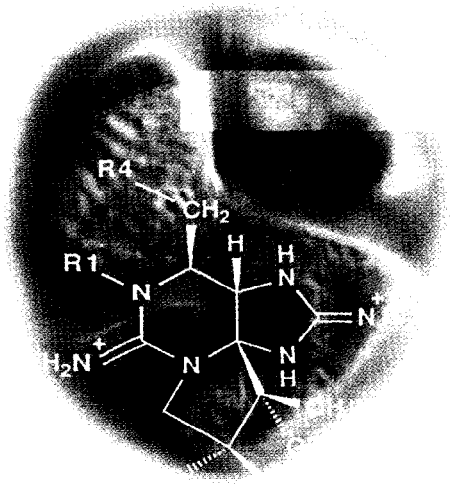
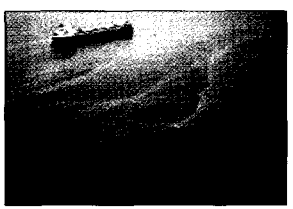
# MITIGATING THE EFFECTS of harmful algae

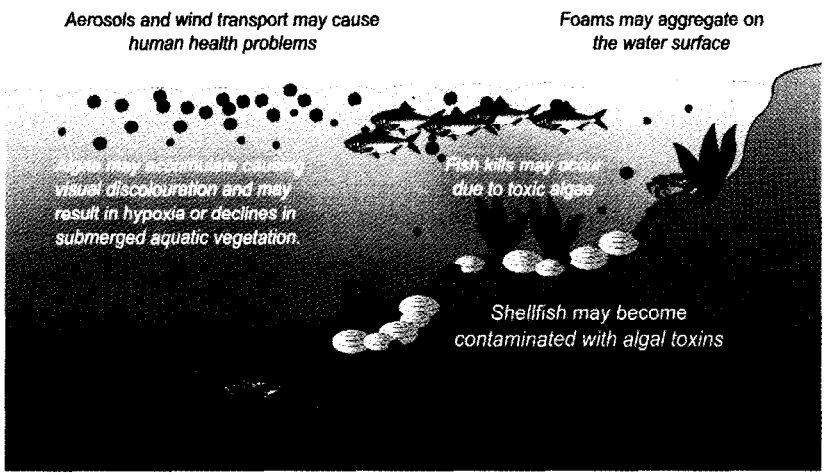
INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
OF UNESCO

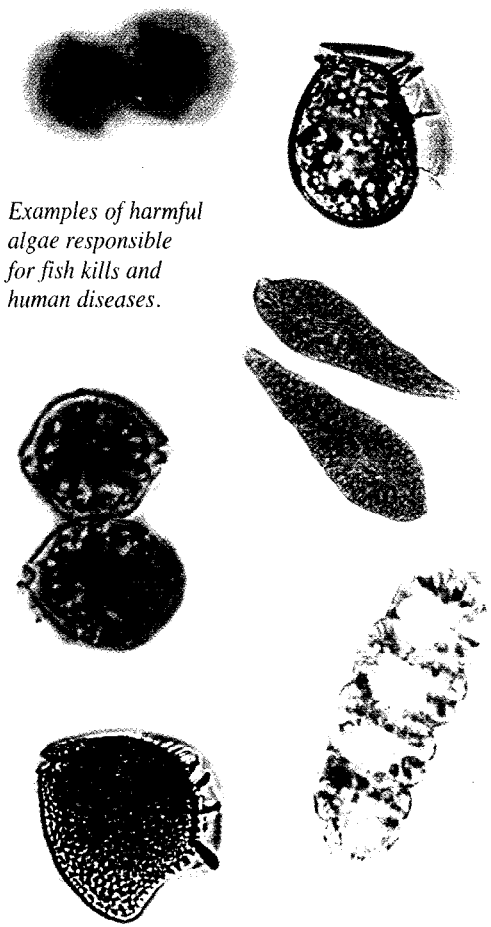


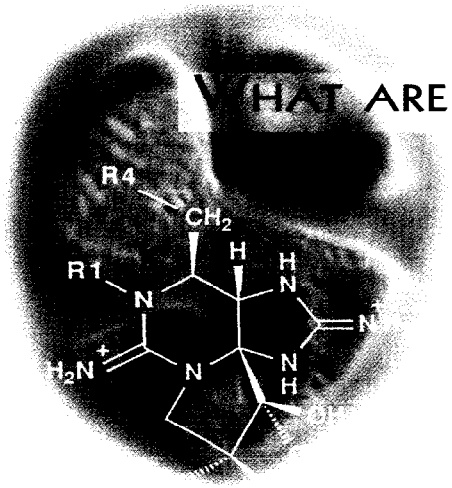
# WHAT ARE
# harmful algae?

PHYTOPLANKTON BLOOMS, MICRO-ALGAL BLOOMS, TOXIC ALGAE, RED tides and harmful algae are all terms for naturally occurring phenomena. About 300 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'.

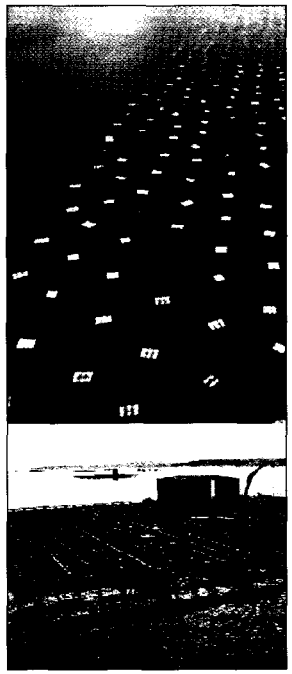


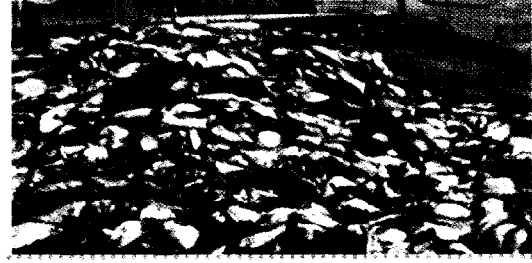



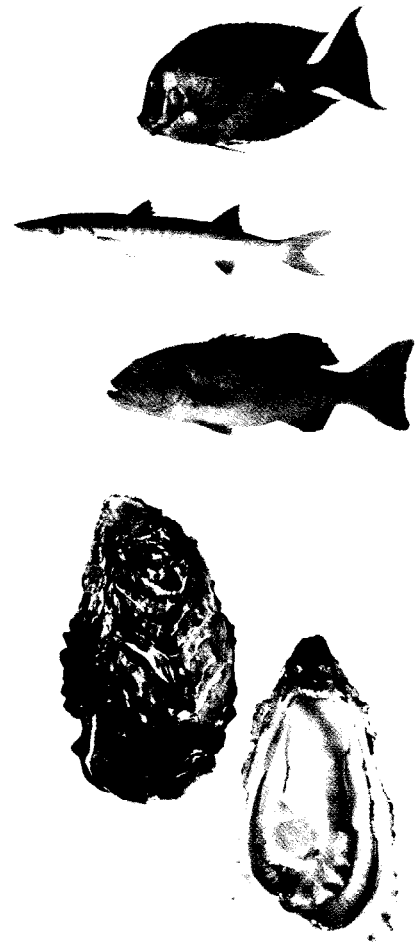
*Examples of harmful algae responsible for fish kills and human diseases.*




# WHAT ARE THE NEGATIVE EFFECTS OF harmful algae?



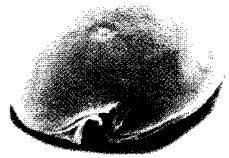




- FISH KILLS AND CONTAMINATED SEA FOOD
- TOXIC EFFECTS ON HUMANS
- AESTHETIC PROBLEMS AFFECTING TOURISM
- MARINE ECOSYSTEM IMPACT

PROLIFERATIONS OF MICROALGAE IN MARINE OR BRACKISH WATERS CAN cause massive 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 occurred long before human activities began to transform coastal ecosystems, a survey of affected regions and of economic losses and intoxication of humans throughout the world 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.

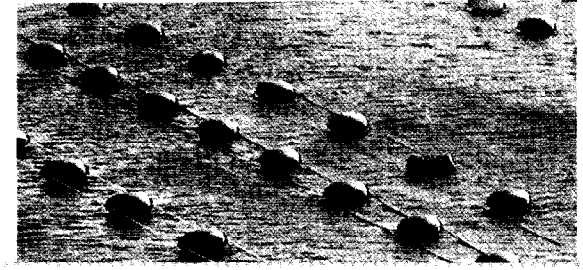
At least six human syndromes are presently recognized to be caused by consumption of seafood which is contaminated with algal toxins:

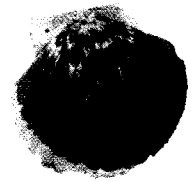
- AMNESIC SHELLFISH POISONING – ASP
- CIGUATERA FISH POISONING – CFP
- DIARRHETIC SHELLFISH POISONING – DSP
- NEUROTOXIC SHELLFISH POISONING – NSP
- PARALYTIC SHELLFISH POISONING – PSP
- AZASPIRACID POISONING – AZP

Some of these diseases 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 assumed 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. Several 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.

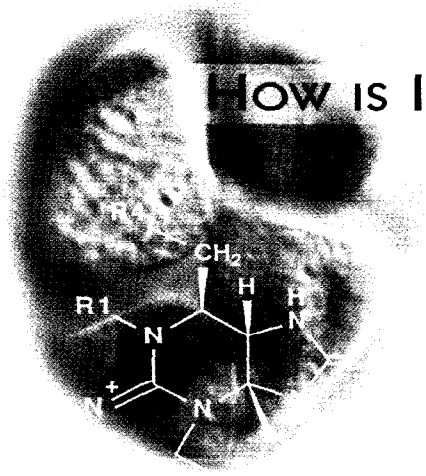
In coastal areas where tourism is important to the local or national economy, the loss of aesthetic quality due to microalgae proliferations may have severe impacts.





*Harmful algae can contaminate seafood and cause massive fish kills as well as harm shellfish and shrimp farms.*

*Harmful algae constitutes a health and an economic risk, especially in developing countries where seafood is an important or even the sole source of protein-based food.*




# How is IOC assisting Member States?

In 1992, IOC established a programme with the overall objective of assisting member states in mitigating the effects of harmful algae.

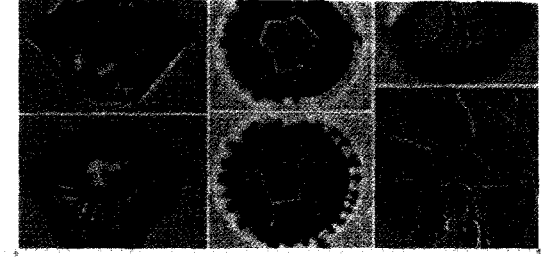
The trans-disciplinary Harmful Algal Bloom Programme Plan focuses on three areas:

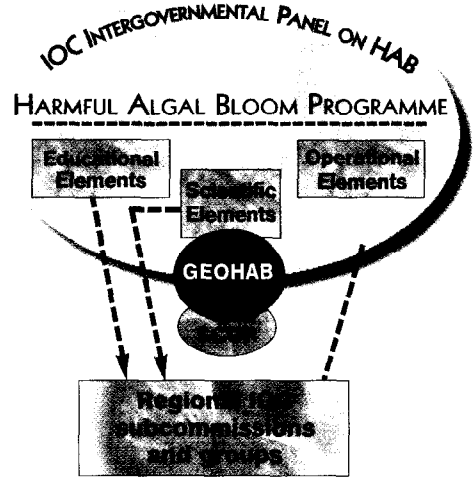
- Training, capacity building and information networks
- Cooperative research
- Monitoring and resource protection

The Programme is supervised and guided by the 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.

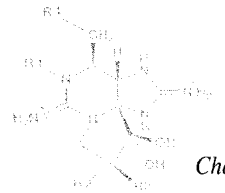
The IOC HAB Programme operates in close cooperation with national institutions and relevant organizations, in particular the Scientific Committee on Oceanic Research (SCOR) and the International Council for Exploration of the Sea (ICES).

IOC Science and Communication Centres on Harmful Algae are established in Copenhagen, Denmark, and Vigo, Spain, to help implement the programme and in particular to provide assistance in training, capacity building and the dissemination of information to developing countries with respect to harmful algae.






*The IOC HAB Programme is based on a Programme Plan with specific objectives and goals within capacity building, science and improved management. A major scientific component is the international research programme Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB), which is co-sponsored by the Scientific Committee on Oceanic Research, SCOR.*

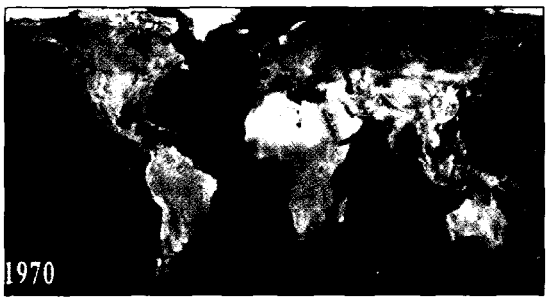


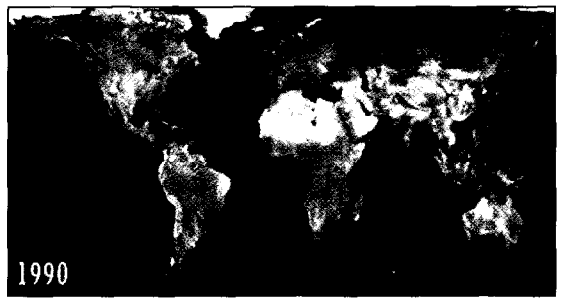
*Chemical structure of a paralytic shellfish toxin (PSP)*

## SCIENCE AND COMMUNICATION CENTRES

**THE COPENHAGEN CENTRE** is located at the University of Copenhagen, Denmark. It is sponsored by DANIDA, the University of Copenhagen, the Danish National Environmental Research Institute, the Danish Institute for Fisheries Research and IOC. The Copenhagen Centre organises training courses in the identification of harmful algal species, culture techniques, quantitative and qualitative assessments, the planning of monitoring programmes and management of harmful algal blooms and provides publications and literature. The Centre has cooperative research projects with institutions in Africa, Asia, and the Caribbean.

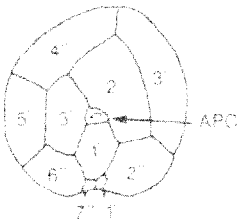
**THE VIGO CENTRE** is located at the Spanish Institute of Oceanography (IEO), in Vigo, Spain. It is sponsored by the Spanish Ministry of Foreign Affairs, the Institute for Ibero-American Cooperation, IEO and IOC. The major focus area is training in toxin chemistry, monitoring and ecological aspects of harmful algae. The Vigo Centre cooperates especially with research institutions in Latin America and assists IOC regional working groups in the region.

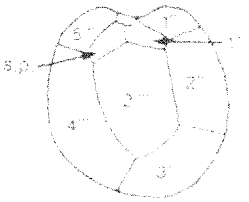



*Maps showing the increase in global distribution of paralytic shellfish poisoning (PSP) from 1970 to 1990.*

*Capacity for management of HAB events is enhanced through cooperative research projects.*



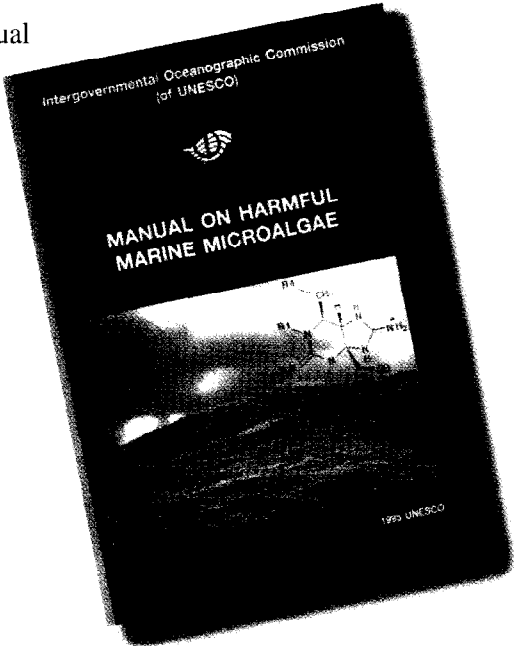
## TRAINING AND CAPACITY BUILDING

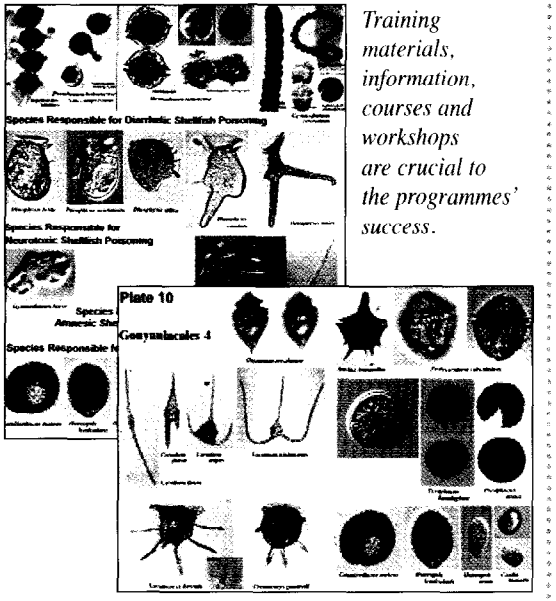
### Training Courses

The IOC offers international training courses in harmful algal identification, toxicology and ecology. The faculty is composed of 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. Training courses are announced on the IOC HAB website.

### Manual

The IOC Manual of Harmful Microalgae is a comprehensive manual on methodologies, identification, toxicity and toxin analysis, monitoring and management of harmful algae. It is written by an international group of 42 leading scientists. The Manual is to be published as a volume in the series UNESCO Monographs on Oceanographic Methodology.



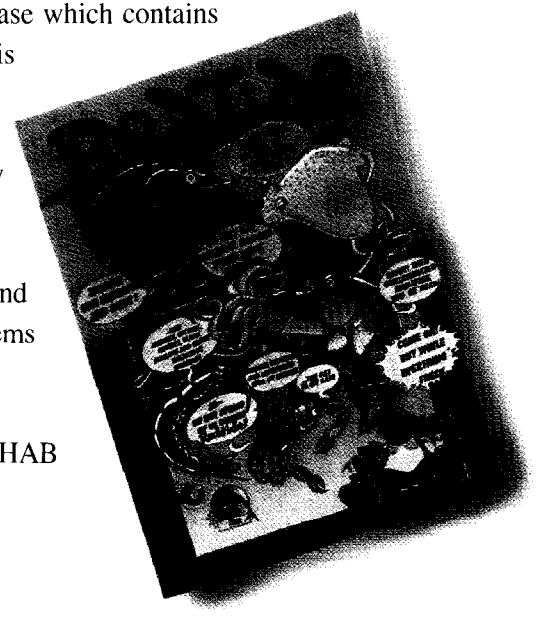

*Training materials, information, courses and workshops are crucial to the programmes' success.*

## INFORMATION NETWORKS

**HARMFUL ALGAE NEWS** is an IOC newsletter on toxic algae and algal blooms. It reports on HAB events around the globe, ongoing research activities, training courses and workshops, publications and more. 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.

**HAB-DIR** is the on-line international directory of experts in harmful algae and their effects on fisheries and public health.

**HAE-DAT** is the on-line IOC-ICES Harmful Algae Event database which contains information on harmful events in the North Atlantic region. It is updated every year 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.

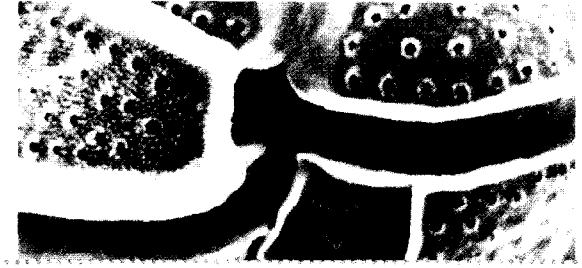


**MON-DAT** is the meta-database with information on the design and implementation of harmful algae monitoring and management systems from all over the world.

HAB-DIR, HAE-DAT and MON-DAT are available via the IOC HAB website.

# GEOHAB

Global Ecology and Oceanography of Harmful Algal Blooms



## COOPERATIVE RESEARCH

GEOHAB is a joint IOC-SCOR international science programme on the Global Ecology and Oceanography of Harmful Algal Blooms.

It is a programme aiming to coordinate research and cooperation in order to develop international capabilities for assessment, prediction and mitigation of harmful algal events.

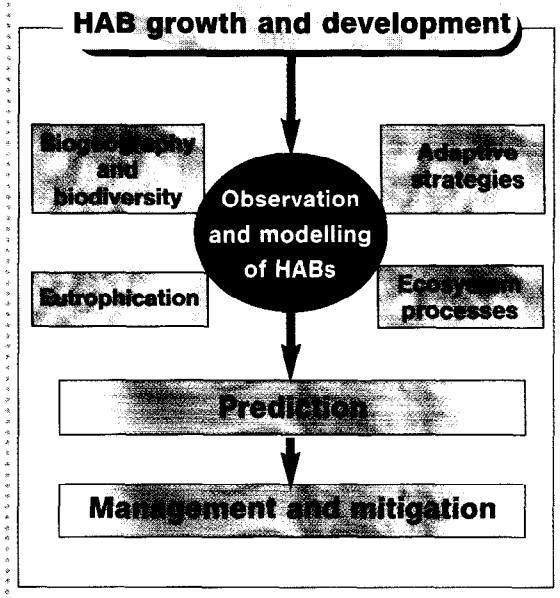
The mission of GEOHAB is to foster international cooperative research on HABs in ecosystem types sharing common features so as to facilitate the comparison of the key species involved and the oceanographic processes that influence their population dynamics.

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 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.

## SCIENTIFIC WORKING GROUPS

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 identifies main gaps in current research. The Group also collects and assesses national HAB event reports, maps HAB events and summarises the information in the harmful algae event database (HAE-DAT) on a regional, temporal and species basis.




*GEOHAB is focused in five Programme Elements. Each Element addresses central research questions, but the goals of GEOHAB will only be advanced through the linkages between them.*

*Photo: Marzosport*

## REGIONAL IOC HAB PROGRAMMES

**WESTPAC/HAB**

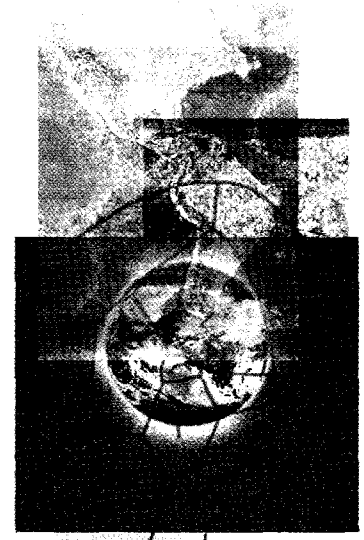
The IOC Sub-Commission for the Western Pacific, WESTPAC, has a regional HAB programme, WESTPAC/HAB, which focuses on organizing training courses, providing literature grants and expert assistance. WESTPAC/HAB is in particular supported by Japan through the University of Tokyo.

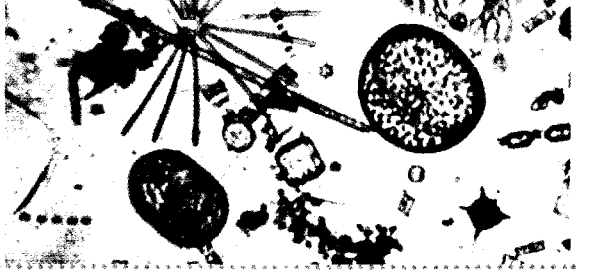
**FANSA**

The countries of South America have an IOC HAB Working Group (Grupo COI sobre Floraciones de Algas Nocivas en Sudamérica – FANSA), which functions as a regional mechanism for the exchange of information, planning of coordinating activities, regional training and inter-calibration as well as cooperative research projects.

**ANCA**

The IOC Sub-Commission for the Caribbean, IOCARIBE, has an IOC HAB Working Group, (Grupo COI sobre Algas Nocivas en el Caribe – ANCA), equivalent to FANSA.







## WHAT IS IOC?

The Intergovernmental Oceanographic Commission of UNESCO addresses the issue of critical uncertainties for the management of the marine environment and climate change by facilitating research, and the development and implementation of operational observing and forecast programmes, by providing data and information services in support of both research and operations; and by working through training, education and mutual assistance to improve capacity in developing countries.

**More detailed information on IPHAB, GEOHAB, WESTPAC, FANSA, ANCA and other ongoing activities, working groups and access to data bases can be obtained on the IOC HAB website: http://www.ioc.unesco.org/hab**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