International Council for
the Exploration of the Sea

C.M. 1962
Shellfish Committee No. 84

4

OIL POLLUTION AND SHELLFISH

by

A. C. Simpson
Fisheries Laboratory, Burnham-on-Crouch

1. Introduction

The pollution of coastal waters, beaches and rocky coasts by fuel and crude oils as a result of accidents to ships and from the discharge of oily wastes is a well known problem affecting especially local amenities, sea and shore birds and organisms living in coastal waters.

The continued advance in International agreements to prevent the wilful discharge of oil and oily wastes at sea should eliminate this cause of oil pollution, but the unavoidable accidents to ships, including tankers and the all too frequent minor and major spillage of oil during its discharge at oil terminals is likely to result in the problem of oil pollution remaining an important one.

In recent years various methods for getting rid of oil floating on the sea or of oil on beaches have been tried and a number of chemical mixtures have proved very successful in dissolving and emulsifying the oil on the sea or after it has stranded on beaches, sea walls or rocky coasts. All the chemicals at present in use appear to be highly toxic to living creatures.

This paper briefly describes the effects on commercial shellfish of oil and of chemicals used to disperse oil.

2. Oil and tainting of shellfish

George (1961) studied the effect of crude oil on intertidal animals and algae following an accident in Milford Haven (S. Wales) in which large quantities of crude oil were released into the estuary. Although the oil stranded in considerable quantities on a variety of intertidal organisms including limpets (Patella) several species of barnacles and the algae Pelvetia and Fucus spiralis there was no evidence of damage to any of them. It would appear that in the sea the toxic fraction of crude and fuel oils is soon leached out and dispersed in the sea and the tarry residues are virtually harmless.

Shellfisheries can however be seriously affected by oil due to the tainting of the shellfish which, as a result, become unsaleable. Early in January, 1952 during a severe storm a quantity of oil of unknown origin was washed ashore on the Lancashire coast in the vicinity of the large mussel banks at Morecambe. Complaints of tainted mussels were soon received from consumers and no further mussels could be sold from these grounds for the remaining three months of the season. The financial loss to local fishermen involved several thousands of pounds. A number of the mussels from the Morecambe beds which were examined at the time were found to have oil globules in their stomachs and it is believed that these globules must have been formed by the breaking up of the oil into an emulsion by the storm.

In February 1961 an oil tanker was damaged at the mouth of Poole harbour and a considerable quantity of crude oil was discharged onto the sea. Some of this oil became stranded among sedges and Spartina grass at the base of which was a substantial population of commercially exploited winkles (Littorina littorea). While evidence of damage to the winkles was not conclusive the winkles were unsaleable from a considerable area for several months due to the oil residue which remained on the shells and tainted the flesh when cooked.

It is concluded that oil pollution does not damage shellfish but can cause serious tainting, rendering them unsaleable for considerable periods.

3. Sinking oil

Various powders have been recommended for spreading on oil while still floating on the sea with the aim of sinking the oil to the sea bed and preventing the oil from reaching and fouling the coastline. These materials are only partially successful in sinking the oil - a significant proportion fails to sink or it rises to the surface again and the oil when sunk remains as oil for sufficient time to taint any shellfish on which it might be sunk or to foul any fishing gear that might be pulled through it.

4. Dispersal of oil by emulsifying chemicals

A very successful method for cleaning oil spill from the intertidal zone, whether it is mud, sand, stones or rock is to spray it with a mixture of an oil solvent and an emulsifying agent and then to disperse the emulsion in the sea by using a pump with fresh or salt water and washing it away. The rising tide alone will also disperse the emulsion so made, but somewhat less effectively.

The use of these chemicals was found to kill animals in the intertidal zone and therefore a study was made of the toxicity of some of the commercial oil spill removers.

Tests of toxicity were done in two ways in order to simulate the conditions that occur during the use of these chemicals in removing oil spill.

In the first series the shellfish were dipped into various concentrations of the chemicals for 30 seconds (equivalent to being sprayed with these in the field), allowed to drain for two hours (the time which may occur between the treatment and the treated area being covered by the tide or washed down with water from a pump), thoroughly washed and transferred to aerated running sea water for seven days. By five days the majority of the treated animals had either died or recovered, though a few deaths occurred on the sixth and seventh days.

Table 1 summarises the results of these tests in which 25 oysters, mussels and cockles and 50 winkles were used in each test at a temperature of 10-12°C.

Percentage dead after 7 days

	Polyclens			Houghtosolv 108			Slix			Gamlen oil spill remover			Control
	25%	50%	100%	25%	50%	100%	25%	50%	100%	25%	50%	100%	
Oysters *O. edulis*	40	76	100	4	32	88	8	16	52	24	16	38	0
Mussels *M. edulis*	88	100	100	8	2	92	8	44	100	16	12	28	0
Cockles *C. edule*	NO TEST			80	100	100	96	94	100	72	80	97	1
Winkles *L. littorea*	4	10	10	0	0	12	0	0	20	0	0	6	0

Table 1 Percentage dead of groups of 25 oysters, mussels and cockles and 50 winkles immersed for 30 seconds in three concentrations (25%, 50% and 100%) of the oil spill removers. After draining for 2 hours the treated animals were transferred to running aerated sea water for 7 days. Temps. 10-12°C.

It is evident that all the chemicals used were highly toxic to the three species of bivalve tested.

Of the three bivalves, cockles were the most susceptible to the chemicals, with oysters and mussels rather more resistent. However it is evident that if any of these chemicals were used undiluted or diluted 1 : 1 with water, to clean oil off mussels, cockles or oysters, or from intertidal areas carrying these shellfish substantial losses would occur.

From Table 1 it is also seen that over 80% of the winkles were active after 7 days. However all the chemicals when applied undiluted caused between 50% and 100% of the winkles to become moribund and extended out of their shells for 2-3 days before recovery. It is possible that during this period the winkles would be damaged or killed by their enemies.

The second series of tests was carried out with suspensions of the oil spill removers to determine their toxicity to shellfish if used near to shellfish grounds.

Suspensions of the chemicals at 10, 32, 100 and 320 parts per million (ppm) were made up in sea water and groups of 20-25 flat oysters, portuguese oysters, mussels and cockles were placed for 24 hours in aquaria containing these suspensions. The water was well aerated. After 24 hours the animals were transferred to clean running aerated sea water. Again any of the animals that died were recorded and removed, up to 7 days after their transfer to the running sea water.

The percentages of dead animals after 7 days are set out in Table 2. Some of the tests were repeated in conjunction with other experiments that were being made and the result of each such test is given in the table. For instance four tests were made using Polyclens on cockles.

Percentage dead after 7 days

	Polyclens				Houghtosolv 108			Slix				Gamlen oil spill remover		
	10 ppm	32 ppm	100 ppm	320 ppm	32 ppm	100 ppm	320 ppm	10 ppm	32 ppm	100 ppm	320 ppm	32 ppm	100 ppm	320 ppm
Flat Oysters O. edulis		0 0	40 10	92 40	0	4	32		4	16	4	4	8	28
Portuguese Oysters G. angulata		0	0	0										
Mussels M. edulis		0	10	35										
Cockles C. edule *	0 0 20	28 16 5 32	100 100 100 100	100 100				8 15	100 100	100 100	* *			

Table 2 Percentage dead of groups of 20 oysters, 20 mussels and 25 cockles held in aerated suspensions of oil spill removers at 10, 32, 100 and 320 ppm in sea water for 24 hours before transfer to running aerated sea water. Temperatures 17-19°C. except in the groups marked * where it was 15-16°C.

It is seen that again cockles were the most susceptible and 50% were killed by concentrations of Polyclens between 32 and 100 ppm and of Slix between 10 and 32 ppm. Only Portuguese oysters were completely resistant to 320 ppm Polyclens for 24 hours.

The occurrence of some dead flat oysters over a wide range of concentrations of the chemicals and no deaths among the Portuguese oysters suggests that the oysters and probably also the mussels were resisting the chemicals by closing their shells and remaining closed for all or part of the 24 hours during which the chemicals were present. The greater susceptibility of the cockles and the clearer mortality picture given by them was presumably due to the fact that cockles are unable to close their shells as completely as the other molluscs used and therefore were always susceptible to some penetration of the chemicals to their tissues.

Under most coastal and estuarine conditions where these molluscan shellfish are cultivated, or gathered from natural beds, there are extensive tidal water movements and even large quantities of oil spill removers will soon be diluted. It would therefore appear that while these chemicals should not be used in large quantities close to cockle, mussel or oyster grounds, they will not do harm if applied at a sufficient distance to allow adequate dilution; the critical distance depending on local conditions of tidal and residual water flow.