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**REPORT OF THE  
WORKING GROUP ON PATHOLOGY AND DISEASES  
OF MARINE ORGANISMS  
(Kiel, 5-8 April 1989)**

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## **SUMMARY**

The Working Group met for 4 days (5-8 April 1989) at the Institut für Meereskunde, University of Kiel, FRG, with 20 participants from 11 countries. National reports on diseases in wild populations of marine organisms submitted from 7 countries were discussed with emphasis on data from studies on pollution effects. Reports on the ICES 2nd Seagoing Workshop on Methodology of Fish Disease surveys, the German multidisciplinary study on fish diseases in the Wadden Sea and the Dutch and British experimental studies on the effects of polluted sediments on fish health were considered. Attention to disease in mariculture centred on the national reports, consideration of recent developments in molluscan disease of economic importance and preparation of data on problems of medication. Proposals for further additions to the ICES disease identification leaflets series and other possible publications to aid fish disease recognition during stock surveys were discussed. The Working Group proposed three main recommendations to be put to ICES Council.

## **RESUME**

Le groupe de travail, qui comprenait 20 participants de onze pays, s'est réuni pendant quatre jours (du 5 au 8 avril 1989) à l'Institut für Meereskunde à l'université de Kiel (RFA). Les rapports nationaux sur les maladies dans les populations naturelles d'organismes marins soumis par sept pays ont été discutés, en particulier au point de vue des résultats d'études sur les effets de la pollution. Des rapports sur le deuxième séminaire en mer ICES sur la méthodologie des études de maladies des poissons, l'étude pluridisciplinaire allemande sur les maladies ichtyologiques dans la mer de Wadden, et les études expérimentales hollandaises et britanniques sur les effets de sédiments pollués sur la santé des poissons ont été étudiés. Dans le domaine des maladies dans les élevages de mariculture, la tension s'est portée sur les rapports nationaux; les récents développements dans les maladies des mollusques ayant une importance économique ont été également été considérés, et des données sur les problèmes de traitement ont été préparées. Des propositions en vue de nouvelles additions aux brochures d'identification des maladies de l'ICES et d'autres publications susceptibles d'aider à reconnaître ces maladies durant les études de populations ont été discutées. Le groupe de travail a proposé trois recommandations principales qui seront soumises au conseil de l'ICES.



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**REPORT OF THE WORKING GROUP ON  
PATHOLOGY AND DISEASES OF MARINE ORGANISMS**

(Kiel, 5-8 April 1989)

**INTRODUCTION**

The meeting of the Working Group on Pathology and Diseases of Marine Organisms (WGPDMO) was held at the Institut für Meereskunde, University of Kiel FRG (C.Res. 1988/2:43) immediately following the ICES Workshop on Nematode Problems in North Atlantic Fish (3-4 April). Local arrangements were kindly made by Dr Heino Moller.

Following the much regretted death of the Chairman of the WGPDMO, Dr. Emmy Egidius, in February the General Secretary of ICES had appointed Dr. Barry Hill to serve as acting Chairman for the meeting.

The participants were welcomed at 0900 on 5th April by the local host Dr. Moller and by the Director of the Institute, Professor J Duinker, who gave a brief account of the research activities of the Institute and wished the participants a successful meeting.

**1. OPENING OF THE MEETING**

The acting Chairman opened the Working Group meeting at 0930 with an explanation of his immediate role and the need for the appointment of the long-term Chairman which will be done at the next Statutory Meeting in October on the basis of a proposal from the Mariculture Committee. He had been informed that it was in order for the WGPDMO to suggest a name in it's report should it wish to. Dr. Hill then welcomed the participants, particularly the two members from the U.S.A. and Norway who had been asked to come at very short notice. The list of participants is attached as Annex 2.

Following a round of introductions and before conducting any further business, the Chairman called for a minute's silence to be observed in memory of Emmy Egidius.

**2. ADOPTION OF THE AGENDA**

The WG members were referred to the terms of reference for the meeting given in ICES C. Res. 1988/2:43 (attached as Annex 1) and to a letter from Dr. Janet Pawlak, ICES Environment Officer, informing that relevant sections of the report of the meeting would be handled by the Advisory Committee on Marine Pollution (ACMP) at its meeting on 20-29 June 1989. In particular, ACMP was interested in reviewing the WG's report on items a), g), h), e), and possibly j) in the terms of reference.

The non-attendance of some members of the WG who had been given specific inter-sessional tasks of preparing reports for the meeting meant it would not be possible to deal with some of the items on the Agenda as comprehensively as originally planned. The Agenda

was discussed and agreed after minor adjustments (attached as Annex 3).

The Chairman gratefully accepted the offer of secretarial assistance from Dr. Kerstin Anders of the Institut fur Meereskunde, in taking the minutes of the proceedings of the meeting to help rapporteurs with the preparation of their reports. Two rapporteurs were appointed for each session.

### **3. REPORT ON THE 1988 ICES STATUTORY MEETING AND COUNCIL RESOLUTIONS.**

The Chairman reported on the 76th ICES Statutory Meeting held in Bergen, Norway in October 1988 drawing attention to those reports and Council Resolutions of relevance to the Working Group. The new Working Group on Environmental Impact of Maricultural under the chairmanship of Dr. H Rosenthal which has replaced the Study Group on this topic held its first meeting in April 1988. The WGPDMO will contribute to this new WG on the topic of medication in mariculture and through the participation of one of its members as required by C.Res.1988/2:42. Arrangements have been made for Dr. A. Munro to be the WGPDMO representative at the forthcoming meeting of the new WG to be held in Oban, Scotland during 19-24 April 1989. Data on chemicals and medicines used in mariculture in ICES countries to be considered under Item 5.3 on the WGPDMO's Agenda would be relayed by the Chairman to Dr. Munro for presentation at the Oban meeting.

The WGPDMO had also been asked to help with the Glossary on Aquaculture Terminology with respect to the pathological terms contained therein. It had been decided to produce a joint ICES/EIFAC Glossary on Aquaculture Terminology and to achieve this an ICES/EIFAC Study Group had been formed under the chairmanship of Dr. Rosenthal. The Chairman felt that it would make most sense for the definitions in the WGPDMO's own Glossary of terms used in pathology which was nearing completion to be incorporated into the Glossary on Aquaculture Terminology and this would be considered under Item 7.1 of the Agenda.

### **4. DISEASES IN WILD POPULATIONS OF MARINE ORGANISMS** **4.1 NATIONAL REPORTS FOR 1988**

No reports were received from Belgium, GDR, Iceland, Poland, Portugal, Spain or the USSR although some data on mollusc diseases in Spain had been submitted by Dr. A. Figueras who was unable to attend the meeting. As normal practice in previous meetings, the disease data were presented both in the narrative form and on the standardised recording forms. This year some members presented their field data from fish disease surveys on the proposed new ICES Reporting Form devised from the ICES 2nd Sea-going Workshop on Methodology of Fish Disease Surveys. Summaries of the National Reports are attached as Annex 4: the disease data record forms have been placed on the WGPDMO file at ICES Headquarters.

Of the 11 ICES member countries submitting reports, Canada, France, Ireland and Norway have no programmes of disease surveys in marine fish stocks nor have any specific studies underway to determine if pollution in the marine environment is causing elevated levels of

certain fish diseases. The main points to emerge from the reports of those countries conducting such work were as follows:-

**Denmark** detected a sharp increase in prevalence rates of lymphocystis and epidermal papillomas in dab in the eastern North Sea, particularly in areas previously affected by oxygen deficiency. In the Kattegat also the disease rates appear to be increasing possibly related to oxygen deficiency in late summer. Disease rates in the Skagerrak appear low and stable.

**Federal Republic of Germany** reported their latest findings from its bi-annual survey of fish disease prevalence rates in the North Sea (including the Elbe estuary) and the Baltic Sea as a continuation of the eleven years of disease survey work specifically aimed at measuring pollution effects on fish disease levels. Details are provided in Annex 5. It was again shown that the highest abundance of epidermal papillomas and liver nodules in dab occur in the dumping areas within the German Bight where also the prevalence of lymphocystis seems to be increasing in contrast to a slight reduction on the Dogger Bank. Additionally in 1988, a remarkable green liver discolouration was found extensively in the western North Sea off the British coast and in the central North Sea on Fischer Bank: the cause is unknown. In the Baltic Sea, off the Polish coast, rockling were heavily affected by large open skin ulcers - the reason for this is unknown.

**Finland** is engaged upon the five year (1987/1991) general survey for fish diseases, mainly focused on the Gulf of Bothnia. Whilst not aimed specifically at polluted areas some attention is being paid to fish in the vicinity of a pulp mill effluent discharge where high prevalence rates of fin lesions have been observed in perch similar to those reported from Sweden near chlorinated pulp mill discharges .

**The Netherlands** are conducting a ten year (started in 1981) survey of fish diseases as part of stock assessment cruises with a view to monitoring the disease levels in fixed positions to look for trends. Some fluctuations have been noted but the present rates appear mostly stable with no trend evident. Lymphocystis rates were slightly higher in 1988 but, as always, the quoted levels are much lower than those found by German workers surveying in the same areas e.g. 3% as opposed to 50%. However, the German teams look very closely for lymphocystis and record even single nodules which are probably missed by the Dutch workers because of the short time available for careful examination of fish on stock assessment cruises. There is also a difference in the time of year at which the surveys are conducted by the two countries.

In a separate programme comprising a five year field study (1983/88) with special attention to possible pollution effects on disease prevalence in the Dutch coastal waters, the highest levels of liver nodules and epidermal papillomas in dab were again observed to be in the titanium dioxide waste dumping areas - agreeing with the work of the German team. It was also reported that the prevalence rates of liver nodules correlates quite well with the concentrations of PAHs in the local sediments but not in the tissues of individual dab. No such correlation has been found with PCBs in the sediments. In flounders, the highest prevalence

of liver nodules/tumor along the Dutch coast clearly correlates with the major pathway of pollutants discharged by the River Rhine. (Other major conclusions from this indepth study are given in the synopsis at Annex 4).

**Sweden** is conducting disease surveys on its east and west coasts in areas affected by pulp mill effluents. In 1988, prevalence rates of liver nodules in dab above 25cm were 24%-29% and plaice caught near the discharge pipe of the Varo pulp mill were found to be affected by depressions of the distal parts of the body - this condition is absent from the clean reference area.

**United Kingdom** reported an increased level of disease survey work both as part of regular stock assessment work and through specific monitoring for disease prevalence rates at dump sites both in the North Sea and Irish Sea. At a dump site in Liverpool Bay, prevalence rates of epidermal diseases in dab were slightly higher on stations away from the dump sites and, of particular significance, there was no evidence of the liver nodules in dab that are seen in North Sea dab. In Scotland, a repeat study was made of the 1987 survey of sewage sludge disposal areas: overall the disease rates were the same or lower at the disposal site than at the corresponding reference sites but in comparison with 1987 results there was a significant increase in the level of lymphocystis at all sites except one.

Independently of the survey work, a field investigation was mounted after reports from the industry of high numbers of large cod showing "blisters" on their visceral organs. Up to 11% of large cod in the effected area in the southern North Sea displayed visceral lesions. All evidence points to an infectious disease progressing naturally in a specific cod population but the aetiological agent could not be identified although there are pathological similarities to "presumptive mycobacteriosis".

**United States** is conducting no monitoring programmes for diseases in offshore marine fish populations: the ongoing studies concentrate on the influence of pollution on the health of estuarine fish populations. Examinations of fish on the Elizabeth River which has the highest concentrations of PAHs in the USA revealed several diseases but no apparent liver nodules/tumours have been observed. Juvenile spot held on contaminated sediment in the laboratory developed ulcers, fin rot and cataracts, with large skin ulcers appearing within seven days. A large multi-disciplinary study to assess possible biomarkers of affects on disease susceptibility in marine fish is in progress. Included are elements of the immune system and a very clear and consistent depression of phagocytic activity is demonstrated in fish from the Elizabeth River - this recovers to normal levels when fish are transferred to clean sediments.

Numerous strandings of dead or dying bottlenose dolphins have been observed on the east coast beaches from New Jersey to Florida. Symptoms include peeling skin and systemic infections with normal bacterial flora suggesting impairment of the immune system. Paralytic shellfish poisoning was a suspected factor.

### **Main points arising in discussion**

1. There was some discussion about the usefulness or otherwise of the data being submitted each year in the National Reports on disease prevalence rates in marine fish stocks. There is no doubt that great improvements have been made in standardization of the format of data presentation and that this has facilitated compilation and the comparison of data from different countries. However, it was the Chairman's view that little was being achieved by submitting all the data record forms from the National Reports as an Annex to the Working Group's report since it was unlikely that these were being examined much by people outside the Working Group itself. Also, a disproportionate amount of time of the WGPDMO's meeting was now being taken up by repeated discussion of the disease prevalence rate data considering possible effects of pollution and that a more efficient procedure was needed. This could be achieved at the next meeting of the Working Group by forming a small sub-group to compile and analyse the data on the record forms (possibly making use of the German computer programme described by Dr. T. Lang) and the information given in the narratives of National Reports, with a view to providing the Working Group with a commentary on the year's findings for different regions/areas, and particularly highlighting any new developments, emerging trends or lack of required data. A synopsis of the analysis with conclusions drawn by the Working Group would then be put in the report and this together with any recommendations would make it easier for other ICES groups to see more clearly the developments taking place in this topic. There was general support for this proposal.

2. It was regretted that information was lacking from some ICES member countries because of the absence of their WG members from the meeting and the failure to submit a National Report. For the next meeting, the Chairman would send reminders well in advance and would press members for submission of a synopsis of their report one month before the WG meeting for circulation in compilation with other synopses to all WG members. This would also apply to reports on diseases in mariculture.

3. The need for more information on comparable fish disease situations outside the North Sea, Irish Sea and Baltic areas was expressed. The brief account by Dr Moller on fish disease prevalences in Nigerian coastal waters had provided an interesting comparison; it seemed that North Sea fish have a much higher prevalence of liver nodules and other disease signs. Another comparison concerned flounder from coastal waters near Venice, also a polluted area. Reported disease rates there are also much lower than those in the North Sea and liver nodules are absent. Several WG members remarked that with regards to fish diseases ICES ought to take into consideration the situations in other parts of the world, possibly through FAO links.

4. Apparent differences in the findings of scientists from FRG and the Netherlands in the prevalence rates observed for some fish diseases in the German Bight started a familiar discussion. It emerged that the data from the Netherlands had been averaged over a large geographical area, whereas FRG data were observations from individual stations and hence referred to much smaller areas. The

German data were, though, found to be close to the maximum levels observed by the Dutch for the same locations.

5. The USA presentation concerning the biomarker techniques, particularly measurements of immune responsiveness, prompted a general discussion on the need for such methods to study the effects of pollution on susceptibility of fish to disease. There was general agreement that such new techniques were required and that these hopefully would be developed into standard ICES methods.

#### **4.2. REPORT OF THE SECOND ICES SEA-GOING WORKSHOP ON METHODOLOGY OF FISH DISEASE SURVEYS**

D Vethaak presented the report of the ICES Second Sea-going Workshop on Methodology of Fish Disease Surveys held in April 1988 onboard the Swedish RV Argos. In considering the written report members of the WG proposed some amendments to the text. In particular, some of the proposed recommendations in the report caused concern and lively discussion. However, after being amended these as well as the whole report were approved unanimously. It was agreed that:-

- the standardized methods would allow a better integration of the various fish disease surveys presently being carried out in the North Sea and Baltic Sea. With regard to this, the paucity of participation and information from the south eastern Baltic countries was regretted and it was agreed that a recommendation should be made in the WGPDMO's report.

- there is need for the data on the disease recording forms from surveys of different ICES countries to be collated at a central point for analysis and identification of trends.

- other relevant ICES working groups should be involved in the design and analysis of the multi-disciplinary fish disease studies proposed in the report.

- the report should now be submitted for publication in the ICES Co-operative Research Report series (C. Res 1988/1:7).

#### **4.3 COMPUTERIZATION OF DATA ON DISEASE PREVALENCE RATES**

T. Lang presented a report on a German computer programme for the analysis of fish disease prevalence data derived from field surveys. Its main purpose is the direct input of data during the examination of fishes on board the research vessel. The programme is mainly based on a data bank system using dBase III and Turbo III Pascal. Up to now only the data input programme is complete, allowing the input of all data for later analysis of the disease recordings. Additionally, results of hydrographic features and other parameters investigated can be entered in special files. The analysis of the data can be done using a choice between different fish species, length strata, sex, sampling areas, and disease signs, and also various combinations of these. At present, the

results are tabulated by disease prevalence in relation to the chosen criteria. For more detailed evaluation of the data it is also intended to include graphic and statistical programmes. During the next year the practicability of the programme will be tested under field conditions. A progress report will then be given at the WGPDMO meeting in 1990.

Although not yet completed, the WG considered the programme presented a promising step towards more effective processing of fish disease data from field surveys, particularly those aimed at comparing stocks in polluted and non-polluted areas. It could eventually lead to standardization of data analysis between ICES member countries involved in marine fish disease monitoring work.

#### **4.4. PROGRESS REPORT ON GERMAN MULTIDISCIPLINARY STUDY ON FISH DISEASES IN THE GERMAN WADDEN SEA**

Dr H Moller presented a report on the co-ordinated multidisciplinary research project conducted by several German institutes which started in 1987 and will be finished probably in 1990. Its purpose is to obtain information on the disease status of fishes in the German Wadden Sea and on the impact of environmental factors, particularly pollution.

On a regular basis, fish (mainly flounder) are sampled on a large number of stations and macroscopically and histologically examined for the presence of external and internal lesions. Besides studies on changes in the activity of MFO and liver lysosomes, contamination with heavy metals and chlorinated hydrocarbons, investigations into biological characteristics of the flounder population (age/length distribution, migration patterns) are performed. Preliminary results reveal higher disease prevalences and MFO activities in fish caught in the estuaries of the rivers Elbe and Weser which might be correlated either with salinity stress or pollution effects.

Dr. Moller presented some colour slides of fish diseases of unknown aetiology which have been found in the Wadden Sea study. These included ulcers with yellow margins in young cod; the disease sign was thus called "yellow pest". A similar disease condition had also been found in smelt and dab. In dab, yellowish inclusions of a different type have been detected which might be due to a protozoan infection.

In the discussion of the project Dr. Moller predicted a controversial interpretation of the future results by the different research teams involved in the study.

Additionally, Dr Moller showed slides of diseases and parasites of commercially important fish species outside the ICES-countries (Philippines, Nigeria). It was recognized by the WG that more attention ought to be given to this topic in the future, particularly in view of the possible public health implication for ICES-countries due to the increasing imports of exotic fresh fish products with unknown nematode (and other parasites) burdens.

#### 4.5. PROGRESS REPORTS ON DUTCH AND BRITISH EXPERIMENTAL STUDIES ON POLLUTED SEDIMENTS AND FISH HEALTH

The studies made both in the Netherlands (Texel) and the U.K (Weymouth) have been initiated to determine whether there is any 'cause-and-effect' relationships between pollution and disease development in marine fish stocks.

The Dutch experiments (presented by Dr D Vethaak) are conducted in 4,500 m<sup>3</sup> basin mesocosms, and involve exposing flounder to heavily contaminated sediments from Rotterdam Harbour and, as a control, to reference sediments. In a pilot study several disease outbreaks occurred in fish exposed to both sediments, including the occurrence of lymphocystis, skin ulcers and fin rot. These latter conditions were more prevalent in fish exposed to the contaminated sediments. However, the most important information gained to date has been learning how to handle the mesocosms, and sorting out problems which arose. Now the experiments appear to be running smoothly, more in-depth studies on the development of changes in fish health will be made, including collaborating studies immunocompetence assays with the Weymouth Fish Diseases Laboratory (UK).

In the Weymouth studies, (presented by Dr B Hill) the experimental system is much smaller than that in the Netherlands; indoor tanks are supplied with a constant flow of clean sea-water at controlled temperature. For the pilot studies test fish (dab) were exposed to highly contaminated sediments from Liverpool Docks and, for comparison, to a reference (clean) sediment for a period of 3 months. The sediments were analysed for contaminants prior to and during the experiments. The contaminated sediments contained significantly higher concentrations of metals (Mn, Cu, Zn, Cd, and Pb) than the reference sediments. These concentrations remained fairly stable throughout the experiment. Concentrations of total hydrocarbons were 2-fold higher in the test sediment and those of a range of organochlorine compounds were low or undetectable in both sediments. The development and comparison of disease prevalences were recorded as possible direct indicators of cause and effect, but also possible indirect effects of exposure to the contaminated sediments on disease susceptibility were measured by challenging the exposed fish with a bacterial pathogen, and comparing immunopathological changes between the two groups. As with the Dutch experiments, several initial technical problems arose with the experimental system including disease outbreaks in both groups of dab. Skin ulcers were more common in the group exposed to the contaminated sediment, but interestingly, almost all ulcers healed rapidly when the fish were removed from the sediments and held in clean sea-water. The initial immunological measurements revealed small but significant differences in antibody response between the two groups with fish on the contaminated sediment having a lower mean titre. Analysis of fish muscle for metals has indicated no significant uptake from either sediment: tests for organochlorine compounds are underway. Further long term exposure studies with improved experimental designs are to commence soon.



## 5. DISEASES IN MARICULTURE

### 5.1 NATIONAL REPORTS FOR 1988

Working Group members presented the 1988 situation reports for diseases in mariculture in their respective countries. Summaries of the narrative reports are at Annex 5. The disease data record forms have been placed on the WGPDMO file at ICES headquarters. The main features of the year were as follows:-

#### FISH

**Salmon lice** continues to be a great problem in salmon farms in Norway, Scotland and Ireland and in all three countries there is mounting concern and adverse reaction amongst fishermen and environmentalists, about the large scale use of Nuvan and Neguvon for control. An environmentally safe alternative is urgently needed and research is underway in all three countries.

**Pancreas disease** is now the most serious disease of farmed Atlantic salmon in Ireland with losses of >80% in some cases and in Scotland its prevalence continues to increase although with variable defects.

**Vibriosis** continues to be a major problem for coastal rainbow trout farms in Denmark and Sweden but in contrast is no longer a problem in salmonid mariculture in France due to the effectiveness of vaccination. However, there were reports from Canada and Finland of outbreaks of Vibriosis in Atlantic salmon and rainbow trout respectively due to failure of vaccination. In Canada, the problem is believed to be due to emergence of a new strain of *V.ordalii* against which the current commercial vaccines provide little protection. The Working Group agreed that this was a worrying new development which may signal future problems for mariculture where there is dependence on vaccination to control this disease.

**Coldwater vibriosis** outbreaks in Norway were fewer in 1988 than the previous year and no cases occurred in Scotland.

**Furunculosis** continues to be the most serious disease of marine farmed rainbow trout in Denmark and in Atlantic salmon farms in Ireland where antibiotic resistance is becoming an increasing problem as it is also in Scotland where the disease is a major problem for the salmon farming industry. In Finland, where the disease was first recorded as recently as 1986 the disease is spreading amongst rainbow trout farms on the west coast and in Norway the disease has spread to a new area with no known connection with previously affected salmon farms.

**Enteric redmouth disease** has spread rapidly in salmon farms in Norway but fortunately mortalities have so far remained low.

**Bacterial Kidney Disease** has spread rapidly in Swedish coastal rainbow trout farms and is causing concern to Finland because of the close proximity of affected sites.

The most dramatic and potentially serious development of the year was the spread of **viral haemorrhagic septicaemia (VHS)** to North

America where the virus was first detected in returning coho and chinook salmon in Washington state USA. This disease has previously been confined to non-migrating species in Europe where it is the most serious economic disease of farmed rainbow trout. No vaccine is currently available. The route of its transfer to the USA is as yet obscure. Large scale efforts at eradication are in progress.

## **SHELLFISH**

Some elements of the National Report were considered under Agenda item 5.2. The main development in disease problems in molluscs in 1988 concerned Bonamiasis in oysters.

**Bonamia** was confirmed for the first time in cultivated oysters in the Mediterranean possibly due to the transfer of stocks from Brittany but of even greater concern was the detection of *Bonamia* for the first time in *Crassostrea gigas* (in southern Brittany, France) which was previously believed to be resistant to the parasite although no mortality occurred in the affected *C.gigas* population. This new finding raises serious questions as to the possible role of this species in the spread of the disease. In the Netherlands, the disease has spread to the previously-free Grevelingen area for the first time and in the Yerseke Bank area it has flared-up within four months in all but one of the relaid beds in the first full commercial operations allowed following the attempted clearance of the disease over the period 1981-87. In Spain, the flat oyster production in the Galicia region has suffered a dramatic decrease due to *Bonamia* - mortalities are now reaching 50% by the end of the 2nd year. However, the situation is static in Ireland and the U.K., with the exception of one area in the latter (the River Fal) where heavy mortalities (up to 100% on some beds) occurred after oystermen, against official advice, relaid oysters taken from local infected natural beds in which the prevalence rate of infection was increasing.

The other serious disease problems in 1988 concerned the spread of **Perkinsus** in Chesapeake Bay. High rainfall during May lowered the salinity in the Bay and eliminated ***Haplosporidium nelsoni*** (MSX) from most of the oyster (*C.virginica*) beds invaded during 1987. *Perkinsus* has now replaced *H.nelsoni* as the most important oyster pathogen in Chesapeake Bay and it is believed there is unlikely to be a commercial oyster harvest in the lower areas of the bay in the next year.

Another serious disease problem in 1988 concerned a **Perkinsus**-like organism causing heavy mortalities in clams (*Venerupis decussatus*) in deputation plants in Spain. It is believed to have been imported in clams from Portugal

## **5.2 RECENT DEVELOPMENTS IN MOLLUSC DISEASES OF ECONOMIC IMPORTANCE**

This item was not considered in the depth planned because of the absence of members of the Working Group from France and Spain who specialise in molluscan diseases. However, a paper was received from Dr A. Figueras summarising his views on the major developments in recent years. Dr Hill also gave a presentation of results obtained at the Weymouth laboratory with the new commercial diagnostic kit for *Bonamia*.

Bonamia disease has caused a substantial reduction in oyster production in France, Netherlands and Spain as well as in some localities in the United Kingdom (England) and Ireland. Serious mortality (up to 100%) can be caused when infected oysters are relaid in inter-tidal zones but infected oysters relaid on sub-tidal beds are much less affected. In the U.K., official guidelines have been issued for commercial growers wishing to cultivate flat oysters in affected areas. Cultivators following these guidelines have successfully produced flat oysters in affected areas by relaying stock only from non-infected areas at low densities and for no more than one year. Minimal handling to avoid stress is important. In the Netherlands efforts over several years have been made to clear all oysters off the affected Yerseke Bank and leave the beds fallow in an attempt to eradicate the disease from this area but this has not succeeded. Commercial relaying in 1988 led to a rapid flare up of the disease (within 4 months) in poorly handled and stressed oysters but not in carefully handled non-stored oysters. In France, regulations introduced to control transfer of flat oysters between growing areas have led to improvement in production but the recent detection of the disease for the first time in Mediterranean flat oyster stocks and in *C.gigas* are cause for concern.

A commercial ELISA diagnostic kit for Bonamia disease has recently been made available by a French company. Independent evaluation of these kits by scientists at the Fish Diseases Laboratory, Weymouth has revealed it to be unreliable. Dr Hill presented results of recent tests with the kit which showed that a high proportion of false positives could be obtained with oysters diagnosed negative by smear and histology, with oysters from coastal areas known to be free of Bonamia and with samples of *C.gigas*. The kit should not yet be used for routine diagnosis, monitoring or surveys for Bonamia until the reasons for the non-specific reactions are identified and overcome. The Weymouth findings have been sent to the French company making the kit.

In the U.S.A., 1987 and 1988 were the worst years on record for mortality of oysters (*C.virginica*) due to the two protozoan oyster pathogens *Haplosporidium nelsoni* (MSX) and *Perkinsus marinus*. During 1987, *H.nelsoni* invaded the upper Chesapeake Bay (State of Maryland) for only the third time in recorded history and also invaded the upper portions of Virginia tributaries. The combined oyster mortality from the two diseases during 1987 averaged between 80% and 90% in the lower bay (Virginia) and between 50% and 70% in the upper bay (Maryland). The transmissibility of *P.marinus* has increased dramatically in recent years in Chesapeake Bay. Infection traditionally has spread slowly within an oyster bed, taking up to three years to infect all the oysters, and normally had spread slowly from bed to bed. However, during 1988, *Perkinsus* infected and killed entire beds within three months and has spread rapidly into previously disease-free areas. Increased salinities caused by the lack of rain in recent years are believed to be the reason for this development.

A *Perkinsus*-like organism has been detected in clams (*Tapes decussatus*) from the south of Portugal (Algarve and Faro), Italy (Venice lagoon) and Spain (south and north west). The presence of

these parasites has been associated with heavy mortalities in culture and in the holding and the depuration facilities. It seems probable that this parasite was introduced into Spain with clams imported from Portugal.

Winter mortalities of scallop *Pecten maximus* in the Bay of St Brieuc, near Brest in France, first appeared in February 1986. Mortality levels were 25-30% in 1986, about 40% in 1987 and important mortality levels were detected at the beginning of 1988. A rickettsia-like organism was present in the gills. The cytopathological effects of this parasite in the infected cells are significant but it is not certain yet that this is the cause of the mortalities.

### **5.3 PROBLEMS OF MEDICATION IN MARICULTURE**

At the 1988 meeting of the WGPDMO Dr E Egidius presented a report on environmental effects of medication in fish farms and proposed to present, at the 1989 meeting, further details of the types and amounts of medication in use in ICES countries and problems identified so far with these. In the absence of this report, the Chairman referred to the letter sent by Dr Egidius to all members of the WGPDMO calling for information on medicines and chemicals in use in mariculture in each country as a first step in assisting the Working Group on Environmental Impacts of Mariculture (WGEIM) in this area. Lists were provided from Canada, Denmark, Netherlands, Sweden and United Kingdom - WG members from other countries had not been able to obtain the information in time. Although the information was incomplete, the Chairman proposed to send the lists to Dr Munro, the WGPDMO's representative at the meeting of the WGEIM in Oban. It was agreed that all WGPDMO members will provide complete lists of medicines and the quantities used annually in mariculture in their respective countries to the Chairman as soon as possible for sending to the Chairman of WGEIM. The information will also be used in the review of problems of medication in mariculture which is to be prepared by the WGPDMO. In preparing the review the division of work for the various areas identified was agreed as follows:

- diseases lacking a medical treatment to date: each member country
- justification for medication in mariculture : F. Baudin-Laurencin
- pharmacokinetics and drug residues : D. Alderman
- public health implications of medication in mariculture: G.Bylund
- development of drug resistance : J. McArdle and B. Hjeltnes
- interactions between antibiotics and immunity in fish: G.Olivier.

These papers are to be prepared in sufficient time to allow their circulation to all members for consideration prior to discussion at the next meeting. On the basis of this review, conclusions and recommendations will be put to ICES and consideration given to the possibility of publication of the report.

#### **5.4 APPROACHES FOR AVOIDANCE AND PREVENTION OF DISEASE IN MARICULTURE**

The W.G. received a paper from Dr J Stewart on this topic. Unfortunately, Dr Stewart was unable to attend the meeting to discuss the paper. Due to the complexity of the subject, the desire to deal with it effectively and the shortage of time available, the Working Group agreed this matter should be postponed until the review of the problems of medication in mariculture has been completed. The importance for the WGPDMO to identify approaches for avoiding and preventing diseases in mariculture and to advise ICES accordingly was agreed upon unanimously.

#### **5.5 COMPARISON OF NATIONAL LEGISLATION FOR CONTROL OF DISEASE IN FISH AND SHELLFISH.**

Dr Hill explained that he had not yet received back all the questionnaires distributed to the W.G. members at the 1988 meeting concerning the current status of legislation on control of fish and shellfish diseases in their respective countries. Furthermore, matters are currently in a state of change in several ICES countries with new legislation being prepared. Also, nine member countries are involved in preparing with the EC a proposed Regulation concerning the health conditions governing intra-Community movements and import from third countries of fishery products and this will have a major impact on the national legislation of these countries if implemented. Dr Hill, who is involved in this work, gave a brief outline of the contents of the draft Regulation as it currently stands. In view of the situation it was agreed that the review of national legislation should be suspended until the final provisions and implications of the EC Regulation are known.

#### **6. REVIEW OF KNOWLEDGE IN IMMUNE MECHANISMS IN MOLLUSCS AND CRUSTACEANS**

At the 1988 meeting of the WGPDMO, inter-sessional tasks had been given to Dr J Stewart and Dr H Grizel for the preparation of reviews on immunology in crustaceans and molluscs respectively. Since neither member was present and the only information presented was an abstract of a review paper in preparation by Dr Stewart the Working Group agreed there was insufficient material for discussion and in view of the heavy workload it was decided not to pursue this subject further for the time being.

#### **7. PUBLICATIONS**

##### **7.1 GLOSSARY OF TERMS USED IN PATHOLOGY.**

Dr F Baudin-Laurencin reported on progress made by the sub-group (himself and Mr D Bucke) on preparing the definitions of pathology terms. There had been some problems with terms which had somewhat different meanings in the English and French languages but these have mostly been resolved. The work is now almost complete. The Chairman reminded the W.G. of the similar task of dealing with the pathology terms contained within the ICES Glossary on Aquaculture Terminology which was now to be produced as a joint document with EIFAC. The W.G. members agreed there was little point in producing

a separate glossary on pathology terms when most of these definitions would appear in the ICES/EIFAC Glossary. It was decided that a copy of the final list of pathology terms and their definitions will be sent together with a copy of the existing ICES Glossary of Aquaculture Terminology (C.M. 1986/F:34) to all W.G. members by Dr Baudin-Laurencin and Mr Bucke for a final list of terms and definitions to be forwarded to the Chairman for submission to Dr H Rosenthal as Chairman of the ICES/EIFAC Study Group.

## **7.2 IDENTIFICATION LEAFLETS (DIAGNOSTIC FICHES) FOR DISEASES OF FISH AND SHELLFISH**

Several W.G. members expressed dissatisfaction and concern that the latest series of leaflets (Nos. 41-49) are taking an extraordinarily long time to reach publication. The Chairman was unable to provide an explanation for the delay since the matter had previously been handled entirely by Dr Egidius who had sent leaflets prepared by the W.G. to the editor of the series Dr C.Sindermann. He would make enquiries with ICES Headquarters. Several W.G. members felt that it would be preferable for the editorship to rest with an active member of the WGPDMO, one who would likely attend future meetings of the W.G. to discuss matters pending and one preferably competent in both English and French. The Chairman pointed out that this could only be done by formal action from ICES but he would pass the views of the Working Group through the appropriate channels.

An additional fiche entitled "Diplostomum in brackish water mariculture" was submitted by Dr J Thulin for editing as No 50. in the series.

Subjects and authors for the next ten leaflets were proposed and drafts will be presented at the next W.G. meeting. W.G. members were requested to consider during the intersessional period, possible further subjects for the series and to propose these at the next W.G. meeting.

## **7.3 OTHER POSSIBLE PUBLICATIONS**

Some members expressed a view that for survey work on diseases in marine fish stocks, it would be helpful to have a leaflet/booklet describing the various disease signs and examination procedures as a training aid or guide for scientists with little previous fish disease experience. The Chairman asked for an example to be drafted during the inter-sessional period for presentation and discussion at the next meeting. It was agreed that the draft will be compiled by D. Vethaak, T. Lang and D. Bucke.

## **8. ANY OTHER BUSINESS**

### **Seal Mortalities In The North Sea.**

The Working Group was given an informal presentation by R Lick of the Institut fur Meereskunde on investigations into the seal mortalities in 1988 due to an epidemic of a virus infection. This was caused by a virus similar to canine distemper virus which has led to the proposed name phocine distemper virus. Several W.G.

members remarked that the WGPDMO should be paying more attention to disease problems of marine mammals and perhaps that initially this could be achieved through provision of information in the National Reports as done for the bottlenose dolphin mortalities in the U.S.A. this year. There was general agreement for this. The Chairman would draw attention to the requirement when sending his reminder for the preparation of the National Reports before the next W.G. meeting.

### **Future Meeting Procedures.**

It was agreed that there was need for improving the manner in which Working Group conducted its business. Over recent years, the terms of reference for the WGPDMO meetings have expanded steadily, not least because of the task of considering the question of impact of pollution on fish disease prevalence rates, with the result that the heavy workload meant insufficient time was available for considering some items on the Agenda properly. The Chairman also felt that a more useful W.G. report was needed with greater emphasis on analysis of the information presented and discussed at the meeting, on reaching conclusions and on making recommendations, if appropriate. Ways and means of improving the situation were discussed and several changes to the arrangements agreed, particularly the manner in which the National Reports should be prepared, presented and the significance assessed. It was also agreed that W.G. members should in future collect national data on marine mammal diseases from the appropriate experts in their country for inclusion in their reports.

It was unanimously agreed that in view of the workload, the next meeting should extend to five days.

### **Chairman of the Working Group**

Following a brief discussion, the Working Group members unanimously agreed to recommend to Mariculture Committee that Dr Hill be appointed as the next long-term Chairman of the WGPDMO.

## **9. RECOMMENDATIONS**

(1) In studies of diseases in marine fish stocks, it is recommended that:

(a) the standardised methods proposed in the Report of the Second Sea-going Workshop on Methodology of Fish Disease Surveys be applied by ICES member countries and that the results be reported to the WGPDMO for computerisation and analysis.

(b) The other appropriate ICES Working Groups should integrate fish disease monitoring whenever possible in their field data collection programmes.

(c) considering the need for improved reporting on fish diseases and parasites within the Baltic Sea, the ICES Baltic countries should increase their efforts and co-operation in this topic.

(d) laboratory studies on the induction/transmission and pathogenesis of diseases occurring in marine fish stocks should be conducted to facilitate interpretation of the field observations on prevalence rates.

(2) In view of the potential impact on the fishing and fish processing industries of public reaction to nematodes in marine fish it is recommended that ICES member countries take notice of the conclusions and recommendations of the ICES Workshop on Problems of Nematodes in North Atlantic Fish.

(3) The Working Group should meet again for five days in Vigo, Spain from 23-27 April 1990 under the Chairmanship of Dr B Hill to carry out the following tasks:

(a) compile and analyse the data in recent National Reports on the prevalence of disease in marine fish stocks in the North Sea, Baltic Sea and Irish Sea.

(b) consider the first draft of the proposed ICES booklet/training aids for identification and recording of diseases by non specialists involved in sea-going surveys of marine fish stocks.

(c) consider proposals for further subjects for publication in the diagnostic fiches series.

(d) to receive and discuss information on disease occurrence in marine mammals including progress report on phocine distemper virus infection of seals and the recent mass mortality of bottlenose dolphins.

(e) review information on the current disease status of mariculture in ICES member countries with emphasis on new developments and identification of trends.

(f) receive and discuss the draft contributions (as specified in item 5.3) for the review on problems of medication in mariculture and to consider preparation of a report for publication.

(g) consider methods for diagnosis, prevention and control of the emerging diseases in mariculture.

(h) receive a report on the analysis of *Vibrio* strains causing disease in mariculture in different ICES countries and to discuss vibriosis vaccination failures.

(i) receive a progress report on the proposed introduction of genetically manipulated *C.gigas* into Chesapeake Bay to replace the recent losses of *C.virginica* due to disease.



ANNEX 1WORKING GROUP ON PATHOLOGY AND DISEASES IN MARINE ORGANISMS

(Kiel, 5-8 April 1989)

**TERMS OF REFERENCE (C.RES. 1988/2:43)**

- a) discuss information on current state of diseases in marine organisms compiled by ICES member countries and on new disease problems in free-living and cultivated organisms.
- b) discuss possible approaches to computerization of the data on fish and shellfish diseases from ICES member countries.
- c) complete the comparison of national legislation for control of diseases in mariculture.
- d) initiate the preparation of a document for publication describing mariculture approaches and concepts which focus on the avoidance and prevention of disease rather than reliance on mitigation.
- e) receive and discuss progress reports on research into problems of medication in mariculture, including its impact on the environment.
- f) discuss the report of the Second Sea-going Workshop on Methodology of Disease Surveys and finalize the report for publication.
- g) receive and discuss progress reports on the Dutch and British experimental studies on the effects of contaminated marine sediments on the health of fish.
- h) receive and discuss a progress report on the German multidisciplinary study on fish diseases in the Wadden Sea.
- i) consider recent development of molluscan diseases of economic importance in ICES member countries.
- j) receive reviews on immune mechanisms in molluscs and in crustaceans, and continue work on the glossary of terms used in pathology.

ANNEX 2WORKING GROUP ON PATHOLOGY AND DISEASES OF MARINE ORGANISMS

(Kiel, 5-8 April 1989)

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**ANNEX 3****WORKING GROUP ON PATHOLOGY AND DISEASES OF MARINE ORGANISMS**

(Kiel, 5-8 April 1989)

**AGENDA**

1. **Opening remarks.**
2. **Terms of reference, adoption of agenda, selection of rapporteurs.**
3. **Report on ICES Statutory Meeting 1988.**
4. **Disease in wild populations of marine organisms.**
  - 4.1 National reports for 1988.
  - 4.2 Report of 2nd ICES Sea-going Workshop on Methodology of Disease Surveys.
  - 4.3 Computerization of data on disease prevalence rates.
  - 4.4 Progress report on German multidisciplinary study on fish diseases in the Wadden Sea.
  - 4.5 Progress reports on Dutch and British experimental studies on polluted sediments and fish health.
5. **Disease in mariculture**
  - 5.1 National reports for 1988:
  - 5.2 Recent developments in molluscan diseases of economic importance to ICES countries.
  - 5.3 Problems of medication in mariculture.
  - 5.4 Approaches for avoidance and prevention of disease in mariculture.
  - 5.5 Comparison of national legislation for control of disease in fish and shellfish.
6. **Review of knowledge on immune mechanisms in molluscs and crustaceans.**
7. **Publications**
  - 7.1 Glossary of terms used in pathology (ref. Glossary of Aquaculture Terminology, ICES CM 1986/F:34).
  - 7.2 Diagnostic fiches - progress and further proposals.
  - 7.3 Other possible publications.
8. **Any other business.**
9. **Recommendations.**

ANNEX 4NATIONAL REPORTS ON DISEASES IN MARINE FISH STOCKS: 1988CANADA

It was reported that no marine fish disease surveys were carried out in Canadian waters in 1988 and that no long-term survey for monitoring the possible effects of pollution and diseases in wild fish populations is planned. Research underway included investigations into the problem of nematode infestation in fish and myxosporidiosis. During the year, isolated cases of atypical furunculosis have been diagnosed in wild fish populations and studies were being made to compare the bacterial isolates with strains of *Aeromonas salmonicida* causing disease in mariculture of salmonids.

DENMARK

The annual fish disease survey covering the eastern North Sea, Skagerrak and Kattegat took place in May. In the eastern North Sea, after having observed a decrease in the prevalence of lymphocystis and epidermal papillomas in dab in the previous two years, a sharp increase was observed in 1988. There is no clear explanation for this at present but it is striking that the increase is particularly noticed in areas with a previous history of oxygen deficiency. High frequencies of x-cell gill lesions were again observed in dab at the same two localities, one coastal and one offshore, as in 1987 although the prevalence rates at 10% and 6% respectively were much lower than the values of 34% and 11% recorded in 1987.

In the Skagerrak the disease problems in dabs is still low at less than 3%. In the Kattegat the disease problems continue to increase, possibly due to the recurrent oxygen deficiency problems in the late summer. The increase is particularly seen for lymphocystis infection which in 1986 had a prevalence rate of 2.6%, in 1987 of 5.4% and in 1988 of 9.6% additional investigations in the Kattegat in March and October produced similar observations.

Infection with the swimbladder worm, *Anguillicola crassus*, has spread to most of the feral eel populations with the prevalence ranging from 2% to 80% depending on the locality.

FEDERAL REPUBLIC OF GERMANY

As in previous years, the 1988 investigations concentrated chiefly on populations of fish in the North Sea (including the Elbe Estuary) and in the Baltic Sea.

In the North Sea, two cruises were conducted in January and May/June each lasting fourteen days with dab being the main species examined. In January, samples were taken only in the southern North Sea but in the May/June cruise the sampling area was extended to cover most of the North Sea. Observing recommendations from the 2nd ICES Sea-going Workshop on Methodology of Fish Disease Surveys,

the results were analysed with regard to the length strata of the fish examined, excluding fish with only slight symptoms of lymphocystis (e.g. only one nodule per fish), epidermal papillomas smaller than 2mm in diameter, and healed ulcers.

In the German Bight, lymphocystis prevalence seems to be increasing, whereas on the Dogger Bank a slight reduction is apparent for this disease. For epidermal papillomas, it was again shown that the highest abundance was in the dumping area within the German Bight. In January up to 13.7% of dabs larger than 24cm were affected compared to 7.6% of dab in the Dogger area. Similarly, the highest number of dab affected with liver nodules was clearly seen at the dumping area in the German Bight in length groups 20-24cm and >24cm the prevalence rates were 32% and 50% respectively. On the Dogger Bank, the prevalence rates in the same length groups were 17.6% and 27.8% respectively. Additionally, a remarkable green liver discoloration of, as yet, unknown cause was found extensively in the western North Sea off the British coast and in the central North Sea on Fischer Bank. For the x-cell gill lesion, the highest frequencies continue to be observed in the western North Sea concentrated mainly in the Dogger Bank area. Compared to previous years the values in winter were very low.

For the Elbe estuary, a final report on the survey of fish stocks, fish diseases, parasites and food resources was published in 1988. In addition, a programme was carried out between October 1987 and September 1988 to compare the disease and parasite prevalence rates in smelt, flounder and eel from the inlet screen of the nuclear power plant to those seen in fish caught in the vicinity by commercial vessels. The study stemmed from speculations that the high amount of fish (about 60 tonnes per year) trapped on the screens might be due to their weakness because of disease or general debilitation in the local fish population. Samples were taken at monthly intervals. No significant differences were observed in the diseased prevalences in smelt and flounder from the screen and the commercial vessels but eels from the inlet screen showed considerably higher prevalences of skin ulcers and cauliflower disease. It is considered that this is probably due to some eels living in the mud of the inlet channel being repeatedly caught and injured by the automatic cleaning brushes on the inlet screens. On a yearly average, 18% of smelt, 13% of flounder and 22% of eel from the inlet screens showed microscopically visible external lesions which had obviously been induced by the screen system.

In the Baltic Sea, studies on the health status of cod and flatfishes have continued. Cod showed prevalences of up to 25% for ulcerations at some sampling sites whereas in flatfish lymphocystis was the predominate externally visible disease with maximum prevalence rates of approximately 20%. Off the Polish coast, rockling were heavily affected by large open skin ulcers - the reason for this is unknown.

In some samples of cod and herring the infestation rates with parasitic nematodes were also recorded. Larval nematodes were found to be mostly *Anisakis* sp. in herring from the southwestern Baltic with prevalence around 40%. Less than 1% of the Baltic cod examined was infected by nematodes (*Pseudoterranova decipiens*) in

the fillets. Infestation rates of North Sea herring and cod are generally higher. A new research project on nematodes in marine fish was started in 1988 in the German Wadden Sea. Smelt with 59% and sea scorpion with 32% prevalence are the most heavily infected species. Most nematodes are *P. decipiens*, while *Anisakis* sp. and *Hysterothylacium* sp. occur less frequently. Another aspect of the project is to determine whether nematodes from different fish species or from different fish stocks may have a different resistance to freezing.

#### FINLAND

The fish disease survey scheduled for 1987-1991 continued with the attention mainly focused on the Gulf of Bothnia. Most fish are examined for external and internal disease signs. Skin ulcerations currently occur at high prevalences in flounder (mean prevalence 5.2% with highest rates seen in Autumn) but only at v. low prevalences on other species. Experiments are being carried out to clarify the aetiology of the disease: a gram negative bacterium of uncertain taxonomy is consistently isolated from the ulcers and has proved highly pathogenic for flounders in experimental infections. Skin hyperplasia /papillomas occur at high prevalences, especially in roach. Liver tumors /nodules were recorded at a 3.1% prevalence in flounder. Lymphoma (a neoplastic condition) occurred at a relatively high prevalence (5.7%) in pike in one southern area. A thesis on the nature of this neoplastic condition has been published in 1989 by J Thompson (Helsinki University).

#### FRANCE

There is no programme to monitor diseases in wild fish populations. Nematode (mainly *Anisakis*) infections have been increasingly reported from fish landed in Cherbourg.

#### IRELAND

There is no ongoing monitoring program for diseases in wild fish populations. Results from a disease survey carried out in Cork Harbour by University College Cork await publication.

Nematode problems are the subject of an increasing number of inquiries from fishermen and members of the public. *Ichthyophonus* in wild Atlantic salmon, is causing increasing concern to fish processors, due to bad smell, taste, and texture: they are now turning to farmed salmon which are not affected.

#### THE NETHERLANDS

Recordings of some diseases of marine wild fish were made on 6 general stock assessment surveys. The area covered was the south-east part of the North Sea. The recordings were in two seasons; one at the end of the cold water period (February - April) and the other at the end of the warm water period (October - November) to cover the periods of good and bad conditions of fish. Dab, plaice and cod were examined. Compared with 1987 lymphocystis disease in dab and plaice showed an increase but all other diseases remained roughly at the same levels.



The final analysis of the results obtained during the five-year field study (1983-88) on the epidemiology of adult flatfish (flounder, dab and plaice) from Dutch coastal waters, with special reference to pollution, is now partially completed. In this study a number of selected disorders were considered: epidermal papilloma; lymphocystis; ulcerations, fin rot, *Glugea stephani* infection and grossly visible liver nodule/tumor (>2mm).

Some of the main conclusions so far are :-

- Overall the disease prevalences were greater for flounder and dab than for plaice.
- There were considerable differences in the prevalences between areas and seasons (March-April versus August- September), and there were also variations between years.
- The prevalences of most diseases under consideration seemed to be considerably influenced by the length, age and sex of the fish. Examples of diseases which have a positive length / age relation are lymphocystis, epidermal hyperplasia / papilloma, skin ulcers and liver nodule/tumor. No correlation with length/age was found for fin rot and *Glugea*-infection in any of the three species. Lymphocystis was about twice as prevalent in males as in females, whereas liver nodules/tumours were more prevalent in females than in males. The disease prevalences in dab were significantly higher in Spring (March-April) than in Autumn (August-September). No seasonal influence was found for the *Glugea*-infection in this species.

The following, more specific findings can be reported:

- In general, most of the putative or true neoplastic lesions found in both species do correspond fairly well to those described by Malins and co-workers for Puget Sound flat fish. An indication of the correlation between macroscopical visible liver nodule/tumor and the underlying histopathology has been obtained.
- In agreement with results of USA studies, a positive correlation was found between the prevalence of hepatic liver nodules/tumors in flounder and PAH-sediment concentrations, but not with PCB's in the livers of those fish.
- A substantially greater prevalence of lymphocystis was found in dab from offshore Dutch waters than in those from onshore Dutch waters.

- The prevalences of liver nodules/tumors and epidermal papilloma in dab in Dutch coastal waters are highest in the dumping area of TiO<sub>2</sub>-wastes.
- The greatest prevalences of lymphocystis and liver nodule/tumor found in flounder from along the Dutch coast correlates with the major pathway of pollutants discharge by the river Rhine
- There is clearly a greater prevalence of diseases in flounder from marine and brackish waters than in those freshwater habitats.

#### NORWAY

There was no special fish disease survey programme carried out in 1988. Some independent research topics included salmon mortalities due to *Gyrodactylus* in rivers, and fish health problems due to algal blooms. No long term survey is planned in the near future to monitor the effect of pollution on fish diseases.

#### SWEDEN

On the north east coast, a survey was started for the diseases and parasites of perch, pike, whitefish and herring in an area affected by pulp mill effluents. Another study was made on diseases of dab, plaice and cod caught near the discharge pipe of a pulp mill on the west coast. Liver nodules in dab longer than 25cm showed prevalences between 24% and 29%. Plaice showed depression of the distal part of the body, with a prevalence of 4%. None of the plaice from the clean reference area 10Km away were affected. This study will be continue.

The eel swim bladder nematode, *Anguillicola* sp., has reached the east coast of Sweden and has become established in an area heated by the effluent of a power station where its prevalence has increased steadily from 0% to 63%.

#### UNITED KINGDOM

##### a) England and Wales

The field monitoring programme was increased during 1988, mainly the result of in-house training of non-disease specialists and making use of scheduled ground fish survey cruises. The monitoring programme in the North Sea revealed no upward trends of disease prevalence over previous years. Dab on the Dogger Bank continue to show prevalences of up to 20% of external diseases and 5% nodule/lesions in the livers of large specimens. A survey in Liverpool Bay, Irish Sea revealed similar external diseases in dab (with the exception of x-cell gill disease), but the absence of the liver nodules seen in North Sea dab.. However, about 2% of dab were found to have a fibrous granulomatous condition in their livers. Disease monitoring continued in the Thames Estuary and certain other esturaries at an increased level but no upward trends in diseases were noted.

Two diseases both affecting cod in different areas of the North Sea have caused some concern to the fishing industry. The first disease, dermal necrosis, described in 1987, was again reported throughout the year, albeit at a low prevalence rate (1 or two fish in every 6 boxes). Again, only large cod, caught from an area to the North of the Dogger Bank were found to be affected. Although various biological and physical factors have been considered, no cause has yet been identified. The second disease, also affecting large cod, but this time caught in the Southern Bight and English Channel, drew attention because of the gross appearance of bizarre nodules and cysts occurring on the visceral organs. The disease has similarities to "presumptive mycobacteriosis", but in the absence of any micro-organisms being identified it has been termed "visceral granulomatosis". A survey revealed prevalences of up to 10.7% of affected fish found in samples taken from stations off the south east English coast. Further investigations on both these diseases are planned.

b) Scotland

A repeat study was made of the 1987 survey of sewage sludge dump sites in the Firth of Forth. Prevalence rates of all diseases in dab showed some variations over the previous year, but it is emphasised that long-term evaluation of trends in several areas is required before any conclusions can be drawn. A survey of fish in the Firth of Clyde sewage dump site revealed some problems in using the dab as an indicator fish, because of its sparsity. However, other fish species examined, did not show any unusual prevalence rates of disease. These studies will continue.

*Ichthyophonus* continues to affect haddock (22% prevalence) in the vicinity of the Orkneys and Fair Isle (north of Scotland). However, compared to 1987, there was a marked decrease in vertebral anomalies in this species (4%). In dab the predominant disease was lymphocystis (<13.8%) with low prevalences of other diseases.

UNITED STATES OF AMERICA

There is no monitoring program for diseases in offshore wild fish populations: the ongoing studies concentrate on the influence of pollution on the health of estuarine fish populations. Scientists at the Virginia Institute of Marine Science (VIMS) have been studying the polluted Elizabeth River, a tributary of the lower Chesapeake Bay. This river has the highest concentrations (up to 30,000ppm) of polynuclear aromatic hydrocarbons (PAH) in the United States. Gross pathological examination of fish revealed fin rot in 6% of oyster toadfish, a benthic resident, eye lens cataracts in 5% of the sciaenids, and skin ulcers in 5% of the juvenile hakes. No obvious liver tumors have been observed. Histology revealed a variety of gill lesions including hyperplasia, hypertrophy and filament deformities. Histology is continuing for other organs. Ulcers, fin rot, and cataracts have been induced in juvenile spot, held over contaminated sediment in the laboratory. Large skin ulcers appeared within 7 days.

A new approach for estimating exposure of organisms to toxic chemicals and the resulting effects at the pollution site is being

evaluated by a team of U. S. scientists. The programme is being coordinated by Dr. R. Huggett (VIMS) and is being conducted in the Elizabeth River estuary. The program will provide a critical evaluation of the strengths and weaknesses of biomarker assays to document the magnitude and extent of stress using biochemical or physiological endpoints. Among the biomarkers to be assessed will be DNA alteration, immunological competence, presence of bile metabolites, and histopathology. The question being addressed is: If you did not know that the site was polluted, could your biomarker assay tell you that it was? The first biomarkers cruise took place on 13 - 14 October, 1988 and a meeting to review the data is scheduled for April, 1989. Three more cruises are planned for summer of 1989. International participation is being encouraged.

Numerous strandings of dead or dying bottlenose dolphins have been observed on the east coast beaches, from New Jersey to Florida. Symptoms included peeling skin and systemic infections of normal bacterial flora suggesting impairment of the immune system. Paralytic shellfish poisoning, was a suspected factor.

ANNEX 5NATIONAL REPORTS ON DISEASES IN MARICULTURE: 1988CANADA**Fish**

On the east coast a marked expansion of marine salmon farming has taken place in recent years. The main disease problem is Vibriosis. Despite all fish being vaccinated prior to transfer from freshwater to seawater losses up to 18% have occurred. It is believed the failure of vaccination is due to new *Vibrio* strains giving rise to disease which current commercial vaccines are not protecting against. The strain leading to recent losses is a variant of *V. ordalii*. One case of furunculosis due to an atypical strain of *A. salmonicida* was observed in 1988. Antibiotics were not effective in eliminating the problem.

On the west coast bacterial kidney disease (BKD) is the biggest problem in salmon due to vertical transmission via the egg. Salmon lice cause some problems in marine cage units but this does not appear to be as great a problem as in European salmon farms.

**Shellfish**

A bivalve parasite and pathology survey recently started in the Gulf of St. Lawrence, Canada, has yielded the following, preliminary results. Many identifications have yet to be made and seasonal collections are just starting.

External and internal ciliates were found on both wild and cultivated mussels but no significant histological responses were observed. Unidentified structures (termed "blue bodies") were observed in both wild mussels and wild and cultivated oysters. In American oysters (*Crassostrea virginica*) a turbellarian *Urastoma* sp. was found on the gills of wild and cultivated oysters. Malpeque Disease, historically known to exist in the Gulf of St. Lawrence, is now difficult to detect because of the development of resistance in the stocks. Brown pustules of sea scallops (*Placopecten magellanicus*) were observed at low levels in samples collected from an inshore site between New Brunswick and Prince Edward Island. Gram negative bacteria may be involved in causing this problem.

DENMARK**Fish**

No new problems have been observed: the main diseases in marine rainbow trout farms continue to be furunculosis and vibriosis, concurrerrently in some sites: vaccination is performed on only 12% of the fish farms. Vibriosis was the only disease problem in turbot production at a land based marine fish farm.

**Shellfish**

No data to report

FEDERAL REPUBLIC OF GERMANY

No data to report

FINLAND**Fish**

Vibriosis remains the main threat for marine rainbow trout farms: failure of vaccination protection was observed. Furunculosis which was first observed in Finland in 1986 was spread in 1988 to 5-6 rainbow trout farms on the west coast archipelago. Vaccination carried out at one farm was totally ineffective in preventing disease. IPN virus was isolated at a number of trout farms which had been negative for several years. Observations during 1988 were Phoma infections in Atlantic salmon and one case of losses due to *Clostridium botulinum* type E intoxication occurred in young Atlantic salmon.

**Shellfish**

No data to report

FRANCE**Fish**

Few disease outbreaks were recorded in 1988: vibriosis is no longer a problem (due to the effectiveness of vaccination), one case of Enteric Redmouth (ERM) occurred in rainbow trout in seawater, and three outbreaks of pancreas disease occurred in Atlantic salmon and two in brown trout.

**Shellfish**

The status of *Marteillia* remains unchanged. *Bonamia* has been confirmed in flat oysters in the Mediterranean and detected for the first time in *C.gigas* in southern Brittany but no associated mortalities have been observed. Some unexplained mortalities have occurred in *C.gigas*. "Brown Ring" disease of clams may be due to a *Vibrio* sp.

IRELAND**Fish**

Pancreas disease is currently the most serious disease of marine salmon farming with losses up to 80% being experienced. Several sites, were affected in 1988. An outbreak of proliferative kidney disease caused low level losses in salmon in sea cages at one site. Furunculosis continues to be the most serious bacterial disease at Farmed Atlantic salmon and drug resistance is becoming an increasing problem. Sea lice infestations is also a serious problem at most salmon farms, requiring regular treatment with

Dichlorvos throughout the summer to the increasing concern of lobster fishermen and environmentalists.

### **Shellfish**

There was no change in the situation of *Bonamia* disease in oyster stocks in 1988.

## THE NETHERLANDS

### **Fish**

No data to report.

### **Shellfish**

High prevalence levels of *Bonamia* (60%) have developed rapidly in oysters deposited on the Yerseke Bank despite the areas having had no significant numbers of oysters for two years as part of an eradication attempt. In the Gravelingen Area, *Bonamia* is now present and has caused mortalities between 1 and 10%. However, significant losses only occur in areas subject to heavy fishing activity suggesting that stress may be an important factor in the development of the disease.

## NORWAY

### **Fish**

Fewer cases of Hitra disease (coldwater vibriosis) were observed in 1988 compared to 1987: the causative organism, *V.salmonicida* was isolated from cod. Research indicated that the organism can survive in sediments for up to 1.1/2 years. Furunculosis in salmon occurred in an area with no known connection to the sites affected in previous outbreaks. Enteric Redmouth (ERM) has undergone rapid spread in the salmon farms but mortalities are low. Salmon Anaemia Syndrome (SAS) now designated Infectious Anaemia of Salmon (IAS) can be transmitted by cell-free filtrates and homogenates suggesting a viral aetiology. Salmon lice continue to be a great problem. *Trichodina* infestation is now proving a serious problem in farmed cod.

### **Shellfish**

No data to report

## SPAIN

### **Fish**

No report

### **Shellfish**

Production of flat oysters in Galicia has dramatically decreased due to high mortalities in the stocks. *Bonamia* is present and leads to 50% mortalities within 2 years. A Perkinsus-like organism has been detected in clams (*Venerupis decussatus*) imported into

Spain from Portugal and causing severe mortalities in depuration plants where imported molluscs must be cleansed. In native *V. decussatus*, a Haplosporidean has been observed also associated with mortalities. The presence of a *Nematopsis* sp. has been associated with mortalities in cockles in depuration plants. No mortalities were observed in cultivated mussels.

## SWEDEN

### **Fish**

Vibriosis is the dominant problem in coastal rainbow trout farms. A big increase in the number of BKD cases (25 farms affected) is causing concern in Finland because of the close proximity of affected sites.

### **Shellfish**

No data to report

## UNITED KINGDOM

### **England and Wales**

#### **Fish**

The number of marine fish farms is very small. Pancreas disease occurred again at a salmon farm on the south coast of England.

#### **Shellfish**

Bonamia was not found in any new areas during 1988. It continued to cause significant mortalities where infected stocks were relayed at high density. However, by relaying Bonanamia-free stock for one season and operating fallow periods, it has been possible to successfully cultivate flat oysters in known infected areas. Trials are underway to examine the effects of depth and density of lay on the development of the disease.

### **Scotland**

#### **Fish**

Furunculosis continues to be a major disease problem. Sites become infected either by movement of infected smolts from freshwater or by lateral transmission between sea sites. The number of infected sites is increasing. Antibiotic resistance is also an increasing problem. Salmon lice affect most sea cage sites and require regular treatment throughout the year. Efforts are being made to find a suitable alternative to Nuvan. Pancreas disease continues to increase in prevalence although its effects are variable. In some areas it is now considered to be the most economically significant disease. Bacterial kidney disease showed a remarkable increase in the number of affected sites in 1988 although losses were variable. The origin of infection is uncertain in most of these sites. Enteric redmouth disease remains confined to one rainbow trout sea cage site where it continues to cause significant



mortalities. *Vibrio salmonicida* was not recorded in Scotland in 1988.

### Shellfish

No data reported.

## UNITED STATES OF AMERICA

### Fish

VHS virus was isolated from returning broodstock of coho and chinook salmon at 2 hatcheries in Washington state. All fish and eggs at the hatcheries were destroyed. This, the first detection of this highly pathogenic virus in N.America has caused considerable concern. The import regulations in the United States for fish health certification were designed to prevent introduction of VHS. The source of the virus is unknown.

### Shellfish

Oyster production in Chesapeake Bay has been largely destroyed due to MSX disease and Perkinsus disease. The upsurge in these diseases is thought to be due to high salinities in the bay and the mild winters of recent years. The big increase of mortality is due mainly to *Perkinsus* whose transmission has become much more rapid. This parasite has now replaced *H.nelsoni* as the most important pathogen in Chesapeake Bay. Mortality since 1985 has eliminated oysters from 95% of the public grounds in Virginia and the remaining 5% are now infected with *P. marinus* and are also being heavily harvested. It is believed that there probably will not be a commercial oyster harvest in the lower Chesapeake Bay (Virginia) during 1989/90.

In an attempt to rehabilitate the Chesapeake Bay oyster industry, *Crassostrea gigas* has been imported under quarantine conditions. This oyster appears to be resistant to diseases around the world. VIMS will attempt to produce a hybrid oyster of *C. gigas* and the native *C. virginica*. This hybrid may retain the best qualities of *C. gigas* (disease resistance) and *C. virginica* (taste). In addition, triploid *C. gigas* will be produced. Both triploids and hybrids will be kept in strict quarantine (to prevent introduction of reproducing populations of *C. gigas*) and will be evaluated for viability, growth and disease resistance. If either hybrids or triploids grow fast, are disease resistant, and are sterile, they could be used in a hatchery-based industry to supplement the existing industry without introducing an exotic species that is reproductively competent.

In the Gulf of Mexico, *P. marinus* has become more prevalent in recent years, especially 1988, and is causing serious oyster mortality, but harvest is still higher than on the east coast.

Compared to the serious problems along the east and Gulf Coasts, the oyster industry in the north west coast has no disease problems and most of the oysters sold in the United States now originate from there.

