International Council for
the Exploration of the Sea

C.M. 1990/F:13
Session T

REPORT OF THE

WORKING GROUP ON PATHOLOGY AND DISEASES

OF MARINE ORGANISMS

(Vigo, 23-27 April, 1990)

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SUMMARY

The Working Group met for 5 days (23-27 April, 1990, at the Instituto de Investigaciones Marinas (CSIC), Vigo, Spain, with 23 participants from 14 countries. National reports on diseases in marine fish and shellfish stocks were presented from 8 countries and discussion centred on prevalence data in connection with considering possible biological effects of pollution on marine fish populations. Developments and experiences with techniques to measure immunocompetence as biomarkers of pollution effects were appraised for ACMP. Regarding diseases in mariculture (fish and/or shellfish), national reports were received from 14 countries on the current status and these were considered with emphasis on emerging diseases and methods for their diagnosis, prevention and control. The WG also reviewed problems of medication in mariculture and agreed that a publication on this important subject should be produced. Considering other future publications, the WG agreed further additions to the ICES disease identification leaflets and also that the training guide for marine fish diseases should be proposed for ICES publication. Finally, the WG proposed 3 main recommendations to be put to ICES Council.

RESUME

Le groupe de travail s'est réuni pendant 5 jours (23-27 avril 1990) à l'Instituto de Investigaciones Marinas (CSIC), Vigo, Espagne avec 23 participants de 14 pays. Huit rapports nationaux sur les maladies des poissons marins, crustacés et mollusques étaient présentés et les discussions se sont concentrées sur des données de la prédominance par rapport aux effets biologiques possible sur les populations des poissons marins provoqués par la pollution. Des développements et expériences avec les techniques pour mesurer l'immunosuffisance comme bioindicateur des effets de la pollution ont été evaluées pour présentation au Comité d'Avis sur la Pollution Marine. En ce qui concerne les maladies dans la mariculture (poissons ou/et crustacés et mollusques) 14 pays ont soumis des rapports nationaux sur l'état actuel de ce problème. Ces rapports ont été considérés en soulignant les maladies qui émergent ainsi que les méthodes pour le diagnostic de ces maladies, la prévention et le contrôle.

Le groupe de travail a également examiné les problèmes de l'emploi des médicaments dans la mariculture et a concordé qu'une publication sur ce sujet important devrait être présentée.

En considérant d'autres publications futures, le groupe de travail a convenu que des fiches additionelles sur l'identification des maladies et parasites des poissons, crustacés et mollusques devraient être publiées, et une proposition devrait être soumis au CIEM de publier le guide d'instruction pour l'identification des maladies des poissons marins.

Finalement, le groupe de travail a proposé au Conseil du CIEM 3 recommendations principales.

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

(Vigo, 23-27 April, 1990)

INTRODUCTION

The meeting Working Group on Pathology and Diseases of Marine Organisms (WGPDMO) met at the Instituto de Investigaciones Marinas (CSIC), Vigo. Spain, with Dr B J Hill as Chairman (C.Res.1989/2: 34). Local arrangements had been made by Dr Antonio Figueras who welcomed the participants at 10.00 on 23 April and gave a brief account on the research activities of the Institute.

1. OPENING OF THE MEETING

The WG Chairman thanked Dr Figueras for his preparatory work and opened the meeting, welcoming the participants, particularly the new members recently appointed by their national delegate to ICES. The list of participants is attached as Annex 1.

2. TERMS OF REFERENCE, ADOPTION OF AGENDA, SELECTION OF RAPPORTEURS

The Chairman referred all those present to the Terms of Reference for the meeting given to the WG by ICES Council via C. Res. 1989/2.34 (as given at Annex 2), copies of which had been circulated to all WG members at the beginning of the year. He also drew attention to a letter he had received from the Chairman of ACMP, Dr J Portmann, explaining the reason for the deletion of the item on seal disease which the WG had included in the list of tasks it recommended in last year's report that it should attend to at this meeting. This was because there is already an ICES working group specifically charged with this task and neither ACMP nor the Consultative Committee felt it necessary for the WGPDMO to deal with it.

Instead, ACMP asked that the WG consider an additional item (task "i" in the Terms of Reference) concerning the possible use of measurements of immunocompetence as biomarkers of pollution effects. In addition to this specific item, the Chairman of ACMP had identified tasks a, b and e as items of particular interest to the Committee who wished to see the WG's report on these items at its meeting during June 4-15. It had been requested that the sections of the WG report dealing with these tasks be sent to ICES Environmental Officer, Janet Pawlak, by early May.

The proposed Agenda sent out to all members in advance was discussed and after minor amendments was adopted (Annex 3).

The Chairman emphasised that the WG would be dealing with a heavy programme of work in the days ahead and in view of the desirability of having an agreed report more or less ready by the

end of the meeting, rapporteurs were requested to complete their tasks as quickly as possible. The Chairman recognised that being a rapporteur was not always particularly popular and to make it less onerous on this occasion the workload would be spread amongst a larger number of individuals than at previous meetings. The Chairman also felt that some recognition should be given to the individuals acting as rapporteurs and he proposed to include a list of the members reponsible for individual items as an annex in the report. The list is shown at Annex 4.

3. REPORT ON THE 1989 ICES STATUTORY MEETING AND COUNCIL RESOLUTIONS

The Chairman gave a brief report on the 77th Statutory Meeting held at the Hague, 5-13 October 1989, drawing attention to those items arising which had relevance to the WGPDMO. In particular, he drew attention to the part of the report of the Mariculture Committee dealing with the WGPDMO report. In discussion the Mariculture Committee had agreed that paragraph 3 on page 10 of the report should be amended following objections from France that an item of information on *Bonamia* disease in France presented to the WGPDMO at its meeting Kiel was inaccurate. The Chairman regretted that this had been necessary and reminded all present of the need to ensure that statements about disease findings in their respective countries are supportable by fact. It was proposed and accepted that the WG's report should, from henceforth, identify the person responsible for compiling the national report.

ICES Council had noted the views expressed by the WGPDMO in its last report concerning the preferability for the editorship of the diagnostic fiches to rest with an active member of the WG, particularly one competent in both English and French. This suggestion had been discussed with the existing editors, Dr C J Sindermann and Dr C Maurin, and it had been agreed to appoint Dr Giles Olivier, Canada, as the new editor for future fiches produced. The Chairman congratulated Dr Olivier on his appointment.

4. DISEASES IN WILD POPULATIONS OF MARINE ORGANISMS

4.1 NATIONAL REPORTS ON DISEASES PREVALENCE IN MARINE FISH STOCKS (1989)

Full reports were presented by eight countries: Belgium, Denmark, FRG, Finland, Netherlands, Norway, Sweden and UK. Synopses of the reports are given at Annex 5. Some countries, in addition to the narrative report, presented numerical field data on fish disease prevalence rates on the new standardised reporting sheets recommended in ICES Coop. Res. Rep. 166, 1989. Other countries were, however, still reporting on the old sheets. All WG members were requested to present their data on the new-style reporting sheets and to send them to the ICES headquarters for compilation for future analysis.

No significant studies on diseases in marine fish stocks were

carried out in 1989 by France, Ireland, Spain, Portugal, Canada and Iceland. However, for the latter country, surveys are planned in the near future. The Portuguese representative, Dr Menezes, reported a locally high (up to 30%) infection of sardine with *Kudoa*, the enzymes of which make the flesh unmarketable if the fish cannot be cooled directly after capture. From Ireland it was reported by Dr McArdle that there had been a collapse of the sea-trout population along its west coast. The remaining fish obviously suffered from starvation, which has added to the conflict between local aquaculture and anti-fish farming groups.

No reports were received from the Baltic States of GDR, Poland and USSR, or from the USA.

Discussion of the National reports presented focussed on the following points:

1. There are still big gaps in knowledge of diseases occurring in marine fish stocks and, particularly, the causes of some diseases, disorders, and starvation-related stock depletions. Every year new cases and conditions are reported to the WG, the explanation for which in many cases remains unclear.

2. Special attention was drawn to a number of cod diseases of ill-defined or unknown cause, some of which appear to be lethal. These include "yellow pest" of young cod, X-cell disease and spleen liquefaction in older age groups. The cause(s) of granulomatosis in cod remains unresolved; some WG members were concerned by the unusual report from Belgium of Ichthyophoniosis as a cause and requested verification through further studies. Several different types of ulcer diseases have been reported from the North Sea and the Baltic Sea. It is not unlikely that some of these diseases (including infection with the copepod *Lernaeocera branchialis* in the 0-group) are affecting cod stocks at the population level.

3. There was confirmation of findings of previous years that high prevalence of certain fish diseases can be limited to clearly defined areas of only a very few square kilometres. This is true particularly for X-cell lesions of dab along the Scottish and the Danish coasts. The reason for this sharp delineation is unknown, but it suggests that there are flatfish groups which do not mix with other groups and which do not leave their localised area over a long period of time.

4. Very high prevalences of flounder diseases were reported in small areas near to sluices in Dutch coastal waters as well as in the centres of several German estuaries. In both cases, strong fluctuations in salinity were considered to be the direct (osmoregulation) or indirect (starvation) cause of increased disease prevalences. It was generally agreed that laboratory studies under controlled environmental conditions are needed to elucidate the cause of these phenomena.

5. Interpretation of results from field surveys for disease prevalence suffer from the fact that the influence of fisheries activities on fish health has not, so far, been considered

properly. It is likely that these will include effects of mechanical damage to discarded and escaping fish, the preferential capture of fish disabled by disease and the influence of fishing effort on the age structure of the fish population.

6. As in former years, the lack of information for diseases in the Baltic from the east European countries was regretted. However, the WG was pleased to hear a report from J. Thulin that the supply of data on fish diseases in these areas will improve with the recent establishment of the Baltic Marine Biologists Working Group on Fish Diseases and Fish Parasites in the Baltic, whose Chairman (G Bylund) and four other memebers are also current members of the WGPDMO.

4.2 ICES/IOC WORKSHOP ON BIOLOGICAL EFFECTS TECHNIQUES, BREMERHAVEN, 12-30 MARCH, 1990

A brief summary of the Workshop was presented by D Bucke and D Vethaak, who gave an account of the Pathology Group's investigation and presented some preliminary results.. An early report of the complete Workshop will be prepared by the Working Group on Biological Effects of Contaminants and the final results will be presented at the ICES Statutory Meeting, 1991, with subsequent publication. During discussion some WG members pointed out that the German Bight transect investigated might contain different stocks of dab which could interfere with causal interpretations of any observed differences in disease prevalence rates at the different stations. Attention was drawn to the fact that this study programme was planned to collect broadly-based information, including several parameters of pollution effects and not only disease prevalence rates in dab. Other parameters investigated included several chemical aspects of water and sediments, abnormalities of embryonic development of dab, oyster larvae bio-assay and enzyme activities in dab. It was commented that these other parameters might be better indicators for the estimation of pollution levels than the disease prevalences of dab. The disease prevalence levels in dab in the study area are already well recorded and differences between certain areas seem to remain fairly constant. If dab is used as a target fish for demonstrating pollution effects, the WG felt that the liver seems the best organ for gross and microscopic studies.

4.3 NORTH SEA TASK FORCE (NSTF)

An outline of the origins of the NSTF and its current proposed programme of field work was presented by D Bucke. The main interest for the WG was the fish disease investigation included in the biological effects monitoring programme. None of the WG members was acquainted with the programme, nor had been involved in design of the fish disease study. This was considered by several members to be regrettable in view of the fact that the WG, on behalf of ICES, has put in considerable effort in recent years in improving and standardising the methodology of fish disease surveys and this expertise could have been made use of in the NSTF programme planning. Some members expressed the view

that the programme as it stood would be unlikely to add much to current understanding of the situation and could be a waste of resources.

4.4 COMPILATION AND ANALYSIS OF DATA ON DISEASE PREVALENCE RATES IN MARINE FISH STOCKS IN NORTH SEA, BALTIC SEA AND IRISH SEA

A sub-group of 4 members of the WGPDMO (D Bucke, S de Clers, J Thulin and D Vethaak) was formed at the meeting to evaluate the present status of available data and the methodology of collecting and analyzing disease prevalences in marine fish stocks in the ICES area. They met separately and reported back to the full WG with their findings as follows:

Consideration was given to the quantity and quality of the data. It almost exclusively concerned the North Sea. Information on prevalences of fish diseases in the Baltic Sea is still very inadequate. The conclusion was that data more than 3 years old would prove difficult if not impossible to analyse. The principal problems defined were associated with diverse study designs (notably small sample sizes and lack of length standardisation). A paper dedicated to this subject is to be submitted for presentation at the 1990 ICES Statutory Meeting by D. Vethaak.

Using data for the North Sea as a model, the statistical analysis required is an interpretation of long-term trends (i.e. over a minimum of 5 years) for the prevalence of diseases in each station, separately, and for the North Sea as a whole. The data should be presented, through maps and tables, on a background of biotic and abiotic data collected independently by other ICES working-groups.

A standardised methodology has been developed to report annually on selected fish diseases (see Methodology of Fish Disease Surveys, ICES Coop. Res. Rep. 166) and, additionally, a supplementary ICES Training Guide for Fish Disease Studies iss being prepared by the WGPDMO. Some WG participants now use standardized forms to present their data and most North Sea countries have been using the standard methodologies for the last 3 years. The scope of the statistical data analyses agrees with the aims and recommendations of ICES. Only data reported in the standard format, when compatible, could be considered by the sub-group, but some member countries have other prevalence data which could be made compatible over a longer period.

The data reported to ICES by the WGPDMO describes the number of fish affected with a chosen number of diseases in a total number of fish examined on one station at a given date. The information also included the following: sampling year and month; mean length (+/-SD) of fish in three given length groups by sex and fish species. Two minor modifications of the ICES reporting form are recommended by the sub-group:

(a) the exclusion of X-cell gill lesions for dab on the grounds that most infected fish are smaller than the recommended length size for sampling, thus not being noted on the forms.
(b) the inclusion of the condition factor for gutted female dab of the 20-24 cm length range.

The sub-group identified two directions for future studies on statistical methods:

(a) research to develop new statistical tools for assessing the significance of variables not reported to date. For example: the age of the fish in the sample, and the occurrence of several diseases in a single fish. It was also felt that for some diseases (e.g. lymphocystis) the prevalence coding should be supplemented by an intensity code.

(b) routine data analysis performed by ICES using existing statistical techniques and data. For the analysis, the use of Generalized Logistic Models is suggested. These models can identify the stations with statistically different prevalences, and can provide observed and expected values to be illustrated on ICES maps.

The WG will determine for each disease the difference in prevalence judged to be biologically significant. Levels of significance depend on e.g. natural sampling variability and spatial patchiness of the disease.

The following is a list of variables needed as background information for the ICES subsquare nearest to the sampling coordinates:

Abiotic variables

- standard hydrographical parameters
- sediment composition
- contamination characteristics.

Biotic variables

These variables refer to any fish species used as a model to monitor diseases (e.g. dab, flounder, cod):

- characteristics of the benthic community,
- catch composition of other fish species.

On the model species the following parameters are also needed:
- catch per unit effort,
- general stock assessment information available to ICES,
- annual age-length keys,
- map of fishing intensity,
- stock separation and migration pattern,
- stomach content analysis.

Conclusions:

1. The use of the revised ICES reporting forms in conjunction with the proposed ICES training guide on marine fish diseases is to be strongly recommended.

2. At the beginning of each year WG members should provide the ICES-Secretariat with data of the previous year to analyse. These results are to be returned to the WG in the form of prevalence values on maps and tables.

3. The first evaluation by the WG of trends should take place in 1992.

The WG accepted the sub-group's report after discussion on the current relative lack of information about disease prevalences in fish stocks in the Baltic Sea. It was welcomed that results should be forthcoming in the future via the new BMB Working Group. There was also discussion about the possibilities for individual countries to re-evaluate and standardise older data to be compatible with the recent data submitted on the new-style reporting forms. The WG decided that the proposed manner of handling the submitted fish disease data forms should be made as a Recommendation in the WG report.

4.5 REVIEW OF EXPERIENCES WITH TECHNIQUES TO MEASURE IMMUNOCOMPETENCE AS A BIOMARKER OF POLLUTION EFFECTS

The Chairman explained that this agenda item was given to the WG by ACMP arising from remarks in the 1989 WGPDMO Report. The question being asked was whether methods currently in use have been sufficiently developed to be applicable to field situations and to consider whether immunocompetence could be used as an alternative assessment method for biological effects monitoring. A summary review paper by B A Weeks *et al.* entitled "Immunocompetence to Assess Environmental Stress" had been prepared for the WG at the request of the Chairman. During its discussion the following were the main points to arise:

(1) Knowledge of the immunology of the marine fish species involved in current disease studies is limited. The information available indicates that pollution may affect the immune system of fish and there is some knowledge of particular elements of the immune system responding to specific pollutants. Many other factors such as nutritional status, maturity and temperature can affect immunocompetence so the appearance of changes in immune parameters in polluted areas may not necessarily indicate a pollution effect. Although in fish farms the relationship between environmental stress, decreased immunocompetence and increased disease with associated mortality is well established, this information is generally lacking for wild marine fish. Ideally, assessment of disease levels in populations as influenced by pollution should precede measurement of immunocompetence.

(2) An additional indicator of pollution which has an unknown biological significance is not desirable. It is therefore necessary to determine the relationships between the degree of change in the immune status of fish and the degree of change in susceptibility to disease and survival. Measured alterations of aspects of the immune system do not necessarily indicate significant change in disease susceptibility, possibly only that the fish is responding or adapting. The use of laboratory based trials such as those taking place in the Netherlands, FRG, England and Scotland are to be encouraged and particularly the use of disease challenge trials following exposure to contaminants.

(3) Field studies have not demonstrated conclusively a cause/effect relationship between pollution and alteration of the immune status in marine fish, or even that the two are consistently or directly correlated when changes are found. Analysis of existing data on multiple diseases in individual fish could indicate if pollution was acting on non-specific immune mechanisms.

Conclusions:

Evidence for immunosuppressive effects of pollution have been demonstrated in experimental systems and in the fresh/brackish water field situations. The frequency, reliability, specificity and significance of such changes in marine fish is poorly understood at present and available knowledge is not yet directly applicable to field studies with any degree of certainty. For progress towards this objective, research is required on the influence of different environmental factors (pollution and non-pollution) on the immune status of fish. The normal range of variability in immunocompetence must be determined and information obtained on the validity of extrapolation of data from individual fish and experimental systems to wild fish populations.

5. DISEASES IN MARICULTURE

5.1 REVIEW OF CURRENT DISEASE STATUS OF MARICULTURE IN ICES MEMBER COUNTRIES

Written reports were submitted to the WG by 13 member countries: synopses are given at Annex 6. During discussion the main problems identified were as follows:

(a) FISH

(i) ATLANTIC SALMON

IPN was isolated in Canada (B.C.) for the first time with a serotype different from Ab, Sp and VR 299 strains. An increase in outbreaks of IPN was observed in Scotland giving cause for concern because of evidence for synergistic effect with pancreas disease in concurrent infections.

Infectious salmon anaemia (ISA) is an increasing problem in Norway; 64 farms are affected and, as with furunculosis, the

disease is considered as one of the most economically important diseases in this country.

Pancreas-disease is a growing problem in many countries and is currently the most serious problem in Atlantic salmon culture of Ireland. The severity seems, to some extent, to be related to stock management on the farms.

Cold water vibriosis (Hitra disease) was observed in Canada for the first time, so far only associated with low mortalities. In Norway, Hitra disease seems to be under control due to widescale vaccination.

Furunculosis, caused by *Aeromonas salmonicida*, continues to be the most serious disease of marine farmed Atlantic salmon. In Ireland, Scotland and Canada problems of antibiotic resistance are occurring. In Norway, furunculosis has spread both north and southwards, and is threatening the most important Atlantic salmon farming areas. Furunculosis has spread along the Baltic coast of Sweden and seems also to affect the wild broodstock. Furunculosis was detected for the first time in Spain. In both the Norwegian and Baltic situations, the disease seems to spread by escaped salmon and 'wild' fish. A new vaccine against furunculosis is under development in Scotland.

Vibriosis No new developments in the vibriosis situation were reported.

Enteric redmouth disease is no longer a problem of any significance in salmon farms in Norway, or in other countries.

Bacterial kidney disease was detected for the first time in Finland, probably originating from Sweden where it was observed for the first time in 1987. It seems that this disease spreads rapidly in the Baltic area where there is low salinity (5.6°/oo).

Sea lice infestation remains a serious parasitic problem for cage culture of Atlantic salmon. New drugs have been tested and showed promising results (Ivermectin, Ireland; Pyrethrum, Norway). A vaccine is in the experimental stage in Scotland.

The parasites *Hexamita salmonis* and *Gyrodactyloides bykowskii* have been reported for the first time in marine salmon culture in Norway.

Conclusions:

There is an apparent serious trend of increasing disease problems in Atlantic salmon farming with well-established diseases such as furunculosis, sea lice and pancreas disease, although some diseases, such as coldwater vibriosis in Norway, have been brought under control through use of vaccine. The increased disease problems have contributed in a large way to decreased performance and increased mortalities in salmon farmed in seawater. Developments in vaccine and chemical control methods are well in progress in several ICES countries, but also the trend is towards greater control through management techniques (e.g. reduction in stocking densities and fallowing of sites),

particularly in Scotland and Norway.

The WG noted that viral disease (especially IPN) and diseases suspected to be of viral aetiology (pancreas disease and ILA) are increasing at an alarming rate. This is a cause for major concern because these diseases are not treatable and can only be controlled by substantial changes in farm management practices. Since diagnosis of these diseases can be problematic, because the viruses cannot be cultured *in vitro* as yet, even the use of management tools can be very difficult and not entirely effective. A strong effort to increase virological research on farmed Atlantic salmon is urgently needed.

(ii) OTHER SALMONIDS

IPN virus of the He serotype was recorded for the first time in trout in Finland: it has previously been found only in Germany.

Pancreas disease, associated with low mortalities, has been observed in brown trout in France. This is the first record of this disease in a species other than Atlantic salmon.

Furunculosis is spreading rapidly amongst rainbow trout farms along the Baltic coast of Finland following the first cases in 1988.

Conclusions:

As culture of "other salmonid species" has not expanded at the same speed as Atlantic salmon culture, outbreaks of new diseases or changes in present disease status have been much less.

(iii) OTHER FISH SPECIES

IPN virus has been isolated from both turbot and halibut in Norway, but whether this is a cause of observed mortalities is not clear. However, in France, a strain of this virus has been shown to be pathogenic for juvenile turbot.

Vibrio anguillarum is the main causative agent in epizootics in juvenile turbot in Spain. A new *Vibrio* sp. related to *V. anguillarum*, *V. splendidus* and *V. pelagius*, has been involved in disease problems in most cultured species in (Galicia) Spain. In turbot, where this bacterium has caused disease, there was an associated iridovirus infection of, as yet, unknown significance.

Costiasis was, for the first time, the apparent cause of a significant mortality in sea bass in France.

Conclusions:

The increasing culture of new fish species, e.g.. turbot and halibut, is promoting new disease problems, including untreatable viral infections. The WG again identified the pressing need for increased efforts in virological research in mariculture.

(b) SHELLFISH

(i) MOLLUSCS

(1) ***Ruditapes philippinarum***

"Brown ring disease" (*Vibrio* sp. P1 tentatively identified as the pathological agent) of *Ruditapes philippinarum* has been controlled successfully in France by destruction of infected stocks. A regular epidemiological monitoring survey for the disease is now in progress. Moreover, an efficient preventive treatment of spat has been established. Brown deposits in shells have been detected in several individual *R. philippinarum* in Spain, but these were not clearly associated with any pathology and a few individual clams have been found infected with *Perkinsus* sp.

(2) ***Ruditapes decussatus***

A drop from 80% to 20% in mortality caused by *Perkinsus atlanticus* was reported for clams cultured in Portugal. This improvement was achieved by the introduction of better management techniques.

(3) ***Ostrea edulis***

Bonamia ostreae has shown only limited spread to new sites in England, Ireland and the Netherlands. The ELISA detection technique has been used effectively by some member countries for detecting low prevalences of the disease organism in lightly-affected stocks, but histological examination was still being widely used for monitoring purposes.

Marteilia refringens has shown a resurgence of virulence and spread in *O. edulis* in France. In Spain, where intensive epidemiological studies of this species are being carried out, no similar resurgences have been reported. *Ostrea puelchana* has been found to be sensitive to *M. refringens* by French scientists.

(4) ***Mytilus edulis/galloprovincialis***

Marteilia spp. There is a continuing problem for regulation/control for the two *Marteilia* spp. (*M. maurini* and *M. refringens*) due to the difficulties of distinguishing between both the mussel species and the parasite species.

Mytilicola intestinalis. Although no mortalities or pathology have been directly associated with infection by this copepod, the high prevalences in some areas and the possibility of debilitatory effects in conjunction with other pathogens or environmental stresses led some WG members to suggest continuation of present precautions against further transfer of this pest to high density/value mussel cultivation areas..

(5) ***Crassostrea virginica/gigas***

Recent increases of infections with the protista, *Haplosporidium nelsoni* (MSX) and *Perkinsus marinus* throughout Chesapeake Bay have almost decimated the remaining *C. virginica* population.

Susceptibility trials with *C. gigas* are ongoing.

(6) ***Argopecten irradians***

A new *Perkinsus*-like protozoan has been identified in bay scallops from Canada. Pathogenic proliferation appears restricted to the pre- and post-spawning period when the bay scallop is moribund. Identification, transmission and pathogenicity studies are ongoing. Concern was raised that this parasite may have been originally introduced to Canada from the eastern coast of the USA despite rigourous quarantine investigations following ICES guidelines on the introduction of non-indigenous species.

(7) ***Pecten maximus***

Epidemiological studies suggest that the *Rickettsia* sp. discovered in the gills of scallops suffering from mortalities in France may be the cause of the pathology.

(8) ***Mercenaria mercenaria***

On investigation of a 50% mortality of hatchery-reared quahogs (1-2 years old) in Canada, the animals were found to be infected by a previously undescribed protozoan (possibly a gregarine species).

Conclusions:

Bearing in mind the endemic nature of diseases in most countries with molluscan aquaculture, it is important that the quality of management of cultivated stocks be assured. There is a continued need for improving epidemiological surveys. Speed of analyses will soon be enhanced by the development of diagnostic techniques which can be automated , e.g. immunodiagnostics and DNA probes. Moreover, it was recognised that the development of cell line cultures for investigation of mollusc diseases of possible viral aetiology is of utmost importance and the current research in this field is to be encouraged.

(ii) CRUSTACEA

Fusarium solani was reported in brood stocks of cultured prawns (*Penaeus japonicus*) in Portugal where there is a rapid expansion of production taking place.

5.2 EMERGING DISEASES AND METHODS FOR THEIR DIAGNOSIS, PREVENTION AND CONTROL

The WG considered reports of a number of emerging disease problems affecting cultured fish and molluscs in ICES member countries and the attempts being made to control them. The most significant of these are as follows:

(i) Infectious anaemia in Atlantic salmon (ISA)

This disease is now regarded one of the most economically important emerging disease in Norway. The major features are:

(a) mortalities on affected farms can reach more than 70% in some instances,

(b) fish of all sizes can be affected, mostly after smolts have been introduced in sea water,

(c) affected fish (apparently only Atlantic salmon) show sluggish behaviour and a variety of clinical signs: low haematocrit values, pale gills, ascites and haemorrhages (particularly in liver),

(d) transmission experiments have shown it to be infectious, and possibly to have a viral aetiology, although cultures have not been achieved, virus-like particles have been seen in blood cells,

(e) control is limited to stock reduction, but because the blood from affected salmon can be considered as infectious, it is important that attention be paid to slaughter houses as a source of transfer to new areas.

(ii) Pancreas disease in Atlantic salmon

From Scotland, there was information demonstrating that:

(a) the disease is highly infectious and on the increase,

(b) mortality can be significant, particularly with the secondary involvement of other pathogenic factors,

(d) there is no control, apart from the limitation of stressing factors.

(iii) Protozoal (microsporidian) disease in turbot

In France and in Spain, microsporidia were found encysted in viscera and muscle of turbot. Although the impact on health of affected fish seems not to be significant, possible effects on muscle tissues could make the fish unsaleable. Control measures are not available and the essential supply of juveniles from the small number of hatcheries makes health regulations difficult to apply without severe impact on this developing industry.

(iv) A form of Vibriosis in clams

A *Vibrio* sp (strain P1) is believed to be responsible for the formation of a "brown ring syndrome" in the clam *Ruditapes philippinarum*. However, the disease can be controlled by the treatment of spat in a bath of Furazolidone (10 ppm, 3x24 h).

(v) Rickettsiae in scallop (*Pecten maximus*)

In France, mortalities in natural beds of scallops may be associated with a rickettsial gill infection. This type of disease in wild populations could easily be overlooked and sensitive methods should be employed for diagnoses. Nucleotide probes currently being developed could be useful for an epidemiologic survey. The initial rearing of young scallops in non-infected areas could limit the subsequent development of infection when they are later introduced onto infected beds.

During a slide workshop, specimen microscope slides of a variety of disease conditions were examined and usefully discussed, particularly those concerning:

- Infectious anaemia in salmon (ISA)
- Turbot microsporidiosis
- Salmon liver granulomatosis
- Turbot liver degeneration
- Recently discovered pathogenic protozoan in Juvenile quahog
- A *Perkinsus*-like protozoan in bay scallops from Canada.
- Halibut gill-aporocyte (blood fluke) eggs.

From the discussion, the WG agreed it should draw the attention of the Mariculture Committee to the following points:

(a) There is a serious disease risk in importing salmon smolts, or other juvenile fish, or molluscan spat for culture in other countries. If such an importation is necessary, health certification should be obtained from competent authorities.

(b) Because of the serious economic threat of infectious anaemia of salmon (ISA), only eviscerated salmon should be imported for consumption from affected countries.

(c) There was concern from the WG that new virulent virus or virus-like diseases are emerging in mariculture, but yet there is a lack of expertise available to research these problems because of a general reduction in this area of research in ICES countries.

(d) More sensitive methods for detection of pathogens causing serious diseases in fish and shellfish need to be developed.

5.3 *Vibrio* STRAINS CAUSING DISEASE IN ICES MEMBER COUNTRIES AND VIBRIOSIS VACCINATION FAILURES

At the 1989 meeting of the WGPDMO some members suggested that there was need to conduct a small-scale collaborative study on some of the difficulties with identification of *Vibrio* spp. One specific question identified was: "When we are referring to 'vibriosis' in fish, are we all referring to the same thing?" In order to answer this a sub-group of 5 WG members was formed to carry out an inter-sessional task of exchanging strains of *Vibrio* spp. from their culture collections and identifying them

according to their own laboratory methods, with optional additional tests like pathogenicity, serology and the use of rapid identification systems.

During the WGPDMO meeting in Vigo the sub-group met separately to discuss their results. The amount of data generated on the characterization of these isolates was too great to allow a full analysis in the time available, but some interesting conclusions about vibrio strains and vibriosis were reached:

(a) almost identical strains occur in many European countries and in Canada.

(b) there is a need for standardization of all techniques, biochemical and serological, to allow comprehensive comparison of results.

(c) there is a need to develop an identification key for bacterial pathogens of fish and to evaluate the possibility of using a modified rapid identification system for this purpose.

(d) further essential experiments on the pathogenicity of many of the "vibrio"isolates need to be carried out.

(e) although the study by the sub-group was not completed, all members were very satisfied with this collaborative effort and have agreed to pursue additional comparative studies before the next WGPDMO meeting.

(f) apart from a few odd exceptions due mostly to mis-use, vibriosis vaccination now seems to be performing well in all ICES member countries.

5.4 PROGRESS REPORT ON INTRODUCTION OF GENETICALLY-MANIPULATED *Crassostrea gigas* INTO CHESAPEAKE BAY FOR DISEASE CONTROL

A report from E Burreson, USA, was received with information about the proposal of introduction of *Crassostrea gigas* into the Chesapeake Bay to rejuvenate the oyster industry that has been decimated by diseases of *C. virginica*.

Diploid and triploid *Crassostrea gigas* have been held in quarantine systems at the Virginia Institute of Marine Science and exposed to *Perkinsus marinus* for periods of 3-5 months. Diploid and triploid strains of native eastern oysters, *Crassostrea virginica*, served as susceptible controls. In an experiment using flowing seawater with treated effluent, *Crassostrea gigas* did become infected with *Perkinsus marinus*, but the prepatent period was much longer than in *C. virginica* and intensity of infection remained low in *C. gigas* compared with infections in *C. virginica*. Most *C. virginica* had already died by the time infections first appeared in *C. gigas*. In recirculating systems, most *P. marinus* infections remained light in all treatment groups, including *C. virginica*, making interpretation difficult. Data suggest that *C. gigas* can become infected with *P. marinus*, but the parasite is not pathogenic. There appears to be no difference in the susceptibility of

diploid and triploid strains. Laboratory challenge with *Haplosporidium nelsoni* (MSX) has not been possible because the infective stage is unknown. A request has been made to the appropriate Virginia management agency for field challenge on a small lot of *C. gigas* to begin 1 May 1990 in the lower Chesapeake Bay. This small-scale introduction will provide data by 1 October 1990 on susceptibility of C. *gigas* to both *P. marinus* and *H. nelsoni* under natural conditions.

The WGPDMO expressed great interest in the report but, unfortunately, no representative from the USA was present to reply to the many questions that the information generated. Because of the applicability of these studies to other member countries, such as Canada, France and Spain, the WG strongly encouraged continuation of these studies. Specific members interested in the progress and details of this research will be contacting the USA representatives directly and it is hoped that more information will be provided by a US representative at the next WG meeting.

5.5 REVIEW OF PROBLEMS OF MEDICATION IN MARICULTURE

The WG received the following papers (by the identified authors) which had been prepared as an inter-sessional task as agreed at the 1989 WGPDMO meeting:

- Diseases currently lacking medical treatment (**various members**)
- 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 resistence (**J McArdle and B Hjeltnes**)
- Interactions between antibiotics and immunity in fish (**G Olivier**).

Following the presentations, the various topics were discussed by the WG and the following conclusions reached:

1. Medication continues to be a useful and necessary means of controlling certain infectious diseases in farmed fish. Because of the nature of marine fish farming, disease will inevitably occur and medication is one of the most important ways of counteracting the economic losses due to such disease. Viral diseases present a particular problem because of non-existence of vaccines and medication to prevent and treat such diseases.

2. All participants reported increasing problems of drug resistance, including multiple resistance, which taken together with the relatively few licensed antibiotics available for use in marine fish farming will have a significant impact on the ability to control infectious disease problems in the ICES area in the very near future.

3. The main public health implications arising from the use of antibiotics and other types of medication in the marine

environment recognised by the WG were the accumulation of residues of pharmacologically active compounds in the flesh of treated fish and the potential for transfer of resistence to human pathogens present in the marine environment in the area of fish farms. Whilst the WG did not seek to minimise such risks the scientific evidence currently available does not currently indicate that these phenomena pose a real public health risk at this time.

4. To ensure the continued efficacy of medicines used in marine aquaculture and to minimise the public health risks from the use of such medicines, adequate controls on the availability of some medicines is necessary.

5. The WG felt that a prerequisite for the effectiveness of medication in marine fish farming was accurate and early diagnosis based on clinical history and disease signs and, where possible, supported by laboratory tests particularly isolation of causative pathogens and antibiograms.

6. The WG reviewed the role of medication and its effect on immunocompetence in fish, and concluded that the available scientific information was sparse and, in some cases, contradictory making a definitive conclusion impossible. However the small amount of information available calls for a rational and restrained use of antibiotics and the avoidance of their prolonged use.

Based on the foregoing conclusions the WG agreed the following needs:

(i) Improvement of disease treatment strategies

It is felt that there is a good deal of scope for research and development in improving the methods in which medicines can be presented to the fish. Reports on novel sea lice treatments and drug encapsulation are encouraging, although at an early stage of development.

(ii) Encourage vaccination programmes

The effectiveness of a number of fish vaccines against such diseases as vibriosis and Hitra disease is now generally accepted. The preliminary reports on the development of vaccines against sea lice and genetically engineered vaccines against furunculosis are also encouraging. The WG felt that the use of vaccines, where possible, should be encouraged in the ICES area as a preferred method of controlling disease to the use of chemotherapy and help reduce the amounts of antibiotics and other medicines being used.

(iii) Improve management at fish farm level

The WG recognised the need to optimise environmental conditions, reduce stress and maintain good husbandry practices (e.g. fallow periods) in marine fish farms for reducing the occurrence of disease outbreaks and hence quantities of medicines used.

(iv) Education for aquaculturists

The WG recommends that aquaculturists should receive adequate education in the correct use of antibiotics and therapy.

(v) Legislation

The WG recommends that governments in the ICES area ensure that adequate regulations are in place and enforced to control the availability of medicines and chemicals used in marine aquaculture.

Finally. the WG agreed that the review had been a useful exercise and that, with some expansion, the different papers prepared should be amalagamated into a single review paper for publication by ICES. It was agreed that a draft should be prepared in time for distribution to all WG members for consideration before discussion and approval at the next meeting. A lead author would be needed to co-ordinate the contributions and the WG unanimously accepted the proposal that this should be Dr D Alderman.

6. PUBLICATIONS

6.1 GLOSSARY OF TERMS USED IN PATHOLOGY

Dr F Baudin-Laurencin and D Bucke presented a copy of their Glossary of Pathological Terms. The WG members commended the authors for their work. It was recognized that there are still some amendments to be made. WG members were asked to send their comments to D Bucke before May 31, 1990. The final copy of the Glossary will then be sent to Dr H Rosenthal, Chairman of the ICES/EIFAC study group. However, the WG members recommend that the glossary of pathological terms should be published as a separate entity by ICES, instead of simply being incorporated into the ICES/EIFAC Glossary on Aquaculture Terminology. The advantages of having a separate document were felt to be: incorporation of French terminology; expansion of some definitions; and addition of more terms, particularly those of greater relevance to fish disease surveys than to aquaculture.

6.2 DIAGNOSTIC FICHES

The latest series of leaflets (Nos 41-50) are currently being edited. All WG members were concerned by the lack of publicity given by ICES to the availability of these fiches. It was recommended that scientific associations such as the European Association of Fish Pathologists and the American Fisheries Society should be advised via their bulletins/newsletters about the existence of these ICES publications. It was also agreed that the drafts of the next block of fiches (Nos.51-60) should be considered at the next WG meeting.

6.3 PROPOSED TRAINING GUIDE FOR MARINE FISH DISEASE SURVEYS

As decided at the 1989 WGPDMO, D Bucke, T Lang and D Vethaak prepared (as an inter-sessional task) a draft Training Guide with illustrated examples (colour prints) of the more common diseases of marine fish with brief descriptions. The Training Guide is intended to be used for disease identification on field surveys. The WG members were very satisfied with the Training Guide and recommend its rapid publication by ICES after minor amendments. The Guide will be very valuable as a complement to the ICES Cooperative Research Report No.166, on the "Methodology of Fish Disease Surveys", and will help to standardize such surveys between different countries. The WG, as a whole, recognized the need for early publication of this document, possibly within the next year and agreed that the final version should be submitted as soon as possible to ICES. As this Guide is intended for use at sea, it will need to be printed on plasticized sheets, in a ring folder, with colour illustrations (similar to the ICES "Plankton Identification Fiches").

6.4 OTHER POSSIBLE PUBLICATIONS

It was suggested that the WGPDMO should prepare a video for ICES production as a complement to the Training Guide to help in the training of non-specialists prior to and during participation in fish disease surveys. Members of the WG will consider how this may best be approached and will discuss proposals at the next meeting.

As agreed under item 5.5, it is recommended that a multi-author review paper on the problems of chemotherapy in mariculture be prepared with Dr D J Alderman as the leading author.

7. ANY OTHER BUSINESS

(a) Future activities

(i) Liaison between WGPDMO and OIE.

It was pointed out to the WG that the Office International des Epizooties (OIE) has a Fish Diseases Commission with the remit being to consider serious diseases of aquatic animals and to make recommendations to national authorities through its Animal Health Code on appropriate health certification procedures and controls to prevent disease spread through international trade in live fish and shellfish. It was suggested by some WG members that perhaps it would be useful to have some liaison between WGPDMO and OIE, particularly concerning information on disease problems in mariculture and advice on international effort to prevent spread. There was not a clear view on how this could be achieved and the Chairman pointed out that ICES WGs should not communicate directly with outside organisations or issue any of their reports without prior clearance by Council. The matter was left unresolved.

(ii) The influence of nutritional problems on the health of marine organisms.

The WG considered whether this should be an area for discussion in future meetings. It was concluded that, in view of the fact that other groups in ICES and EIFAC are involved in this area, and that the main purpose of the WGPDMO members is primarily with pathological conditions, it was agreed that only cases of diseases caused by nutirion should be considered by the WG and that data on these could be included in the national disease reports.

(b) Directory of specialists

A proposal that a detailed list of specialists working on research topics (modelled on the Frisk Fisk Norwegian Programme) be published was rejected because of the problems of the constant need for updating. It was agreed, however, that it would be useful if each national report to the WGPDMO could have an addendum listing current research projects on diseases of marine organisms in that country to be included as an annex of the WG report.

(c) National Reports

In future, the following protocol will be followed to avoid lengthy discussion during the WG meeting:

(i) Full national reports will be sent to all members of the WG well in advance of the WG meeting.

(ii) A synopsis of each national report for direct inclusion in the WG report will be provided by each country's representative to the Chairman prior to WG meeting.

(iii) Only significant changes or trends during the previous year should be identified by each country's delegate and a short discussion prepared for presentation at the WG meeting.

During the WG meeting specialist interest sub-groups (e.g salmon diseases, mollusc diseases) should meet, separately, to discuss the details or trends and developments within their specialist area, and subsequently make a report with recommendations to the full WG.

(d) Baltic Marine Biologists (BMB) Working Group 25 (WG 25)

BMB is a group of independent biologists from the Baltic countries, and WG 25 was formed to consider fish diseases and fish parasites in the Baltic. Drs Thulin and Bylund reported that accounts of WG 25 metings, symposia and field studies (cruises) will be made available to ICES through meetings of WGPDMO.

WGPDMO commended the initiative being shown by this organisation

and welcomed the prospect of improved provision of much-needed data on marine fish disease from **all** Baltic countries.

(e) ICES/EIFAC Codes of Practice and Manual of Procedures for Consideration of Introductions and Transfers of Marine and Freshwater Organisms

In light of recent advances in diagnostic techniques, changing disease profiles and appearance of new diseases in molluscs, it was pointed out that some of the disease aspects of the "Codes of Practice" guidelines, particularly Appendix 1, are in need of updating. It was agreed that relevant members of the WGPDMO should review the current molluscan disease control guidelines for each country as an inter- sessional task and report on these for discussion at the next WG meeting.

(f) Impact of disease on marine fish stocks

It was felt by several WG members that lethal or acute diseases in marine fish stocks are likely to have more serious effect at population level than chronic on-going diseases used in investigating pollution effects. A review of current and historical data on lethal diseases of wild fish is necessary in order to see which should be taken into account, for improving understanding of population dynamics as part of stock assessment. WG members will give further thought to this during the inter-sessional period and discuss again at the next meeting.

8. RECOMMENDATIONS

(1) As a consequence of ICES resolution (C. Res. 1989/2.34), data on diseases in marine fish stocks is being collected by member countries and compiled on an annual basis for submission to ICES. It is recommended that ICES statistically process this data according to the guidelines presented in WGPDMO 1990 (Report section 4.4) and the results returned to the WG for consideration.

(2) It is recommended that current molluscan disease control measures for each ICES country and their applicability to new or emerging diseases, changing disease profiles as well as diagnostic techniques be evaluated in order to update the disease aspects of the ICES/EIFAC Codes of Practice for introductions and transfers of marine organisms.

(3) That the WGPDMO meet for 4 days at the Fisheries Research Station, Ostende, Belgium, 19-22 February 1991, under the Chairmanship of Dr B. Hill, to carry out the following tasks:

(a) to consider the National Reports on diseases in wild fish and shellfish stocks throughout ICES member countries, with special reference to the anticipated new information being made available from Baltic countries;

(b) to consider recent disease trends and developments in mariculture throughout ICES member countries, with special attention to advice on preventive and control measures;

(c) to receive a review of current molluscan disease control measures in ICES member countries in order to provide advice on updating the relevant ICES/EIFAC "Codes of Practice" guidelines on introductions and transfers of non-indigenous organisms;

(d) to review current and historical data on lethal diseases of wild marine fish and consider the possible relevance to stock assessment;

(e) to review information on dab (*Limanda limanda*) and flounder (*Platychthys flesus*) migration habits, as these may have relevance to studies on disease prevalence in polluted areas of the North Sea, Baltic Sea and Irish Sea.

CLOSING OF THE MEETING

The Chairman, of behalf of the WG members, expressed many thanks to the Instituto de Investigaciones Marinas (CSIC) for their hard work and hospitality, and especially to Dr Antonio Figueras and the secretarial staff.

ANNEX 1

WORKING GROUP ON PATHOLOGY AND DISEASES OF MARINE ORGANISMS

(Vigo, 23-27 April, 1990)

LIST OF PARTICIPANTS

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ANNEX 2

WORKING GROUP ON PATHOLOGY AND DISEASES IN MARINE ORGANISMS

(Vigo, 23-27 April 1990)

TERMS OF REFERENCE (C. RES. 1989/2.34)

(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, and review the status of such studies from areas usually not fully reported (e.g. Baltic);

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

(e) in conjunction with the Working Group on Environmental Impacts of Mariculture, receive and discuss the draft contributions (as specified in item 5.3 of the Working Group report) for the review of problems of medication in mariculture and consider preparation of a report for publication;

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

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

(h) receive a progress report on the proposed introduction of genetically-manipulated *Crassostrea gigas* into Chesapeake Bay to replace the recent losses of *Crassostrea virginica* due to disease;

(i) review experiences on techniques to measure immunocompetence, to use biomarkers, and to determine phagocytic activity as tools in biological effects studies.

ANNEX 3

WORKING GROUP ON PATHOLOGY AND DISEASES OF MARINE ORGANISMS

(Vigo, 23-27 April, 1990)

AGENDA

1. **Opening remarks.**

2. **Terms of reference, adoption of agenda, selection of rapporteurs.**

3. **ICES Statutory Meeting 1989: points of relevance to WGPDMO.**

4. **Diseases in marine fish stocks.**

   4.1. National reports for 1989.
   4.2 ICES/IOC Workshop on Biological Effects Techniques, Bremerhaven, 12-30 March, 1990.
   4.3 North Sea Task Force
   4.4 Compilation and analysis of data on disease prevalence rates in marine fish stocks in North Sea, Baltic Sea and Irish Sea [sub-group task].
   4.5 Review of experiences with techniques to measure immunocompetence as a biomarker of pollution effects:

   (a) Experimental studies (b) Field studies

5. **Diseases in mariculture.**

   5.1 Review of current disease status of mariculture in ICES member countries:

   (a) fish (b) molluscs (c) crustacea

   5.2 Emerging diseases and methods for their diagnosis, prevention and control [including slide workshop].
   5.3 Vibrio strains causing disease in ICES member countries and vibriosis vaccination failures.
   5.4 Progress report on introduction of genetically-manipulated *Crassostrea gigas* into Chesapeake Bay for disease control.
   5.5 Review of problems of medication in mariculture.

6. **Publications**

   6.1 Glossary of terms used in pathology.
   6.2 Diagnostic fiches.
   6.3 Proposed training guide for marine fish disease surveys.
   6.4 Other possible publications.

7. **Any other business.**

8. **Recommendations.**

9. **Approval of WG report.**

ANNEX 4

RAPPORTEURS

Agenda item	Rapporteurs
1, 2, 3	A Figueras, J Menezes
4.1	G Bylund, H Möller
4.2, 4.3	D Bucke, D Vethaak
4.4	S de Clers, J Thulin
4.5	A McVicar, S Helgason
5.1	P van Banning, S Mellergaard
5.2	D Bucke, F Baudin-Laurencin
5.3, 5.4	G Oliver, E Miahle
5.5	J McArdle, B Hjeltnes
6	D Declerk, C Couillard
7, 8	A McVicar, S McGladdery

ANNEX 5
SYNOPSES OF NATIONAL REPORTS ON DISEASE PREVALENCE IN MARINE FISH STOCKS (1989)

Belgium (D Declerk) The Belgian disease surveys included a biannual (May and October) survey in the Belgian continental shelf and an annual survey (August) of adult flatfish. Taking the 1985-88 survey period as reference for the disease situation along the Belgian coastal zone, during 1989 a slight increase was noted for skeletal deformities in dab, flounder and cod, and for fin erosion, there was a slight decrease in prevalence in dab and in plaice. Skin ulcers occurred at the same prevalence rate for all species examined, apart from an increase in cod (5.4%). Due to the abnormally high water temperatures last October, the expected cod population did not arrive. Of the cod examined (n = 75), there were high levels recorded for *Ichthyophonus hoferi* (13.3%) and liver anomalies (10%). The protozoan disease *Glugea stephani* in dab, plaice and flounder showed little differences during this period compared with 1985-88, but on the other hand, a decrease of lymphocystis in dab and flounder was noted. A systematic bacteriological examination was carried out on flounder livers and 6.6% found positive. A significant decrease in the *Anisakis* larvae in herring was noted.

Denmark (S Mellergaard) The overall impression was a decrease in disease prevalence in dabs caught in the German Bight and along the Danish west coast. The decrease involved both lymphocystis and epidermal papillomas. In the Skagerrak, an increase in the prevalence of ulcerations was observed, probably due to a marked increase in fishing intensity in the area. In the southern Kattegat, which suffered from oxygen deficiency in the summers since 1986, the prevalence of lymphocystis and epidermal papillomas are still increasing. Fishing in a grid system at a station ca. 20 nm NW off Esbjerg revealed a very sharp delineation of a dab stock with a high prevalence of X-cell gill disease.

Federal Republic of Germany (H Möller) Routine monitoring of cod and flatfish diseases in the North Sea and of *Anisakis* infection in Baltic herring was carried out. No noticeable differences were found in comparison to former years. A yellow discolouration was recorded in dab, now identified by Scottish colleagues as lipoma. The causes for spleen liquefaction of cod remain unknown.

Attention was drawn to the "Multi-Institutional Project on Fish Diseases in the Wadden Sea", the results of which will be presented before the end of this year. Within the frame of this project, the occurrence of external diseases had been studied in 122,000 fish of different species. So far, results are available only for cod. "Yellow pest", a lethal condition considered to be caused by *Flexibacter* spp. bacteria, occurred mainly in the estuaries of the Weser and Elbe rivers where cod also showed the lowest nutritional condition. On the other hand, no clear regional differences were found in the occurrence of skeletal compression which affected 4.9% of the population of young cod from the Wadden Sea. By statistical analysis, a normally grown and a compressed group of fish could be separated

by using the relationship of total length to head length as a criterion.

One year after the seal epidemic in the Wadden Sea, parasitological studies revealed a reduction for about one third in the infection prevalence of the main fish carriers of the nematode *Pseudoterranova decipiens*. Smelt (60%) and sea scorpion (35%) were the most heavily affected among 20 fish species studied. Studies of the stomach nematodes of marine mammals confirmed harbour seal to be the main final host for *Pseudoterranova*, and dolphin as the main final host for *Anisakis*. The primary intermediate host of *Pseudoterranova* remains uncertain. Only one larva was found in 8,000 crustaceans examined from the Wadden Sea. Laboratory studies revealed a significant reduction in the swimming speed of smelt infected with *Pseudoterranova crassus* and of eel infected with *Anguillicola* in the swim bladder.

Finland (G Bylund) The general fish disease survey was focused mainly on the northernmost parts of the Baltic Sea (salinity 0.2-0.4‰). It was discovered that there was almost complete infertility in the burbot population in that area. Investigations to find a reason for this phenomenon are in progress in Finland as well as in Sweden.

As in previous years, high prevalences of skin ulcers were recorded in flounders. A bacterial agent regularly found in the affected fish is the subject of experimental investigation. The results indicated that we might be dealing with a new subspecies of *Aeromonas salmonicida*. Additionally, a fairly high prevalence of liver changes (liver spots, liver nodules) recorded from flounder. Histological examination showed that in the main these changes were of neoplastic nature.

Netherlands (P van Banning and D Vethaak) A long-term monitoring programme for diseases in flatfish (dab - *Limanda limanda*, and flounder - *Platichthys flesus*) in Dutch near-shore waters, applying the protocols recommended by ICES, has been initiated as a continuation of the previous 5-year in-depth studies. Although in 1989 spatial patterns of the various diseases recorded were largely in accordance with findings in previous years, their prevalence levels were much lower compared to those found at similar times and sites in 1988.

Recordings for base-line data in wild fish stocks were carried out with 5 general stock assessment surveys in the south-east part of the North Sea (area: Dutch coastal waters, German Bight, Danish coastal waters). Dab, plaice and cod were examined for grossly visible anomalies and diseases. The recordings were made at the end of the cold water period (February-April), with fish generally in poor condition, and at the end of the warm water period (October-November), with fish generally in good condition. Comparison of data for the foregoing years (1988 and 1987) showed an increasing trend of prevalence of liver nodules of dab and plaice. For the other diseases recorded, fluctuating prevalences were established over the past 3 years in the areas mentioned, and no conclusions of clear trends could be drawn.

Norway (B Hjeltnes) has no programme of disease surveys in marine fish stocks. There have been some specific studies undertaken to determine if pollution in the marine environment may have some impact on the fish health. NIVA and The National Veterinary Institute has conducted a pilot study with the main goal to measure levels of PAH in wild fish off the coast of Karmıy. The fish were also observed for abnormalities. Because of the limited number of fish sampled no firm conclusion can be drawn.

Flatfish caught at four different sites in the Hvaler Archipelago were analysed for content of organochlorine contaminants and polyaromatic hydrocarbons. The area investigated revealed elevated levels of organochlorine contaminants in the selected fish. Of the biochemical responses in the fish, the use of cytochrome P-450-dependent activities (EROD) in the liver for environmental monitoring showed promising results.

Sweden (J Thulin) The study in the Bothnian Bay continued. Perch were found with a rather high prevalence of gill damages (24%) at one locality, whilst results elsewhere were similar to those obtained last year. Parasitological examinations showed that microsporidians in the gills and kidneys of perch and white-fish were much more common at the northern localities than further south. The Fishery Board recorded ulcerations of cod in the southern Baltic during August at prevalences between 0 and 7.3% in the different catches (n = 26). During monitoring outside the Oskarshamn nuclear power station, SW Baltic, a total of 12,090 specimens of fish belonging to seven species were examined for external signs of disease. Ulcerations were the dominant disease.

United Kingdom

(a) England and Wales (D Bucke). Monitoring wild stocks of fish for diseases included studies on sewage-sludge dump-sites and other stations spread around the North Sea and Irish Sea. On the dump-sites the results of gross pathological conditions in dab did not reveal any differences in disease prevalences compared with the reference stations (1,500 dab examined). Liver nodules in dab were not observed macroscopically; however, histological examination of livers of dab (>25 cm length size) revealed a 3.7% prevalence of pathological changes. On the more comprehensive summer ground-fish survey (August/September) disease prevalences in dab were overall similar to those recorded in previous years. Six thousand dab were examined from 30 stations spread over the North Sea. Highest disease prevalences were recorded off the Firth of Forth and on the Dogger Bank. Liver nodules were generally recorded at low prevalences, but widespread with indications of higher prevalences on the Dogger Bank. Studies on a dump site in Liverpool Bay (Irish Sea) were rather inconclusive, with few fish being caught on the dump-site station. Prevalences for diseases in dab on reference stations were similar to those recorded previously. An ulcerative skin condition of cod, reported in 1988, continued to occur at a low but persistent level throughout the year. The aetiology has not been resolved. Visceral granulomatosis in cod was rarely reported this year.

(b) Scotland (A McVicar). A repeat survey on sewage sludge dump grounds off the Forth, adjacent and distal reference areas and in the vicinity of an oil field showed no significant differences in the prevalence of Lymphocystis, skin ulcers and hyperplasia/papilloma in common dab. No general or localised trends in prevalence levels were apparent over 3 year's data from the same localities sampled by standardised methods. A hypodermal lesion in dab, with significantly highest prevalence off east Orkney, was diagnosed as a multiple lipoma. Mature females were mainly affected. The prevalence of the Digenean parasite *Zoogonoides* in *Buccinum* was significantly lower in sampling areas close to a sewage dump site compared with more distal areas. Studies on the parasite system in the second intermediate and final hosts in field and experimental conditions have suggested decreasing trends in infection levels with increasing levels of sewage concentrations. Intensive studies of dab disease trends in relation to physical, chemical, biological variables and seasonally have commenced on a sewage sludge dump site.

Other countries No significant studies on wild fish diseases had been carried out in 1989 by France, Ireland, Spain, Portugal, Canada and Iceland. However, for the latter country, surveys are planned in the near future. The Portuguese delegate reported a locally high (up to 30%) infection of sardine with Kudoa, the enzymes of which make the flesh unmarketable if the fish cannot be cooled directly after capture. From Ireland it was reported that there had been a collapse of the sea-trout population along its west coast: the remaining fish obviously suffered from starvation. The situation has added to the conflict between local aquaculture and anti-fishfarming groups.

No reports were obtained from the East European countries or from the USA.

ANNEX 6

SYNOPSES OF NATIONAL REPORTS ON DISEASE STATUS IN MARICULTURE

(a) FIN FISH

Canada (G Olivier)

Vibrio salmonicida, the causative agent of "Hitra Disease" or cold-water vibriosis has been identified in Atlantic salmon for the first time in North America on the east coast of Canada. The disease only affected one farm which experienced chronic mortalities in April and May 1989. Elsewhere, infectious pancreatic necrosis virus (IPNV) was isolated for the first time from Atlantic salmon in British Columbia, no mortalities were associated with this finding. Also on the west coast *Vibrio anguillarum* serotype 0-2 was recognised for the first time in 1989, this finding may explain the continuing significant losses attributed to vibriosis even in vaccinated fish. On both coasts bacterial kidney disease (BKD), vibriosis and furunculosis, as well as sea lice, continue to cause significant problems in the salmonid aquaculture industry. Considered as a pressing problem is the syndrome of marine anaemia in chinook salmon on the Pacific coast, a viral aetiology is suspected for this disease.

Denmark (S Mellergaard)

Most of the Danish marine fish farms (rainbow trout) had one or two outbreaks of vibriosis and furunculosis; 40% of the rainbow trout were vaccinated against vibriosis and furunculosis before their transfer to seawater. Vibriosis observed in vaccinated fish stocks was caused by the same serotype (Type 1) as the one in the vaccine. Several outbreaks of vibriosis was observed in elvers during the first week after arrival. A syndrome with unknown aetiology, "red-head disease", in eels caused severe problems.

Finland (G Bylund)

One main problem was the very rapid spread of furunculosis amongst the rainbow trout farms. The first few cases in the sea farms were recorded in 1988; during 1989 the disease was recorded from 26 farms. The bacterial strains isolated are fairly resistant to oxytetracycline. Bacterial kidney disease (BKD) was recorded for the first time in Finland in 1989. The disease occurred in a cage farm with Atlantic salmon and rainbow trout. The affected salmon were slaughtered out. As the disease occurred in an area with intensive fish farming, it is expected the disease will spread more widely. A project on the accumulation and retention of antibiotics in fish farm sediments was carried through.

France (F Baudin-Laurencin)

Pancreatic disease was the most significant disease since an outbreak in Atlantic salmon gave a 25% mortality rate. Again, this disease was also observed in brown trout. Most of the salmonids were successfully vaccinated against vibriosis, but the disease gave a significant mortality in non-vaccinated juvenile turbot. A second pathogenic strain of *Vibrio anguillarum* was

identified in turbot in the south of the French Atlantic coast. New problems of unknown future significance were hepatic nodules in Atlantic salmon and a muscular and visceral microsporidiosis in turbot.

Iceland (S Helgason)

Diseases of salmonids: Atypical furunculosis (*Aeromonas salmonicida* subsp. *achromogenes*) has been detected in Atlantic salmon and arctic char in 11 shore-based rearing facilities and one cage farm - a similar situation as the year before. All sizes of fish from smolts to slaughter size fish and brood fish are affected. Disease symptoms vary. Fish may die without obvious lesions, but sometimes haemorrhage is seen in the eyes and at the base of the pectoral and pelvic fins. In more advanced cases, haemorrhage and blood-filled pustules and even open lesions develop. There are varying degrees of haemorrhage in internal organs. The frequency and severity of outbreaks depends on various factors such as the quality of smolts, grading technique and frequency, and the stability of environmental factors such as salinity and temperature. The outbreaks are almost always limited to brackish water. Oxolinic acid and a sulpha-trimethoprim compound is generally used to control outbreaks. Frequently, repeated treatment is needed. In 1989, the first antibiotic-resistant strain of *A. salmonicida* subsp. *achromogenes* was detected, i.e. resistant to a sulpha-trimethoprim.

In 1989, bacterial kidney disease (BKD) was detected on four sea cage sites rearing Atlantic salmon and rainbow trout, compared to two in 1988, and in returning Atlantic salmon to one sea ranch, compared to two in 1988. The two cases from 1988 had both the same source of smolts, but the two new cases in 1989 were tied together and could be traced to a new source of infection. Presently there is insufficient information available regarding the significance of this disease on the cage sites, because the mortality is frequently associated with other factors such as skin lesions which develop during the coldest winter months. The initiation of these skin lesions may be mechanical damage caused by lice (*Caligus* spp.) with subsequent rubbing in nets, or by mechanical damage of skin by nets in heavy seas, especially when fish are crowded in cages. The healing of the wounds is hampered at low temperatures and/or by low vitamin content, especially vitamin C, in wet food pellets, and by environmental bacteria, such as *Vibrio* spp. and *Flexibacter* spp., which easily invade the open lesions. Occasionally, similar lesions develop on fish in shore-based tanks. The initiation of these lesions is likely to be due to the bad quality of smolts, grading of fish and insufficient vitamin content of the food.

Sea lice, especially *Caligus* sp., are frequently a problem on fish in sea cages. Nuvan and Neguvon have been used to control this problem. Sea lice have not been able to proliferate on fish in shore-based tanks, even in full strength seawater because the rearing water is either pumped through bore-holes or directly from the sea at some depth. The lice will gradually die off fish when they are transferred from sea cages to tanks with full-strength seawater, without any special treatment. Most likely the renewal of seawater is sufficient to wash all larvae out of

the system.

Exophiala sp. was isolated for the first time in 1989 from Atlantic salmon on 2 fish farms rearing fish in shore-based tanks. Infected smolts were transferred from one of the farms to the other. The origin of infection is unknown. The prevalence of infection is apparently low and no mortality has been associated with this infection.

Diseases of halibut: As mentioned above, small wild fish have been caught at sea and transported alive to shore-based rearing tanks. Disease problems have been few and of minor importance. Mechanical damage of epithelial tissue which occurs during catching and transport may lead to open skin lesions and subsequent death due to osmoregulatory failure. Favourable environmental rearing conditions, e.g. a layer of sand in tanks, aids the healing of lesions, but occasionally a bath treatment with a compound like flumequine is needed. Parasites like *Lepeophtheirus hippoglossi*, *Entobdella hippoglossi* and *Trichodina* sp. have been isolated from newly caught individuals. Formalin treatment is efficient, but the overall effect of these parasites is small.

Ireland (J McArdle)

Pancreas disease: This disease continues to be the most serious disease of farmed salmon in Ireland. About 15 sites were affected and losses due to the disease were severe, up to 80% losses in some instances. No disease agents have been isolated from affected fish. A major research project funded by the EC is at present underway at University College, Galway. Like DAFS at Aberdeen, it seems they have had some success in transmitting the disease. Good management practices appear to be important in alleviating the losses.

Sea lice: Sea lice continue to be a significant problem at most marine salmon farms in Ireland. *Lepeophtheirus* sp. and *Caligus* sp. are involved. The standard treatment continues to be Dichlorvos. Because of pressure from environmentalists and the difficulties in effectively treating the disease with this drug, newer treatments are being studied at University College, Galway. The use of Ivermectin is showing some promise and trials have shown that lice can be very well controlled by this drug. However, further work on residues and environmental effects are required.

Furunculosis: This continues to be the most important bacterial disease of farmed salmon in Ireland. A number of sites were affected in 1989. Problems of antibiotics resistance have begun to emerge, in some cases multiple drug resistance. Trials using commercial vaccines were commenced at one site last year and some immunity appears to have been conferred following use of an injectable vaccine. A "relative percentage survil (RPS) of 68% was the level of protection achieved.

Emerging disease problems: An intra-erythrocyte inclusion-type virus was detected in fish at one farm which was associated with mortality.

Actinobacillus-like disease: A disease which resembled actinobacillosis was observed at one farm and resulted in significant losses was detected at one farm.

Norway (P van Banning)

Bacteria: Furunculosis has had a significant spread among seawater fish on the west coast of Norway and is continuously spreading to new areas. The most likely way of spread has been through water. The frequency of Yersiniosis has been reduced significantly and is no longer a problem of any significance in fish farms in Norway. *V. vulnificus* infection in farmed eel and *Nocardia* infections in Atlantic salmon were detected for the first time in 1989.

Viruses: Infectious anaemia in Atlantic salmon (ISA) has now been detected in about 80 farms since its first description. In affected fish, two virus particles with a size of approximately 80-90 nm have been detected in red blood cells. The significance of these virus particles is still to be determined. There seems to be an increase in the number of cases of clinical IPN in Atlantic salmon and IPN virus has been isolated from moribund turbot and halibut fry. Erythrocytic inclusion body syndrome virus (EIBSv) has been detected in Norway for the first time.

Parasites: Salmon lice is still the major parasite problem. Trials with a new compound (pyrethrum) have shown promising results. *Gyrodactylus salaris* has been detected in two additional rivers. *Hexamita salmonis* and *Gyrodactylus bykowskii* have been reported found on Atlantic salmon in seawater.

Portugal (J Menezes)

Concerning finfishes, mariculture is not yet very significant. Nevertheless, in some coastal areas, artisanal polyculture had social economic interest; however, about 50% of farmed finfishes were mullets that are (for the time being) low-price marketable species. After 1986, considering the availability of EEC/FEOGA funds, 71 projects were submitted, concerning mainly sea bass, gilthead seabream, salmon, turbot and eel (as well as kuruma prawn, clam and sea scallop). The approved projects, including 2 hatcheries, are almost in full operation. The majority of finfish cultures are low semi-intensive units in earth ponds improved from artisanal polycultures and from inactivated salt basins. The two hatcheries, two intensive salmon farms, and some semi-intensive fish farms (sea bass and gilthead sea bream the target species) are in process.

This preliminary information allows an understanding of the knowledge of the actual health status of mariculture in Portugal. Indeed, a high number of potential pathogens in culture conditions were identified which allowed the implementation of prophylactic measures. Among them are conspicuous parasitic diseases like sea bass argulosis and diplectanosis of skin and gills. The importance of prophylaxis, including the adequate management implementation, is emphasised.

Spain (A Figueras)

Since 1983, *Vibrio anguillarum* continues to be the main causative agent of epizootics in small turbot (<20 g). Serotypes 01 and 02 of this species have been isolated. Since 1986, vibrios closely related to *V. anguillarum* (*V. splendidus* and *V. pelagius*) have been implicated in mortalities of all cultured fish species in the Atlantic coast (turbot, Atlantic salmon, Pacific salmon and rainbow trout) affecting both juveniles and adult fish. On some occasions, these vibrios were isolated from turbot in association with viral infections. Vibriosis caused by *V. vulnificus* biotype 2 was only notified in European eel cultured in the Mediterranean coast and represents the first description of this species in Spain. Other vibrios, *V. fischeri* and *V. harveyi*, were isolated from turbot in sporadic cases associated with mixed pathologic syndromes (i.e. parasites, tumours).

Septicaemia by aeromonads (*Aeromonas hydrophila* and *A. sobria*) caused low and continuous mortalities in European eel, affecting all sizes. In sea bass cultured on the Mediterranean coast, an *Edwardsiella* sp. has been isolated for the first time, which caused the mortality of practically all the fish stock.

The drugs routinely administered to farmed fishes for controlling the majority of bacterial infections are oxytetracycline, oxolinic acid, flumequine and nitrofuranes. Whereas, the *V. anguillarum* strains isolated on the Atlantic coast were sensitive to oxytetracycline, an important number of *V. splendidus* implicated in turbot mortalities showed their resistance to this antibiotic.

Until now, the viral infections in farmed fishes in marine waters did not represent important economic losses. In cultured turbot, only an Irido-like virus has been isolated in association with *V. splendidus* from an haemorrhagic syndrome which produced low mortalities in adult fishes. Viral erythrocytic necrosis (VEN) was only reported in sea bass, affecting both cultured and wild populations which appear to be becoming more susceptible to bacterial infections.

Fishes with external symptoms similar to pancreas disease were observed for the first time in 1989 in Atlantic salmon imported from Ireland. Parasitation of turbot by *Bothryocephalus* will be an interesting topic to study in the next years.

Sweden (J Thulin)

Two serious infectious diseases, furunculosis and BKD, have spread considerably, the latter one with over 60% increase since last year. The diseases are spread mainly by transport of living fish and eggs. Regarding furunculosis, the white-fish (*Coregonus* spp.) is also a suspected vector. The infectious dermatitis (ASA) has been recorded in 58 farms in different parts of the country and two new cases of Yersiniosis have occurred. Finally, a disease similar to the Norwegian infectious salmon anaemia has been recorded to occur in rainbow trout.

United Kingdom

(a) England and Wales (D Bucke)

Significant numbers of fin-fin are not cultured in the marine environment in England and Wales and no major disease problems have been observed.

(b) Scotland (A McVicar)

Atlantic salmon: The salmon farming industry in Scotland continues to grow with the 1989 production being 28,553 tonnes (a 58% increase from 1988). A trend in decreasing survival rates from smolt to harvest has continued with only 2 out of 3 fish now surviving. This and the lowest ever recorded mean weight for harvested salmon has been attributed particularly to disease and is not solely due to management and marketing decisions. The industry is responding by introducing area management plans where different companies with local interests co-operate and by reducing maximum stocking densities in cages. Furunculosis continues to be an increasing problem, particularly with strains showing multiple antibiotic resistance. Trials are in progress on a new vaccine. There are indications of increasing tolerance of sea lice to Dichlorvos and alternative compounds and strategies, e.g. vaccination, cleaner fish are being investigated. Increased research effort is being directed into the infectious cause, prevention and control of pancreas disease which shows a gradually increasing prevalence in the industry with direct and indirect economic effects.

A new problem first recognised in 1988, and apparent again in 1989, was "fading smolt syndrome" where post-smolts having grown well after seawater transfer. There is no evidence of infection but at present the aetiology is unknown.

(b) SHELLFISH

Canada (S McGladdery)

This year, a previously undescribed protozoan parasite was found in the connective tissue of broodstock bay scallop (*Argopecten irradians*). This parasite elicited a strong hyalinocyte encapsulation response, but was only readily detected, using histology, in adult scallops. It appears to be transmitted from the broodstock to the spat generation, although transmission studies are ongoing. It produced Lugol-positive spores after incubation in fluid thioglycollate, hence the tentative description as *Perkinsus*-like. So far, this parasite has not been detected in indigenous bivalves, although field surveys are continuing. The known occurrence of what appears to be the same parasite in bay scallops from Rhode Island and Cape Cod suggests that it may have been introduced with the original bay scallop stock in the late 1970s at an undetectable level. Extensive quarantining to the 7th generation, however, failed to reveal this parasite at that time.

Recently, a die-off of quahog (*Mercenaria mercenaria*) spat at an experimental shellfish hatchery revealed massive inflammation, hemocyte necrosis and what appear to be gregarine gametocytes.

Work on the identification and epidemiology of this parasite is just starting.

France (E Miahle)

Marteilia refringens/Ostrea edulis. In relation to a particularly hot summer, several *Marteilia* outbreaks were observed in different areas (west and south Britanny, Arcachon Basin). The high prevalences, noticed in Rade de Brest, led to block transfers to Cancale. Thus, marteiliosis continues to limit flat oyster production, especially in rivers and bays. First experiments have shown that *O. puelchana* is sensitive to this parasite.

Bonamia ostreae/Ostrea edulis: The disease prevalence was relatively high in all the flat oyster production areas. Good results were obtained in deep waters where there were low spat densities. Several comparative assays are in progress for different spat origins (Mediterranean, Atlantic). Experimental stresses (mechanical, emersion) have been applied to establish their effect on bonamiasis development. Complementary experiments are being conducted to determine the best times for oyster transfers. Concerning *Bonamia* diagnosis, it is now important to indicate the reliability and suitability of the ELISA kit, which has been tested by teams in different countries. In the case of large epidemiological surveys at the European scale, this qualitative and quantitative assay is more efficient that light microscopy because it is better adapted for large samples and equivalent in sensitivity. In order to have a very sensitive method in fundamental research for *Bonamia* diagnosis, the parasite's DNA was cloned and restrictive fragment sequencing is in progress for PCR application.

Rickettsia sp./Pecten maximus: A gill rickettsia, observed in 1986 in several *Pecten maximus* beds, is now putatively related to the scallop mortalities on the basis of epidemiological surveys and physiopathology analyses. The procaryote appears non-transovarially transmitted and experimental horizontal infections were successfully performed with purified rickettsias. In the field, scallop spat become quickly infected. Preliminary experiments suggest a positive effect at first rearing time (3-6 months) in non-infected areas (e.g. Mediterranean), since such young scallops are significantly less infected than control animals after several months in the same infected area. Complementary experiments will be performed.

Vibrio sp.(P1)/Ruditapes philippinarum: After a serious national outbreak of brown ring disease, the situation has eased because of the elimination of infected stocks and by the possible beneficial effect of high summer temperature.(*Vibrio* P_1 is sensitive to temperatures above 30°C when exposed for a few hours). Moreover, a treatment was devised for decontamination of young scallops, applied when leaving the nurseries (Furazolidone, 10 ppm, 3 x 24 h). Other bivalve species in contact appear non-sensitive to *Vibrio* P_1.

Perkinsus sp./R. philippinarum: *Perkinsus* sp. is always observed in *R. philippinarum* populations, but the prevalences are always

very low. No mortality was related to the parasite.

Crassostrea gigas: A collaborative study (France/USA) is being conducted on oyster velar irido-virus, which is ultrastructurally similar to LDV. In order to try to obtain suitable reagents for epidemiological studies in larval populations, a set of polyclonal and monoclonal antibodies for LDV has been prepared.

In collaboration with S Bower, serological comparisons between *B. ostreae* and Denman Island microcell were performed, leading us to totally distinguish the parasites. DNA probes, specific for *B. ostreae*, will also probably be tested.

Germany (H Möller)

No information is available on the disease status of the oyster, *Crassostrea gigas* and the mussel, *Mytilus edulis*, cultured along the German North Sea and Baltic Sea coast. However, a veterinary authority is conducting microbiological and chemical studies on a regular basis on the occurrence of pathogens, algal toxins and pollutants potentially harmful to human consumers.

Ireland (J McArdle)

No disease outbreaks reported.

Netherlands (P van Banning)

The protozoan oyster pathogen *Bonamia ostreae* has spread in 1989 through the central part of the Dutch oyster area Grevelingen. Only the oyster stock of the eastern and western part of the Grevelingen was still free of Bonamiasis. In the central part of the Grevelingen, Bonamiasis reached in the autumn (September-November) a prevalence range of 6-8% in the wild oyster stock, and a prevalence range of 2-46% in the commercial oyster plantings. For management purposes, a special research programme was started to check the possibilities for continuation of a commercial oyster production under the recently developed status of Bonamiasis in the Grevelingen. The results of this research programme showed that in the oyster growing season of 1989 the Bonamiasis prevalence increased from a range of 2-8% in June to a range of 20-40% in October. Mortalities due to Bonamiasis reached in October/November a prevalence range of 20-47% in the management research programme and a range of 6-80% in the commercial oyster plantings. The results of the Bonamiasis research of 1989 revealed that planting densities of oysters and different fishing or planting techniques are of no effect on the development of Bonamiasis. However, environmental circumstances ruling the physiological status of the oysters (e.g. temperature and depth of an oyster area) and stress-inducing factors (e.g. fishing and replanting of oysters) have a boosting effect on the development of Bonamiasis.

Norway (B Hjeltnes)

A new screening programme has been started for control of the health and parasite status of bivalve molluscs in commercial production. Broodstock population of oysters and clams used in hatcheries and lagoons are the primary subjects of investigation. No pathogenic agents (*Bonamia*, *Marteilia*, *Perkinsus*,

haplosporidia, etc) have so far been detected.

Portugal (J Menezes)

In Portugal up to 1986, mariculture social economic importance was related to clam, *Ruditapes decussatus*, production in Algarve (south coast) representing about 73% of total Portuguese aquaculture production. It is important to underline that 20 years ago, Tagus and Sado estuaries (near Lisbon) produced around 20,000 metric tonnes of Portuguese oyster, *Crassostrea angulata*, being now almost nil due to environmental degradation after non-controlled industrial development (shipyard, chemicals, pesticides, etc) and opportunistic pathogens that found suitability in debilitated animals. The culture of other molluscs, like mussel, flat oyster and crustacea, was very small or absent.

Spain (A Figueras)

Culture of the flat oyster is almost non-existent. The main activity is based on the importation of flat oysters from all over Europe: the most important providers are Greece, Turkey, Italy, Yugoslavia and England. *Bonamia* is present in Galician waters and cumulative mortalities reach 80-90% by the end of the second year. The health status of the imported oysters is not monitored, although there is a strict regulation on imports and quarantines because the volume of the merchandise is such that it is almost impossible to control the disease. In a study carried out with native oysters, *Bonamia ostreae* had the highest prevalence at the end of the culture cycle with values of 80%. During the year of 1989, the monthly mortality rate reached 30% in the experimental culture trays.

The most valuable species of clams is *Venerupis decussatus*. One of the most important providers of clams is Portugal where a *Perkinsus*-like organism causing mortalities has been detected. This organism has been detected also in clams imported into Spain and held, as is ruled by law, in depuration plants. Severe mortalities were detected. In November 1987 another mortality was detected in several depuration plants. The histological examination revealed the presence in 50% of the 30 animals examined had plasmodial stages of an *Haplosporidium* similar to the one described by Chagot *et al.* (1986) in Portuguese clams and a *Perkinsus*-like organism. A study is being carried out to clarify which of the two parasites could be causing these mortalities. The same parasites have been detected in cultured clams from the south of Spain. Attention should be paid to these parasites, keeping in mind the *Marteilia* and *Bonamia* examples in the *Ostrea edulis* culture in France. A monitoring experiment has been carried out during the year 1989. Mortality rates could not be followed. The prevalences of *Perkinsus* sp., tested using the thioglycollate method, reached 30%. Right now the prevalence of *Perkinsus* sp. and of the *Haplosporidium* sp. is being studied. The first results show a prevalence of around 30% for both parasites.

There have been importations of Manila clams (*Venerupis semi-decussatus*) from France showing signs of what is called "brown ring disease". No mortalities were detected, nor was the syndrome found in the areas where these species of clams are

cultured (mainly the south of Spain). In Andalucia, clams of the same species have been found with a similar type of brown deposit in the internal part of the shell, but no mortalities were detected. A bacteriological study made with samples of clams with and without the syndrome showed the presence of several strains of *Vibrio* sp.

Mortalities of cockles (*Cerastoderma edule*) have occurred in depuration plants. The relationship between the presence of parasites and the mortalities is not clear.

In the case of the mussel culture, although several parasites and histopathological conditions have been detected there have been no mortalities at all. Mussel growers complain that during summer the mussels must be handled with a lot of car because there is an important death rate. This, if true, could be attributed to the combination of double and triple infections with different parasites (*Marteilia maurini*, ciliates and the parasitic copepod, *Mytilicola intestinalis*) and adverse environmental factors such as high temperatures. Mussels have an advantage in that there is almost no time available for the development of a strong infection, since they reach the commercial size (7-9 cm) in less than 18 months.

United Kingdom (D Bucke)

Bonamia in *Ostrea edulis* remains the only problematic disease in relaid molluscan stocks. Where stocks were relaid under MAFF guidelines prevalence levels of the disease were kept below 10% after one growing season.

Gaffkaemia was confirmed as the cause of substantial losses (up to 20% per day) of *Homarus gammarus* stocks held in 3 holding sites on the south and west coasts during the summer months. The cases could be tentatively linked imports of North American lobsters. Sites were emptied and the holding facilities disinfected.

U.S.A. (E Burreson)

After 4 years of drought, 1989 was a year of above-average rainfall for the eastern United States. The resulting low salinity greatly reduced the prevalence and intensity of *Haplosporidium nelsoni* (MSX) in oysters along the Atlantic coast, including Delaware Bay and Chesapeake Bay. This disease was not a source of significant oyster mortality in most areas during 1989. Unfortunately, the decreased salinity has little effect on *Perkinsus marinus* in the Chesapeake Bay. This parasite persisted tenaciously on all oyster beds in Virginia and most beds in Maryland and caused mortality in areas where salinity was above about 12 ppt during summer. Oyster production in Virginia declined to a record low 209,605 bushels in 1989 as a result of the combined effects of the two diseases and continued fishing pressure. There have been no reports of new diseases or significant changes in the status of other, less important, shellfish diseases.