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A monitoring programme for Paralytic Shellfish Poisoning (PSP) on the northeast coast of England

Notes on the 1975 programme with a review of work during the period 1968-1974

by

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SUMMARY

Paralytic shellfish poisoning (PSP) is rare in Britain with only 10 incidents reported since 1828, involving a total of 146 people. The most recent incident occurred in May 1968 when 78 people were affected after consuming mussels (Mytilus edulis) taken from the northeast coast of England. The present paper reviews the findings of this incident and the subsequent annual monitoring programme which was initiated. Investigations have shown that the development of PSP toxicity has so far been limited to the area affected in 1968 but toxin has been detected annually. The area affected and maximum levels of toxin observed showed a decline until 1972-1973 but have increased during 1974-1975. A number of factors implicate the dino-flagellate Gonyaulax tamarensis (G excavata Balech /Braarud/) as the source of toxin. Apparent absence of this organism on some occasions when toxin in mussels was demonstrated and the discovery that two toxic principles may be involved poses questions on the origin of the toxin.

INTRODUCTION

At the end of May 1968, 78 persons on the northeast coast of England were admitted to hospital with a paralytic illness following the consumption of locally gathered mussels (Mytilus edulis). Of those affected, most had purchased cooked mussels from a retail outlet and a few had cooked the mussels at home. Subsequent investigations (McCollum et al., 1968) demonstrated that the symptoms were typical of paralytic shellfish poisoning (PSP). This form of shellfish poisoning is exceedingly rare in Britain, only 10 outbreaks, involving 146 people, having been recorded since 1828; all were associated with the consumption of mussels, (Ayres 1975).

MONITORING PROGRAMME

As a result of the 1968 outbreak (Wood and Mason 1968, Wood 1968) an annual monitoring programme was established along the northeast coast of England. Samples of littoral mussels have been taken from fixed localities at regular intervals between March and August of each year and levels of toxin determined by mouse bioassay (Wood 1969, Wood & Ayres 1970, Ayres 1971). In addition, a survey of all the major molluscan shellfisheries in England and Wales was undertaken (Wood 1969) to determine whether toxicity was limited to the northeast coast. Examination of water samples for phytoplankton was abandoned in 1971 and replaced by examination of mussel gut contents. Although this was not strictly quantitative, it has proved useful for the rapid assessment of the major genera and species of dinoflagellate ingested by mussels containing toxin and permitted comparisons of phytoplankton at several sampling sites.

1975 RESULTS

The results for the current year's monitoring are shown in Table 1: sampling commenced in mid March and will be continued until August from within the area shown in Figure 1. Toxicity appeared in early May and by the middle of the month had exceeded the generally accepted action level of 400 mouse units/100g shellfish tissue at Budle Bay. This permitted adequate notification to public health authorities and fishermen of potential hazards to human health, and all commercial gathering of mussels and scallops was halted. Maximum toxicity was observed at Berwick at the end of May and the value of 6146 mu/100g was the highest value obtained since 1969. Coincident with maximum toxicity at Berwick, reports of dead seabirds, particularly shags (Phalacrocorax aristotelis) were received from the Farne Islands. Similar deaths were associated with the 1968 outbreak of mussel toxicity (Coulson et al., 1968) when toxicity levels reached 50,000 mu/100g at Holy Island, but were not reported in 1969 when toxin levels in mussels were comparable to those of 1975 (Figure 2). More recently, large numbers of Herring gulls (Larus argentatus) have also been reported dead in the area and in the Firth of Forth (Scotland), but with declining toxicity it is unlikely that this is associated with the earlier deaths of shags.

No phytoplankton 'blooms' have been reported off the northeast coast and no particular genus or species of dinoflagellate has occurred in unusually high concentrations during the phytoplankton examination of mussel gut contents.

In trying to make a broad summary of the results for 1975 and those of previous years since monitoring commenced, a number of points emerge:-

1) The presence in mussels of toxin characteristic of that associated with paralytic shellfish poisoning has been demonstrated annually since May 1968 when 78 people were affected after consuming mussels from the northeast coast of England.

2) A survey of all major commercial molluscan shellfisheries in other parts of England and Wales failed to demonstrate the presence of toxin in other areas; no clinical cases of PSP have been reported in the United Kingdom since 1968.

3) Examination of phytoplankton samples and of the toxicity data suggests that the dinoflagellate Gonyaulax tamarensis (G excavata?) was the source of toxin.

4) Shellfish appeared to become toxic following continued exposure to low concentrations of toxin producing organisms, rather than a short term exposure to 'bloom' concentrations.

5) High levels of toxin in littoral shellfish were preceeded by the presence of toxin in offshore shellfish stocks and the appearance of dinoflagellates in offshore waters as early as April.

6) Toxicity has developed annually since 1968 and although the levels recorded and the area affected generally decreased until 1972-1973 there has been a reversal of this trend during the last two years (1974-1975).

During the course of the investigations two major anomalies have come to light concerning the nature and origin of toxicity on the northeast coast. Samples of toxic mussels and acid extracts of mussels from the 1968 outbreak have been examined by Dr E Schantz (USA), a world authority on dinoflagellate toxins, and Dr M Evans of Cambridge (UK).. Schantz (pers. comm.) found that the acid extract contained a poison with properties similar to that of a substance obtained from axenic cultures of Gonyaulax tamarensis grown in the laboratory.. Evans (1970), however, extracted two toxic fractions, the minor one of which was identical to saxitoxin which has been identified by Schantz (1967) as the toxic principle in similar PSP outbreaks in North America. The major fraction obtained by Evans exhibited similar properties to those of saxitoxin but had a poor affinity for ion exchange resin (Amberlite CG50) in comparison with saxitoxin. These results suggest that either Gonyaulax tamarensis produces both saxitoxin and another toxin (the major fraction found by Evans) or that the major toxin originated elsewhere. Attempts to use standard saxitoxin procedures to extract poison from Bay of Fundy (Canada) scallops also failed. (Schantz 1960).

Throughout this paper the name Gonyaulax tamarensis has been retained in keeping with earlier reports on the 1968 outbreak. However Braarud (1945) designated the toxic form of G. tamarensis as G. tamarensis var excavata. More recently Balech (1971) raised this to specific level ie Gonyaulax excavata (Braarud) Balech. Although

the taxonomy of the species occurring on the northeast coast of England have not been examined in detail it seems probable that this name should be applied, in preference to G. tamarensis.

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Table 1 Levels of toxin in mussels: 1975 (mouse units/100g)

Week ending Station ‡	15/3	22/3	29/3	5/4	12/4	19/4	26/4	3/5	10/5	17/5	24/5	31/5	7/6	14/6	21/6	28/6	5/7
Berwick	*	-	*	*	*	*	*	*	184	341	476	6146	1080	283	284	201	-
Budle Bay	*	*	*	*	*	*	*	*	*	575	1200	3918	1382	1290	462	414	-
Holy Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	286	1149	-
Seahouses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1657	-
Amble	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	206	-
Blyth	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1450	-
Cullercoats	-	-	-	-	-	-	-	-	-	-	-	-	-	-	727	-	-
Sunderland	*	-	-	-	*	*	-	*	-	*	-	*	3918	-	-	-	-
Seaham Harbour	-	-	-	-	-	-	-	-	-	-	-	3915	-	-	-	-	-
Hartlepool	*	-	-	*	*	*	-	*	-	*	*	-	3068	-	-	-	-
Redcar	-	*	-	*	*	-	-	-	-	-	-	-	-	-	-	-	-
Whitby	*	*	-	*	-	*	-	*	-	*	*	-	-	-	220	-	*
Scarborough	*	-	-	-	*	-	*	-	-	214	-	-	+	251	-	*	*
Bridlington	*	*	-	*	-	-	*	-	-	-	*	-	*	-	*	-	-

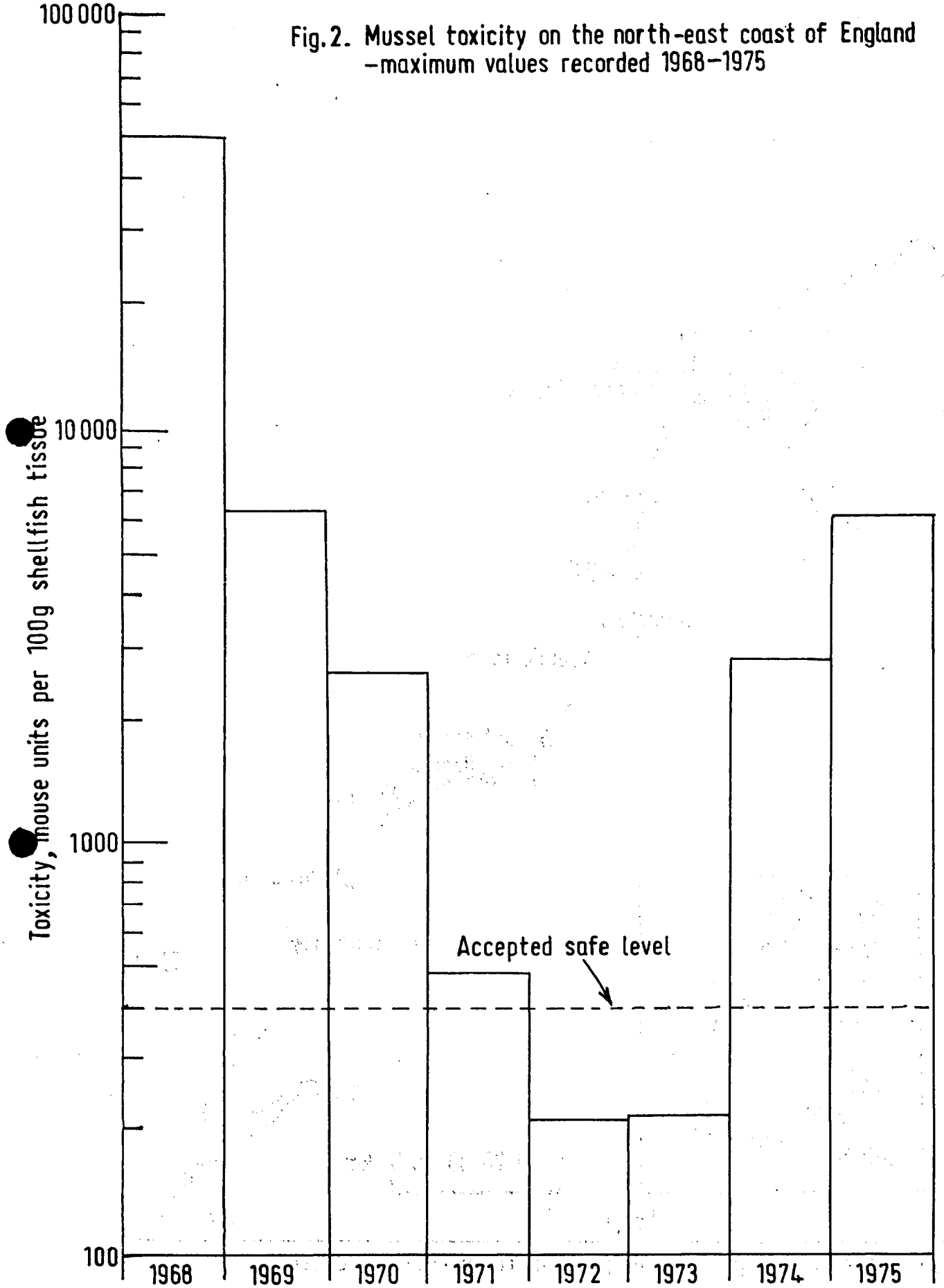
* negative response

\+ sublethal response

\- no sample

‡ See Fig 2 for major stations. Other stations may be interpolated.

Fig. 2. Mussel toxicity on the north-east coast of England
–maximum values recorded 1968–1975



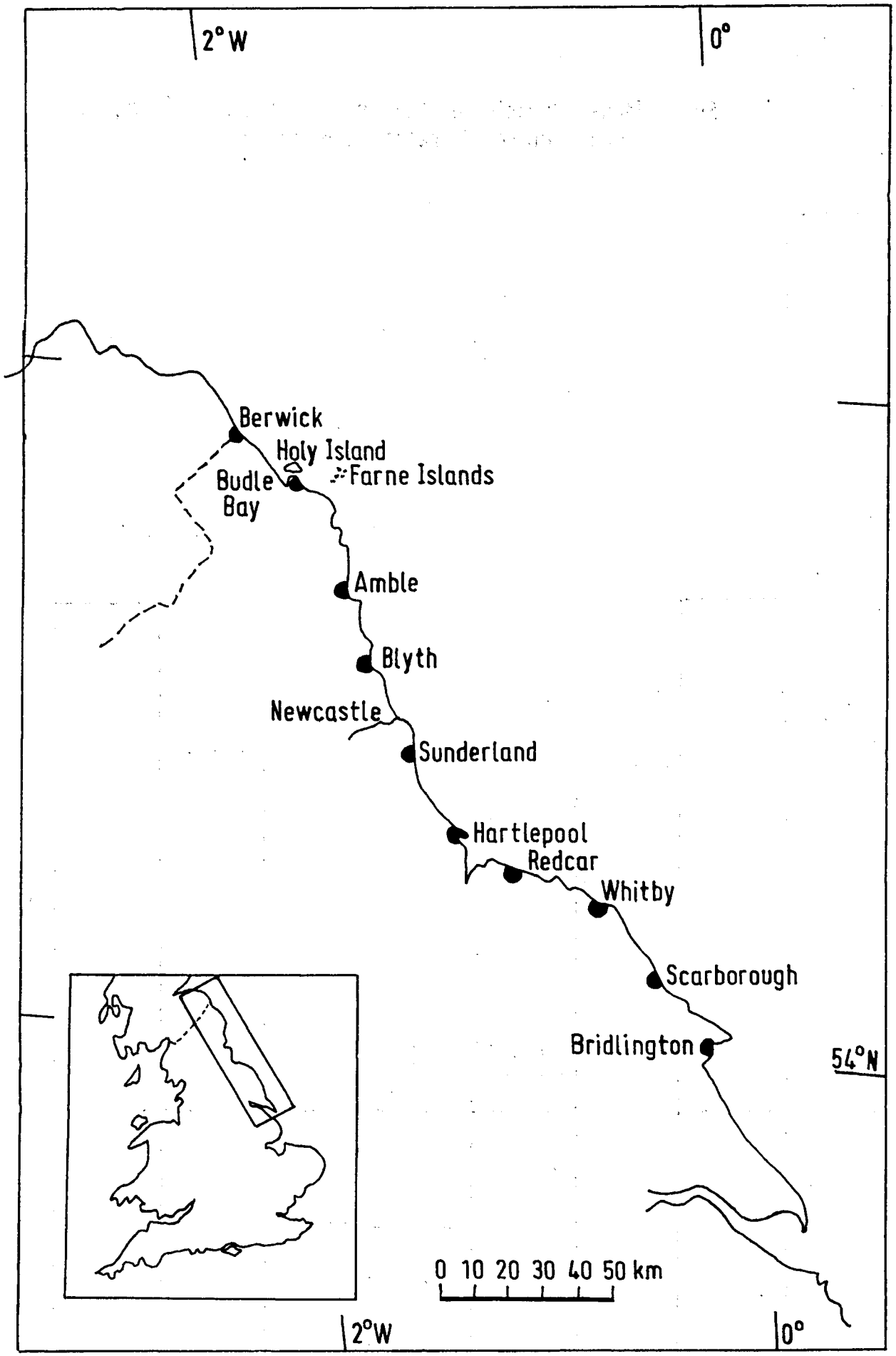


Fig.1. Location of major sampling points on the north-east coast.