

“SEED”

How natural and man-made phenomena affect HAB formation

Contamination of shellfish stocks with biotoxins poses a continual threat to both the shellfish industry and public health all over Europe. In coastal and estuarine waters, one of the major causes of toxin contamination of shellfish is the presence of harmful and toxic algae, commonly called “harmful algal blooms (HAB’s)”. For this reason, biotoxin monitoring programmes in regions of shellfish production are required to screen the algal population for the presence of HAB forming phytoplankton.

Yet, despite these monitoring programmes, knowledge regarding the distribution of HAB species remains sketchy and the identification of algal cells observed in seawater samples remains difficult without either specialized morphological analysis or the use of molecular genetic identification techniques.

seed

HAB species have different life cycle stages. They reproduce primarily through fission – asexual reproduction, giving rise to a population expansion of vegetative cells – but some are also able to reproduce sexually. This is usually the case when environmental conditions become unfavourable, for example when nutrients become depleted or there is insufficient light. The cells will then form resting cysts that may lie dormant for prolonged periods in sediment prior to excystment, division and a return to a vegetative state. **It is cyst deposits that are widely believed to act as the seed reservoirs which give rise to HAB’s, although explanations of how and why blooms form remain elusive.**

In 2005, the EU-funded project **SEED** was established **to study how and to what extent anthropogenic forces influence these non-vegetative stages of the life cycles of harmful algal species**, thereby contributing to the increase in harmful algal blooms in European marine, brackish and fresh waters. The project’s overall objectives were:

- to improve and extend our understanding of the transition between the different life history stages;
- to identify the environmental and physiological factors that

regulate those transitions, and hence the relative importance of anthropogenic vs. natural causes; and

- to integrate the recent acquired knowledge in the development of new simulation models or refining existing ones.

During the project, SEED partners characterised and quantified the different stages of the life cycle in a bloom development of various HAB species. The project focused on an array of target HAB species, ranging from marine to brackish to fresh water organisms, and covering a broad range of phylogenetic types. The genus studied were *Alexandrium*, *Kryptoperidinium*, *Gymnodinium*, *Pseudo-nitzschia*, *Peridinium*, *Gonyostomum*, *Scrippsiella*/*Wolosznkia* complex, *Peridiniella*, *Nodularia*, *Anabaena*, and *Aphanizomenon*.

The studies were carried out both in laboratory and in the environment. Nine areas, where monitoring programs were ongoing and much baseline information about distribution of species and physical-chemical data already existed, were studied:

- the Catalan and Galician coast (Spain)
- Sardinia, the Tyrrhenian coast, and Sicily (Italy)

Project acronym:

SEED

Full title of Project:

Life cycle transformations among HAB species, and the environmental and physiological factors that regulate them.

EU contract number:

GOCE-CT-2005-003875

Web-site:

<http://www.icm.csic.es/bio/projects/seed/>

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“SEED PARTNERS FOUND THAT THE MAGNITUDE OF BENTHIC-PELAGIC TRANSITIONS IN MICROALGAE WAS DETERMINED BY THEIR LIFE CYCLE FEATURES AND THE FACTORS THAT REGULATE RESTING STAGE FORMATION“

- Gulf of Finland (Finland)
- the Estonian coast (Estonia)
- Cork (Ireland)
- the British coast (United Kingdom)

Based on their life histories, it appeared possible to divide the studied phytoplankton species into three groups:

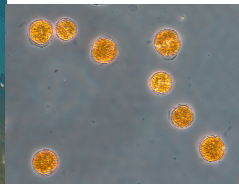
- holoplanktonic: present in the water year round;
- meroplanktonic: with a documented resting stage which inhabits the benthos; and
- potentially meroplanktonic: presence of a resting stage but no indication of bloom initiation from these benthic resting stages.

From the results, it was concluded that the heteromorphic life cycle (i.e. having different forms at different periods of the life cycle) could represent an advantage for the species concerned, since it allows

the allocation of the species biomass into stages of different size ranges, morphology, and survival capabilities in different ecological niches.

SEED partners found that the magnitude of benthic-pelagic transitions in microalgae (such as encystment and excystment in the case of dinoflagellates) was determined by their life cycle features and the factors that regulate resting stage formation. In other words, these processes are controlled by intrinsic factors, unique to each species. Timing and scale of response however appeared to be modulated by the environment, and it was shown that the predictability of blooms increased with the degree of physical forcing that controlled them.

Based on these results, the SEED partners recommended mapping the distribution of benthic dormancy stages of HAB species in superficial sediments. This would allow the establishment of a baseline for monitoring spreading events, introduction of new species and human-assisted dispersal, thus allowing for improved prediction, mitigation and management strategies.



HABS IN THE MEDITERRANEAN: THE BLOOM (SOURCE: AGENCIA CATALANA AIGUA), THE ORGANISM (SOURCE: ESTHER GARCÉS).