Botanica Marina
Vol. 36, pp. 313–319, 1993

Long-term Effects of the Water-accomodated Fraction (WAF) of Diesel Oil on Rocky Shore Populations Maintained in Experimental Mesocosms

T. L. Bokn, F. E. Moy and S. N. Murray*

Norwegian Institute for Water Research, P.O.B. 69, Korsvoll, N-0808 Oslo, Norway

* *Department of Biological Science, California State University, Fullerton, California 92634, U.S.A.*

(Accepted 18 May 1993)

Abstract

The long-term effects of continuous doses (average hydrocarbon concentration = 129.4 $\mu g\ L^{-1}$ and 30.1 $\mu g\ L^{-1}$) of the water-accommodated fraction (WAF) of diesel oil on 15 rocky littoral populations were determined at three tidal levels in experimental mesocosms over two years. At each tidal level, most species exhibited similar abundance changes in both oil-contaminated and control (average background hydrocarbon concentration = 5.6 $\mu g\ L^{-1}$) mesocosms. Significant changes in species abundances attributable to oil (WAF) were demonstrated for only two of ten seaweeds and three of five invertebrates. Compared with the other mesocosms, significantly greater reductions in upper-level cover were recorded in the basin receiving the highest oil dosage for the seaweeds *Phymatolithon lenormandii* and *Fucus evanescens* together with lower recruitment of the barnacle *Semibalanus balanoides*. The mussel *Mytilus edulis* was strongly affected by the oil treatments and essentially disappeared from both oil-contaminated mesocosms. Numbers of the starfish *Asterias rubens* also fell to zero at the lowest tidal level in the basin receiving the highest oil dosage. There were no demonstrable differences in the abundance patterns of the gastropod *Littorina littorea*, the crab *Carcinus maenus*, and a total of eight brown (*Ascophyllum nodosum*, *Fucus serratus*, *F. vesiculosus*, *Laminaria digitata*), red (*Chondrus crispus*), and green (*Cladophora rupestris*, *Enteromorpha* spp., *Ulva lactuca*) seaweeds in the oil-contaminated compared with the control mesocosms.

Introduction

Determining the impacts of oil on marine littoral populations has recently received much scientific attention. Most studies, however, have concentrated on describing changes in species abundances and shifts in community structure following catastrophic spill events. As emphasized by Foster *et al.* (1988) and Dethier (1991), generally these studies have yielded only short-term descriptions of impact and have led to few generalizations except that effects of oil spills are unique and difficult to evaluate. Despite their predictive value, few field experiments have been performed to determine the effects of large spills of oil on rocky littoral biota (*e.g.*, Crapp 1971, Straughan 1971, Moore and McLaughlin 1978, Vanderhorst *et al.* 1980, Nelson 1982, Bonsdorff 1983, Crothers 1983, Cross *et al.* 1987 a, b). Experimental knowledge of the impact of low, chronic doses of oil on littoral systems is also lacking (Southward 1982). Yet, low-level hydrocarbon contributions from terrestrial runoff, municipal wastes, aerial fallout, natural seeps, and routine tanker and refinery operations result in far greater total inputs to littoral environments than catastrophic spills (Foster *et al.* 1988). In response to this deficiency, a large-scale experimental project was initiated in 1982 at the Marine Research Station at Solbergstrand, Norway (see Bakke 1986, Bokn and Moy 1991), to study the effects of continuous low-level doses of the water-accommodated fraction (WAF) of diesel oil on rocky littoral populations. Previous con-