

## SESSION 2: ADDRESSING CLIMATE CHANGE CHALLENGES

### PANEL 2.2: Monitoring and mitigation of the impact of climate change



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# IAEA Ministerial Conference on Science and Technology: Addressing Current and Emerging Development Challenges

Panel 2.2: Monitoring and mitigation of the impact of climate change

## Challenges for monitoring of biotoxins in relation to seafood safety and the related needs for capacity development

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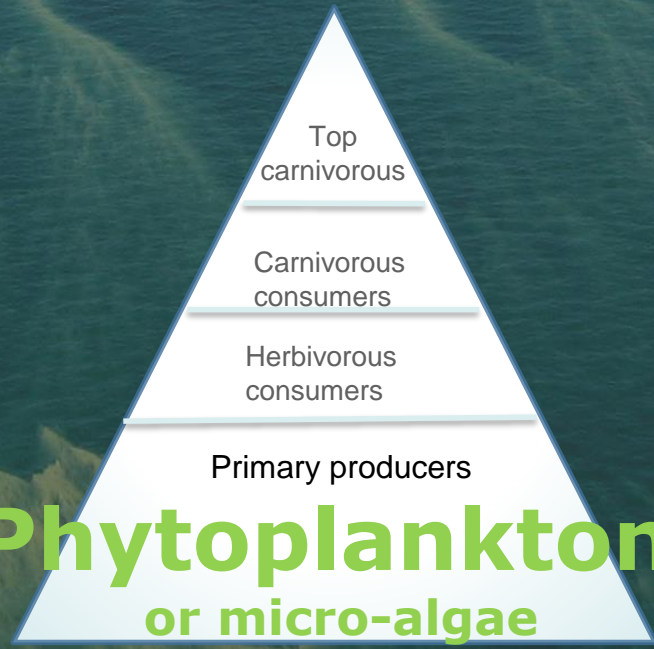


Intergovernmental  
Oceanographic  
Commission

# Human Health, Wellbeing and Economy

## Living marine resources

*Food, Energy, Leisure/Tourism, Economic Development*



- At the basis of the marine food web, and key food item in aquaculture
- ~2% of the thousands of species are harmful and/or toxic

# What is harmful algae?

- Some single celled micro-algae in the marine environment produce toxins. Some cause harm due to their biomass.
- A natural phenomena
- Increase in severity of HAB events



*Microalgae*

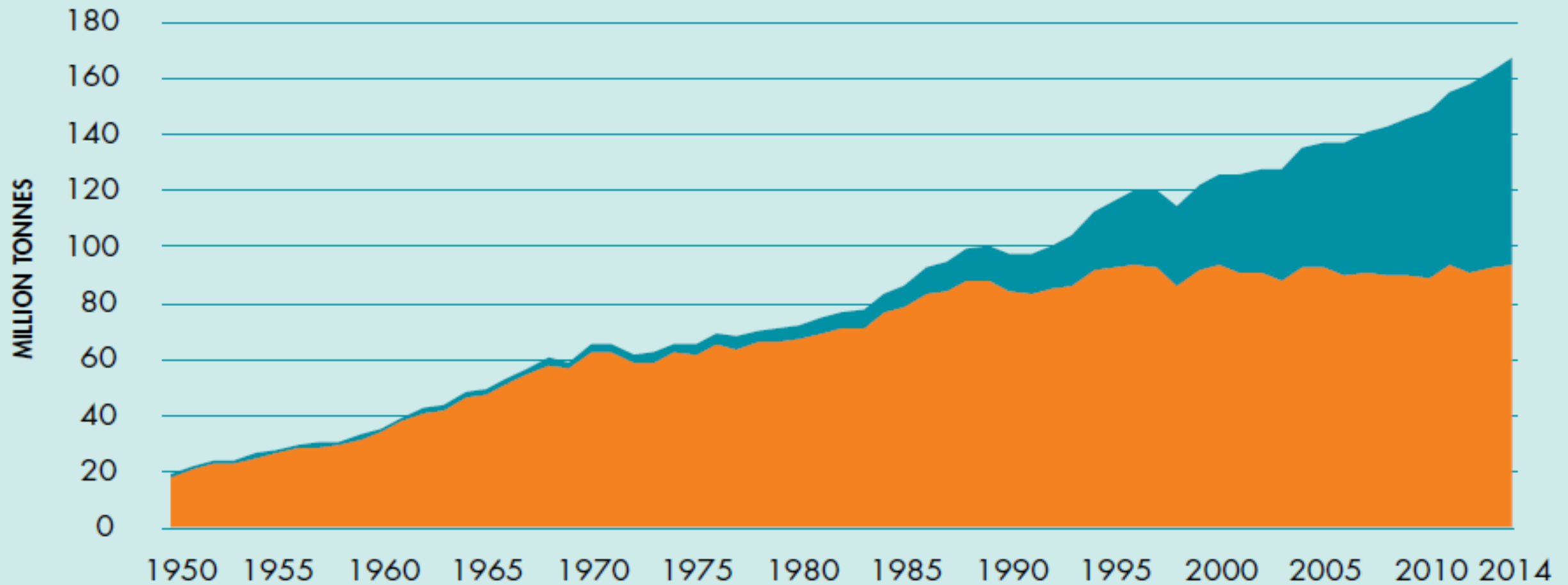


*Blooms*



*Toxic or dead seafood*

# WORLD CAPTURE FISHERIES AND AQUACULTURE PRODUCTION



■ Aquaculture production  
■ Capture production

World total (2015)  
Capture: 92.6 million tonnes  
Aquaculture: 106 million tonnes

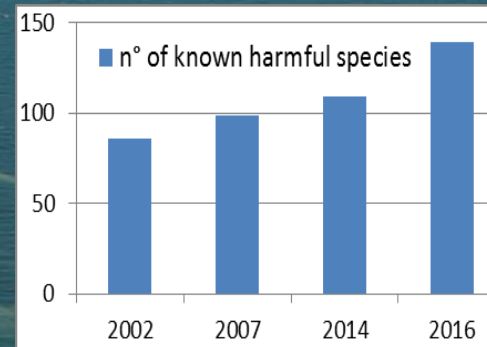
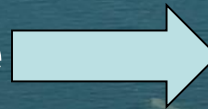
# Harmful algal event impacts

- Directly affect almost all coastal states
- Contaminates seafood, threatening public health and industries
- Kill wild and farmed fish; aquaculture impacts likely to increase with growth of industry
- Threaten drinking water supplies from desalination
- With rapidly growing populations in coastal areas and reliance on aquaculture, global economic and human health impacts of toxic microalgae are chronic and widespread



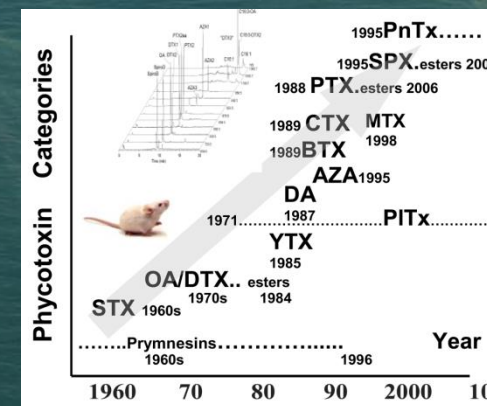
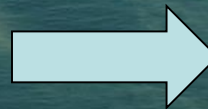
# Challenges:

•Number of known toxic species increase



Number of species known to produce toxins impacting on seafood safety and security and humans, as listed in the IOC-UNESCO Taxonomic Reference List of Harmful Micro Algae (Moestrup *et al.* 2002-2018).

•Number of known toxins increase

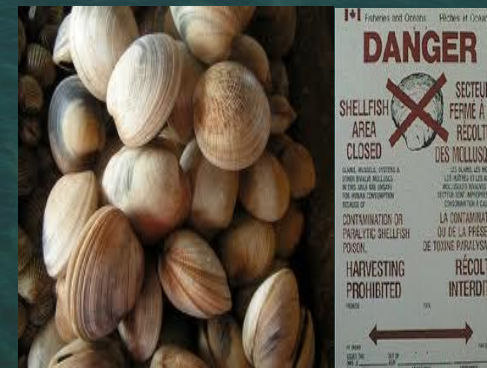


Timeline of discovery of the major categories of phycotoxins (modified after Hess 2008).

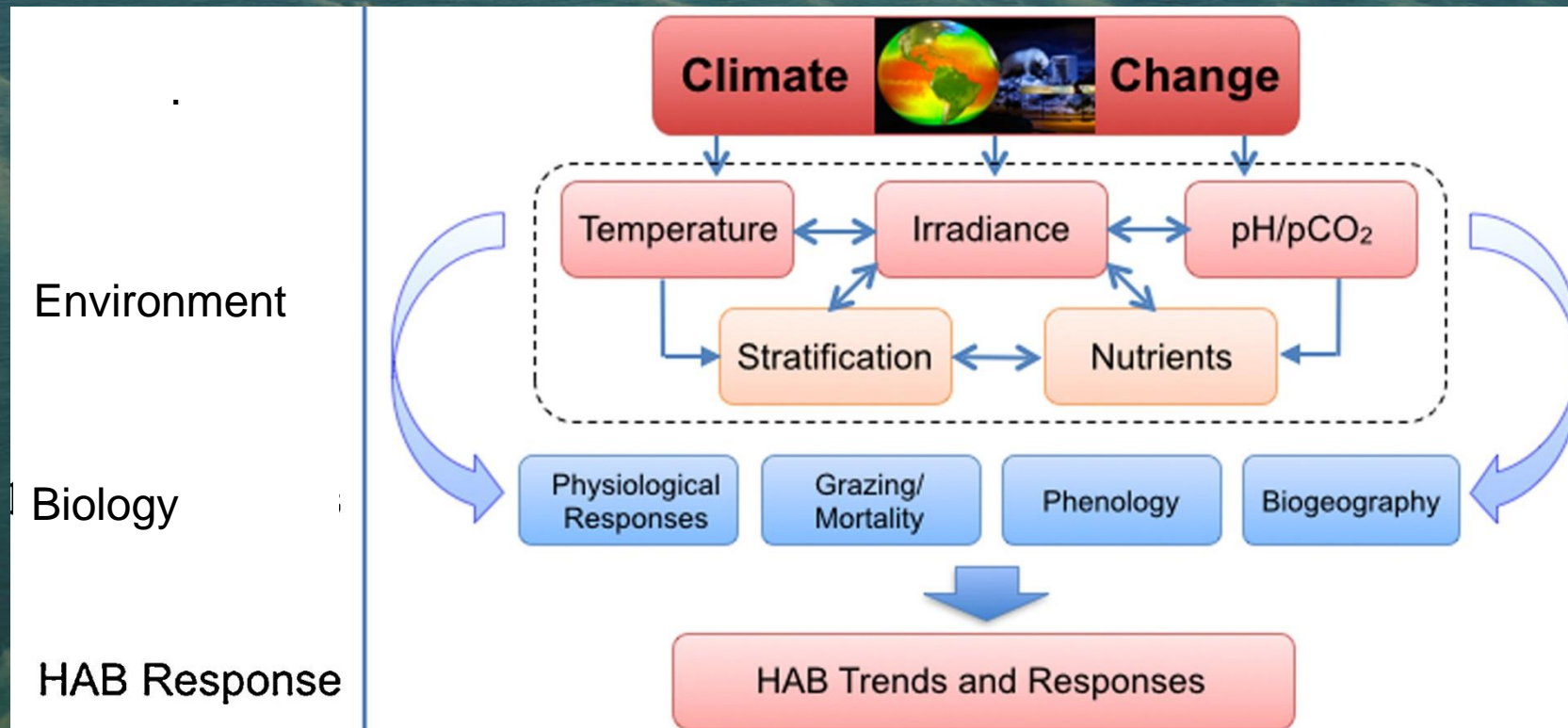
•Challenges monitoring and management



•Require development of new technology and methods





# And what may climate/global change imply?



The progression of climate change pressure on key variables and related HAB interactions that will drive HAB responses in the future ocean. (Wells *et al*, 2015)



# And what may climate change imply?

- Several types of Harmful Algal events
- - some will increase others decrease
- BUT, those most harmful are likely to increase! 
- The need for management and mitigation will increase 

HAB Type	Environmental Factor				
	↑ T°C	↑ Stratification	↑ OA	↑ Cultural Eutroph.	Grazing
Diatoms (e.g., <i>Pseudo-nitzschia</i> spp.)	↕ +	↓ ++	↕	↓	↕
Toxic Flagellates (e.g., <i>Alexandrium</i> , <i>Pyrodinium</i> , <i>Gymnodinium</i> )	↑	↑ ++	↕	↑	↕
Benthic (e.g., <i>Gambierdiscus</i> spp.)	↕ ++	↑ ++	?	↑	↕
Fish Killing (e.g., <i>Heterosigma</i> spp.)	↑	↑ ++	?	↑ +	↑ +
High Biomass (e.g., mixed spp.)	↕	↕	↕	↑ ++	↕
Cyanobacteria (e.g., <i>Nodularia</i> spp.)	↑ +	↑ ++	↕	↑ ++	?
Cell Toxicity	?	?	↕	↕	↕

A general overview of the current understanding from the literature of how different HAB types will be affected by climate change stressors. Arrows indicate changes that either increase, decrease, or can occur in both directions. Symbols suggest the level of confidence: + (reasonably likely), ++ (more likely). (Wells *et al*, 2015)

# Priority is to protect of public health and secure safe seafood :

- Enhance capacity in countries to mitigate the effects of harmful algal events;
- Cooperative research to better understand key environmental parameters that control harmful algal events;
- Strengthen or develop regional networks for early warning of HABs and biotoxins in seafood
- Method validation and acceptance (CODEX, EU, USFDA etc), provision of reference material
- Improve data collection, reporting and assessments



*Public health*



*Sustainability*

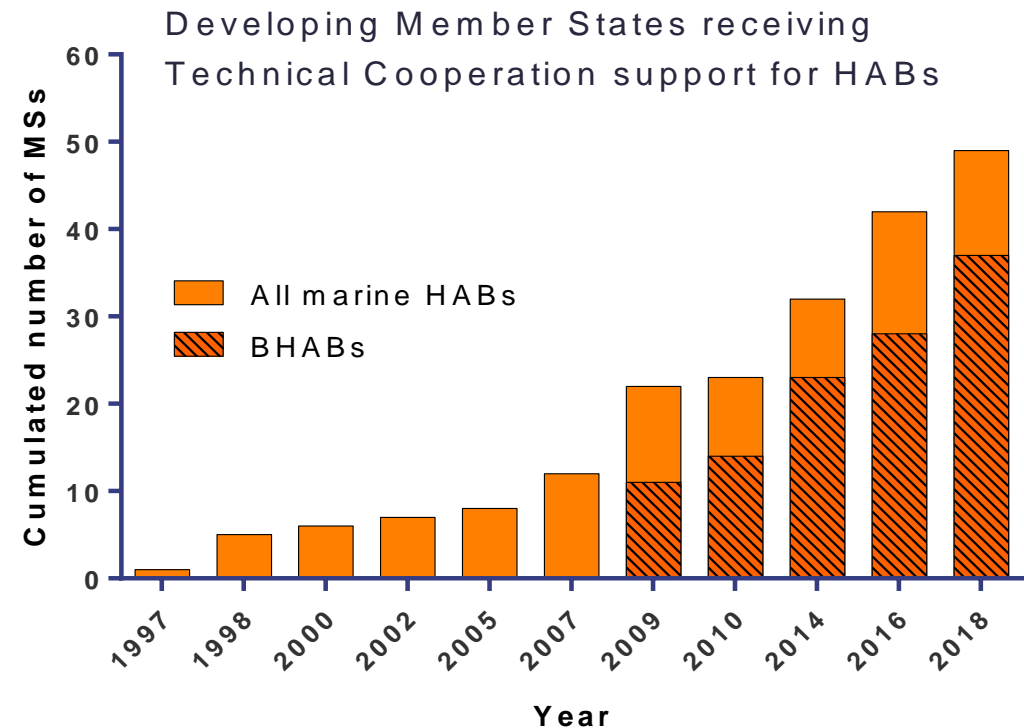
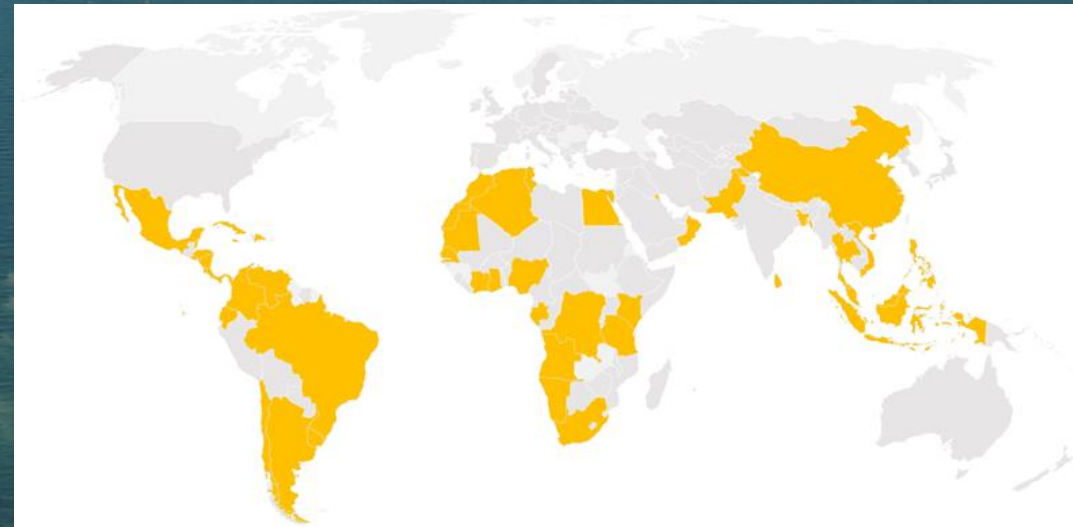


*Safe seafood*

# Specific IAEA initiatives:

- In 2018, TC projects involve more than half of IAEA coastal Member States
- 49 countries, all regions trained on sampling and identification of toxic phytoplankton and 18 equipped for toxin detection\*
- Increasing demand from developing countries to address HABs and biotoxins

\*Receptor Binding Assay, a nuclear technique



# IAEA –IOC UNESCO initiatives

## Production of training material and manuals

IAEA TECDOC SERIES

### Detection of Harmful Algal Toxins Using the Radioligand Receptor Binding Assay

A Manual of Methods



IAEA-TECDOC-17

Intergovernmental Oceanographic Commission  
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Guia para el diseño y puesta en marcha de un plan de seguimiento de microalgas productoras de toxinas  
Proyecto ARCAL RIA 7/014

Beatriz Reguera, Rosalba Alonso, Ángel Moreira y Silvia Méndez



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### GUIDE FOR DESIGNING AND IMPLEMENTING A PLAN TO MONITOR TOXIN-PRODUCING MICROALGAE

Second Edition



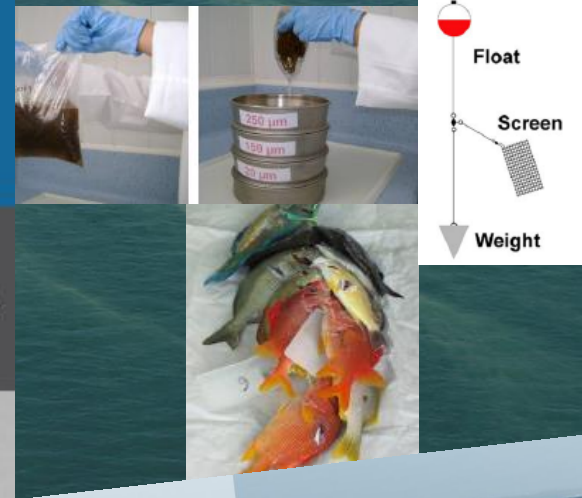
Beatriz Reguera, Rosalba Alonso, Ángel Moreira, Silvia Méndez and Marie-Yasmine Dechraoui Bottein



### 3 Methods for sampling benthic microalgae

Angel Moreira<sup>1</sup> and Patricia A. Tester<sup>2</sup>

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#### PARTNER ORGANIZATIONS SUPPORTING IAEA FOR HAB MANAGEMENT

- University of Queensland AUSTRALIA
- University of Chile CHILE
- Intergovernmental Oceanographic Commission - United Nations Educational, Scientific, and Cultural Organization (IOC-UNESCO) FRANCE
- Institut Louis Pasteur (ILM) FRENCH POLYNESIA
- National Atomic Energy Agency INDONESIA
- Departamento del Material e Recurso Nuclear ITALY
- Universiti Kebangsaan Malaysia MALAYSIA
- Environmental Laboratories - International Atomic Energy Agency (IAEA) MONACO
- Chemtron Institute NEW ZEALAND
- Philippine Nuclear Research Institute - Department of Science and Technology (PNRI-DOST) PHILIPPINES
- Marine and Coastal Management BOTSWANA
- Thailand Institute of Nuclear Technology (TINT) THAILAND
- Florida Marine and Fisheries Research Institute - California Department of Public Health CENTER FOR FOOD SAFETY AND APPLIED NUTRITION - Food and Drug Administration NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) UNITED STATES OF AMERICA

The next two instruments Application of Receptor Binding Assay for Harmful Algal Toxins are supported by the following:

IOC-UNESCO

NOAA

INSTITUT LOUIS PASTEUR

CHEMTRON INSTITUTE

IAEA COLLABORATING CENTER ON HARMFUL ALGAL BLOOM MONITORING AND CONTROL

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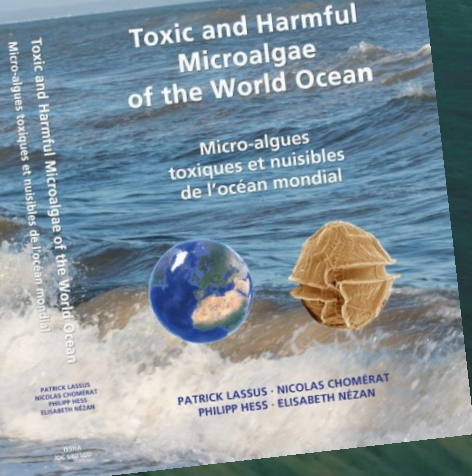
APPLICATIONS OF RECEPTOR BINDING ASSAY ON HARMFUL ALGAL BLOOM EPISODES IN THE ASIAPACIFIC

### RECEPTOR BINDING ASSAY A NEW, VALIDATED, COST-EFFECTIVE, METHOD FOR SEAFOOD SAFETY



This book updates available international databases on toxic and harmful species of phytoplankton and micro-phytobenthos. It lists regional occurrences at site-wide scale: localities, cell densities, toxicity levels in contaminated animals, human and animal poisoning, identified active molecules and toxins, documented sources. Finally, this book addresses the geographic distributions of phytoplankton producers from recent data. The objective is to analyze the evolution of toxic and harmful episodes over the past 30 years to identify trends, and to introduce a discussion on the reality of a time-dependent increase in the number of known species and toxins.

Cet ouvrage met à jour et complète les données internationales disponibles sur les espèces toxiques et nuisibles du phytoplancton et du micro-phytobenthos. Il répertorie les occurrences régionales à l'échelle de sites: localités, densités cellulaires, toxicité de molécules actives, intoxications humaines et animales, sources documentaires, répartition géographique des producteurs de phytoplankton à partir de données récentes. L'objectif est d'analyser l'évolution des épisodes toxiques et nuisibles sur les 30 dernières années afin de dégager des tendances et d'introduire une discussion sur la réalité d'une augmentation du nombre d'espèces et de toxines connues au cours du temps.





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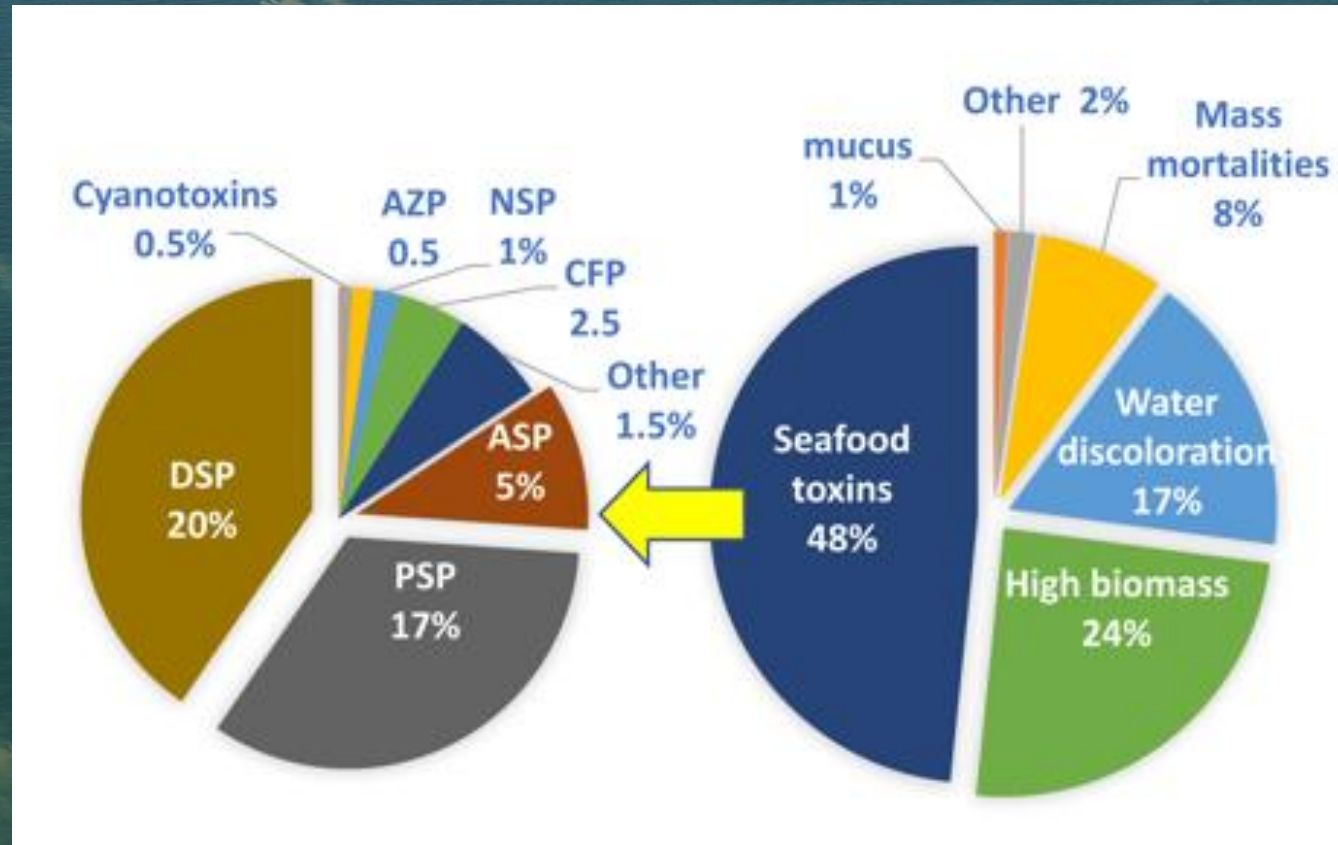
**IAEA**  
International Atomic Energy Agency



# Joint IOC-IAEA-FAO-WHO Ciguatera Strategy

- **Guidance to Local Communities**
- **Guidelines on ciguatera poisoning management**
- **WHO-FAO *Codex Alimentarius* Guidance for ciguatoxin contamination in food**

# IOC UNESCO is with partners IAEA, ICES, PICES and ISSHA developing the first Global HAB Status Report

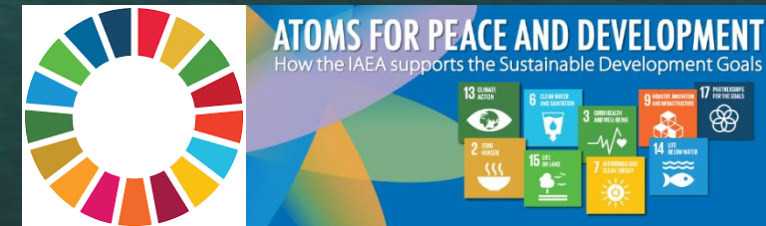


**-Will be an input to the World Ocean Assessment, IPCC, and other global assessments**

Partitioning of 4528 global HAEDAT events into seafood toxins, high biomass water discolorations, fauna mass mortalities, and the further breakdown of seafood toxins into DSP, PSP, ASP, NSP, CFP, AZP and cyanotoxins. Data as of 1/3/2017. Compiled by L. Schweibold & G.Hallegraef.

# The IAEA plays a key role in all this work to ensure:

- sustainable and safe seafood production
- efficient monitoring strategies to reduce human health and environmental impacts due to biotoxins and HABs
- and hence contribute to achieve SDGs





*Thank you for your attention*