

## FOREWORD

Marine contamination by petroleum, whether by natural seepage or by spills from ships at sea, by accidents in harbour or at offshore installations or by atmospheric or terrigenous input is by no means a new or rare phenomenon. In recent years however, the problems have been highlighted not only by the increased utilisation and marine transport of oil but also by a number of spectacular accidents which have raised questions about possible effects on the ecosystem. A number of detailed studies have been carried out in an attempt to answer these questions. The demands for such knowledge have been further increased by the various questions raised as a result of expansion of offshore exploration and exploitation for oil, particularly in environments hostile to these operations, in regions as far apart as the northern North Sea and the coast of Alaska.

Consequently, diverse aspects of the problem are being studied in several parts of the world by chemists and biologists who are often asking the same questions but using different approaches and sometimes producing conflicting views. Against this background, it seemed timely therefore to bring together a group of scientists from university, industry and government, actively engaged in such work, to examine and discuss common problems relevant to petroleum hydrocarbon contamination of the marine ecosystem and so a Work-

shop was sponsored by the International Council for the Exploration of the Sea, and held in Scotland at Aberdeen in September 1975.

The Workshop considered methodology, occurrence and fate in the environment, and effects on the ecosystem of petroleum hydrocarbons in the sea. Most of the papers presented and updated where necessary, are brought together in the present volume together with an edited version of the recorded discussion that followed each session. Of necessity, the reportage of the discussion is very brief although the proportion of time available for discussion compared favourably with that set aside for formal presentation of the papers. In preparing the discussion reports, the editors were assisted in particular by Dr R. Hardy, Dr R. Johnston, Mr P. R. Mackie and Dr I. C. White, and by comments from several contributors.

No attempt was made to produce specific recommendations but a study of the papers in this volume does give a clear indication of several lines of research which must be followed up before an adequate understanding can be reached of the effects of petroleum in the sea and it is evident that widespread monitoring operations will be fully effective only when the basis of our knowledge has been thus extended.

A list of participants to the workshop may be found in Appendix I.

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## A FIVE YEAR STUDY OF THE OCCURRENCE OF NON-POLAR HYDROCARBONS (OIL) IN BALTIC WATERS 1970-1975

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Water samples were collected during the period 1970-1975 from several depths in the Baltic and Kattegat areas and analysed for non-polar hydrocarbons by an infra red technique. The results are presented and discussed.

### INTRODUCTION

At the statutory meeting of ICES in 1969 some interest was raised in analytical techniques suitable for detection and monitoring of oil pollution in sea water. As a result, a study was initiated at the National Board of Fisheries in Sweden. A well known analytical method (Simard et al, 1951; Lindgren, 1957) for oil pollution investigations in fresh water was adapted for work in sea water and, at the same time, the sensitivity of the method was improved. As a first application of the method some samples from the Kattegat and the Baltic were analysed and some preliminary results were reported to ICES (Carlberg and Skarstedt, 1970). Further results were reported later (Carlberg, 1973).

Since the start of this study more sensitive and specific methods have been elaborated than the infra red technique we still apply. This investigation has been carried out on marginal resources within a larger project concerning the hydrography and pollution of the Baltic. As a result of this our laboratory has not been able to analyse large numbers of samples with gas chromatographic or fluorescence techniques on a routine basis. However, as we had the opportunity to carry out repeated regional sampling of the entire Baltic area, and also along the west coast of Sweden, it was decided to use the less sensitive infra red technique. As the concentrations turned out to be lower than some people feared at that time, it became evident that the analytical method should be combined with or replaced by more sensitive and specific techniques.

### SAMPLING AREA AND PERIOD

The study was started in May 1970 and still continues. All sampling has been carried out on regular hydrographic cruises. Although focused on the central part of the Baltic, and for comparison on two stations

in the Kattegat, additional stations have been sampled at lower frequencies in the entire Baltic area and the Kattegat-Skagerrack area. The stations, of which the

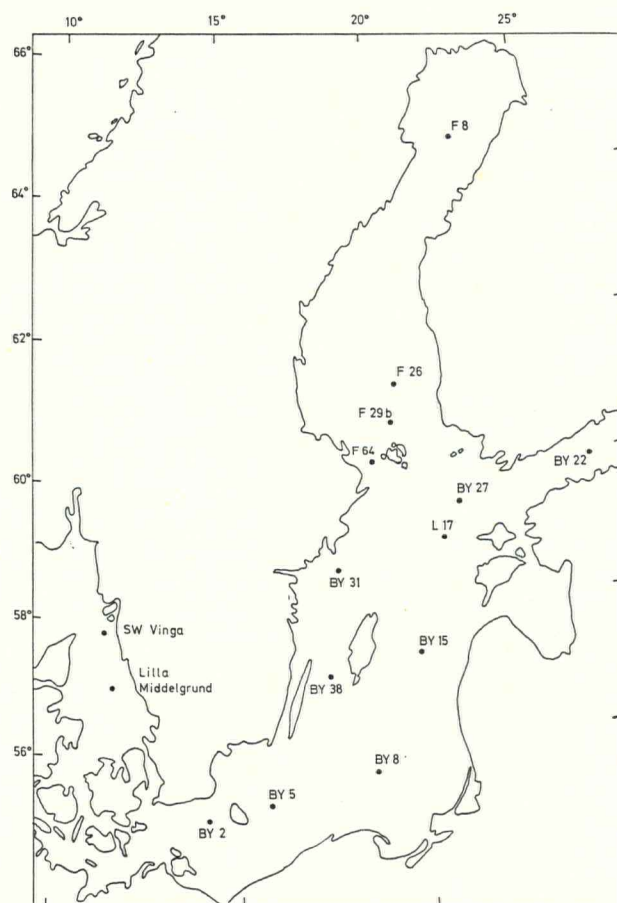


Figure 55. Non-polar hydrocarbons in sea water. Main sampling stations in the Baltic-Kattegat areas.



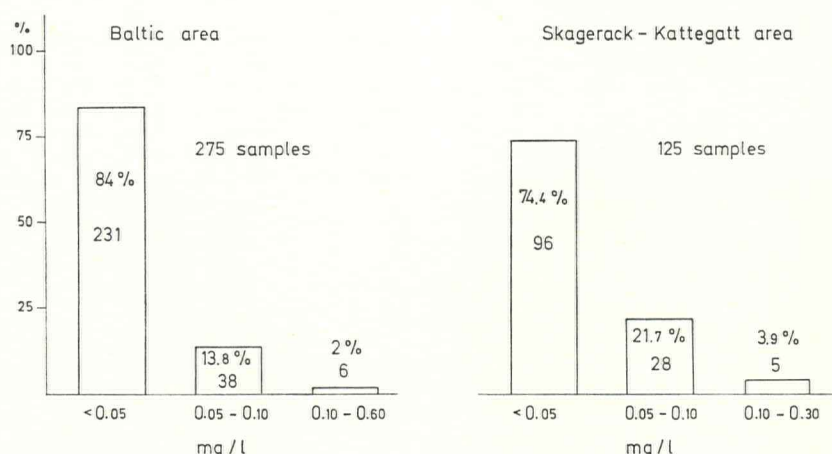


Figure 56. Comparison of contents of non-polar hydrocarbons in water samples from the Baltic and the Kattegat areas, 1970-1975.

more important are shown in Figure 55, have been sampled on from one to fourteen occasions.

#### MATERIALS AND METHODS

In most cases three samples have been taken at each station. Initially water was collected from the surface, 5 m and one depth below the halocline. Later the 5 m sample was replaced by sampling at the depth of the halocline.

Most of the surface samples were obtained with a carefully cleaned stainless steel bucket, which was thrown into the water from the stem of the ship, as it slowly approached the sampling station. Recently this method was discontinued in favour of submerging a bottle to a depth of 1 m with the aid of a weighted frame. On some stations the sampling was limited to this surface layer sampling.

Samples from greater depths were obtained with plastic samplers fastened to a nylon rope, which in turn was tied below the hydrographic wire.

The analytical procedure by carbon tetrachloride extraction, separation on an aluminium oxide and subsequent infra red measurement has previously been described by Carlberg and Skarstedt (1972). All samples were preserved with mercuric chloride and analysed ashore.

#### RESULTS AND DISCUSSION

The results of this study are summarised in Figure 56, showing that for the Baltic 84% of the analysed samples contained less than 0.05 mg/litre, which is the detection limit of the method. Of the rest only 2% contained hydrocarbons in concentrations exceeding 0.10 mg/litre with a highest observed value of 0.57 mg/litre. In all 275 samples were analysed.

For comparison, the figures for the Kattegat-Ska-

gerrack area are 74.4% below 0.05 mg/litre and 3.9% exceeding 0.10 mg/litre and with a highest value of 0.23 mg/litre. In all 125 samples were analysed.

Since 1973, the number of samples analysed from the Baltic has doubled and the number for the Skagerrack-Kattegat area has been trebled. The number of samples showing concentrations higher than 0.10 mg/litre doubled for both areas, but the proportions between the samples with the low concentrations — less than 0.05 mg/litre — are still about the same. In 1973 they were 83.3% and 77.5% respectively. However, the majority of the highest concentrations were found during the last two years.

People have tried to interpret these figures as an indication that the Baltic is less polluted with oil than the Kattegat-Skagerrack. However, we consider that conclusion to be premature, since it must be pointed out that even if the infra red method is sensitive enough to study some aspects of pollution, it is not specific for the hydrocarbons derived from mineral oils. This is why the title of this paper puts the word "oil" within brackets.

#### CONCLUSIONS

From pollution statistics we can conclude that the influx of oil to the Baltic ought to be of the order of some tens of thousands of tonnes per year. Our analyses do not seem to confirm the presence of such quantities. There could be several reasons for this. For instance, our samples of about 2 litres may not be representative. Therefore our sampling programme should be combined with neuston net sampling of particles of oil or tar, to see if they appear in low or high quantities. Furthermore, field studies ought to be carried out on two other subjects; the quantity of oil present in marine sediments and the quantitative role of micro-biological processes.

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