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ASSESSMENT OF FISH FROM THE NORTHERN  
NORTH SEA FOR OIL TAINT

by

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SUMMARY

This paper presents the results of a monitoring programme for oily taint in the flesh of commercial fish species caught in northern and central areas of the UK sector of the North Sea at distances greater than 3 km from any production site. Over three hundred fish, cod (*Gadus morhua*), plaice (*Pleuronectes platessa*) and dab (*Limanda limanda*), were obtained for 37 ICES squares. Oil and gas production, from 58 fixed installations and subsea completions, are concentrated within 14 of the 37 squares sampled, exploration activity was associated with a further 11 squares, wholly or in part, and the remainder (11) were considered to be remote from oil and gas related activity.

Of the 190 fish assessed by taste none was found to show evidence of taint.

INTRODUCTION

Exploration for, and the production of, oil and gas continue to be the largest sources of hydrocarbons discharged to the North Sea. In recent years 12,000-20,000 tonnes per annum of oil attached to drill cuttings have reached the seabed around offshore oil exploration and production sites in the UK sector (Department of Energy, 1990). Regular monitoring of surface sediments has shown hydrocarbon levels are elevated up to ~10,000 times background in the immediate vicinity of fixed installations, between 10 and 700 times background from 500 m to 2,000 m distance and up to 10 times background as far as 4,000 m from a single point source

(Davies *et al.*, 1988). Therefore, it is clear that sediment hydrocarbon contamination is elevated above background at distances well outside the 500 m no-fishing exclusion zones and the question arises as to whether commercial fish could become contaminated and subsequently tainted as a result of living and feeding close to hydrocarbon enriched sediments.

Previous studies have investigated taint in flesh, and hydrocarbon contamination of liver and flesh of fish in the vicinity multiwell development sites (McGill *et al.*, 1987; Davies *et al.*, 1988; UKOOA Study 1989; COWIconsult 1986/88). However, with the proliferation in recent years of oil exploration and production sites in the UK sector of the northern and central North Sea and evidence of widespread low level hydrocarbon contamination of surface sediments covering large areas such as the East Shetland Basin, DAFS Marine Laboratory, Aberdeen initiated a sampling programme to obtain samples of commercial fish from the wider area of the North Sea. To this end, cod (*Gadus morhua*), plaice (*Pleuronectes platessa*) and dab (*Limanda limanda*) were obtained from as many ICES squares as possible (Fig. 1). Oil and gas production, from 58 fixed installations and subsea completions, are concentrated within 14 of the 37 squares sampled, exploration activity was associated with a further 11 squares, wholly or in part, (Fig. 2) and the remainder (11) were considered to be remote from oil and gas related activity. In order to investigate any link between taint, if present, petrogenic contamination and oil and gas related activities, detailed chemical analysis of flesh and liver tissue of cod is being undertaken and results will be reported at a later date.

## METHODS

Between February 1989 and February 1990 152 cod, 53 plaice and 101 dab were obtained from 37 ICES squares in the northern and central areas of the UK sector of the North Sea (Fig. 1) using a 48' Granton trawl deployed from FRV *Scotia* at distances greater than 3 km from any production site. The average time for each tow was one hour. Where possible, cod of 30-60 cm length and flatfish of 20-25 cm length were selected from the trawls for this study. As the fish came aboard, those chosen for taint assessment and chemical analysis were immediately removed to a clean handling area and either the whole fish, or a gutted steak from very large fish, was each wrapped separately in solvent washed aluminium foil, labelled and stored deep frozen at -20°C. On return to the Laboratory all samples were transferred to Torry Research Station where they were stored in a -30°C holding facility for as short a time as possible before taste panel assessment.

Where possible one fillet was removed from each fish sample for tasting, the other being reserved for chemical analysis. Where necessary, with smaller fish, both fillets were used for taint assessment. Up to 10 randomly selected samples were prepared for each tasting session. The fillets were cooked, with the skin on, in lidded glass casseroles in a microwave oven. This method of cooking the flesh samples ensured that any taint present was not destroyed by cooking. The cooked samples were then presented to a panel comprising 8-10 assessors experienced in recognising taint in fish flesh from oil contamination. The assessors were asked if they could detect an oil taint and, if so, to score each sample with an intensity rating on a scale of one (slight taint) to five (severe taint). Samples in which no taint was detected were attributed a score of zero. A sample is deemed tainted if more than half of the panel score it positively, regardless of the intensity rating.

## RESULTS AND DISCUSSION

By the criteria detailed above, none of the 152 cod, 16 plaice or 23 dab tasted were assessed as tainted. The details of the assessments are presented in Table 1 (cod), Table 2 (plaice) and Table 3 (dab). In only one fish, a plaice caught in square 41F0 outwith the influence of any oil and gas activity, did one assessor out of nine record finding an oil taint at an intensity of one (Table 2).

Results of other studies conducted by DAFS in 1985 have shown that no taint was present in the flesh of bottom feeding roundfish, cod and haddock, caught by trawl within 1-2 km of a platform in the East Shetland Basin and, by longline, 400 metre from another platform to the south of that area (Davies *et al.*, 1988).

In 1986 dabs (flatfish), which tend to remain within a local area, were caught by trawl between 0.5-1 km and also between 1-2 km from a platform in the shallower waters of the Moray Firth (McGill *et al.*, 1987). They were compared with dabs caught 20 km away. The taste panel assessment found that although there was a significant tendency towards taint in the fish caught closer to the platform compared to those caught further away and at the reference site none were assessed as tainted by the method used. The chemical analysis of the flesh of the four fish identified as having possible taint showed petrogenic hydrocarbons were present in only some of them with gas chromatographic traces very different from that of a dab caught at 20 km distance but similar to the trace of the oiled sediments from around that platform. It was noted that the level of hydrocarbons present was unrelated to the taint detected.

In a United Kingdom Offshore Operators Association (UKOOA) funded study (AUMS, 1989), saithe (*Pollachius virens*), another roundfish, commonly found shoaling in the water column around platforms in the deeper, northern waters, were caught in 1988 at a platform in the East Shetland Basin. They were compared with saithe from the open sea and from around a pumping station on the Frigg gas line where no drilling had taken place. The results showed that none of the saithe could be classed as tainted but some of the assessors did detect taint in some fish from all sites. Chemical analyses were performed on the flesh and livers of some of the fish. The open sea fish contained no petrogenic hydrocarbons in either flesh or livers. The pumping station fish contained no petrogenic hydrocarbons in their livers and the source of the hydrocarbons in the flesh of one only was possibly heavy fuel or lubricating oil and not low toxicity oil used in drill muds. Of the 10 platform fish analysed small traces of low toxicity oil were present in the flesh and livers of two of them. The petrogenic hydrocarbons in the flesh only of another two fish could have been diesel in one and heavy fuel or lubricating oil in the other. The liver of another fish apparently contained diesel and heavy fuel or lubricating oil. Again no correlation was found between taint and the levels of petrogenic hydrocarbons present.

Studies on taint and hydrocarbon levels in plaice, dab and cod caught by gill nets between 0.5-5 km from Danish platforms and also at remote sites have been carried out between 1983-1988 (COWIconsult, 1986, 1988). Tasting was carried out by two experts who distinguished between "oily" taints attributable to effects of drilling and "other taints" not related to drilling activity. The results showed that none of the dab or cod were tainted by oil but that oily taint was found in plaice caught within 5 km of platforms where 9-18 wells had been drilled with low toxicity oil based mud. At the remote sites the occasional plaice was also found to have an oily taint. Chemical analysis of some of the plaice showed that the petrogenic hydrocarbons were derived from low toxicity base oil. As in the previous UK studies, however, there was no correlation between petrogenic hydrocarbon levels and taint in the fish.



## CONCLUSIONS

Although there is plenty of evidence of widespread low level oil contamination of sediments in many of the areas from which these fish samples were taken, there is, to date, no suggestion that the flesh of cod from the North Sea is tainted by hydrocarbons of petrogenic origin. This is evident from the results of this and other programmes where cod samples have been offered for taste assessment by a panel trained to detect oil taint in fish flesh.

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TABLE 1

Taste panel results of COD taken from ICES squares

ICES square	No of fish caught:tasted	No of assessments	No detecting taint	No of fish with more than half the assessors detecting taint
40F0	4:4	28	0	0
40F1	5:5	35	0	0
40F2	3:3	27	0	0
40F3	3:3	21	0	0
41E7	5:5	40	0	0
41E8	5:5	45	0	0
41E0	5:5	45	0	0
41F1	2:2	18	0	0
41F2	4:4	36	0	0
41F3	2:2	18	0	0
42F0	3:3	21	0	0
42F1	4:4	36	0	0
43E8	5:5	45	0	0
43F0	5:5	45	0	0
43F1	4:4	36	0	0
44E7	3:3	27	0	0
44F0	5:5	45	0	0
45E6	5:5	40	0	0
45E7	3:3	27	0	0
45E9	5:5	45	0	0
45F0	6:6	54	0	0
46E7	5:5	45	0	0
46E8	8:5	45	0	0
46F0	5:5	45	0	0
46F1	5:5	45	0	0
47E7	5:5	45	0	0
47E8	5:5	40	0	0
47E9	5:5	45	0	0
47F1	1:1	45	0	0
48F1	3:3	27	0	0
49E9	5:5	45	0	0
50F0	5:5	40	0	0
50F1	2:2	16	0	0
51F0	3:3	24	0	0
51F1	5:5	40	0	0
52F1	3:3	24	0	0
	152:149	1305	0	0

TABLE 2

Taste panel results of PLAICE taken from ICES squares

ICES square	No of fish caught:tasted	No of assessments	No detecting taint	No of fish with more than half the assessors detecting taint
40F0	2:1	9	0	0
40F1	6:1	9	0	0
40F3	2:1	9	0	0
41E9	5:1	9	0	0
41F0	3:1	9	1	0
41F1	1:1	9	0	0
41F2	1:1	9	0	0
41F3	4:1	9	0	0
42F3	1:1	9	0	0
43F0	2:1	9	0	0
43F1	1:1	9	0	0
44E6	6:1	9	0	0
44E7	4:1	9	0	0
45E6	6:1	9	0	0
45E7	5:1	9	0	0
45E8	4:1	9	0	0
	53:16	144	1	0

TABLE 3

Taste panel results of DAB taken from ICES squares

ICES square	No of fish caught:tasted	No of assessments	No detecting taint	No of fish with more than half the assessors detecting taint
40F0	5:1	9	0	0
40F3	6:1	9	0	0
41E9	5:1	9	0	0
41F1	5:1	9	0	0
41F2	4:1	9	0	0
41F3	5:1	9	0	0
42F0	5:1	9	0	0
42F1	5:1	9	0	0
42F2	4:1	9	0	0
42F3	4:1	9	0	0
43F0	6:1	9	0	0
43F1	3:1	9	0	0
44E6	4:1	9	0	0
44E7	2:1	9	0	0
44F0	5:1	9	0	0
44F1	4:1	9	0	0
45E6	4:1	9	0	0
45E7	6:1	9	0	0
45E8	5:1	9	0	0
45E9	5:1	9	0	0
45F0	4:1	9	0	0
46E9	4:1	9	0	0
	101:22	198	0	0





Fig. 2 The area of oil and gas exploration and production in the UK sector of the North Sea

