Harmful and nuisance algal blooms in Irish coastal waters 1990 - 1993.

by

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Abstract

Algal blooms occur naturally around our coast. These high concentrations of planktonic algae are associated with favourable conditions of light and nutrients, and often occur at stratification / mixing fronts. Many blooms are completely harmless, and form the diet of shellfish and zooplankton. Some colour the water red or brown. A few species are toxic and can cause fish kills or make shellfish unsafe to eat. The Fisheries Research Centre monitors phytoplankton in order to detect any toxic or potentially harmful blooms. The harmful and nuisance algal events from 1990 to 1993 are described.

Introduction

As a consequence of the increasing problem that blooms were causing fisheries and aquaculture in the mid 1970's, a monitoring program for phytoplankton was initiated by Fisheries Research Centre. Samples of sea water from a variety of locations, particularly fin-fish and shellfish growing areas, are taken regularly and examined by the phytoplankton laboratory as part of this phytoplankton programme.

Apart from the regular diatom spring blooms of *Chaetoceros* spp, *Nitzschia* spp. and *Skeletonema* spp., occurrences of the harmful and nuisance species; *Gyrodinium* cf. *aureolum* , *Alexandrium* spp., *Hetrosigma akashiwo* Hada, *Phaeocystis pouchettii* Hariot, *Noctiluca scintillans* Ehrenberg and *Mesodinium rubrum* Lohmann were observed in Irish coastal waters between 1990 - 1993. Doyle et.al. (1984) described the impact of blooms on mariculture in Ireland, particularly blooms of *Gyrodinium* cf. *aureolum* and Flagellate 'x'. Flagellate 'x' has now been tentatively identified as *Hetrosigma akashiwo*. This species has been associated with fish kills in Bealacragher Bay (Doyle et.al. 1984) and in both Lough Striven (Tett 1980) and Upper Lough Fyne (Gowen and Lewis 1982)

in Scotland. *Alexandrium* sp. has bloomed in Cork harbour in the past and is of particular interest due to it's potentially lethal poison, saxitoxin, which can cause paralytic shellfish poisoning. Fortunately no incidence of PSP has been detected from the area. *Noctiluca scintillans* has occasionally produced red discolourations in coastal waters (Parker et.al. 1981). This species has no known toxic effects, but it has been suggested that the high ammonia content of the cells irritate fish (Okaichi and Nishio 1976). This species arouses much public attention from the bright red water that it produces during dense blooms. *Mesodinium rubrum* is a ciliate which also elevates public interest, due to it's characteristic dark brown tide. Water discolourations of red, brick-red, wine-red, maroon, muddy and even purple have been ascribed to this species. It's presence is regular in the plankton and has recently been associated with coloured water in the Southwest.

Dinophysis species are important constituents of the summer phytoplankton assemblage, and produce the toxins responsible for Diarrhetic Shellfish Poisoning. DSP has been recorded in south-western bays each year since 1984 and is described elsewhere (Jackson and Silke 1993).

Methods

Discrete water samples were taken at a variety of locations, mainly fin-fish and shellfish growing areas. Samples were either taken on a weekly, fortnightly or monthly basis depending on the time of the year and the site. The sampling stations are shown in figure 1. The samples were taken at 0m, 2.5m, 5m, 10m, 15m, 20m and 25m. They were taken with a 2.5l Ruttner bottle. Sub-samples were removed from this bottle and preserved in 25ml sterilin tubes with 3 - 5 drops of acidified Lugols iodine. The samples were returned to the lab, shaken and transferred to 25ml Hydro-Bios plankton chambers and allowed to settle for 24 hours. They were examined under an Olympus IMT-2 inverted microscope. Counts of all phytoplankton were either recorded to genus, or where possible to species level. Cell counts were taken according to the method of Utermöhl (1958).

Results

A total of over 8500 samples have been analysed from sea sites around the coast since 1990. The majority of these were taken close to mariculture

installations as part of a public health monitoring programme. The results of five phytoplankton and one ciliate species are presented here .

1: *Noctiluca scintillans*: (Fig. 1).

(1990); Only one major count was recorded during the year. Reports of red water were received from along the east coast during September, and subsequent sampling revealed a maximum count of 0.5×10^6 cells / litre.

(1991); *Noctiluca* presented no problems this year.

(1992); Blooms of *Noctiluca* were abundant from late July until September in Southwest area. Many reports of Red water were received, from Kenmare Bay to Castletownbere. Highest count was 1.46×10^6 cells / litre on 29th July near Deenish Island, Kenmare Bay.

2: *Hetrosigma akashiwo*:(Fig. 2).

(1990); Recorded in low numbers from Youghal around the West coast to Inver Bay in Donegal from June to October. Most frequently encountered in Connemara Bays. It was closely monitored due to the speed with which it can form fish killing blooms. The highest count was 240 cells per litre in Killary Harbour on the 30th July.

(1991); Higher counts were obtained than in 1990 but again no major blooms occurred. Cells were observed from Bantry up to Mannin Bay from 12 August to the end of September. Highest count was 4.48×10^3 cells / litre on the 25th August in Mannin Bay. No fish kills were associated with the species in 1991.

(1992); Low counts again this year from Bantry up to Cranford in Donegal during the period from July to end of September. Highest count was 400 cells / litre recorded in Inver Bay in co. Donegal. No mortalities on fish farms were attributed to this species again this year.

3: *Phaeocystis pouchettii*:(Fig. 3).

(1990); A presence of Phaeocystis was observed from Castletownbere up to Inver Bay, but mostly from Connemara sampling sites in the West. One record

was observed on the East coast in June and a small bloom developed in Roundstone in mid may.

(1991); No records this year.

(1992); Present in Bantry Bay in early April. No other recordings.

4: *Alexandrium* spp:(Fig. 4).
(1990); No records this year.

(1991); Two samples from Cork Harbour gave cell counts above 1000 cells / litre, at the end of August and the end of September. Shellfish were tested in both of these minor blooms but no PSP toxicity was found.

(1992); More extensive than previous two years, recorded from Cork Harbour up to Bealacragher Bay. It occurred from Mid June to the end of August, mostly giving low cell counts except for a bloom of 39000 cells per litre in Lettercallow on 6th July and three samples from Mannin Bay area above 1000 cells per litre on 20th July. Again samples for PSP toxicity were negative.

5: *Gyrodinium* cf. *aureolum*:(Fig. 5).
(1990); Mainly low counts observed this year. Cell counts greater than 1000 per litre occurred from Dunmore East around to Kenmare Bay during the month of August. A bloom was recorded in Dunmore East in mid August, with cell counts up to 1.83×10^6 cells / litre.

(1991); In general, higher counts and more widespread than in 1990. 67 records were found with cell counts greater than 10000 cells / litre. High counts all occurred from mid August to mid September. A bloom was recorded during the first two weeks of September in area from Roaringwater Bay up to Lambs Head. The start of this bloom was recorded on a research cruise aboard the Lough Beltra at the end of August. Highest count during this was 1.87×10^6 cells / litre recorded at Deenish Island on 2nd September.

(1992); Not as intensive as in 1991 and it did not get established in the Southwest, but it was recorded further North than previous years. A bloom in the Northwest was claimed to be responsible for a fish kill in Donegal and a shellfish and littoral organism mortality in Sligo Bay. Counts greater than 10000 cells per litre were recorded up along the West coast from July to the end of August. The highest counts recorded were during the Northwest bloom of 1.12×10^6 cells / litre in Inver Bay on 6th August.

(1993); Some low counts were obtained in early July in the Castletownbere area. Highest counts were 2.5×10^3 cells / litre in this area.

6: *Mesodinium rubrum*:(Fig. 6).

(1990); Present in Connemara Bays in late autumn, but no high counts.

(1991); Not recorded.

(1992); Low counts in Bantry-Castletownbere area in late autumn.

(1993): High counts recorded in Castletownbere which discoloured the water in several patchy areas in early July. Highest count recorded was 36×10^3 cells / litre.

Discussion

Two types of blooms were recorded during the past three years, those that developed offshore, before been transported by some oceanographic process toward coastal waters and those that developed as localised events within these inshore waters.

Intense blooms of *Noctiluca scintillans* were recorded in 1990 in the Northeast region and again in 1992 in the southwest. The 1990 bloom followed several reports of red water along the East coast and were probably localised events. The 1992 Southwest bloom was more extensive and lasted over one month. This was probably associated with the coastal frontal systems in this area. This bloom occurred in the area and in the month more normally associated with blooms of *Gyrodinium* cf. *aureolum*. It is interesting that Evans (1977) suggests an inverse relationship between blooms of *Gyrodinium* and *Noctiluca*. It is also possible that

Noctiluca blooms depend upon increased diatom populations (on which they prey). The 1992 phytoplankton counts show increased levels of several diatom species at the time. *Noctiluca* has bloomed several times in this area in the past. Fish tend to avoid the area of a bloom due to the high ammonia content of the cells, and this has been reported to have contributed to the decline in the Indian Ocean fishery. In Irish waters, basking sharks and other species have been reported to swim unharmed through patches of *Noctiluca* bloom (Parker et.al. 1981)

Mortalities of fin-fish in a sheltered sea loch on the West coast in the mid-1980's were attributed to blooms of what has now been tentatively identified as *Heterosigma akashiwo.* During these blooms, counts of up to 2.5 x 10^6 cells/litre were present. In the past three years however, no high levels of the species have been recorded. The highest counts were 4480 cells/litre in Mannin Bay at the end of August 1991. The mechanism by which *H.akashiwo* blooms cause fish mortalities is not fully understood. Both gill injury by haemolytic substances and physical clogging by viscous mucilage may be involved. It is important once it is recorded in an area to increase sampling frequency due to the speed with which it can elevate to fish killing blooms. Blooms of this species appear to be highly localised events, and may be associated with enrichment from mariculture activities.

Phaeocystis pouchettii has been recorded in high numbers intermittently in the early 1970's and in the mid-1980's (Parker et.al. 1982, Doyle and Dunne 1984). During it's growth period it forms a mucilaginous substance around the cells, making it clearly visible to the naked eye. This mucilage has been reported to choke tow nets and to make salmon nets visible, thus reducing catches. It may also have been responsible for water discolourations and fouling of beach and amenity areas when it dies and decays. During this study period, there has only been one isolated bloom of the species recorded. This was in Roundstone during mid-May 1990. No deleterious effects were observed.

From a public health viewpoint, *Alexandrium* sp. (possibly *minutum*) poses a more serious hazard in bloom quantities because of the potent neurotoxin saxitoxin which it possesses. This toxin produces "Paralytic Shellfish Poisoning" when it is passed via filter feeding shellfish to the human consumer. Although this species has formed bloom quantities both in the past three years of this present study, and previously (Dunne and Parker 1981), all PSP tests have given only negative results. It is possible that the species in Irish waters has less

of a toxic capability than some of it's close European relatives. *Alexandrium* sp. was found in high numbers in Cork Harbour in 1991 at 6000 cells/litre and in Lettercallow in 1992 at 36000 cells/litre. Cork Harbour has had several blooms of the species in the last decade and is currently being studied for the presence of cysts. Cysts of the species may be more toxic than the vegetative cell, and may present a more persistent problem.

Mortalities of farmed salmonids and littoral and sub-littoral organisms in Irish waters have been attributed to *Gyrodinium* cf. *aureolum* since 1976 (Ottway et. al. 1979). Blooms of *G.aureolum* have occurred each year during the present study. The densest blooms each year were in Dunmore East in 1990, Castletownbere in 1991, and in Inver Bay in 1992. These blooms ranged between approximately 1 - 2 million cells / litre. The bloom in 1992 was circumstantially linked to a major fish mortality in the area. In recent years, the intrusions of warm surface waters from offshore containing dense populations of *G.aureolum* have been shown to occur across the Atlantic shelf front to the Southwest coast. The use of satellite imagery, moored strings of thermistors and conventional chlorophyll measurements have shown these intrusions of water into the deep bays and inlets of the south coast (Raine et.al. 1992). Advance warnings such as these may provide the fish farmer with options to take evasive action (harvest, reduce stocking densities or aerate water column etc.).

Mesodinium rubrum, a ciliate has been included in this current work due to the similarities in the red water colourations that it produces to that of algal red tides Parker et.al. (1982) reported on blooms in 1979 and 1980 in the West coast. Although broadly present in most areas, the species bloomed only once in the past three years. This was in July 1993 in the Southwest, where it caused much public concern from the bright red waters that it displayed. The species is non-toxic but may cause oxygen depletion when the bloom is decaying.

Although much oceanographic evidence has been collected in recent years, and the causes of algal blooms are emerging from these studies, much more information is needed on the oceanographic processes at work around our coastline before the dynamics and causes of these blooms can be properly understood. The over wintering of non-cyst forming species and the distributions of cyst forming species must be investigated fully.

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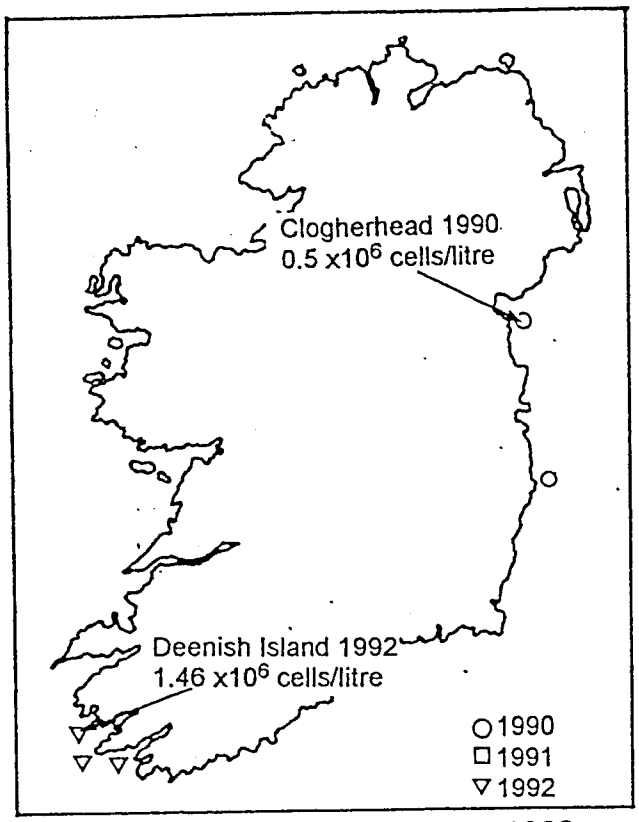

Fig.1: *Noctiluca scintilllans*:1990 -1992.

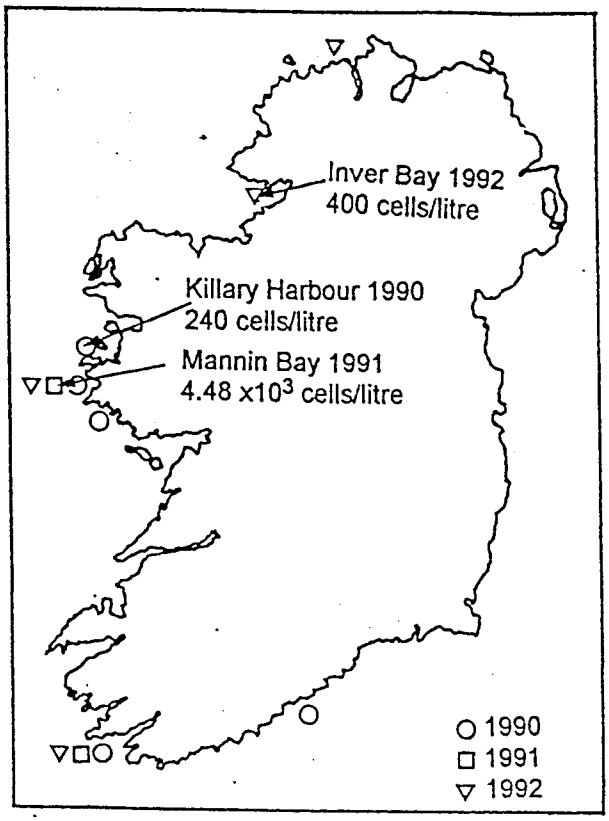

Fig.2:*Hetrosigma akashiwo*:1990 - 1992.

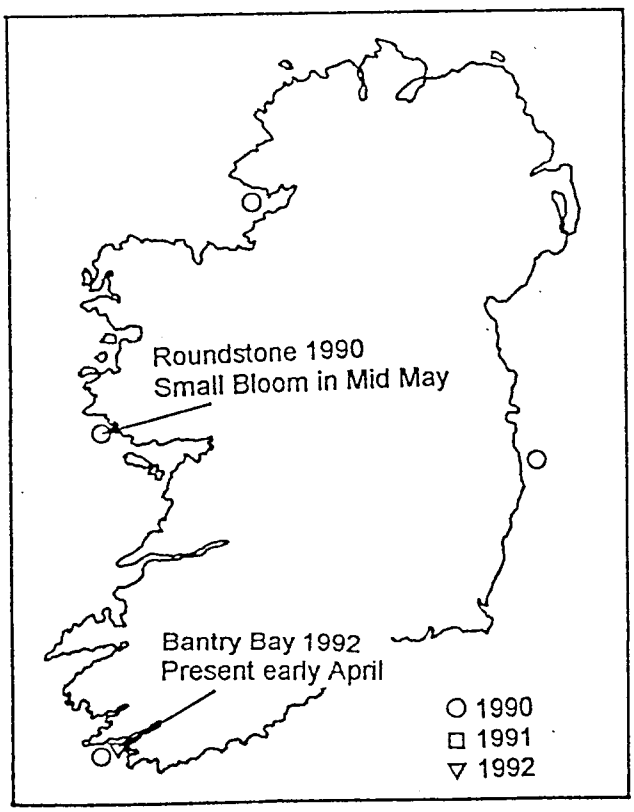

Fig.3:*Phaeocystis pouchettii*:1990 - 1992.

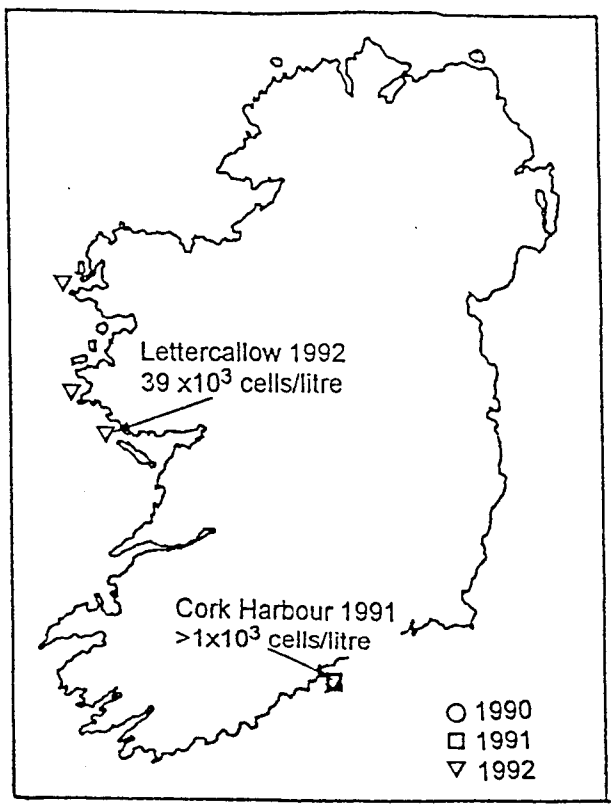

Fig.4:*Alexandrium* spp.:1990 - 1992.

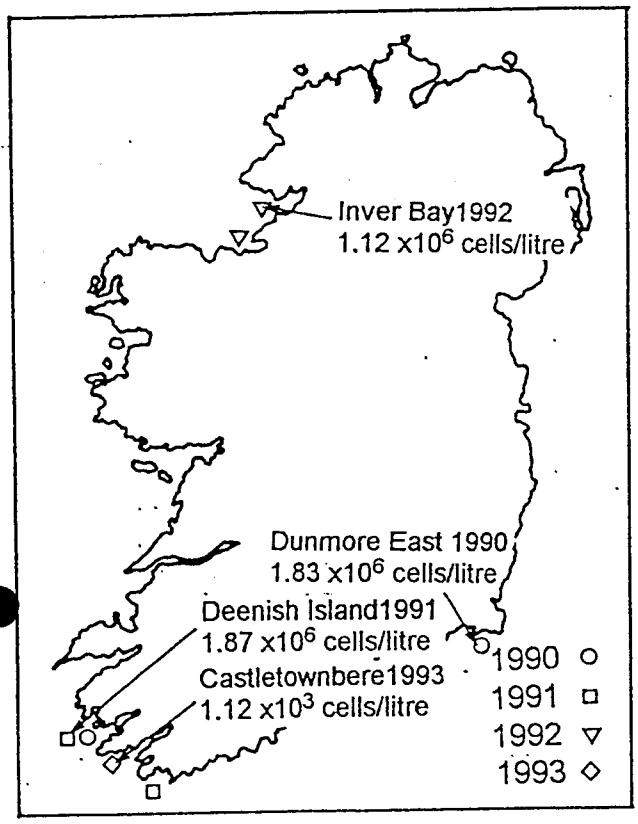

Fig.5:*Gyrodinium* cf.*aureolum*:1990 - 1993.

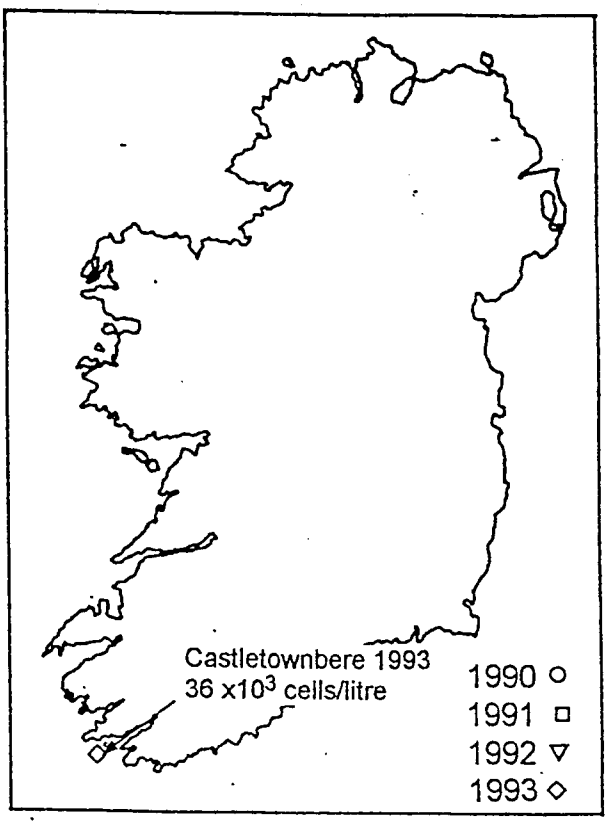

Fig.6:Mesodinium rubrum:1990 - 1993.