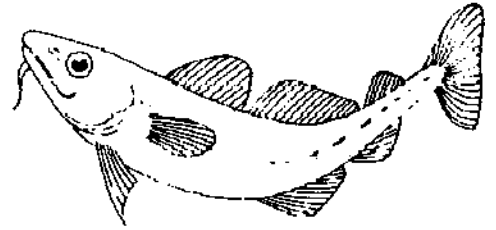


# AQUATIC ENVIRONMENT MONITORING REPORT

Number 46



## Monitoring for diseases in marine and freshwater fish, 1992



**Directorate of Fisheries Research**  
Lowestoft, 1995

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD  
DIRECTORATE OF FISHERIES RESEARCH

AQUATIC ENVIRONMENT MONITORING REPORT  
Number 46

**Monitoring for diseases  
in marine and freshwater fish, 1992**

LOWESTOFT  
1995

This report has been compiled by E. B. Hudson (Grade 7) of the MAFF Fish Diseases Laboratory, The Nothe, Barrack Road, Weymouth, Dorset DT4 9UB, from whom further copies may be obtained.

Aquat. Environ. Monit. Rep., MAFF Direct. Fish. Res., Lowestoft, (46): 27pp.

ã Crown Copyright 1995

*Requests for reproduction of material contained within this report should be addressed to MAFF*

# CONTENTS

Page

## FOREWORD

## MARINE FISH DISEASES MONITORING PROGRAMME

<b>1. The monitoring programme for determination and surveillance of disease in marine fish</b> .....	7
1.1 Introduction .....	7
1.2 Materials and methods .....	7
1.3 Results .....	8
1.3.1 <i>Dab diseases</i> .....	8
1.3.2 <i>Cod diseases</i> .....	8
1.3.3 <i>Flounder diseases</i> .....	8
1.3.4 <i>Extended examination of female dab &lt;23 cm length-size from 6 areas of UK coastal waters</i> .....	8
1.3.5 <i>Data on examination of total catch for fish diseases</i> .....	8
1.3.6 <i>Conclusions</i> .....	8

## STATUTORY MONITORING FOR FISH AND SHELLFISH DISEASE

<b>2. The monitoring programme for control of disease in farmed stocks and its transmission to wild stocks</b> .....	15
2.1 Introduction .....	15
2.2 Materials and methods .....	16
2.2.1 <i>Sampling methods</i> .....	16
2.2.2 <i>Laboratory tests</i> .....	16
2.3 Statutory field investigations for fish diseases .....	17
2.3.1 <i>Investigations into the cause of disease outbreaks in fish</i> .....	17
2.3.2 <i>Investigations to monitor for specific diseases of fish</i> .....	17
2.3.3 <i>EC survey for IHN and VHS</i> .....	18
2.3.4 <i>Re-tests for specific diseases of fish on designated sites</i> .....	18
2.4 Statutory field investigations into diseases of shellfish under the Sea Fisheries (Shellfish) Act, 1967 .....	18
2.4.1 <i>Investigations to monitor for specific diseases of shellfish</i> .....	18
2.4.2 <i>Test for Gaffkaemia</i> .....	19

## MICROBIOLOGICAL CLASSIFICATION OF SHELLFISH HARVESTING AREAS

<b>3. The monitoring programme for <i>Escherichia coli</i> in shellfish</b> .....	19
3.1 Introduction .....	19
3.2 Materials and methods .....	20
3.3 Results .....	20
3.4 Discussion .....	20
3.5 Conclusions .....	20
<b>4. References</b> .....	25
<b>Appendix. Staff responsible for the disease monitoring projects in 1992</b> .....	27



## *FOREWORD*

The Directorate of Fisheries Research (DFR) through the Fish Diseases Laboratory (FDL) has a long history of monitoring for diseases in marine and freshwater fish, shellfish and crustacea. This has included the statutory testing for diseases under the Diseases of Fish Act, 1937 (Great Britain - Parliament, 1937), Diseases of Fish Act, 1983 (Great Britain - Parliament, 1983) and the Sea Fisheries (Shellfish) Act, 1967 (Great Britain - Parliament, 1967) and more recently responsibilities for shellfish hygiene matters. This, the third report in the series from the Fish Diseases Laboratory at Weymouth presents a summary of the findings of this work and related microbiological surveys.

With the creation of the single European market and free movement of goods, persons, services and capital by the end of 1992, it was necessary to have common standards to safeguard animal health and hygiene matters. Thus, the EU single market fish and shellfish health regime under EC Directive 91/67 (European Communities, 1991(a)) came into force on 1 January 1993, replacing the previous UK national arrangements. The regime permits the free movement of fish and shellfish throughout the EU, but incorporates exceptions designed to protect the high health status of approved zones within the Union. In order to gain and maintain the UK approved zone status for fish and shellfish an intensive inspection and testing regime for farmed fish and shellfish stocks is required. During 1992, this has resulted in major expansion in inspection and testing and required a significant investment in additional staff and resources.

The establishment of a common approach to controls on shellfish hygiene under EC Directive 91/492 (European Communities, 1991(b)) has also necessitated extensive testing of shellfish from all areas where they are commercially harvested. The results of the testing, which establishes the level of faecal contamination in the shellfish, are used for classification of the areas in order to identify what, if any, treatment is required to reduce such contamination prior to consumption. This classification process is continuous and requires regular updating of the published list.

The separate long-established monitoring programme for marine fish diseases has continued to explore possible links with pollution in response to concerns that sewage and industrial wastes entering the sea may cause increased levels of disease in fish. The Ministry of Agriculture, Fisheries and Food (MAFF) has responsibilities for controlling and monitoring waste disposal by dumping at sea under the Food and Environmental Protection Act, 1985 (Great Britain - Parliament, 1985(a)) and point discharges under the Environmental Protection Act, 1990 (Great Britain - Parliament, 1990). The testing in 1992 continued the long-term programme and completed 3 years of monitoring to the internationally agreed standards recommended by the International Council for the Exploration of the Sea (ICES, 1989) and directed to the requirements of the North Sea Task Force (NSTF MMP, 1990).

J. E. Portmann  
Deputy Director  
(Aquatic Environment Protection)  
Ministry of Agriculture, Fisheries and Food  
Directorate of Fisheries Research



---

---

# MARINE FISH DISEASES MONITORING PROGRAMME

---

---

## 1. THE MONITORING PROGRAMME FOR DETERMINATION AND SURVEILLANCE OF DISEASE IN MARINE FISH

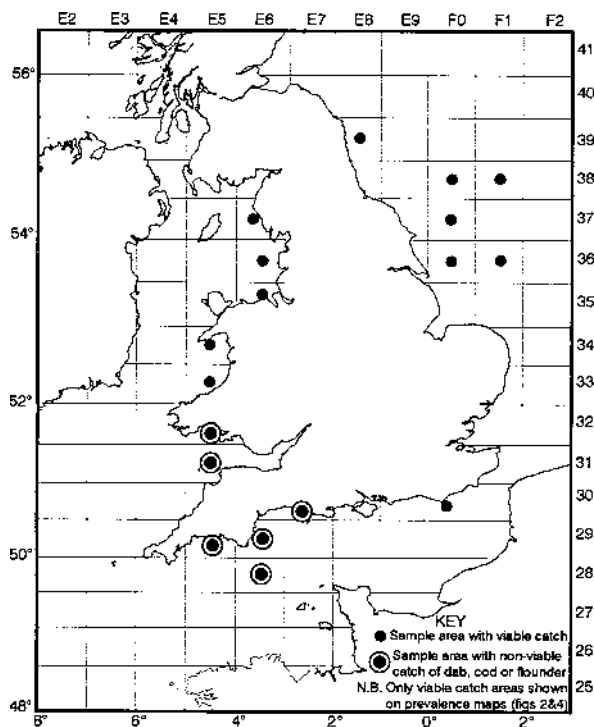
### 1.1 Introduction

Fish Diseases Monitoring Programmes have been conducted by DFR, through its Fish Diseases Laboratory, Weymouth, on a fairly regular basis since 1980 and previously to that on an *ad hoc* basis. For the past 3 years the methodologies for sampling and reporting have followed international standards as recommended by the International Council for the Exploration of the Sea (ICES, 1989). National reports on the status of marine fish diseases have been submitted to ICES on an annual basis, and in recent years, data have been published in the DFR's Aquatic Environmental Monitoring Reports (MAFF, 1991, 1993(a), 1993(b), 1994). A number of scientific reports and papers relating to marine fish diseases have been published (e.g. Bucke *et al.*, 1983; Bucke and Nicholson, 1987; Bucke and Stokes, 1988; Bucke, 1989; Bucke, 1990; GESAMP, 1991; Bucke and Feist, 1993). Of significant importance, the emphasis on disease monitoring for the past 3 years has been directed to the requirements of the North Sea Task Force (NSTF MMP, 1990) and the disease data collated with that of other North Sea countries and incorporated into the North Sea Task Force Quality Status Report (NSTF MMP, QSR, 1993). Further disease data will be submitted to the UK National Marine Monitoring Plan (UK NMMP, 1994).

MAFF continues to monitor for changes of trends in fish disease prevalences in accordance with its obligations under various Government Acts, e.g. the Food and Environment Protection Act, 1985 (Great Britain - Parliament, 1985(a)). Furthermore, the Ministry needs to have information on the status of new fish diseases, as well as an understanding of fish disease pathogenesis. For that reason, research investigations are initiated to complement disease monitoring. Results are published in the scientific literature, as the tasks are completed.

### 1.2 Materials and methods

A single cruise was conducted for monitoring fish diseases (RV CORYSTES Cruise 5, 14-30 April, 1992). The areas sampled included stations in the coastal waters off the north-east coast (Tyne), the Dogger Bank, Humber, the outer Thames Estuary, the English Channel, the South-Western Approaches, Bristol Channel, Cardigan Bay, Liverpool Bay and Morecambe Bay (Figure 1).



**Figure 1. Areas sampled, by ICES rectangle for fish disease monitoring, RV CORYSTES Cruise 5, 14-30 April 1992. Note that the recommended species for disease monitoring, dab, cod and flounder were not available on all stations**

The methods for sampling and disease reporting, where possible, followed the recommendations of ICES (ICES, 1989). However, because the ICES Disease Database only requires information of disease prevalences on selected fish species, the dab, *Limanda limanda* and cod, *Gadus morhua*, for offshore stations, and flounder, *Platichthys flesus*, for estuarine stations, DFR sampling included examination of all fish and most other species

for significant diseases. Furthermore, because of the special interest in liver changes in dab because of their possible pollution link, extended sampling of dab livers for chemical and histological analysis was made. Random samples, each consisting of 50 dab >23 cm length, were examined for liver changes by microscopical examination. The liver changes were placed into 4 categories: Category 1 represented no obvious abnormalities; 2 = non-neoplastic changes, including necrosis and parasitic lesions; 3 = hepatocellular alterations, including basophilic foci, clear cell foci and fatty cell foci; 4 = hepatocellular adenoma and cholangioma. Samples of these livers were individually frozen, and submitted for chemical analysis by their histopathological categories to demonstrate whether a link existed between levels of contamination uptake and neoplasia development.

## **1.3 Results**

### **1.3.1 Dab diseases**

One hour bottom trawl hauls were made at each of 41 stations. Thirty-one of these hauls in 16 separate ICES rectangles provided a total of 4697 dab for disease examination. Table 1 presents data for dab, including numbers of hauls, numbers of dab and weight of total catch, the numbers of dab by sex in each size range examined, the numbers of individual diseases by severity, and the positions of sampling by ICES rectangles. The diseases recorded included lymphocystis, epidermal hyperplasia/papilloma, epidermal ulcers, epidermal melanosis and liver nodules larger than 2 mm<sup>2</sup> (from female dab >20 cm length). Table 2 presents data on the histological interpretation of the liver nodules recorded in Table 1. Figure 2 illustrates the distribution and prevalences of the above diseases. Where numbers of dab caught in an ICES rectangle were sufficient to represent populations, length-size distributions for those populations were recorded, and are illustrated in Figure 3.

### **1.3.2 Cod diseases**

Cod were caught in sufficient numbers for disease reporting purposes from only 3 ICES rectangles. Table 3 presents the catch data, disease prevalences by severity and positions of sampling. Figure 4 illustrates the distribution and prevalence for skeletal deformities, the only significant disease in cod recorded. Figure 5 illustrate the numbers and length-size distribution, by sex, of 162 cod in the 3 areas sampled.

### **1.3.3 Flounder diseases**

Flounder were rarely caught on these offshore stations. Table 4 presents the data for 27 flounder from a single trawl haul in ICES rectangle 30FO (off south Kent coast).

### **1.3.4 Extended examination of female dab <23 cm length-size from 6 areas of UK coastal waters**

Table 5 presents data on histological characterisation of livers by category from 50 randomly-selected female dab sampled from Rye Bay (Eastern Channel), Liverpool Bay, Morecambe Bay (north-east Irish Sea), west Dogger Bank, Flamborough Off Ground, Humber Off Ground, and Sole Pit. It should be noted that most livers showed no signs of disease, but samples from stations off the north-east English coast revealed highest numbers of pre-neoplastic or neoplastic lesions (Categories 3 and 4). The analytical data from the above samples is presented in MAFF (1993(b)).

### **1.3.5 Data on examination of total catch for fish diseases**

Table 6 presents data on sample positions, catch data and numbers of species examined for gross diseases (other than dab and flounder).

### **1.3.6 Conclusions**

This 1992 disease monitoring study has shown that overall levels of all epidermal diseases in dab were generally of low prevalences and for the North Sea stations, comparable to recent years' results. Individual diseases were predominantly in the lowest severity category, with the exception of higher prevalences of epidermal ulcers recorded in Liverpool Bay and Morecambe Bay, and higher prevalences of epidermal melanosis recorded on stations on Flamborough Off Ground, Humber and Sole Pit. This latter abnormality appears to be an emerging disease. All diseases were at lowest prevalences in Rye Bay.

Gross examination of dab livers on the routine survey revealed higher prevalences of nodular lesions >2 mm diameter in female dab >20 cm length in samples from stations on the western Dogger Bank, Flamborough Off Ground, Humber Off Ground and Sole Pit. The prevalences increased in fish <sup>3</sup>25 cm length. However, histological examination of the nodules demonstrated that not all nodules were hepatocellular adenomas or pre-neoplastic foci. Confirmed hepatocellular adenomas were recorded at coastal stations on the west coast, as well as at stations off the north-east coast. Higher prevalences of confirmed adenomas were recorded in the latter area. The detailed dab liver examination confirmed this finding. Disease monitoring in other fish species showed low prevalence with no significant trends compared with previous years' results. Generally, the vast majority of fish appeared to be in good condition.

**Table 1. Catch data and disease prevalence in dab (*L. limanda*) by size categories on stations sampled in the North Sea for fish disease monitoring (1 hour tows using a Granton Trawl), RV CORYSTES Cruise 5/92**

ICES Rectangle	No. of hauls	Total catch		range	Size examined (cm)		No. and severity of disease cases recorded according to ICES (1989)												
		Numbers	Weight (kg)		Male	Female	LY			E/P			U			MEL			LN
							1	2	3	1	2	3	1	2	3	1	2	3	
30F0	2	1079	65.4	15-19	155	45	2	0	0	2	0	0	1	0	0	2	0	0	NR
				20-24	47	80	0	0	0	3	1	0	1	3	3	4	2	1	1
				>25	2	6	0	1	0	0	0	0	0	0	0	0	2	0	0
30E7	2	14	0.645	15-19	2	3	0	0	0	0	0	0	0	0	0	0	0	0	NR
				20-24	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
				>25	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
29E6	1	6	0.277	15-19	1	3	0	0	0	0	0	0	1	0	0	0	0	0	NR
				20-24	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
				>25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28E6	1	4	0.184	15-19	2	0	0	0	0	0	0	0	0	0	0	0	0	0	NR
				20-24	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				>25	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
29E5	1	2	0.092	15-19	2	0	0	0	0	0	0	0	0	0	0	0	0	0	NR
				20-24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				>25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34E5	1	141	6.5	15-19	23	24	0	0	0	0	0	0	0	0	0	0	0	0	NR
				20-24	6	57	1	1	0	1	0	0	0	0	0	1	0	0	2
				>25	0	31	1	0	0	0	0	0	0	0	0	0	0	0	0
33E5	5	913	44.065	15-19	245	56	10	0	0	2	0	0	4	0	1	0	0	0	NR
				20-24	24	96	4	1	0	1	0	0	3	1	2	0	0	0	7
				>25	1	20	1	0	0	1	0	0	1	0	0	0	0	0	2
35E6	2	1385	127.6	15-19	167	33	8	0	0	2	0	0	14	2	4	0	0	0	NR
				20-24	70	100	4	1	0	6	0	0	12	2	4	0	0	0	3
				>25	0	64	0	0	0	5	0	0	2	0	2	0	0	0	6
36E6	1	368	30.9	15-19	173	27	0	0	1	0	0	0	3	0	1	0	0	0	NR
				20-24	41	59	5	2	1	1	0	0	5	0	2	0	0	0	2
				>25	0	39	0	0	0	1	0	0	1	0	0	0	0	0	0
37E6	3	2347	108.22	15-19	186	114	1	2	0	2	1	0	11	3	3	0	0	0	NR
				20-24	47	143	2	5	0	2	0	0	10	1	3	0	0	0	0
				>25	1	18	0	0	0	1	0	1	0	0	0	0	0	0	1
39E8	2	621	23	15-19	129	61	17	3	0	2	0	0	0	2	3	0	2	0	NR
				20-24	15	63	1	3	6	3	2	0	0	0	0	0	0	0	1
				>25	0	26	0	0	0	1	0	0	0	0	2	1	0	0	1
37F0	3	6100	266.98	15-19	123	77	10	0	0	2	1	0	0	0	1	4	3	0	NR
				20-24	89	133	12	3	2	1	4	0	2	0	12	15	10	6	10
				>25	73	61	4	0	0	3	0	0	1	1	3	2	1	0	5
38F0	1	157	7.2	15-19	56	44	12	2	0	3	0	0	0	0	0	0	0	0	NR
				20-24	3	38	0	0	0	3	0	0	2	1	0	0	0	0	0
				>25	0	16	2	0	0	2	0	0	1	1	0	2	0	1	1
38F1	2	4841	256.5	15-19	123	77	14	2	0	7	1	1	1	1	5	3	0	0	NR
				20-24	40	160	12	3	2	1	0	0	0	0	10	9	3	0	5
				>25	2	43	6	0	0	0	0	0	1	1	3	2	1	0	14
36F0	3	3615	155.9	15-19	228	72	13	4	0	4	0	0	1	1	0	12	5	1	NR
				20-24	85	108	6	1	2	2	1	0	4	1	6	15	9	9	8
				>25	0	33	1	0	0	0	0	0	0	0	1	6	2	1	2
36F1	3	17921	741.2	15-19	96	104	2	0	0	0	0	0	2	0	2	5	4	2	NR
				20-24	32	141	3	2	0	3	1	0	2	0	1	3	8	10	1
				>25	3	182	5	1	0	4	2	1	3	0	2	10	11	18	20

Key: LY = Lymphocystis

E/P = Epidermal papilloma

U = Ulcers

**Table 2. Histological distribution of liver diseases in female dab (*L. limanda*) by two larger size categories on stations sampled in the North Sea (1 hour tows using a Granton Trawl), RV CORYSTES Cruise 5/92**

ICES Rectangle	Size range (cm)	Macro examination		Micro examination remarks	Macro		Micro	
		Female	LN		Total no. LN	% total no. LN	Total no. adenomas +PNF	% total no. adenomas + PNF
30F0	20-24	80	1	1 Pre neoplastic foci	1	1.2	1	1.2
	>25	6	0	—				
30E7	20-24	4	0	—	0	0	0	0
	>25	1	0	—				
29E6	20-24	2	0	—	0	0	0	0
	>25	0	0	—				
28E6	20-24	0	0	—	0	0	0	0
	>25	1	0	—				
29E5	20-24	0	0	—	0	0	0	0
	>25	0	0	—				
34E5	20-24	57	2	2 No abnormalities detected	2	2.3	0	0
	>25	31	0	—				
33E5	20-24	96	7	3 Parasite cysts 4 No abnormalities detected	9	7.8	1	0.9
	>25	20	2	1 Fatty focus (necrosis) 1 Adenoma				
35E6	20-24	100	3	1 Fatty focus 2 Pre neoplastic foci	9	14.1	5	7.8
	>25	64	6	3 Melano macrophage centres 2 Adenomas 1 Pre neoplastic foci				
36E6	20-24	59	2	1 Peliosis 1 Necrosis	2	2.0	0	0
	>25	39	0	—				
37E6	20-24	143	0	—	1	0.6	0	0
	>25	18	1	1 No abnormalities detected				
39E8	20-24	63	1	1 No abnormalities detected	2	2.2	1	1.1
	>25	26	1	1 Adenoma				
37F0	20-24	133	10	2 Cysts 1 Melano macrophage centre 2 Necrosis 1 Fatty focus 4 No abnormalities detected	15	7.7	2	1.0
	>25	61	5	2 Cysts 2 Adenomas 1 No abnormalities detected				
38F0	20-24	38	0	—	1	1.9	1	1.9
	>25	16	1	1 Adenoma				
38F1	20-24	160	5	2 Fatty focus 1 Adenoma	19	9.4	10	4.9
	>25	43	14	8 Adenomas 1 Pre neoplastic foci 2 Fatty foci 2 Cysts 1 No abnormalities detected				
36F0	20-24	108	8	1 Fatty focus 2 Adenomas 5 No abnormalities detected	10	7.1	4	2.8
	>25	33	2	2 Adenomas				
36F1	20-24	141	1	1 No abnormalities detected	21	6.5	11	3.4
	>25	182	20	1 Abnormal body shape 2 Cysts 3 Pre neoplastic foci 2 Multi granulomas 8 Adenomas 4 No abnormalities detected				

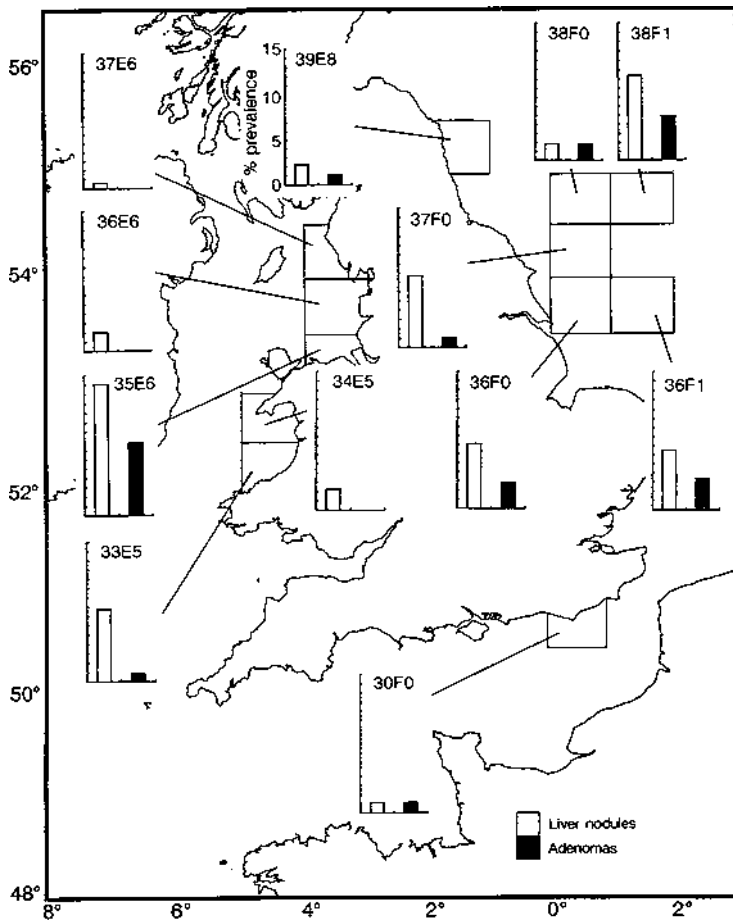
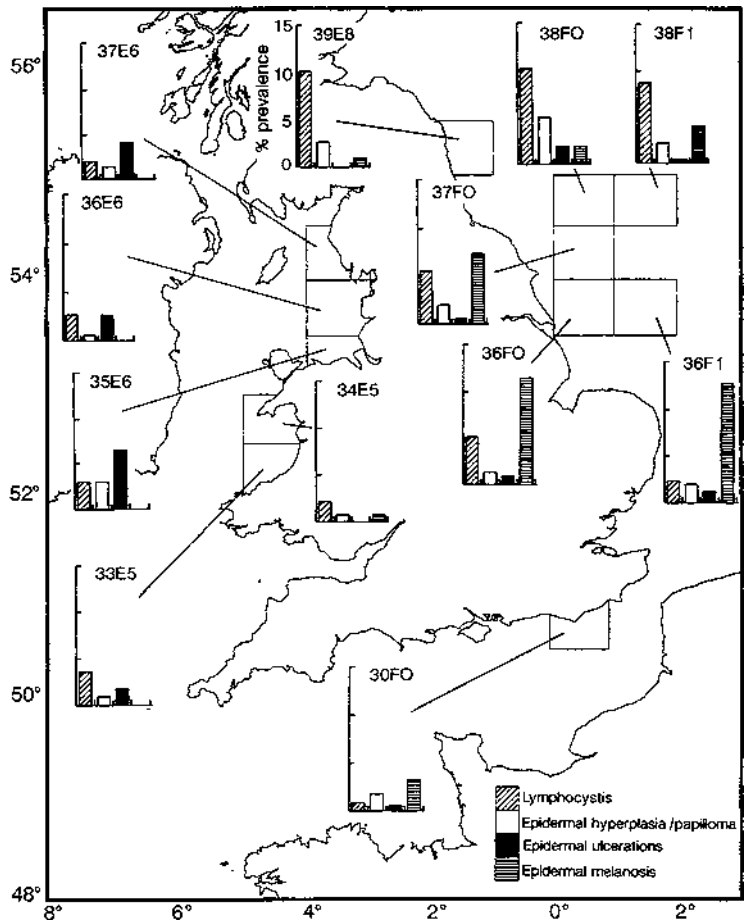
Note: LN = Liver nodules

PNF = Pre neoplastic foci

Calculation of prevalence - % Prevalence = (No. Adenomas + No. PNF)/(Total No.>25) x 100.

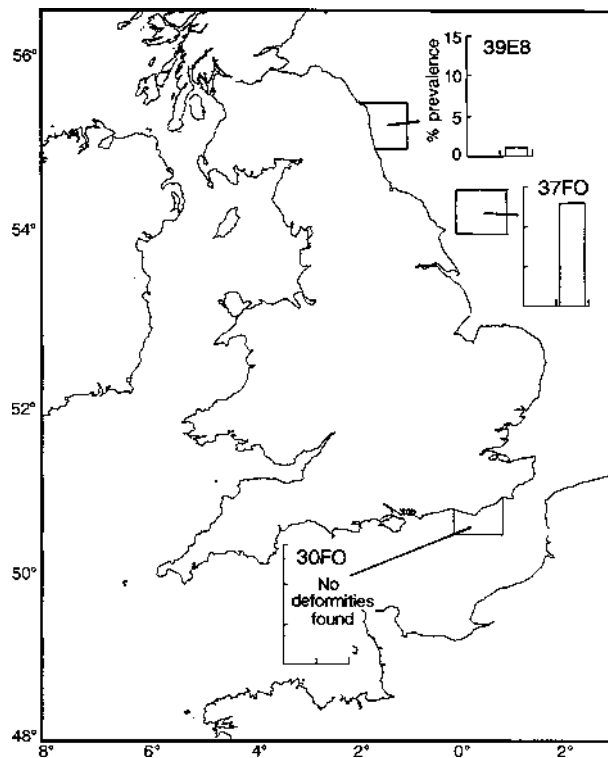
If total No. >25 is <50 it is made up to 50 from the next group down

**Figure 2(a).**  
**% prevalence levels of lymphocystis, epidermal hyperplasia/papilloma, epidermal ulcerations and epidermal melanosis recorded in all size categories of dab, RV CORYSTES Cruise 5/92**

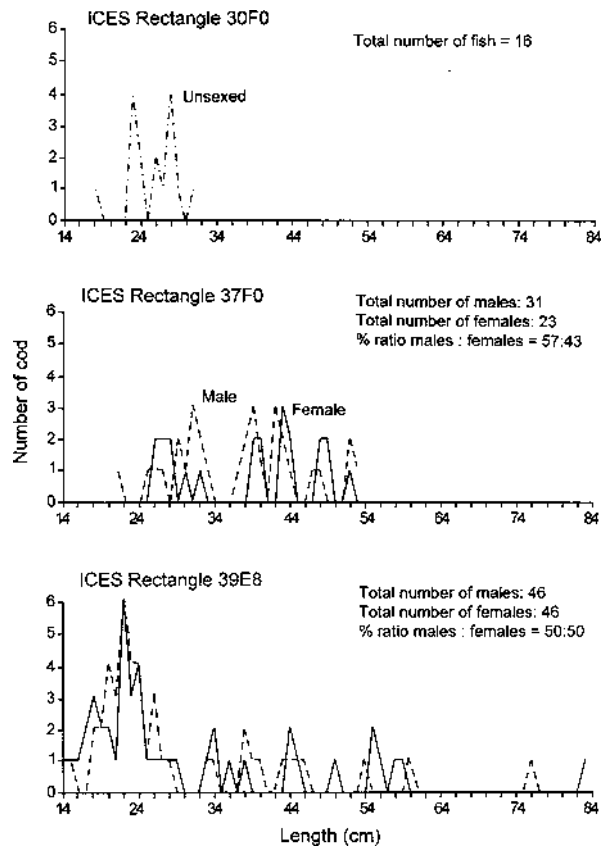


**Figure 2(b).**  
**% prevalence levels of liver nodules recorded in all size categories of dab together with histologically confirmed hepatic adenoma from female dab >20 cm length, RV CORYSTES Cruise 5/92**





**Figure 4.** % prevalence levels of cases of skeletal deformities recorded in cod caught from ICES rectangles 30F0, 37F0 and 39E8, RV CORYSTES Cruise 5/92



**Figure 5.** Length size distribution by sex for all cod caught from ICES rectangles 30F0, 37F0 and 39E8, RV CORYSTES Cruise 5/92

**Table 4.** Catch data and disease prevalence in flounder (*Platichthys flesus*) on stations sampled in the North Sea for fish disease monitoring (1 hour tow using a Granton Trawl), RV CORYSTES Cruise 5/92

ICES Rectangle	Station	No. of hauls	Average depth (m)	Total catch		Sex		No. and severity of disease cases recorded						Remarks
				No.	Mass (kg)	M	F	Ulceration			Lymphocystis			
								1	2	3	1	2	3	
30F0	4	1	35	27	1.5	NR	NR	1	0	0	0	1	0	None

**Table 5. Summary of histological results for samples of dab livers (from female dab >23 cm length sampled from six areas in UK coastal waters, RV CORYSTES Cruise 5/92)**

ICES Rectangle	Area examined	No. of fish	Categories of liver histology			
			Grade 1	Grade 2	Grade 3	Grade 4
30F0	Rye Bay	50	39	11	0	0
	36E6	Liverpool Bay	50	37	10	2
1 38F1	West Dogger Bank	50	29	14	2	5
37F0	Flamborough Off Ground	50	29	16	2	3
	36F0	Humber Off Ground	50	33	10	2
5 36F1	Sole Pit	50	34	9	6	1

Key: Grade 1 = No abnormalities detected

Grade 2 = Hepatocyte necrosis, peliosis, parasite cysts, melanomacrophage cell increase

Grade 3 = Foci of hepatocellular change (putative pre-neoplastic lesions)

Grade 4 = Hepatocellular adenoma or other liver neoplasias

**Table 6. Overall positions, sampling areas, catch data and disease results for less common conditions, RV CORYSTES Cruise 5/92**

ICES Rectangle	Area	No. of hauls	No. of baskets	No. of species	Remarks
30F0	Rye Bay	2 (Granton)	11	10	No abnormalities detected (NAD)
30E7	Lyme Bay	3 (Granton)	10	16	NAD
29E6	Start Point (Inner)	2 (Beam)	4	16	NAD
28E6	Start Point (Outer)	2 (Beam)			
29E5	Plymouth Sound	2 (Beam)	4	14	NAD
26E1	South Western Approaches	2 (Granton)	6	22	1 cod with vertical compression
31E5	Bristol Channel	3 (Beam)	2.5	12	NAD
32E5	Carmarthen Bay	1 (Beam)	3	9	NAD
33E5	Outer Cardigan Bay	2 (Granton)	41.5	11	NAD
	Inner Cardigan Bay	3 (Granton)	11.5	20	NAD
34E5	Tremadog Bay	1 (Granton)	16	12	NAD
35E6	Liverpool Bay	4 (Granton)	28	18	NAD
37E6	Morecambe Bay	3 (Granton)	27	24	Approx. 1% lymphocystis in plaice Skeletal deformities in dab (6 fish)
	Off Sellafield	1 (Granton)	7	16	NAD
39E8	Amble	2 (Granton)	8.5	18	Skeletal deformities in haddock (3%) and cod
38F0	Baymans Hole	1 (Granton)	13	18	Skeletal deformities in haddock (3%)
38F1	West Dogger	2 (Granton)	14	16	NAD
37F0	Flamborough Off Ground	3 (Granton)	23.5	22	Approx. 1% Skeletal deformities in haddock
36F0	Humber Off Ground	4 (Granton)	40.5	19	NAD
36F1	Sole Pit	3 (Granton)	82	15	NAD

Note: All herring hearts were examined histologically, when present for signs of ichthyophonosis (not identified)

Livers from megrim, thickback sole and hagfish were examined histologically, abnormalities were not identified

---

---

# STATUTORY MONITORING FOR FISH AND SHELLFISH DISEASE

---

---

## 2. THE MONITORING PROGRAMME FOR CONTROL OF DISEASE IN FARMED STOCKS AND ITS TRANSMISSION TO WILD STOCKS

### 2.1 Introduction

Statutory controls, to prevent the introduction and spread of fish disease in Great Britain, have existed for more than 50 years. These are derived from the Diseases of Fish Act, 1937 (Great Britain - Parliament, 1937) as amended by the Diseases of Fish Act, 1983 (Great Britain - Parliament, 1983). The controls relate to salmon, trout and other freshwater fish and operate to prevent the introduction and spread of disease. They prohibit the importation of live salmonids into Great Britain, except from Northern Ireland, and imports of salmonid ova are permitted only under licence with supporting health certification. Similar licensing controls also apply to the importation of other types of freshwater fish and their ova which are likely to be released into the wild. The Acts also give the regulatory authorities powers to control the spread of serious 'notifiable' diseases. The following diseases are the only ones which at present come into this category:

- viral haemorrhagic septicaemia (VHS);
- infectious haematopoietic necrosis (IHN);
- infectious salmon anaemia (ISA);
- gyrodactylia caused by *Gyrodactylus salaris*;
- bacterial kidney disease (BKD);
- infectious pancreatic necrosis (IPN);
- whirling disease (WD);
- enteric redmouth (ERM) (Scotland only);
- furunculosis in salmon; and
- spring viraemia of carp (SVC).

Apart from SVC, these are diseases of trout and/or salmon and the effects are much more pronounced under intensive farming conditions. The viral diseases VHS and IHN are by far the most serious of the trout diseases on this list but both of them are absent from British waters as are gyrodactylia and ISA of salmon.

Marine shellfish are regulated under the Sea Fisheries (Shellfish) Act, 1967 (Great Britain - Parliament, 1967).

The Act controls the depositing of molluscan shellfish and lobsters in coastal waters. The mollusc controls operate on shellfish of UK or imported origin and cover the bivalve pests, *Mytilicola*, *Crepidula* and American tingle and a range of diseases such as *Bonamia*, *Marteilia* and Haplosporidia. Controls on lobsters were specifically designed to prevent the spread of Gaffkaemia. This is a bacterial septicemic condition caused by *Aerococcus viridans*, commonly imported in North American lobsters and which may be transmitted to our native lobster stocks.

FDL has responsibility for fulfilling the Department's statutory inspection and diagnostic duties in England and Wales under these Acts. Inspectors visit farm, river and large open water sites to examine fish or shellfish where notifiable or other serious diseases are suspected and samples are taken for laboratory testing. This inspection, together with programmes for monitoring certain other serious diseases, provides for an assessment of the incidence, prevalence and significance of diseases of fish and shellfish generally in England and Wales. This information provides a scientific basis, for *inter alia* governmental policies and the application of statutory measures for such diseases.

When notifiable diseases have been confirmed by testing, or are suspected, an Inspector has the powers to enter sites and prohibit or regulate the movement of live fish, ova and foodstuffs into and out of the designated infected area and to regulate the removal and disposal of dead and dying fish. Inspection and laboratory testing of cultivated and wild stocks of fish and shellfish are also undertaken for health certification to facilitate exports.

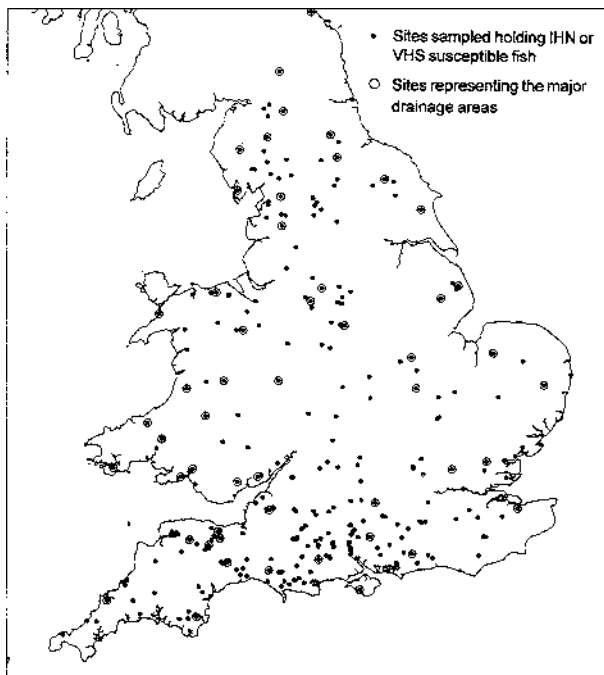
Since 1985, under the Registration of Fish Farming and Shellfish Farming Businesses Order (Great Britain - Parliament, 1985(b)), it has been a legal requirement that all fish and shellfish farming businesses in England and Wales register with MAFF in order to assist efforts to prevent the spread of disease. There are currently some 731 registered fish farms and 258 registered shellfish farms. Inspectors are charged with checking the registration details and movement records which must be kept by such registered businesses.

During 1992, significant changes were incorporated in disease monitoring, test procedures and farm inspections in preparation for 1 January 1993, when the single European market was to become operative and trade barriers for live fish and shellfish, as well as other

animals, were to be removed. The aim of the EC Directive 91/67 concerning the animal health conditions governing the placing on the market of aquaculture animals and products (European Communities, 1991(a)) was to provide a framework within which Member States could take action to prevent introductions and spread of serious fish and shellfish diseases whilst facilitating inter-community trade in farmed fish and shellfish. The basis of this control was the establishment of zones free of certain diseases and controls limiting movements of live fish and shellfish to those originating from zones of equivalent or higher health status.

To safeguard the UK's existing health status, a case had to be made to the Commission to establish Great Britain as a zone of the Community approved as being free of VHS and IHN and other serious diseases of fish and shellfish.

Following outbreaks of IHN in France and Italy in 1987 (and latterly in Belgium and Germany), an EC Decision 90/495 (European Communities, 1990) was agreed requiring Member States to undertake a VHS/IHN survey to establish the distribution of these diseases in the Community. In support of the case for the UK, a programme of testing all drainage areas with salmonid farms was undertaken in England and Wales involving the testing of 52 individual sites (see Figure 6).



**Figure 6. Sites holding fish susceptible to IHN or VHS and sampled as part of IHN/VHS survey under EC Decision 90/532**

This programme, applying initially to sites in different drainage areas, was further extended during the year to include the inspection and sampling of all sites holding species susceptible to VHS and IHN and the inspection of all other fish farm sites. In addition, in support of the case for an application for approved zone status for freedom from *Bonamia* and *Marteilia*, diseases of the flat oyster, *Ostrea edulis*, a programme for testing to achieve approved zone status for these diseases within the Community was prepared for the Commission.

In 1992, the Fish Health Regulations (Great Britain - Parliament, 1992(a)) came into operation, implementing EC Directive 91/67. The effect of these Regulations was to supplement existing measures of fish and shellfish diseases in the United Kingdom. Controls which had existed in 1991 were continued, but the disease monitoring took account of the information and procedural changes in the regulations which were due to come into force within the European Community and nationally on 1 January 1993.

## 2.2 Materials and methods

### 2.2.1 Sampling methods

The way in which samples are selected is important, whether the samples are being taken for monitoring or for investigating the cause of outbreaks of clinical disease. Prior to sampling, an assessment of the site and husbandry conditions which prevail may be needed, as well as an inspection of the fish or shellfish present. For monitoring purposes, sites are generally sampled to a statistical standard which provides for a 95% confidence level of detecting a 2% incidence of disease (Ossiander and Wedemeyer, 1973). This means that, in practice, 150 animals are sampled on site from across the population. With 'wild' populations, which are at lower densities and where sample size is limited, sampling to give a 95% confidence level of detecting disease at the 10% level is acceptable. Where overt clinical disease is manifested, sampling will normally be limited to 5-10 affected animals.

Because of the long history of freedom from IHN and VHS in the UK, the testing undertaken to monitor for these diseases in the survey under EC Decision 90/495 and in support of the case for zone approval under EC Directive 91/67 was limited to a 30 fish sample from each farm site tested.

### 2.2.2 Laboratory tests

(a) **Virology:** Testing of fish for viruses depends primarily on the isolation of the virus through passage in tissue culture, but an enzyme-linked immunosorbent assay (ELISA) for early identification of viral antigen can

be used in cases of clinical disease. For isolation of viral disease agents, viscera (kidney, spleen and brain for salmonids; spleen, kidney and brain for cyprinids) are pooled from 5 fish and homogenised with sterile sand and balanced salt solution (Hank's or Earl's) using a pestle and mortar. To eliminate contamination, the homogenates are diluted with a high-level balanced salt solution (containing the antibiotics penicillin at 1000 i.u. ml<sup>-1</sup>, streptomycin at 1000 mg ml<sup>-1</sup> and mycostatin at 50 i.u. ml<sup>-1</sup>). Cell cultures are inoculated with extracts prepared from pooled homogenates and incubated for one week before a repeat passage and a further week's incubation. The type of cell culture used is dictated by the virus under investigation. Passage of a virus through a tissue culture is normally accompanied by cytopathological effects (CPE) and confirmation of the identity of a virus causing CPE is achieved by means of a serum neutralisation test or ELISA (Way and Dixon, 1988).

In drawing up the protocols for virological testing to be undertaken throughout the European Community from 1 January 1993, a common methodology was agreed under EC Decision 92/532 (European Communities, 1992) and these methods were used for testing during the period of this report in order to meet the requirements of EC Decision 90/495.

**(b) Bacteriology:** In testing for *Renibacterium salmoninarum*, the causative agent of BKD, sterile swabs are used to take fresh kidney samples which are plated onto specific kidney disease medium (Austin *et al.*, 1983). Plates are incubated at 15°C for up to 10 weeks and examined weekly. Confirmatory tests for the organism include an immuno-fluorescent antibody test (Bullock and Stuckey, 1975), the API enzyme test (Austin *et al.*, 1983), and the co-agglutination test (Dixon, 1987).

Tests for *Aerococcus viridans*, the causative agent of gaffkaemia, are based on isolation of the organism from haemolymph samples in presumptive gaffkaemia broth or directly on brain-heart infusion and blood agar plates following incubation at 28°C for 3-5 days (Stewart *et al.*, 1966). Confirmation of any presumptive gaffkaemia organisms which exhibit the typical tetrad form, are Gram-negative, and catalase-negative is obtained using the co-agglutination test.

**(c) Parasitology:** Tests for WD are based on the examination of Giemsa-stained histological sections of cranial cartilage and bone for evidence of spores of *Myxobolus cerebralis*, the causative agent.

Tests for the oyster parasite *Bonamia ostreae* also rely on histological examination. A 5 mm slice through the gills and digestive tract is fixed in Davidson's seawater fixative (Shaw and Battle, 1957). Sections are stained by Gomori's one-step trichrome method (Drury and Wallington, 1973).

**(d) Crayfish plague:** The tests used for the identification of *Aphanomyces astaci* are those described by Alderman and Polglase (1986).

## 2.3 Statutory field investigations for fish diseases

The fish disease testing in 1992 included: (a) tests on fish from sites where notifiable or serious disease was suspected; (b) the annual monitoring of trout hatcheries and salmon sites for IPN; (c) re-tests on sites already designated for SVC and BKD; and (d) tests for IHN and VHS on all farms holding species susceptible to List II diseases under EC Decision 90/495.

### 2.3.1 Investigations into the cause of disease outbreaks in fish

In 1992, 119 cases of fish mortality were investigated, including one where IPN was confirmed on a site previously negative for the disease. Fifty-eight cases of suspected SVC were investigated, but none proved to be positive. Reported mortalities occurred in wild Atlantic salmon in 3 river catchment areas, with furunculosis confirmed in one of the cases and other bacterial infections implicated in the other cases. Additionally, bacterial problems were implicated as the primary source of problems on both farms and in still-water fisheries, with *Yersinia ruckeri* being found as the cause of a major mortality in a population of bream and a persistent cause of mortality on rainbow trout farms. In addition, a variety of parasitic infestations were implicated in many cases. Both trout fry anaemia and proliferative kidney disease (PKD) were recorded as causes of mortality and morbidity on fingerling and table trout farms, respectively.

### 2.3.2 Investigations to monitor for specific diseases of fish

**(a) Infectious pancreatic necrosis:** The annual programme was set up to monitor rainbow trout hatcheries and salmonid sites for IPN, following the variation in policy in 1984. The tests this year were limited to the 24 sites registered as holding Atlantic salmon, with one proving positive for the virus. In addition, in response to a request for re-tests on the designated rainbow trout hatchery sites, IPN was re-confirmed in 4 out of the 5 sites.

**(b) Whirling disease:** Monitoring for WD was also instigated as a result of the 1984 policy changes. However, following provisional agreement within the EC that WD was not of sufficient seriousness to warrant movement controls, no monitoring for this disease was undertaken in 1992 other than on sites with a specific requirement to facilitate exports.

### 2.3.3 EC survey for IHN and VHS

Some 52 farm sites, of which 21 held broodstock, chosen as being representative of individual drainage areas were tested as part of the EC survey for IHN and VHS during late 1991 and early 1992. Virological tests on all samples proved negative, confirming the absence of these diseases from England and Wales. A full inspectoral survey was also concluded on the 731 registered fin fish farm sites and the 288 found to be holding species susceptible to IHN or VHS were tested (see Figure 6). All sites proved to be negative for the viruses IHN and VHS and these results were used as the basis of the submission for approved zone status made to the Commission late in 1992. In addition to samples being taken for virological examination, the sites sampled were screened visually for the presence of clinical BKD, again as part of the case being constructed in support of the submission made to the Commission with reference to possible controls on List III diseases under the EC Directive 91/67.

### 2.3.4 Re-tests for specific diseases of fish on designated sites

(a) **Bacterial kidney disease:** Sites where BKD is confirmed are designated as infected and controls are imposed on movement of live fish off such sites. In 1992 re-tests on 2 BKD-designated sites were negative, and no new BKD-positive sites were found. Two designated sites, one, a fallow site, and the other, a lake, were not tested. Overall, tests for BKD were conducted on a total of 12 sites, all of which proved negative.

(b) **Spring viraemia of carp:** Following outbreaks of SVC in 1988 and early 1989, some 40 sites had been found to be infected and had restrictions imposed on movement of stock. Subsequently, many of the sites undertook clearance and/or disinfection, and by 1991, all of the remaining sites had been tested and declared negative. Unfortunately, 2 unrelated fishery sites which had been experiencing mortalities were found to be positive and subsequently designated for SVC. During 1992 both these sites were re-tested and proved to be negative on this occasion.

## 2.4 Statutory field investigations into diseases of shellfish under the Sea Fisheries (Shellfish) Act, 1967

Under this Act, the coast of England and Wales is divided into 27 'Control of Deposit' areas, as shown in Figure 7, and transfer of molluscan shellfish into and between these areas for deposit is controlled by licensing. Shellfish testing policy in support of this Act includes examinations of shellfish stocks where serious disease is suspected and the tracing of contacts when

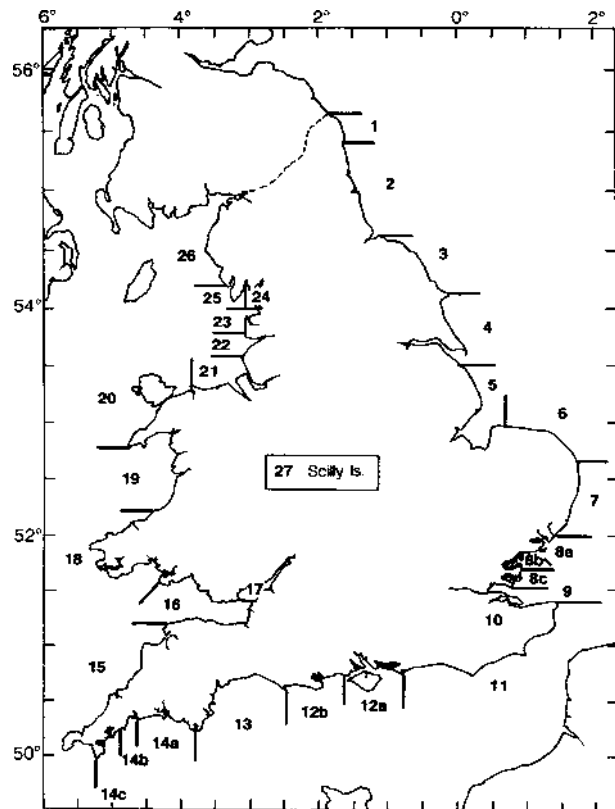


Figure 7. Control of Deposit areas in England and Wales

disease has been confirmed. Annual monitoring of *Ostrea edulis* stocks for *Bonamia* is also undertaken in coastal areas with a past history of disease, to establish the levels of infection and the implications for both wild and farmed stocks and to permit control of its spread by licensing movement of stock. Details of the impact and spread of *Bonamia* in the UK has been published elsewhere (Hudson and Hill, 1991; MAFF, 1993(a)).

### 2.4.1 Investigations to monitor for specific diseases of shellfish

Because of the development of the new duties arising from EC Directive 91/67 on fish and shellfish disease, and EC Directive 91/492 on shellfish hygiene (European Communities, 1991(b)), staff time available for *Bonamia* monitoring was limited in 1992. Less effort was invested in monitoring hatchery suppliers and shellfish growing areas adjacent to known infected areas for disease spread.

One hundred and eighty-nine farms were visited for registration and movement record checks in support of Great Britain's application for approved zone status under EC Directive 91/67. The visits were intended to survey for the presence of *Ostrea edulis* on site, to inform shellfish farmers of new regulations, and to check compliance with requirements to keep up-to-date movement records and production figures of stock entering and leaving sites. This led to considerable extra work in updating the shellfish farm database and this work is still ongoing.

Less effort was applied to *Bonamia* testing this year, as staff time was required to conduct the EC survey of shellfish farm sites to establish the current distribution of *O. edulis*. However, 4 samples of oysters were tested to add to the background record of *Bonamia* present at wild sites. In one site, Stanswood Bay, *Bonamia* was confirmed at a low level. This was the first recorded positive evidence of *Bonamia* being present in the open Solent and invalidates local industry claims of freedom from the disease which had formerly led to lucrative relay and export markets. This led, for the first time, to restrictions on the relaying of oysters from this stock under the 1992 Fish Health Regulations.

Three samples of scallops were examined following mortalities (in a hatchery in North Wales and in Lantern nets at farm sites in southern England), but no significant pathology was observed in them. However, heavy growths of *Vibrio* spp. and *Aeromonas hydrophila* were recorded in all specimens. Two

samples from wild populations not known to be suffering any mortalities were also examined as controls. These samples contained the same range of bacterial types, so it appears that water quality or some other environmental stress, rather than a pathogen, was the cause of death.

#### **2.4.2 Test for Gaffkaemia**

Tests were conducted on serum samples of 10 lobsters from 2 sites where Gaffkaemia had previously been confirmed and where the owners suspected that it might well be endemic but in a sub-clinical or carrier state being kept under control. Both samples proved to be negative for the presence of *Aerococcus viridans*, the causative agent of Gaffkaemia. No excessive lobster mortalities in tanks were reported, although rumours of Irish lobsters dying in vivier lorries *en route* to France via England and Wales were reported.

---

---

## **MICROBIOLOGICAL CLASSIFICATION OF SHELLFISH HARVESTING AREAS**

---

---

### **3. THE MONITORING PROGRAMME FOR *ESCHERICHIA COLI* IN SHELLFISH**

#### **3.1 Introduction**

Bivalve molluscs growing in sewage-contaminated water concentrate micro-organisms in their intestinal tract as a result of filter-feeding. Consumption of such contaminated shellfish may cause gastro-enteritis or hepatitis A infections. Most developed countries have means of controlling the risk of infection.

Classification of shellfish harvesting areas is specified in Article 3 of the EC Directive 91/492 (European Communities, 1991(b)) on Shellfish Hygiene. The Food Safety (Live Bivalve Molluscs and Other Shellfish) Regulations, 1992 (Great Britain - Parliament, 1992(b)) incorporated the Directive into UK law. MAFF and the Department of Health (DoH) are joint competent authorities for the purposes of the Regulations in England, but MAFF has prime responsibility for the classification process. In Wales the competent authorities are the comparable departments of the Welsh Office. The Weymouth Laboratory is responsible for

giving scientific and technical advice to MAFF, DoH and the Welsh Office.

The criteria for the classification of the areas are given in Table 7. The aim of this classification is to determine the extent of faecal contamination of molluscs in harvesting areas and to identify, where necessary, the type of treatment needed to reduce such contamination prior to consumption. Where contamination is gross it is necessary to prohibit the harvesting of molluscs for commercial sale. The bacteria belonging to the group called 'faecal coliforms' occur in faecal material from humans and other warm-blooded animals and are often used as indicators of contamination with such material. The species *Escherichia coli* is a member of this group and is a more specific indicator of faecal contamination. Prior to the introduction of EC Directive 91/492, there was no national scheme for monitoring the degree of contamination of bivalve molluscs. Previous controls had been effected on a local basis under the Public Health (Shellfish) Regulations, 1934 (Great Britain - Parliament, 1934). There were no requirements for continued monitoring of harvesting areas under these controls. Monitoring was undertaken by some local authorities, but the results were not necessarily available to central government. Many recognised shellfish harvesting areas were not subject to control under the 1934 Regulations.

**Table 7. Classification criteria for harvesting areas**

Class	Microbiological Standard	Treatment Level
A	All samples contain <300 faecal coliforms or <230 <i>E. coli</i> per 100g of mollusc flesh	None
B	90% of samples must not exceed 6,000 faecal coliforms or 4,600 <i>E. coli</i> per 100g of mollusc flesh	Depurate or heat treat
C	All samples must not exceed 60,000 faecal coliforms per 100g mollusc flesh	Relay for 2 months prior to appropriate treatment for the class of relay area, or heat treat by an approved method
D	Do not conform to at least class C	Prohibited

The current classification exercise is based upon the identification of commercial harvesting areas by Food Authorities. One or more representative monitoring sites are identified within each area by agreement between the Food Authority and the Weymouth Laboratory. In selecting sites, account is taken of the extent of the shellfish bed(s), the nature of the area, and the location of known sewage discharges. Where more than one species is harvested from a single area each species is normally sampled separately because the extent of contamination may differ markedly from one to another because different species of shellfish have different filter feeding characteristics. Sampling is undertaken on a monthly basis throughout the year.

### 3.2 Materials and methods

Samples of bivalve molluscs were collected from the agreed sampling sites by officers of the Food Authorities or their agents. The samples were sent to a laboratory (normally a local Public Health Laboratory Service (PHLS) laboratory) under controlled conditions and tests for faecal coliforms and *Escherichia coli* performed according to a standard method (MAFF; DoH; PHLS Working Group, 1992). Copies of the results were sent to the Weymouth Laboratory where they were collected and analysed.

### 3.3 Results

The data obtained were used to classify the shellfish species from the harvesting areas according to the criteria given in Table 7. As this was the first year of the monitoring programme preliminary classification lists, rather than definitive ones, were issued in June and October 1992. The classification list for October 1992 is presented in Table 8.

### 3.4 Discussion

The provisional classification list presented in Table 8 shows that the harvesting areas around the coast of England and Wales contain all possible categories; from A class which may go direct for human consumption to D class which may not be harvested at all. The bulk of the harvesting areas fall into categories B and C. Until the full implementation of EC Directive 91/492 bivalves from both these categories may be sold for human consumption after undergoing depuration; ultimately C class shellfish will have to be relayed in A or B areas if they are to be sold live for human consumption. Relaying or purification is not necessary if the shellfish are heat-treated by an approved process, although class D shellfish are still not deemed fit for human consumption.

Depuration plants are facilities which enable bivalve molluscs to be held in clean sea water under such conditions that they undergo the normal 'pumping' activity associated with filter-feeding. This process gradually eliminates micro-organisms from the digestive tract of the animals. Such plants have to be approved under the terms of the Directive and a range of requirements are stipulated.

### 3.5 Conclusions

The Shellfish Hygiene Directive and the associated UK Regulations have introduced a degree of consistency in the approaches taken to minimise the risk of infection associated with eating bivalve molluscs. It remains to be seen whether this is reflected in future statistics of shellfish-associated infections.

**Table 8. Provisional harvesting classification list, 1992**

Harvesting area	Bed name	Species sampled	Class	Comment
Holy Island	Holy Island	Mussels	B	
	Ross Links	<i>C. gigas</i> and mussels	B	
Budle Bay	Budle Bay	Mussels	B	
Humber	Wonderland	Mussels	C	
	Yacht Club	Cockles	C	
	Anthony's Bank and Horseshoe Point	Cockles	B	
The Wash-Boston	Witham Bank, Toft Lays, Gat Sand, Maretail and Butterwick	Mussels	B	
	Friskney	Cockles	B	
The Wash-Kings Lynn	Nene, Daseleys and Hunstanton	Mussels	B	
	Thief, South Daseleys, Stylemans and Pandora	Mussels	C	
	Training Wall	Mussels	D	
	Breast Sand	Cockles and mussels	C	
Brancaster	Burnham Overy	Mussels	B	Provisional classification
	Brancaster	Mussels	B	
	Thornham	<i>C. gigas</i> and mussels	B	
	Titchwell	<i>C. gigas</i>	A	
	Mullins	<i>C. gigas</i>	A	
Blakeney	Simpool	Mussels	A	
	Morston	<i>C. gigas</i>	A	
Wells Harbour		Mussels	C	
Blyth	Blythbrough Creek	<i>C. gigas</i>	B	Provisional classification
Alde/Ore	Stoneyditch Creek	Mussels	A	Provisional classification
Butley	Creek	<i>O. edulis</i> and mussels	B	Provisional classification
Deben	Methersgate Quay	Mussels	C	Provisional classification
Orwell	Nacton Shore	Mussels and cockles	B	
Walton Backwaters	Twizzle and Kirby Creek	<i>O. edulis</i> and <i>C. gigas</i>	B	
Colne	Peewit Island and Pyefleet Spit	<i>C. gigas</i>	A	Provisional classification
	Colne Buoys 1 and 13, The Wreck Marker and Brightlingsea Harbour	<i>C. gigas</i> and mussels	B	Provisional classification
	Colne Point	Mussels	C	Provisional classification
West Mersea	Tollesbury, Salcott and Little Ditch	<i>O. edulis</i>	B	Provisional classification
	Free Ground	<i>O. edulis</i>	B	
	The Nothe	<i>O. edulis</i>	C	
Blackwater	Goldhanger	<i>C. gigas</i>	A	Provisional classification
	Thirslet Creek	Mussels	A	
	Bench Head, St Peters Flats and Batchelor Spit	<i>O. edulis</i>	A	
	Buxey Sands	Cockles	A	
	The Nass	<i>O. edulis</i>	B	
Crouch	Althorne Creek and Purleigh Shawl	<i>O. edulis</i>	B	Provisional classification
	Outer Crouch	<i>O. edulis</i>	C	
Roach	Paglesham Pool	<i>O. edulis</i>	A	Provisional classification
	Dunhopes and Pond Lays	Cockles	B	
	Dunhopes	Mussels	C	
	Middleway	Cockles	C	
Thames Estuary	Northside	Mussels	B	Provisional classification
	Northside	Cockles	C	
	Middle	Cockles	C	
	Sheppey	Mussels and cockles	B	
	Margate	Cockles	B	

**Table 8. Provisional harvesting classification list, 1992 (continued)**

Harvesting area	Bed name	Species sampled	Class	Comment	
North Kent Coast	Studhill, Leonards Hole and The Street	<i>O. edulis</i>	A	Provisional classification	
	Minnis Bay	Mussels and cockles	B		
	Seasalter, Whitstable, Herne Reculver and Swalecliffe	Mussels	B		
	North Woolpack and East Last Bank	Swale sites 1-3	<i>O. edulis</i>	B	Provisional classification
		Swale sites 1-3	Mussels and cockles	C	
		Swale site 5	Clams	C	Provisional classification
Herne Hampton and Belinge Bay		Mussels	C		
All other areas	Mussels, cockles and <i>O. edulis</i>		B Provisional classification		
Stour Estuary	Pegwell and Sandwich Bays	Cockles	C		
Adur	River	Mussels	B		
Chichester Harbour	All areas	<i>O. edulis</i>	B		
Langstone Harbour	All areas	<i>O. edulis</i>	B		
Portsmouth Harbour	All areas	<i>O. edulis</i> and clams	B		
Southampton Water	All areas (except Fawley)	Clams and <i>O. edulis</i>	B		
		<i>O. edulis</i>	C		
Solent	Ryde Pier, Osborne Bay, Lymington Estuary and Sowley	<i>O. edulis</i>	C	Provisional classification	
		<i>O. edulis</i>	D		
		<i>O. edulis</i>	B		
Medina	River and Wharf	<i>O. edulis</i>	C		
Newtown	River and Clamerkin	<i>O. edulis</i>	B		
	Western Haven	<i>O. edulis</i>	A		
Beaulieu	Bucklers Hard and Needs Ore	<i>O. edulis</i>	C		
Poole	Poole Bay and Harbour areas (except Lake Road)	<i>O. edulis</i> , clams, and mussels	B		
	Lake Road	Mussels	C		
Portland	Harbour-Several Order Harbour (except Several Order) Fleet Shambles Bank	Mussels	A	Provisional classification	
		Mussels	A		
		<i>C. gigas</i>	B		
		Mussels	B		
Exe	All western areas	Mussels and <i>C. gigas</i>	B		
Teign	All areas (except The Salty) The Salty	Mussels and <i>C. gigas</i>	B		
		<i>C. gigas</i>	C		
Dart	Blackness Waddeton	<i>C. gigas</i>	C		
		<i>C. gigas</i>	B		
Salcombe	All areas	<i>C. gigas</i>	B		
Bigbury and Avon	West and East Bank West and East Bank	<i>C. gigas</i>	B		
		Mussels	C		
Yealm	Upper and Lower	<i>C. gigas</i>	B		
Plymouth	Tamar-above Saltash Bridge	Mussels and <i>O. edulis</i>	D	C	
	Tamar-below Saltash Bridge and Lynher	Mussels, <i>O. edulis</i> and cockles			
	Mayflower Marina and Cawsand/Kingsand	Mussels	D		
	Whitsand Bay	Mussels	B		
Fowey	All areas	Mussels and <i>O. edulis</i>	C		
Truro River	All areas	Mussels and cockles	D		
Tresillian River	All areas	Mussels	C		

**Table 8. Provisional harvesting classification list, 1992 (continued)**

Harvesting area	Bed name	Species sampled	Class	Comment
Fal	Ruan Creek	Cockles	C	
	Turnaware Bar, Channels Creek and Parsons Bank	<i>O. edulis</i>	A	
	All other areas	<i>O. edulis</i>	B	
Helford	All areas	<i>O. edulis</i>	A	
Scilly Isles	Bryher	<i>C. gigas</i>	A	Provisional classification
Camel	Porthilley Farm	<i>C. gigas</i>	B	
Taw/Torridge	Lifeboat Slipway, Spratt Ridge, Pulleys Ridge, Appledore area, and sites A/B, H/I and K/L Sites C/D/E/F/G and J	Mussels	C	
		Mussels	D	
Porthcawl	All areas	<i>O. edulis</i>	B	Provisional classification
Swansea	Swansea Bank	<i>O. edulis</i>	B	Provisional classification
	Mumbles	<i>O. edulis</i>	B	
	Swansea Bay	Mussels	C	
Burry Inlet	Pwll and Machynys	Mussels and cockles	D	
	Burry Port	Mussels	C	
	Northside	Cockles	C	
	Southside-East and West	Cockles	C	
	Southside-Middle	Cockles	B	
	Whiteford Point	Mussels	B	
Three Rivers	St Ishmaels	Mussels	B	
	All other areas	Cockles	C	
Milford Haven	Above Woodhouse Spit	Mussels and cockles	C	
	Beggars Reach, Black Mixon, Mount Pleasant, Herbrandston North, Sandy Haven Pill	Mussels	C	
	Ferney Pits	Mussels, <i>O. edulis</i>	C	
	All areas	Cockles	C	
	All areas (except Ferny Pits)	<i>O. edulis</i> and <i>C. gigas</i>	B	
	Four Ashes, Benton Castle, Herbrandston	Mussels	B	
	South, Musselwick Angle Point, Roscrowther, Warrior Berth and Castle Beach Bay			
Fishguard	Goodwick Sands and Harbour	Mussels	B	
	Lower Town	Mussels	C	
Dovey	All areas	Mussels and cockles	C	
Mawddach	All areas	Mussels and cockles	B	
Menai Strait-West	Abermenai and Barras	Mussels and <i>C. gigas</i>	B	Provisional classification
	Traeth Melynog, Llanidan and Llanfairisgaer	Mussels and cockles	C	
Menai Strait-East	Gallows Point, Gannet and Wilsons (area 4)	Mussels	B	
	Bangor sites 9/10/11/12 (areas 2 and 5)	Mussels	B	
	Bangor sites 5/6/7 (area 1)	Mussels	C	
	Lavan Sands	Cockles	C	
Anglesey-Maltrath Bay	All areas	Mussels and cockles	B	
Anglesey-Inland Sea	Holyhead	<i>C. gigas</i>	A	Provisional classification
	Cymyran	<i>C. gigas</i>	B	
Anglesey-Red Wharf Bay	All areas	Cockles	C	

**Table 8. Provisional harvesting classification list, 1992 (continued)**

Harvesting area	Bed name	Species sampled	Class	Comment
Conwy	All estuary areas	Mussels	C	Provisional classification
	Llandudno	Mussels	B	
Colwyn Bay	Rhos and Llanddulas	Mussels	C	
Dee	All areas	Cockles	C	
Liverpool Bay	Crosby	Cockles	C	
	All areas (except Crosby)	Cockles	B	
Mersey Estuary	Rock Ferry	Cockles	C	Provisional classification
Southport	All areas	Cockles	C	
Ribble	All areas	Cockles	C	
Lune	Sunderland Bank and Shoulder, Cockerham Sands and Pilling	Cockles	B	Provisional classification
	Knott Spit	Mussels	C	
	Plover Scar	Mussels	D	
Morecambe Bay-East	Old Skeer	Mussels	B	Provisional classification
	Bare Ayre, Shelly Bed and Heysham Flat Skeer	Mussels	C	
	Reap Skeer	Mussels	C	
Morecambe Bay- Roosebeck	All areas	<i>C. gigas</i> and cockles	B	
	Roosebeck-2A and 2C	Mussels	B	
	All areas (except Roosebeck 2A and C)	Mussels	C	
Duddon	Askam Pier	Mussels	C	
Ravenglass	All areas	Mussels	B	
Maryport	All areas	Mussels	B	
Silloth	Lees Scar	Mussels	C	
	Beckfoot	Mussels	B	

*Explanatory footnotes:*

1. 'Provisional classification' indicates that only the minimum amount of information has been collected in order to define a category. Additional data are required to define these areas more accurately and they will be updated as soon as possible
2. 'All areas' indicates shellfish harvesting beds sampled in accordance with an agreed monitoring programme. Beds not sampled in this way are unclassified

## 4. REFERENCES

- ALDERMAN, D. J. AND POLGLASE, J. L., 1986. *Aphanomyces astaci*: isolation and culture. J. Fish Dis., **9**(5): 367-379.
- AUSTIN, B., EMBLEY, T. M. AND GOODFELLOW, M., 1983. Selective isolation of *Renibacterium salmoninarum*. FEMS Microbiology Letters, **17**: 111-114.
- BUCKE, D., 1989. Observations on visceral granulomatosis and dermal necrosis in populations of North Sea cod (*Gadus morhua*). ICES CM 1989/E:17, 9 pp. (mimeo).
- BUCKE, D., 1990. Marine fish diseases: an overview of 10 year's investigations by MAFF (UK). ICES CM 1990/E:12, 16pp (mimeo).
- BUCKE, D. AND FEIST, S. W., 1993. Histological changes in the livers of dab, *Limanda limanda* (L.). J. Fish Dis., **16**: 281-296.
- BUCKE, D. AND NICHOLSON, M. D., 1987. Fish disease investigations in the Irish Sea. ICES CM 1987/F:19, 12pp (mimeo).
- BUCKE, D., NORTON, M.G. AND ROLFE, M.S., 1983. The field assessment of effects of dumping wastes at sea: II. Epidermal lesions and abnormalities of fish in the Outer Thames Estuary. Fish. Res. Tech. Rep., MAFF Direct. Fish Res., Lowestoft, (**72**): 16pp.
- BUCKE, D. AND STOKES, K., 1988. Fish disease monitoring on the 1987 North Sea Groundfish Survey. ICES CM 1988/E:7, 10pp (mimeo).
- BULLOCK, G. L. AND STUCKEY, H. M., 1975. Fluorescent antibody identification and detection of the *Corynebacterium* causing kidney disease of salmonids. J. Fish. Res. Bd. Can., **32**: 2224-2227.
- DIXON, P. F., 1987. Comparison of serological techniques for the identification of *Renibacterium salmoninarum*. J. Appl. Ichthyol., **3**: 131-138.
- DRURY, R. A. B. AND WALLINGTON, E. A., 1973. 'Carleton's Histological Technique', 4th edn. Oxford University Press, London. 432pp.
- EUROPEAN COMMUNITIES, 1990. Council Decision 90/495/EEC introducing a Community financial measure with a view to the eradication of infectious haematopoietic necrosis of salmonids in the Community. Off. J. Eur. Commun., **L276** (1990): 37-39.
- EUROPEAN COMMUNITIES, 1991(a). Council Directive 91/67/EEC concerning the animal health conditions governing the placing on the market of aquaculture animals and products. Off. J. Eur. Commun., **L46** (1991): 1-18.
- EUROPEAN COMMUNITIES, 1991(b). Council Directive 91/492/EEC laying down the health conditions for the production and the placing on the market of bivalve molluscs. Off. J. Eur. Commun., **L268** (1991): 1-14.
- EUROPEAN COMMUNITIES, 1992. Council Decision 90/532/EEC laying down the sampling plans and diagnostic methods for the detection and confirmation of certain fish diseases. Off. J. Commun., **L337** (1992): 18-27.
- GESAMP, 1991. Review of potentially harmful substances: carcinogens. WHO Rep. & Studies **No.46**: 1-56.
- GREAT BRITAIN - PARLIAMENT, 1934. The Public Health (Shellfish) Regulations 1934. Her Majesty's Stationery Office, London. 6pp.
- GREAT BRITAIN - PARLIAMENT, 1937. Diseases of Fish Act 1937. Her Majesty's Stationery Office, London. 11pp.
- GREAT BRITAIN - PARLIAMENT, 1967. The Sea Fisheries (Shellfish) Act 1967. Her Majesty's Stationery Office, London. 20pp.
- GREAT BRITAIN - PARLIAMENT, 1983. Diseases of Fish Act 1983. Her Majesty's Stationery Office, London. 16pp.
- GREAT BRITAIN - PARLIAMENT, 1985(a). Food and Environment Protection Act, 1985. Her Majesty's Stationery Office, London. 38pp.
- GREAT BRITAIN - PARLIAMENT, 1985(b). Registration of Fish Farming and Shellfish Farming Businesses Order, 1985. Her Majesty's Stationery Office, London. 7pp.
- GREAT BRITAIN - PARLIAMENT, 1990. Environmental Protection Act, 1990, Chapter 43. Her Majesty's Stationery Office, London. 235pp.
- GREAT BRITAIN - PARLIAMENT, 1992(a). The Fish Health Regulations, 1992. Her Majesty's Stationery Office, London. 17pp.
- GREAT BRITAIN - PARLIAMENT, 1992(b). The Food Safety (Live Bivalve Molluscs and Other Shellfish) Regulations 1992. Her Majesty's Stationery Office, London. 22pp.
- HUDSON, E. B. AND HILL, B. J., 1991. Impact and spread of bonamiasis in the UK. Aquaculture, **93**: 279-285.
- ICES, 1989. Methodology of fish disease surveys. Co-op. Res. Rep. Int. Coun. Explor. Sea., **166**: 1-43.
- MAFF, 1991. Monitoring and surveillance of non-radioactive contaminants in the aquatic environment and activities regulating the disposal of wastes at sea, 1988-89. Aquat. Environ. Monit. Rep., MAFF Direct. Fish. Res., Lowestoft, (**26**): 90pp.

- MAFF, 1993(a). Monitoring and surveillance of biological contaminants and disease in the aquatic environment, 1990. Aquat. Environ. Monit. Rep., MAFF Direct. Fish. Res., Lowestoft, (35): 35pp.
- MAFF, 1993(b). Monitoring and surveillance of non-radioactive contaminants in the aquatic environment and activities regulating the disposal of wastes at sea, 1991. Aquat. Environ. Monit. Rep., MAFF Direct. Fish. Res., Lowestoft, (36): 78pp.
- MAFF, 1994. Monitoring and surveillance for diseases in marine and freshwater fish, 1991. Aquat. Environ. Monit. Rep., MAFF Direct. Fish. Res., Lowestoft, (41): 21pp.
- MAFF; DoH; PHLS; Working Group, 1992. Bacteriological Examination of Shellfish. PHLS Microbiology Digest 1992, 9: 76-82.
- NSTF MMP, 1990. North Sea Task Force Monitoring Master Plan. North Sea Environment Rep. 3. North Sea Task Force/Oslo and Paris Commissions/ICES: London. 37pp.
- NSTF MMP, QSR, 1993. North Sea Task Force Quality Status Report. Oslo and Paris Commissions, London: 252 pp + sub-region 36: 154 pp, + sub-region 76: 86pp.
- OSSIANDER, F. J. AND WEDEMEYER, G., 1973. Computer programme for sample sizes required to determine disease incidence in fish populations. J. Fish. Res. Bd. Can., 30: 1383-1384.
- SHAW, B. L. AND BATTLE, H. I., 1957. The gross and microscopic anatomy of the digestive tract of the oyster, *Crassostrea virginica* (Gmelin). Can. J. Zool., 35: 325-347.
- STEWART, J. E., CORNICK, J. W., SPEARS, D. I. AND MCLEESE, D. W., 1966. Incidence of *Gaffkya homari* in natural lobster (*Homarus americanus*) populations of the Atlantic region of Canada. J. Fish. Res. Bd. Can., 23: 1325-1330.
- UK NMMP, 1994. National Marine Monitoring Plan, Marine Pollution Monitoring Management Group. HMP: 39 pp.
- WAY, K. AND DIXON, P. F., 1988. Rapid detection of VHS and IHN viruses by the enzyme linked immunosorbent assay (ELISA). J. Appl. Ichthyol., 4: 182-189.

*The reference to proprietary products in this report should not be construed as an official endorsement of these products, nor is any criticism implied of similar products which have not been mentioned.*

## **APPENDIX. Staff responsible for the disease monitoring projects in 1992**

### **Marine Fish Diseases Monitoring in the North Sea**

D. Bucke  
S. W. Feist  
G. Jones

### **Statutory Monitoring Fish and Shellfish Disease Monitoring in England and Wales**

E. B. Hudson  
D. McGregor  
A. Howard  
K. Denham  
W. Leschen  
N. Auchterlonie  
R. Gardiner  
S. Hovey  
C. Wood  
S. Gandhi  
M. Gubbins  
R. Turner  
B. P. Wood  
G. Taylor  
C. Crane  
M. Booth  
L. Richens  
R. Comben  
P. Dunn  
S. Swaine

### **Microbiological Classification of Shellfish Harvesting Areas in England and Wales**

E. B. Hudson  
C. J. Rodgers  
L. Hunt



**Ministry of Agriculture, Fisheries and Food**  
**Directorate of Fisheries Research**  
**Fisheries Laboratory**  
**Lowestoft**  
**Suffolk**  
**NR33 OHT**