Dinoflagellate Cysts in Irish Coastal Sediments

- A Preliminary Report (1993)

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Introduction

Since the mid 1970's the production of bivalve shellfish in Ireland has increased annually to a present level of some 17,000 tonnes. Several problems limit the continued expansion of the industry, most notably the problem of natural biotoxins. These toxins are accumulated in the product by the ingestion of toxic phytoplankton. This causes no obvious ill effects to the shellfish themselves but upon consumption may be transferred to human or other vertebrate consumers causing illness and sometimes death. In Ireland the most common of the toxins are those associated with Diarrhetic Shellfish Poisoning (DSP) which causes diarrhoea. Other more serious toxins which todate have not been confirmed in Ireland are those associated with Paralytic Shellfish Poisoning (PSP) which causes paralysis or even death and Amnesic Shellfish Poisoning (ASP) which causes short term memory loss.

Of the phytoplankton species which can result in toxicity, under both bloom and non bloom conditions, the dinoflagellates play an important role. Many of these dinoflagellates have been shown to include a dormant benthic cyst stage in their life cycle. Therefore a better understanding of the dynamics of toxic events may be obtained by studying the distribution and abundance of benthic cysts.

There is growing international concern about the transport of harmful aquatic organisms, including cysts, into new areas via the discharge of ships ballast water. Also, as a result of EC directive 91/67/EEC permitting the free movement of shellfish between EU member states there is now increasing concern in Ireland that harmful cysts may be introduced with shipments of imported shellfish.

Little research has been carried out on the distribution of dinoflagellate cysts in Irish marine sediments. In this paper preliminary results of a study designed to map the distribution and undertake taxonomic studies on dinoflagellate and other cysts in Ireland are presented and discussed. Also presented are the results of the examination of cysts associated with imported shellfish.

Materials and Methods

Sediment Samples

Samples were taken from the R.V. Lough Beltra and a variety of other sampling platforms at a range of coastal sites and also offshore in the Irish Sea (Fig. 1). The sediment type varied from gravelly/shelly sand to very fine silt. Sediment samples were collected using both Van Veen and Day grabs, Reineck corer and surface scrapes by SCUBA divers. The sediment samples were stored in the dark at 4° C until analysed. They were prepared for examination by sieving, after ultra-sonic disaggregation to separate the cysts form organic and inorganic aggregates. The sonicated suspension was then examined on Utermohl slides, using an Olympus IMT-2 microscope. Cysts were identified, counted and photographic data was prepared from this analysis.

Shellfish Samples

Samples were taken from several consignments of imported French oysters (C. gigas) between 23 January and 22 April 1993 and examined as described in O'Mahony (1993)

Results

In the samples examined to date a total of 58 phytobenthic species have been recorded. Of these 38 species of dinoflagellate cysts were identified. Dinoflagellate cysts were recorded in all areas examined although the number of different species recorded varied between each site ranging from 2 at locations on the east coast to 26 in the inner Bantry Bay (Table 1) The relative proportions of different species found also varied between sites. A list of the dinoflagellate cysts recorded during the study is given in Table 2. A dual nomenclature exists for dinoflagellate cysts, the first being palaeological and the second being a thecal based botanical system. Both are included here as a final nomenclature system has yet to be satisfactorily established.

The highest number of cysts recorded were from Inner Bantry Bay where the cysts of *Gonyaulax polyedra* comprised up to 94% of the cyst assemblage. Several of these cysts were sucessfuly hatched in the laboratory yielding viable vegetative cells. *Alexandrium* spp. were also identified in samples from Bantry Bay although not in any great numbers. Also identified again in low numbers were cysts of *Gonyaulax grindleyi.*

In the imported shellfish examined 15 dinoflagellate cyst species were found. Two cyst forms of *Alexandrium spp.* were recorded. Two types of *Scrippsiella* cysts were also found. Gonylaulacoid cysts identified included *G. spinifera,* and *G. grindleyi.* Other cysts identified included *Polykrikos schwartzii* and several Protoperidinoid species.

Discussion

The majority of toxic dinoflagellates that affect shellfish aquaculture produce resistant cysts that can remain viable under unfavourable conditions for 10 - 20 years. If cyst-producing species that are not endemic to an area are inadvertemtly introduced, their cysts stages may be buried below the sediment surface from which they are gradually resuspended into the water column. This may result in years of recurrent germination attempts by the cysts which, when successful, will result in dinoflagellate blooms in the overlying water column. Once the species produces new cyst stages, it will have effectively colonised a new water body from which it cannot be eradicated. Local shipping and coastal currents can then spread the species beyond the initial point of introduction.

Dinoflagellate blooms especially for *Gonyaulax polyedra* often appear very suddenly and erratically. It is probable that the presence of large numbers of dormant cysts in the underlying sediment given the right stimulus is the causative agent for this sudden abundance. With such numbers the potential for a red tide of *Gonyaluax polyedra* are great. Such a red tide could have serious repercussions for the shellfish and tourism industries in the affected areas. Recent work in Italy (Bruno et al, 1990) has suggested that *Gonyaulax polyedra* may contain Saxitoxin, one of the PSP toxin complex.

There is increasing evidence in the literature that accumulating resting stages of A. tamerense can form "seed beds" which initiate recurrent blooms when the cysts germinate induced by environmental stimuli e.g. changes in temperature, light intensity or oxygen concentration. Once introduced into sensitive aquaculture areas the results could be disasterous for commercial shellfish farming. Recurrent blooms of this species have been documented on the east coast of the United States and the North Sea coast of Scotland.