REVIEW OF PHYTOPLANKTON MONITORING 2006

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Introduction

In recent years the national phytoplankton monitoring programme has become more and more important with its integration into Management Cell decision operations as part of the biotoxin monitoring programme. This programme fulfils national obligations to monitor toxic phytoplankton under Regulation (EC) No 854/2004 which enforces the following in relation to the monitoring of harmful algal species (extract):

> *"(a) Periodic sampling to detect changes in the composition of plankton containing toxins and their geographical distribution. Results suggesting an accumulation of toxins in mollusc flesh must be followed by intensive sampling;"*
> *"(b) Periodic toxicity tests using those molluscs from the affected area most susceptible to contamination."*

These sampling plans, as provided, must in particular take account of possible variations in production at relaying areas in the presence of plankton containing marine biotoxins. The sampling plans must be organised to detect changes in the composition of the plankton containing toxins and the geographical distribution thereof. Information leading to a suspicion of accumulation of toxins in mollusc flesh must be followed by intensive sampling.

The Irish monitoring programme provides robust and thorough toxic phytoplankton data that fulfils the following requirements:

- Provides early warning of potential shellfish toxicity
- Focuses attention on potential toxins for analysis that might otherwise not be detected
- Provides information on which algae are responsible if a new biotoxin event occurs
- Guides management decisions on protecting consumer safety

Recently the phytoplankton monitoring has taken an extra dimension with its incorporation into the Water Framework Directive as a required biological classification element. In developing an index of water quality in Ireland and Europe the existing Irish monitoring programme has been extremely valuable for the purpose of determining threshold values and providing intercomparison information. The programme also regularly provides important public health information to County Councils, Environmental Health Officer's and the public during times of bloom events.

Overview

The following paper provides an overview of phytoplankton sampling, analysis and reporting in 2006. The occurrence of potentially toxic and harmful phytoplankton found in Irish coastal and shelf waters in 2006 is compared with the previous year. The succession of phytoplankton blooms in Bantry is described and environmental data that may explain the onset of toxic species is described.

Methodology

Sampling Sites

Phytoplankton sampling sites are located around the Irish coast, usually within shellfish production areas or adjacent to finfish sites. Generally, samples submitted from south-west to south-east coastal sites are analysed in the MI laboratory based in Bantry, Co. Cork, while all remaining samples submitted are analysed in the MI laboratory based in Galway.

Throughout 2006, 2034 samples were submitted to the phytoplankton laboratories. Of these, almost 86% were processed as part of the National Monitoring Programme, from 46 shellfish sites and 42 finfish sites around the coast. The remaining were analysed as part of various research projects, surveys and quality control checks.

Sampling Protocol

The Lund tube sampling method accounted for the majority of samples collected in 2006. A smaller proportion was collected by surface sampling or discrete depths where the Lund tube was not suitable. A proportion of samples are still not adequately labelled with over 11% of samples received by the laboratories giving no information on sampling method.

In total, 82 samples or (5%) were rejected in 2006, broadly similar to the previous year and down from 9.9% in 2004 and 12.6% in 2003. This drop is due to a combination of improvements made to both procedures and sampling strategies.

Sampling Analysis & Reporting

All samples analysed for the presence of toxin producing/ problematic phytoplankton were examined using the Utermöhl method (Trondsen, 1995) following INAB accredited procedures. The method has a sensitivity of 40 cells.l-¹. By the end of 2006, the results of a total of over 1532 samples were reported back to the industry and related bodies, in 290 individual phytoplankton reports, issued on a daily basis. The overall turnaround time from laboratory receipt to reporting is ~ 80% within one working day, and 95% in two working days (Figure 1), well exceeding the 80% within two working days requirement as stated in the service agreement between the MI, FSAI and DCMNR.

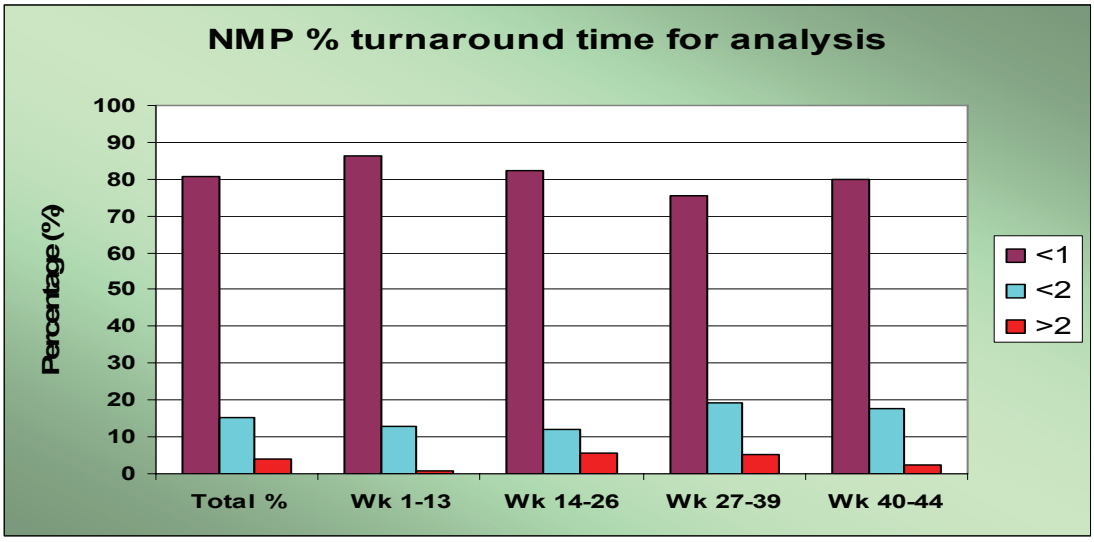

Figure 1. Turnaround of phytoplankton samples from receipt to reporting (Overall actual turnaround time 2006: 95% <2 working days)

Toxic phytoplankton in Irish waters in 2006

At present there are four main toxic algal groups that occur in Irish waters. These are the phytoplankton species that produce the toxins that cause

- Diarrhetic Shellfish Poisoning (DSP)
- Paralytic Shellfish Poisoning (PSP)
- Amnesic Shellfish Poisoning (ASP)
- Azaspiracid Poisoning (AZP)

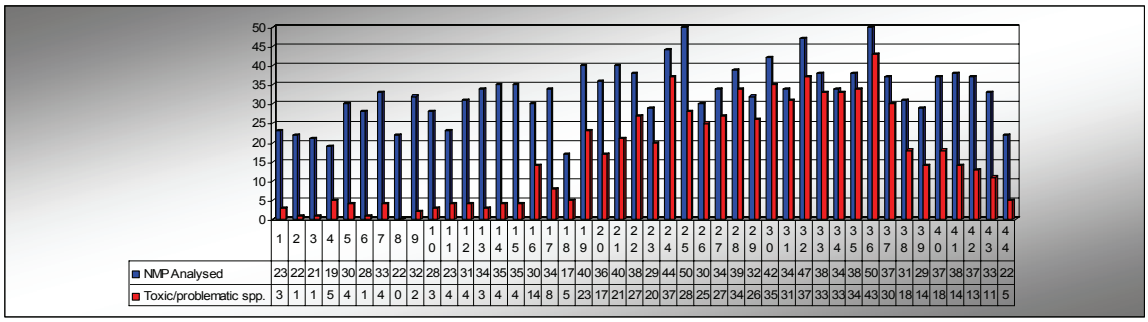

Figure 2. Graph showing the total number of National Monitoring Programme (NMP) samples analysed on a weekly basis (blue columns) and the number of samples containing one or more toxic species (red columns)

Similar to in 2005, prolonged closures also occurred in 2006 due DSP and AZP events. In addition there were localised closures in Cork Harbour due to PSP events.

In contrast to the previous year however, there was a significant reduction in the presence, intensity and distribution of toxic species in 2006. The highest counts for both 2005 and 2006 for the main toxic species are shown in Table 1. In 2006 *Alexandrium* peaked at 18% of the 2005 high count. Similarly, *Dinophysis acuminata* showed only 2.4% and *Dinophysis acuta* 10.4% of 2005 levels. *Pseudo-nitzschia* spp. was also notable by its reduction to 14.7% of the previous year's intensity.

Table 1: The highest counts of toxic phytoplankton detected in 2006, and corresponding high counts in 2005

	2005		**2006**	
	Cells/l	Location	Cells/l	Location
Alexandrium spp.	49,680	Banc Fluich, Castlemaine Hbr	9280	Oysterhaven, Cork
Dinophysis acuminata	82,547	Sheephaven, Donegal	2000	Drumcliff Bay, Sligo
Dinophysis acuta	2680	Kealincha-Inishfarnard, Kenmare Bay	280	Dunmanus Inner, Cork
Pseudo-nitzschia seriata group	2,304,272	Hawks Nest, Mannin Bay	339,592	Rosroe, Killary Hbr
Protoperidinium crassipes/curtipes	80	9 sites	120	Cuigeal, Galway

Dinophysis spp.

The phytoplankton responsible for Diarrhetic Shellfish Poisoning (DSP) toxins (okadiac acid and DTX's) are mainly produced by the dinoflagellates of the *Dinophysis* genus in Irish waters. Historically, the majority of closures in Irish production areas have occurred as a result of this toxin. Toxicity in shellfish can be recorded at very low cell counts (>200cells/l). In 2006, the occurrence of two main species (*D. acuminata* and *D. acuta*) is shown in figure 3.

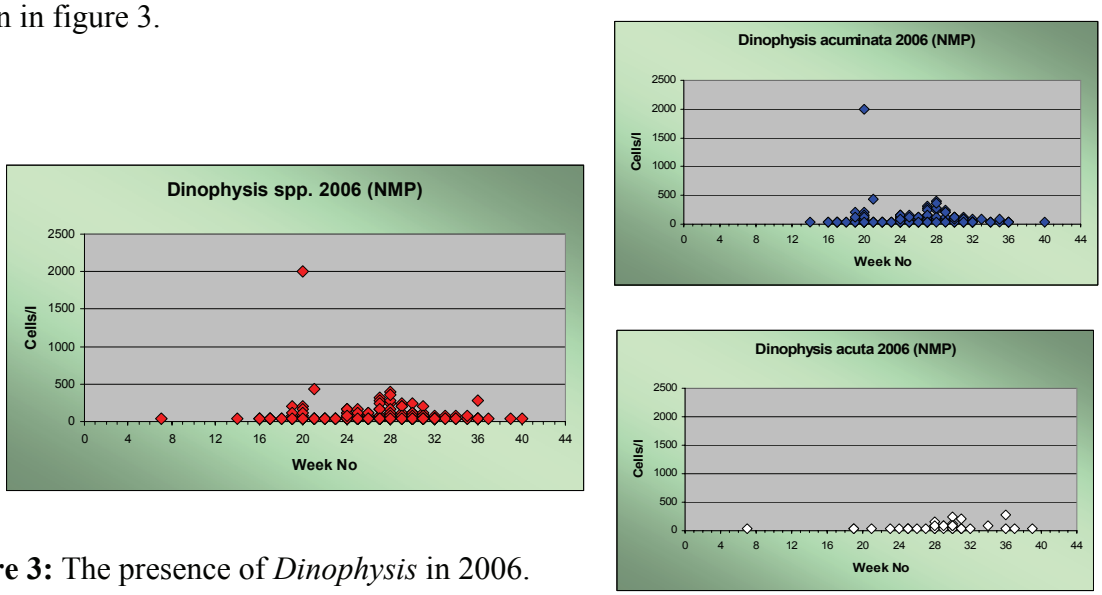

Figure 3: The presence of *Dinophysis* in 2006.

The onset of *Dinophysis* was detected in early summer with low levels in May and June. These levels were observed to increase in a small number of locations in the south west, but typically remained at very low levels in comparison to previous years. While the presence of these did result in DSP toxicity in shellfish, the toxin levels were not particularly high and cleared out of most areas by late September.

Pseudo-nitzschia spp

As the phytoplankton group responsible for Amnesic Shellfish Poisoning (ASP) toxicity, *Pseudo-nitzschia* spp are carefully monitored in Irish waters. Where high counts and in particular monospecific blooms are detected, extra shellfish are sampled and analysed for domoic acid (the toxin responsible for ASP). ASP is usually only found at high levels in the digestive system of scallops, but in 2005 mussels and a lower number of oyster closures occurred in the south west and to a lesser extent in the north west due to this toxin (Clarke *et al*., 2006).

In 2006, *Pseudo-nitzschia* spp did not reach particularly high levels (Figure 4) and apart from one minor detection at borderline levels in mussels from Ardgroom (June), only the usual scallop toxicity was detected above regulatory levels. A relatively minor bloom of the species occurred in autumn with no toxicity in shellfish occurring.

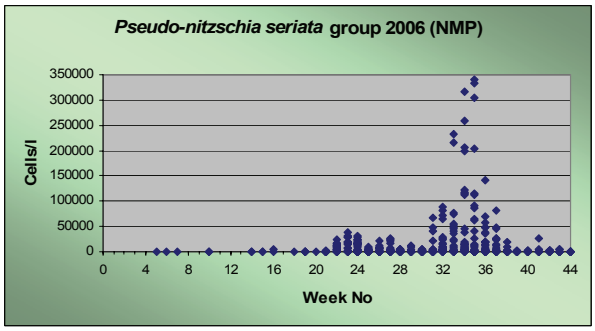

Figure 4. The presence of *Pseudo-nitzschia* spp in 2006

Alexandrium Spp.

One of the most potentially dangerous toxin producers in Irish waters are the Paralytic Shellfish Toxin (PSP) producing *Alexandrium* spp. Due to the potential severity of this neurotoxin, the presence of this species in water samples triggers increased testing of shellfish samples for PSP toxins. To date the main production area that has experienced closures due to PSP toxins is North Channel in Cork Harbour. Levels of *Alexandrium* spp. were generally observed at low levels in 2006 (Figure 5) with the highest levels observed as usual in the summer in North Channel and Oysterhaven, County Cork. Toxicity levels just over the regulatory threshold of 81.4µg/100g were observed in mussels from North Channel, on 20th June (Week 25). Following this, the levels and distribution of *Alexandrium* spp. decreased over the summer months and no other unusual events were observed.

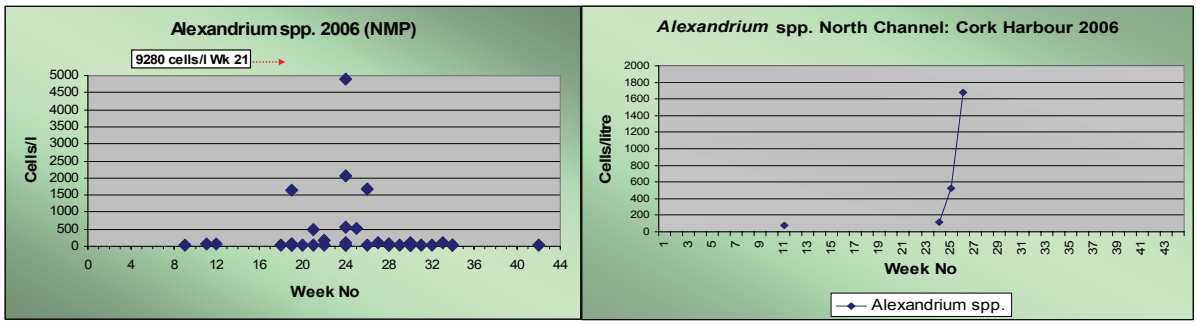

Figure 5. The presence of *Alexandrium* spp in 2006.The bloom observed in North Channel around week 25 corresponded with low level toxicity in shellfish

Protoperidinium spp

This genus of dinoflagellates have been associated with the presence of Azaspiracid shellfish toxins (AZA), however the conclusive proof of this is still outstanding. The correlation between the presence of *Protoperidinium* and Azaspiracid intoxication in shellfish has never been clearly shown. Nonetheless, *Protoperidinium* spp are monitored and their presence in 2006 showed little correspondence to the Azaspiracid event that occurred in the late summer through to winter period. The *Protoperidinium* spp distribution is shown in figure 6. Highest levels observed were in Drumcliff Bay on the 15th May with 74,880 cells/l and a later presence of *P. brevipes* in Greenore on 4th Sep, at a level of 2,000 cells/l.

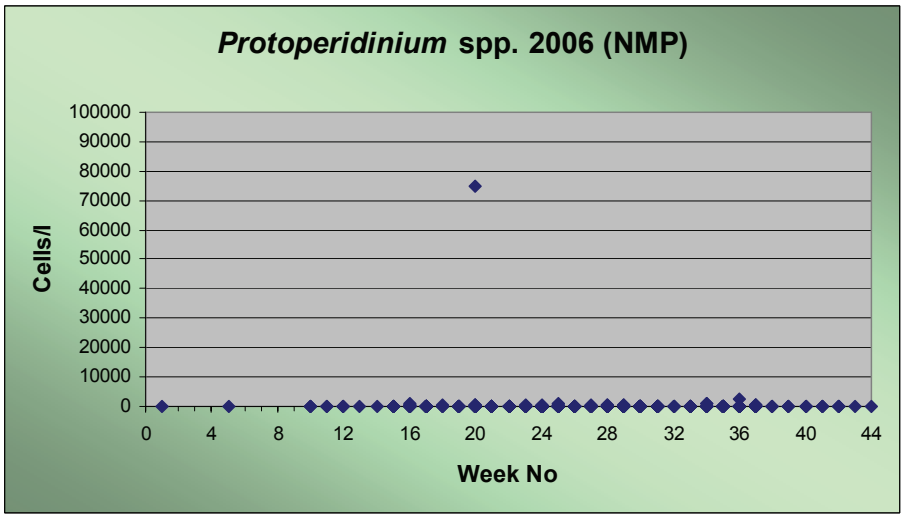

Figure 6. The presence of *Protoperidinium* spp in 2006.

Conclusion:
The extent and intensity of toxic phytoplankton in Irish waters was much reduced than in previous recent years. This resulted in lower levels of toxins observed in fewer areas. The most probable reason for this was the difference in wind climate between 2005 and 2006.

It has been suggested that in the main rope mussel growing region of Ireland (The south western bays) that *Dinophysis* and possibly other toxic species are delivered into these bays by relaxation in upwelling caused by wind direction. (Raine and McMahon 1998, Mc Dermott *et al.* 2004 and Cusack *et al.* 2006). This relaxation results in upper warm water exiting the bay which is then replaced with colder deeper water. This cold water is most likely to be the most significant delivery mechanism for *Dinophysis* species into these south west bays of Ireland.

The Marine Institute maintains a network of temperature probes around the country. These temperature probes (loggers) record hourly temperature at each site at various depths providing a comprehensive time series of temperature around Ireland. This information is invaluable in understanding oceanographic events using temperature as a marker.

The data shown in Figure 7 shows the temperature obtained at one of the temperature logging stations in Bantry in 2005 and 2006. The red arrows indicate cold water pulses in the summer period, which suggest intrusions of water from outside the bay in response to wind stress. The contrast between these events in 2005 and 2006 are obvious with much less colder deeper water pulses observed in 2006. This may explain the reduced observations of *Dinophysis* and consequent toxicity in 2006.

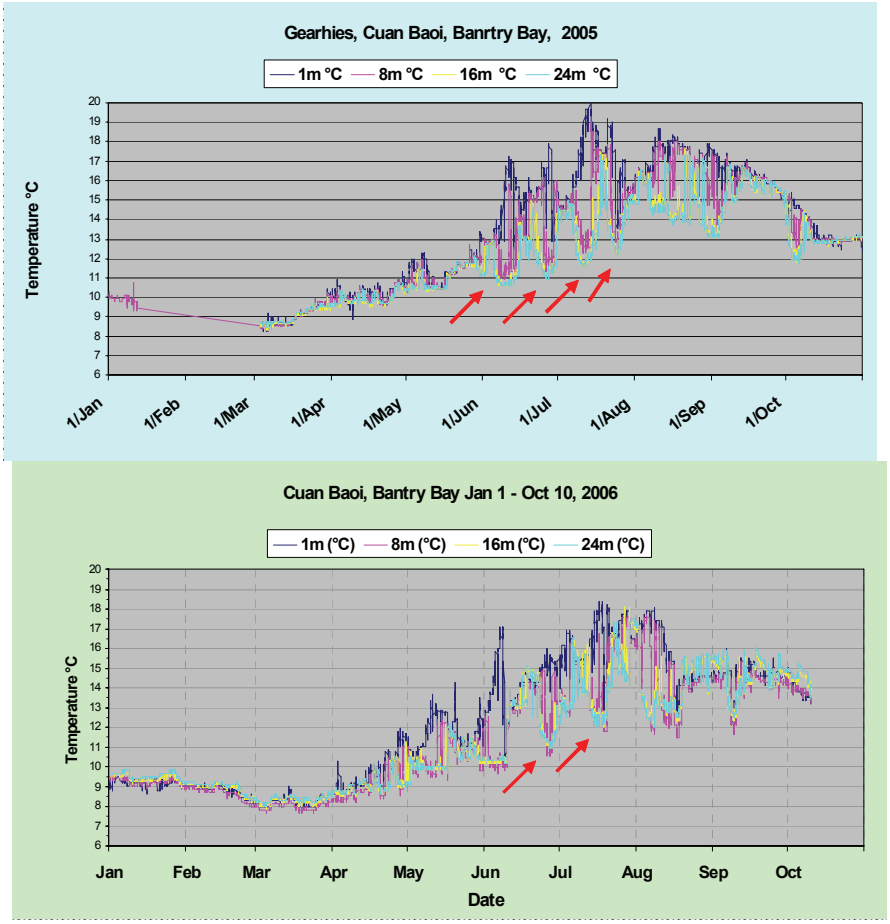

Figure 7. *Sea temperatures measured at 1m, 8m, 16m and 24m in Gerahies Bantry Bay for 2005 and 2006.*

References

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