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 Workshop 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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Rapp. P.-v. Réun. Cons. int. Explor. Mer, 171: 184–185. 1977.

THE SUB-LETHAL EFFECTS OF WATER-SOLUBLE EXTRACTS OF CRUDE OIL ON THE FERTILISATION AND DEVELOPMENT OF *FUCUS SERRATUS* L. (SERRATED WRACK)

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Many studies of oil pollution have shown that shore algae frequently flourish following elimination or severe reduction of the more sensitive grazing organisms.

Preliminary studies suggest that although adult fucoid plants can tolerate exposure to spills of crude oil, the young developing zygote is sensitive to relatively low concentrations of "water soluble" extracts of crude oils.

Eggs and spermatozoids were isolated from fertile *Fucus serratus* L. by a method based on that of Petersen and Torrey (1968). Fertile receptacles of the different sexes were collected from shore plants at ebb tide, sealed in separate polythene bags and stored overnight at 8°C. Gamete discharge occurred within 2–5 hours (often as quickly as 30 minutes) when the receptacles were placed in Millipore filtered sea water at 8°C and the subsequent gamete suspensions were used directly in the fertilisation experiments. Allowing 30 minutes after mixing for fertilisation, the suspension was filtered through a 102 micrometre nylon mesh to remove debris and clumps of antheridia, then the fertilised eggs were collected on a 35 micrometre nylon mesh with ample washing to remove unfertilised eggs and excess spermatozoids. The unfertilised eggs, with only a thin cell membrane passed easily through the mesh whereas the fertilised eggs with their rapidly deposited cell wall were retained for study.

From the viewpoint of this study the sequence of events in *Fucus* egg fertilisation, settlement and zygote growth can be resolved into four stages:

1. spermatozoid attraction to the non-motile egg and subsequent fertilisation;
2. deposition of mucilaginous cell wall round the zygotic cell;
3. settlement and adhesion of zygote to substrate;
4. formation and extension of rhizoid, plus cell division to produce multicellular sporelings.

Water soluble extracts of crude oils were produced by the method of Gilfillan (1973).

Extracts prepared from North Sea oils containing more than 1 µg/ml (1–5 µg/ml) as measured by the method of Anderson et al (1974) did not kill developing fucoid embryos even after 96 hours exposure, but at these concentrations a significant reduction in zygote growth was observed. What is perhaps of greater ecological significance, however, was that under such conditions the adhesion of settling sporelings was inhibited. Cytological, including ultrastructural, examination indicated that this inhibition of adhesion was due to a marked decrease in the secretion of polysaccharide mucilage, i.e. reduction in a Golgi body mediated process.

Exposure of the unfertilised egg to concentrations as low as 0·1 µg/ml prevented further development, often even resulting in cell lysis, whereas 0·05 µg/ml greatly reduced the percentage fertilisation. Extracts from North Sea oils were between 2–3 times more toxic than those prepared from equivalent amounts of Kuwait crudes, the differences in toxicity being proportional to the levels of aromatic hydrocarbons as determined spectrofluorimetrically.

Although adult fucoids are remarkably resistant to exposure to oil pollution when compared to associated grazing animals, the susceptibility of the fertilisation and settlement process to low levels of aromatic hydrocarbon pollution could have considerable significance in areas of chronic oil pollution.

The relative simplicity of this study system and the short test period required makes it an ideal bioassay routine for assessing sub-lethal effects of aromatic hydrocarbons in sea water. An added advantage of this test system is that the unfertilised egg responds like an

animal cell with an exposed cell membrane, whilst the developing zygote with its protective coating of a polysaccharide cell wall shows a more typical plant cell reaction.

REFERENCES

Anderson, J. W., Nee, J. M., Cox, B. A., Tatem, H. E. & Hightower, G. M. 1974. Characteristics of dispersions and water-soluble extracts of crude and refined oils and their toxicity to estuarine crustaceans and fish. Mar. Biol., 27: 75–88.

Gilfillan, E. S. 1973. Effects of seawater extracts of crude oil on carbon budgets in two species of mussels. Proc. Conf. Prev. Control of Oil Spills, A.P.I., E.P.A. and U.S.C.G., 691–95.

Petersen, D. M. & Torrey, J. G. 1968. Amino acid incorporation in developing *Fucus* embryos. Pl. Physiol., 43: 941–47.