Minimum frequency is once a day

Recommended frequency is every 1-3 hours

In Ferry Box systems recommended horizontal frequency is 200 m or better.

Arrangements should be made for adaptive sampling triggered from data provided by *in situ* sensors.

Quality assurance and quality control of data collected should be documented
Reference water sampling and analyses of reference samples is an essential part of automated
HAB-monitoring. Here follows some examples:

a) Microscopy for cell counts and HAB species identification (also molecular methods may be included)
b) Phytoplankton pigment analysis using laboratory fluorometry or spectrophotometry, ideally combined with High Performance Liquid Chromatography
c) Some automated instruments can archive samples for quality assurance.

All *in situ* instruments must include anti bio fouling measures adapted to local conditions and the deployment period. Anti bio fouling measures include
Copper shutters covering optical windows

Chlorination

Special coatings of optical windows

Automated cleaning/washing equipment in Ferry Box and other flow through systems

Profiling platforms that spend most of their time in deep water with few fouling organisms

Optical techniques for observing HABs *in situ* include but are not limited to:

Fluorescence

Total phytoplankton biomass can be estimated using *in situ* instruments for measurement of chlorophyll a fluorescence, however quenching of chlorophyll a fluorescence e.g. by sun light should be taken into account and hence:

a) Use only measurements from night (at least 1 h after sunset and 1 h before sunrise)
b) Minimize quenching effect by allowing a period of darkness before measurement

Biomass of phycocyanin containing cyanobacteria can be estimated using *in situ* instruments for measurement of phycocyanin fluorescence. An example of a HAB-organism is *Nodularia spumigena* and other cyanobacteria that co-occur during blooms in the Baltic Sea.

Biomass of phycoerythrin containing organisms can be estimated using *in situ* instruments for measurement of phycoerythrin fluorescence HAB-organisms containing phycoerythrin include:

a) *Dinophysis* spp. (Diarrhetic Shellfish Toxins)
b) some cyanobacteria
c) the photosynthetic ciliate *Myrionecta rubra* (synonym *Mesodinium rubrum*) that is an optimum prey for *Dinophysis* spp. Blooms of *Myrionecta rubra* itself caused fish kills in the Bay of Fundy, Canada and elsewhere.

Absorption and scatterring

Example of a HAB-organism detectable using its absorption characteristics

a) *Karenia brevis* (Brevebuster)
b) *Phaeocystis* spp. (high chl, absorption over broad spectrum without scattering)

Automated image analysis in flow cytometers (e.g. Flowcam and flowcytobot) is useful for certain hab-species with distinctive morphology.

Molecular methods for automated in situ identification of HAB-species

Molecular methods make it possible to identify and quantify hab-organisms at the species or even at the strain level. Probes may also be directly targeted at genes controlling toxicity.

Molecular methods are being implemented in automated in situ laboratories. At least one system will be available commercially within a few years.

Both antibody and dna-based methods must be verified with local populations of hab-species

Many different types of molecular based assays are under development, ranging from quantitative pcr to sandwich hybridisation and surface plasmon resonance.

In situ sensors for detecting algal bloom physiological processes

These sensors do not give specific information about harmful algae but may contribute to the understanding of high biomass bloom dynamics. Bio fouling protection is essential as for all *in situ* sensors.

Oxygen sensors may give and indirect measure of photosynthetic activity minus respiration
Examples
a) Optode based oxygen sensor
b) Other oxygen sensors

Sensors for some specific fluorescence parameters may give information related to primary productivity

Examples:

a) Fast repetition rate fluorometers
b) Fluorometers aimed at fluorescence induction and relaxation

Remote sensing systems

Remote sensing systems for ocean colour estimate total phytoplankton chlorophyll-a in near surface water. In some cases, e.g. *Karenia brevis* in the Gulf of Mexico, a good "climatology" exists for HABs and their expression in the chlorophyll field. Many HABs occur deeper down and only a few HAB organisms have optical signatures detectable by remote sensing that can be used to differentiate them from phytoplankton in general. Detection using optical sensors on satellites is often restricted by cloud cover. Despite these limitations, remote sensing detection and monitoring of HABs may be very useful in some circumstances. The advantages are that remote sensing systems can observe over large areas on a regular basis and so can detect rapid increases in chlorophyll-a that can be targeted with *in situ* sampling. Remote sensing of currents and coastal upwelling/downwelling cycles through ocean colour, SST and altimetry observations can show how an algal bloom is advected, say, inshore or into neighbouring waters; these observations also provide valuable input to assimilate or update physical and / or ecosystem models. Remote sensing systems for HAB-observations include Sensors on satellites.

Airborne systems
In air observations from ships, buoys and masts

PARAMETERS USEFUL FOR HAB-OBSERVATIONS FROM REMOTE SENSING INCLUDE

Chlorophyll a
Turbidity
Some algae-group specific algorithms, e.g. for certain cyanobacteria
Sea Surface Temperature (SST), e.g. for detection of specific water masses and advection processes

REMOTE SENSING SYSTEMS SHOULD BE COMBINED WITH *IN SITU* SYSTEMS TO ENSURE THAT NON SURFACE BLOOMS ARE INCLUDED IN OBSERVATIONS

QUALITY ASSURANCE AND QUALITY CONTROL OF DATA COLLECTED SHOULD BE DOCUMENTED

Reference measurements (sea truth) are an essential part of automated HAB-monitoring using remote sensing

- a combination of reference measurements from automated *in situ* systems and reference sampling from ships is recommended
- cell counts and identification of HAB-species using microscopy or molecular methods should be part of the quality control and assurance procedure
- phytoplankton pigment analysis using laboratory fluorometry or spectrophotometry ideally combined with High Performance Liquid Chromatography may also be part of the quality control and assurance procedure

HAB-forecasting systems

Short term HAB forecasting models are most often driven (forced) by the same type of physical meteorological models that produce weather forecasts. The maximum length of these forecasts, often 5-10 days, also limit the range of HAB forecasts.This could be lengthened if observing systems could be placed in the (known) path of the bloom, upstream of the point of impact. To be able to model HAB development a basic requirement is that the HAB species possess properties that can be used to differentiate it from other phytoplankters.

These properties must be described in mathematical terms. The existing HAB forecast models can be divided in three main types:

a) transport models, e.g. the use of drift models for prediction of movements of surface HABs
b) biogeochemical models for predicting some high biomass HABs
c) Lagrangian models ~ particle based models specifically designed for HAB-species

Forecasting systems should be combined with observation systems

Assimilation of data from observation systems is an integrated

Part in forecasting systems

Quality assurance and quality control of forecasts should be documented

Models:

a) Equations and algorithms should be published scientifically
b) Computer program code should be documented
c) It is recommended that computer program code is made available to the scientific community as open source software.

Validation of model results

a) Reference measurements from *in situ* observation systems should be used for validation of forecasts. Skill assessments are essential.

HAB-warnings

Warnings must be based on best available knowledge, derived from a combination of observations, forecasts and expert knowledge.

GOOS Regional alliances identified for the first HAB observation and forecasting systems

One of the activities of the Task Team is to *identify regional locations where the first HAB observation and forecasting systems should be implemented.* A large part of the infrastructure needed should already be in place. The following is a list of GOOS regional alliances and the regional locations that the Task Team has identified:

EUROGOOS

BOOS - Baltic Sea Operational Oceanographic System
examples:
a) blooms of HAB-cyanobacteria

NOOS - North West Shelf Operational Oceanographic System
examples:
a) Skagerrak-Kattegat blooms of fish killing flagellates, e.g. *Pseudochattonella farcimen*.
b) Scottish waters with blooms of the fish killing dinoflagellate *Karenia mikimotoi*

IBI-ROOS - Iberia-Biscay-Ireland Regional Operational Oceanographic System
examples:
a) Blooms of *Dinophysis* spp. in Galician Rias, Irish waters and in the Bay of Biscay.
b) Blooms of *Karenia mikimotoi* in the Bay of Biscay and in Irish waters

Mediterranean GOOS, Northern Adriatic Sea

Black Sea GOOS – No Regional ocation identified

Near - North-East Asian Regional-GOOS
Japan – Seto Inland Sea – several HAB species
Korea – Blooms of *cochlodinium polykrikoides*

PI-GOOS - Pacific Islands Global Ocean Observing System – No regional location identified

Indian Ocean GOOS – No regional location identified

IOCARIBE-GOOS - Global Ocean Observation System in the Caribbean Region – *Karenia Brevis* Blooms in the Gulf of Mexico.

GOOS-AFRICA

Benguela area
Example: High biomass blooms of dinoflagellates cause hypoxia resulting in mortalities of fish and shellfish

US GOOS
Gulf of Mexico Coastal Ocean Observing System (GCOOS)
Example: *Karenia brevis* blooms

North-eastern Regional Association Of Coastal Ocean Observing Systems (NERACOOS) example:
a) *Alexandrium* blooms (PSP) in the Gulf of Maine and in the Bay of Fundy (Canada)

Northwest Association of Networked Ocean Observing Systems (NANOOS)
Example: Blooms of *Pseudo-nitzschia* (ASP) along the west coast of the North American continent.

SEA-GOOS - Southeast Asian GOOS – No regional location identified

Oceatlan - Regional Alliance for the Upper Southwest and Tropical Atlantic – No regional location identified

GRASP - GOOS REGIONAL ALLIANCE FOR THE SOUTH PACIFIC – NO REGIONAL LOCATION IDENTIFIED

ANNEX XVII

GLOBAL PARTNERSHIP ON NUTRIENT MANAGEMENT

Brief Information.

A global partnership of scientists, policy makers, private sector, NGOs and international organisations has been formed to address the growing problem of nutrient over-enrichment. The Partnership will be launched formally on 6 May 2009 at this year's meeting of the UN Commission on Sustainable Development.

Nutrients, such as nitrogen, are a key part of delivering food security and sustainable development. But excess use and inefficient practices leads to nutrient over-enrichment, causing soil acidification and groundwater pollution, harmful algal blooms and dead zones in the sea, and loss of coral and sea grass cover. As a result, marine and coastal ecosystems and the services and livelihoods they support are undermined and the resilience of ecosystems to climate change weakened.

For the benefits of nutrients to be realised effectively, including their contribution to food security, countries need access to improved information and assessment of the multiple and linked impacts of nutrients. Countries also need access to more integrated management approaches, tools and training which address the root causes of over-enrichment, and help prevent the release of excess nutrients. *A global partnership, the GNMP, can help mobilise these changes.*

The Partnership will raise awareness among policy makers about the causes and harmful impacts of over-enrichment, and the benefits of taking action. It will foster engagement by all stakeholders and exchange information and good practice with a view to assisting the delivery of knowledge based, remedial action and training, tailored to the circumstances of developing countries and countries in transition and their associated watersheds and coastal areas. In this way, the Partnership can help countries to engage actively in identifying and implementing cost effective and workable solutions.

Modalities: the GPNM will operate as a voluntary network of organisations and individuals, who are willing to take opportunities and work together on nutrient related activities. Drawing on the work of previous initiatives, the Partnership will provide a web based platform, presenting information on major emission sources and impacts, cross-media transfer of nutrients, environmental costs of over-enrichment, and an identification and analysis of impacts in coastal areas and Large Marine Ecosystems (LMEs. Lessons and practices developed under Global Environment Facility projects as well as nutrient management initiatives by countries and other organizations will be made available through the Partnership platform. The aim is to provide stakeholders with a consolidated source of causal impacts, their costs and future trends, and access to effective tools, approaches and training.

A key focus will be on facilitating implementation partnerships between and within countries. Using the web based information provided by the GPNM, such partnerships involving stakeholders from different countries and disciplines will be able to identify the necessary research, policies, partners, tools and training to make informed on the ground interventions. In turn, information, approaches and lessons learned from these interventions would be made available for all partners for future use.

The GPNM will be a key initiative to help implement the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA), a non

binding multi-lateral environmental agreement addressing the links between watersheds and coastal systems using an ecosystem management approach.

The UNEP/GPA Co-ordination Office, consistent with its role as a facilitator and catalyst for action by countries in relation to implementing the Global Programme, will set in hand initial actions and co-operation, establish an information and activity sharing system, organise meetings, and facilitate implementation partnerships and activities. [Website ref].

Nutrients + Eutrophication and Dead Zones.

Nutrient over-enrichment of coastal waters and Large Marine Ecosystems (LMEs) is an increasing problem worldwide. Key sources of nutrients include: agriculture - in particular through fertilizer leaching, runoff from agricultural fields, manure from concentrated livestock operations and aquaculture - wastewater discharge from sewage and industry, and fossil fuel emissions. These nutrients can enter coastal and marine ecosystems through the air and riverine transport. Increased nutrients, such as nitrogen and phosphorous, can cause phytoplankton and macro algae blooms which can block light and lead to the loss of sub-aquatic vegetation (SAV). This process is known as eutrophication and can lead to fish kills and shellfish poisoning in humans. Eventually, coral reefs can be damaged and species diversity can be substantially reduced. Globally, harmful algae blooms are considerably more widespread and frequent than they were a decade ago, a situation that is expected to further deteriorate by 2020 (GIWA, 2006).

Eutrophication can lead to oxygen depletion (hypoxia) or ‘dead’ zones. Since 1960, when there were 9 documented hypoxic zones, the number of hypoxic areas has doubled every decade. A panel of experts convened under the auspices of the World Resources Institute (WRI) in 2007 identified 415 eutrophic and hypoxic coastal systems worldwide. Of these, 169 are documented hypoxic areas, 233 are areas of concern and 13 are systems in recovery (WRI, 2008). Oxygen depleted zones are now present not only in enclosed seas, such as the Baltic Sea and the Black Sea, but also in large coastal areas which have internationally important fisheries (GIWA, 2006). Eutrophication is likely to intensify in response to the increased application of fertilizers, growth in the aquaculture industry, increasing quantities of human sewage, the generation of nitrogen from fossil fuel combustion, and potentially as a result of global warming (GIWA, 2006).

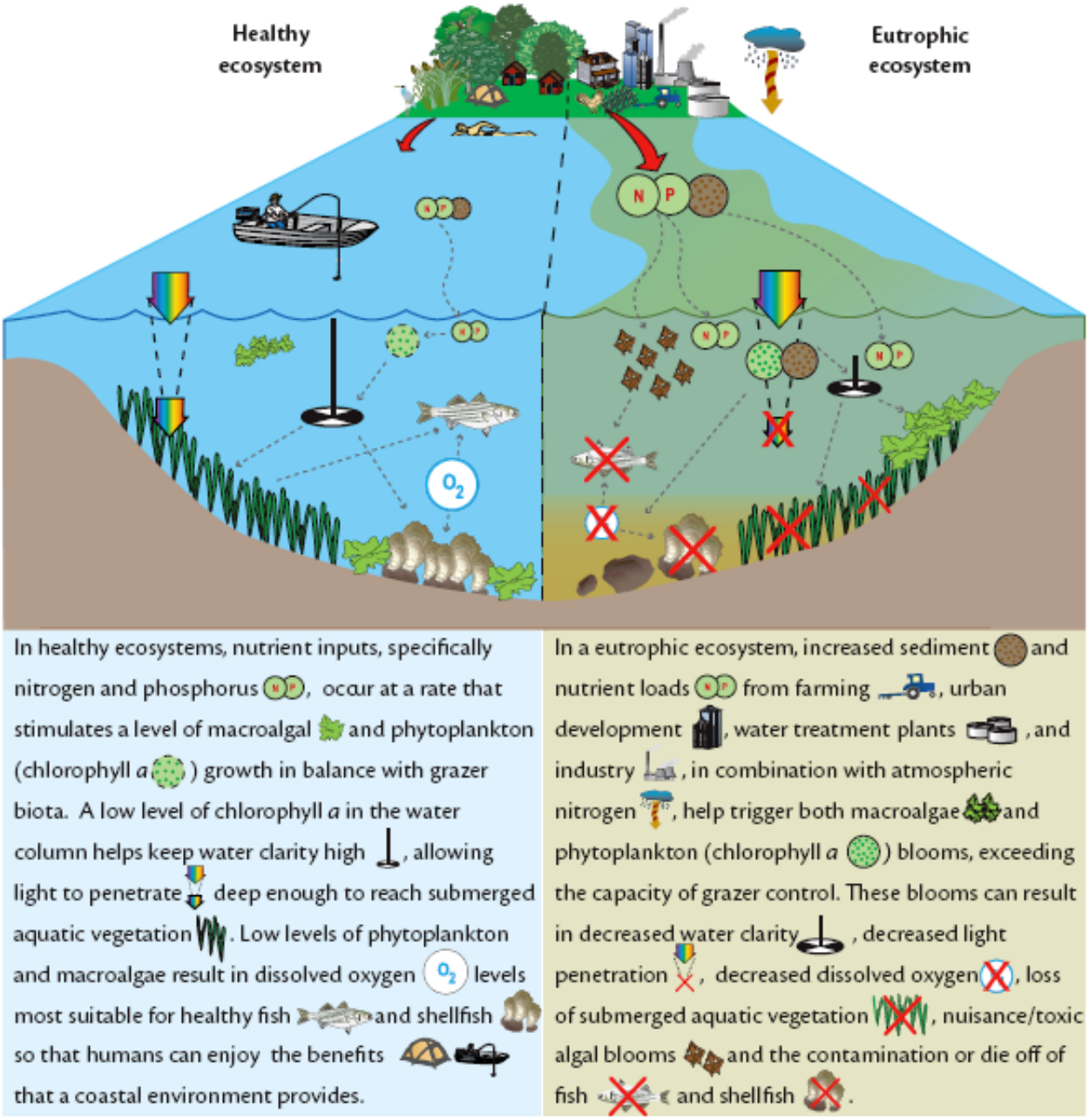


Figure 1: From: Bricker, S., B. Longstaff, W. Dennison, A. Jones, K. Boicourt, C. Wicks and J. Woerner. 2007. Effects of Nutrient Enrichment in the Nation's Estuaries: A Decade of Change, National Estuarine Eutrophication Assessment Update. NOAA Coastal Ocean Program Decision Analysis Series No. 26. National Centers for Coastal Ocean Science, Silver Spring, MD. 322 pp.

The Cascading Effects of Nitrogen

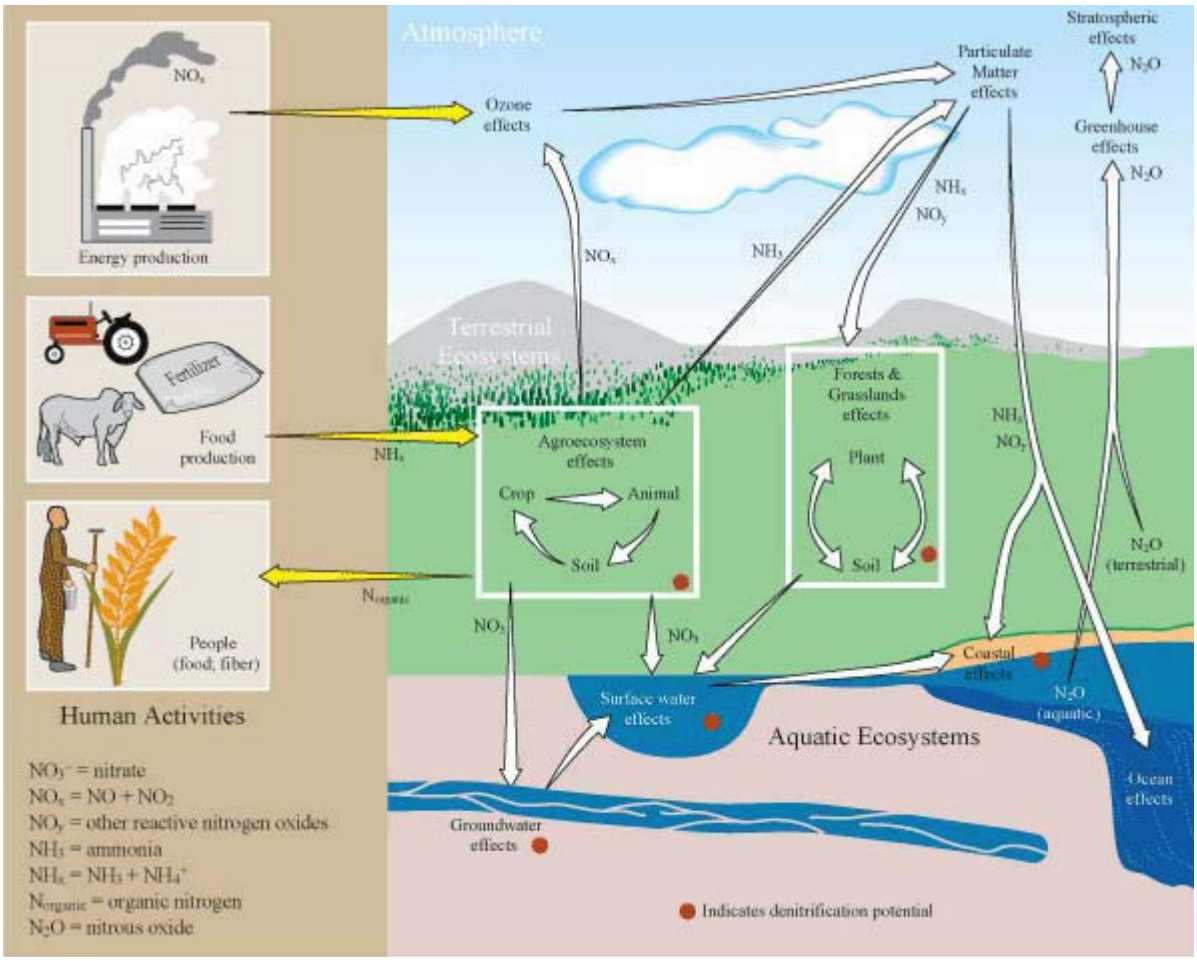
In addition to eutrophication, reactive nitrogen – which entails any form of nitrogen compound active in the environment - can cause a range of other, less obvious harmful impacts.

As the total production of nitrogen from human activities has accelerated, exceeding limits of utilisation and natural processes of conversion, so the global nitrogen cycle has altered. The result - known as the 'nitrogen cascade', is that a single molecule of reactive nitrogen may move through the environmental landscape in a variety of ways and forms. In turn, this can successively lead to a variety of environmental, health and social impacts. For

example, in the air reactive nitrogen can contribute to higher levels of ozone in the lower atmosphere causing respiratory ailments and damaging vegetation. From the atmosphere, the nitrogen generally falls to the surface in atmospheric deposition, generating a series of effects – corrosion of buildings, bridges and other human–made structures, acidification of soils and other water bodies, and inadvertent fertilization of trees and grasslands, creating unnatural growth rates, nutrient imbalances and decreasing or altering of biodiversity. Leaching out into the soils, reactive nitrogen can make groundwater and surface water unfit for human consumption. Once it reaches coastal zones it can cause eutrophication, which can negatively impact fish stocks and biodiversity. Finally, a portion of reactive nitrogen is converted to nitrous oxide, which contributes to both the greenhouse effect and to stratospheric ozone depletion (UNEP/WHRC, 2006).

Given this ability of reactive nitrogen to transform in this way, policy options aimed at addressing a single impact of reactive nitrogen are unlikely to be sufficient, and indeed may result in passing the problem along the line, known as 'pollution swapping'. This illustrates the need for an approach that considers the multiple and linked impacts, and prevents the release of excess nitrogen (UNEP/WHRC, 2006). In this regard, it is important to consider the trade-offs and synergies that can arise between and among ecosystem services and human well-being when developing management options. And it underlines the importance of engaging all stakeholders – including scientists, policy makers and private sector leaders – to foster better understanding of these issues and to actively engage in identifying and implementing workable solutions. A Global Partnership can assist in providing this engagement and act as a catalyst for co-operative, integrated action.

Figure 2: The nitrogen cascade (Source: adaptation)



ANNEX XVIII

INFORMATION ON THE PROBLEMS THE PACIFIC ISLANDS COUNTRIES AND TERROTORIES (PICT) FACE WITH HABS

Harmful Algal Blooms in the Pacific Islands

The Pacific Islands community is characterized by multiple cultures among small populations on hundreds of islands scattered over vast distances across the ocean. The total land area makes up only 2% of the total area of the Pacific Ocean (Rapaport, 1999:367). Twenty two Pacific Island countries and territories[4] manage over 29 million square kilometers of ocean (Rapaport, 1999:367), equivalent to the combined area of Canada, China and the USA.

Harmful Algal Blooms (HABs) have a long history in the Pacific Islands, with reports of this problem recorded by Fernandez da Queiros in 1606 and Captain James Cook in 1776. Some of the species which have been implicated in Pacific Islands HABs include the ciguatera-causing dinoflagellates such as *Gambierdiscus toxicus,* the benthic algae *Prorocentrum lima,* the nuisance algae *Phaeocystis sp.* and the cyanobacteria *Lyngbya majuscula*.

Of these, ciguatera is by far the greatest HAB problem in the Pacific Islands affecting Pacific Island health, economy, livelihoods and food security. Pacific Islanders are one of the highest consumers of seafood in the world with consumption of over 200kg/capita/annum of seafood (Rapaport, 1999:366). However due to the increasing incidence of ciguatera, a study on one island showed that 71% of people are no longer eating local reef fish due to concerns about ciguatera fish poisoning (Hajkowicz and Petero, 2005:37). Indeed the South Pacific region has the highest incidence of ciguatera in the world with 3400 to 4700 cases recorded per year most likely representing only 10-20% of the actual number of cases (Laurent et al, 2005:14). The incidence of ciguatera in each country ranges from 1/1,000-20/1,000 (Laurent et al, 2008:17-22).

The result is an increased reliance on pelagic fish and a less healthy diet of imported canned fish and red meat. This new diet combined with a reduction in inshore fishing activity contributes to the problem of poor diet and reduced levels of physical activity noted amongst Pacific Islanders in recent research (SPC, 2002:9). Ciguatera fish poisoning is an additional burden on health care systems in the Pacific Islands.

Ciguatera fish poisoning also has an economic impact on Pacific Island countries. A survey of ciguatera-poisoned patients in French Polynesia found that losses in productive working days through sick leave amounted to US$1 million/year (Bagnis, 1992). In addition, the live reef fish trade was severely impacted in the country of Kiribati when people in Hong Kong contracted ciguatera from fish allegedly imported from Kiribati. The incident resulted in a total closure of the trade in Kiribati and a loss in income for several fishermen (Laurent et al, 2005:15).

Another incident that had a serious impact on health and the economy in the country of the Cook Islands is likely to have been caused by an HAB. Between November 2003 and May 2004 Rarotonga experienced an “irritant syndrome” characterized by a painful burning sensation in the nose, sore, watery eyes, breathing difficulties, skin itchiness/rash and throat irritation. The syndrome resulted in school closures and cancellations in tourist

[4] American Samoa, Cook Islands, Fiji, French Polynesia, FSM, Guam, Kiribati, Marshall Islands, Northern Mariana Islands, Nauru, New Caledonia, Niue, Palau, Papua New Guinea, Pitcairn Island, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, Wallis & Futuna.

accommodation bookings. Research during and after the syndrome indicated that an aerosol of the cyanobacteria *Lyngbya majuscula* may have been a possible cause (Evans, 2008). Reports of shellfish poisoning allegedly due to other species of dinoflagellate and cyanobacteria have been reported in the Cook Islands, New Caledonia and French Polynesia (Skinner, 2009; Laurent et al., 2008)

A "Ciguatera and Related Biotoxins" workshop that was jointly organized by the Secretariat for the Pacific Community (SPC)[5], the Institute for Research and Development, the Pasteur Institute, the Malardé Institute and University Paul Sabatier was held in Noumea, New Caledonia 27-31 October 2008. The workshop indicated that Pacific Islands Countries and Territories (PICTs) face an increasing incidence in ciguatera and related biotoxins. The workshop recommended that:

9. Coordinated and collaborative research be set up on ciguatera between the various research institutes and the Pacific Islands Countries and Territories

10. SPC be the coordinator of this regional effort in liaison with each PICT government administration

11. Partnerships with the following institutes be fostered :
    - L'Institut Louis Malardé, French Polynesia
    - L'Institut Pasteur, New Caledonia
    - L'Institut de Recherche pour le Développement, New Caledonia
    - L'Institut Cawthron, New Zealand
    - L'University of Queensland, Australia
    - La FDA Gulf Coast Seafood Laboratory, United States of America
    - La NOAA Hollings Marine Laboratory, United States of America

12. The establishment and the efforts of a steering committee which would be responsible for the development of an action plan with regards to ciguatera in the Pacific, in consultation with the PIVTs governments be supported. This Committee would include:
    - Marie-Yasmine BOTTEIN (NOAA Hollings Marine Laboratory, USA)
    - Mireille CHINAIN (Louis Malardé Institute, Papeete, French Polynesia)
    - Robert DICKEY (Food and Drug Adminstration, USA)
    - Jacqueline EVANS (Ministry of Health, Rarotonga, Cook Islands)
    - Patrick HOLLAND (Cawthron Institute, New Zealand)
    - Dominique LAURENT (Institute for Research and Development-Toulouse, France)
    - Richard LEWIS (University of Queensland, Australia)
    - Jordi MOLGO (C.N.R.S., Gif sur Yvette, France)
    - Serge PAUILLAC (Pasteur Institute, New Caledonia)
    - Being YEETING (Secretariat of the Pacific Community)

13. Funding mechanisms be sought to assist countries in training and capacity building to set up and implement a monitoring/control system and to set up a database for recording fish poisoning cases through health and fisheries departments

14. The possibility of creating a regional reference center on ciguatera and marine biotoxins, with the aim of facilitating and enabling exchanges between PICTs be explored. This Center will also be able to conduct research on ciguatera, analyse fish and algae samples (in order to identify toxins and other biotoxins) and maintain a database on these toxins in the Pacific for reference.

[5] SPC was previously the South Pacific Commission, a Pacific regional organization currently with a membership of 22 Pacific Island countries and territories plus Australia, France, New Zealand and the United States of America

15. That SPC take these outcomes of the conference and present them to the Pacific Head of Fisheries Meeting in 2009 to seek support and endorsement for a coordinated regional effort.

16. The recommendations received endorsement at the 6th SPC Heads of Fisheries Meeting in New Caledonia in February 2009.

References

Bagnis, R. 1992. *Ciguatera in French Polynesian islands: of coral fish and men.* Bulletin de la Societe Pathologique Exotique 85:412-414.

Evans, J. 2008. *Lyngbya majuscula (Microcoleus lyngbyaceus)* as a possible cause of the Irritant Syndrome in Rarotonga, Cook Islands. Ciguatera and Related Biotoxins Workshop, Noumea, New Caledonia, 27-31 October 2008. Secretariat for the Pacific Community, Noumea.

Hajkowicz, S and Okotai, P. 2005. *An Economic Valuation of Watershed Pollution in Rarotonga, Cook Islands.* CSIRO Sustainable Ecosystems, Brisbane.

Laurent, D. Yeeting, B. Labrosse, P. Gaudechoux, J. 2005. *Ciguatera: a field reference guide.* Secretariat of the Pacific Community, Noumea.

Laurent, D. Kerbrat, A. Darius, T. Peyraud-Thomas, C. Mejean, A. Molgo, J. Llewellyn, L. Tandeau de Marsac, N. Lewis, R. Golubic, S. Pauillac, S. Chinain, M. 2008. *A new ecotoxicological phenomenon related to marine benthic Oscillatoriales (cyanobacteria) blooms.* Ciguatera and Related Biotoxins Workshop, Noumea, New Caledonia, 27-31 October 2008. Secretariat for the Pacific Community, Noumea.

Rapaport, M 1999. *The Pacific Islands Environment and Society.* Bess Press, Honolulu.

SPC, 2002. *Obesity in the Pacific: Too Big to Ignore.* Secretariat for the Pacific Community, Noumea.

Skinner, M. Lewis, R. Johnstone, R. Turua, T. Evans, J. Shaw, G. 2009 *A Harmful Algae Bloom (Prorocentrum gillespii), Ciguatera, Nutrients and a case of DSP, from Muri lagoon, Rarotonga, Cook Islands*. Poster presentation 11th Pacific Science Inter-Congress 2009

ANNEX XIX

GLOSSARY OF ACRONYMS AND SPECIAL TERMS

ANCA	Working Group on Harmful Algae in the Caribbean and Adjacent Regions
CFP	Ciguatera Fish Poisoning
DANIDA	Danish International Development Agency
DSP	Diarrhetic Shellfish Poisoning
EFSA	European Food Safety Authority
FANSA	Working Group on Harmful Algal Blooms in South America
FAO	Food and Agriculture Organization of the United Nations
GEOHAB	Global Ecology and Oceanography of Harmful Algal Blooms
GOOS	Global Ocean Observing System
GPNM	Global Partnership on Nutrient Management
GRA	GOOS Regional Alliances
HAEDAT	Harmful Algal Event Data Base
HAIS	Harmful Algal Information System
IAEA	International Atomic Energy Agency
ICAM	Integrated Coastal Area Management Programme
ICES	International Council for the Exploration of the Sea
IMO	International Maritime Organization
IOC	Intergovernmental Oceanographic Commission
IOCARIBE	IOC Sub-Commission for the Caribbean and Adjacent Regions
IPHAB	Intergovernmental Panel on Harmful Algal Blooms
ISSHA	International Society for the Study of Harmful Algae
LOICZ	Land-Ocean Interaction in the Coastal Zone
PICES	North Pacific Marine Science Organization
PICO	Panel for Integrated Coastal Observations
PSP	Paralytic Shellfish Poisoning
ROOS	Regional Ocean Observing System
SCOR	Scientific Committee on Oceanic Research
UNCED	United Nation Conference on Environment and Development
UNEP/GPA	United Nations Environment Programme/ General Plan of Action
UNESCO	United Nations Educational, Scientific and Cultural Organization
WESTPAC	IOC Sub-Commission for the Western Pacific
WGBOSV	Working Group on Ballast and other Ship Vectors
WGHABD	Working Group on Harmful Algal Bloom Dynamics
WHO	World Health Organization
WoRMS	World Register of Marine Organisms

In this Series *Languages*

Reports of Governing and Major Subsidiary Bodies, 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 *ad hoc* 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-Cornmission 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, Papetee, 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*

CONTINUED ON NEXT PAGE

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*
134.	Twenty-third Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, Apia, Samoa, 16–18 February 2009 (*Executive Summary available separately in E, F, S & R)	E*
135.	Twentieth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Beijing, China, 4–8 May 2009 (*Executive Summary available separately in E, F, S & R)	E*
136.	Tenth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE), Puerto La Cruz, Bolivarian Republic of Venezuela, 22–25 October 2008 (*Executive Summary available separately in E, F, S & R)	E, S*
137.	Seventh Session of the IOC Sub-Commission for the Western Pacific (WESTPAC-VII), Sabah, Malaysia, 26–29 May 2008 (*Executive Summary available separately in E, F, S & R)	E*
138.	Ninth Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, France, 10–12 June 2009 (* Executive Summary available separately in E, F, S & R);	E*
139.	Fifth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, Athens, Greece, 3–5 November 2008 (* Executive Summary available separately in E, F, S & R)	E*
140.	Fourth Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Fort-de-France, Martinique, France, 2–4 June 2009 (* Executive Summary available separately in E, F, S & R)	E*
141.	Twenty-fifth Session of the Assembly, Paris, 16–25 June 2009	E, F, R, S
142.	Third Session of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology, Marrakesh, Morocco, 4–11 November 2009	E, F, R, S
143.	Ninth Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, Paris, France, 22–24 April 2009 (* Executive Summary available separately in E, F, S & R)	E*