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Second Interim Report of the Working Group on Pathology and Diseases of Marine Organisms (WGPDMO)

25–28 February 2014

ICES Headquarters, Copenhagen, Denmark

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Contents

Executive summary

The ICES Working Group on Pathology and Diseases of Marine Organisms (WGPDMO) met on 25–28 February 2014 at ICES in Copenhagen, Denmark. The meeting, chaired by Neil Ruane (Ireland), was attended by 12 participants representing 10 ICES Member Countries. In order to consider the 11 Terms of Reference, intersessional work was done by WGPDMO members and several working documents were provided in advance of the meeting.

The agenda items covered a wide range of topics related to diseases and pathology in wild and farmed finfish and shellfish.

The group produced a report on new disease trends in wild and farmed fish and shellfish in the ICES area, based on national reports received from 10 member countries. Norway has reported a 50% decline in the number of cases of infectious pancreatic necrosis, believed to be due to eradication of IPN virus in hatcheries along with the use of selective breeding for resistance to the disease. It is hoped that in the future, a similar success can be achieved against other viral diseases such as pancreas disease. Amoebic gill disease, which is now endemic on marine Atlantic salmon farms in Ireland and Scotland, is spreading in Norway. The disease has also been reported in cleaner fish which are increasingly used as a biological control for sea lice.

The FDI methodology is currently being prepared for publication as an ICES TIMES report. A number of additional working documents were also discussed, such as "Parasites of marine finfish and shellfish posing a hazard to human health", "Trends in important diseases affecting the culture of fish and molluscs in the ICES area" and "Disease-associated population effects in commercial marine fish and shellfish species". All of which are planned to be ready for publication by the final meeting next year.

WGPDMO also discussed the current OSPAR request on 'Disease interactions between wild and captive fish stocks', the summary response can be found in Annex 5.

Two new ICES Identification Leaflets for Diseases and Parasites of Fish and Shellfish were published and are available on the ICES website. These are 'Piscine myocarditis (cardiomyopathy syndrome)' and 'Amoebic gill disease (AGD) of farmed Atlantic salmon'.

Specific recommendations from the meeting include (see Annex 2):

- It is recommended to obtain material of 'red eye syndrome' in Barents Sea cod for histological and other laboratory analysis for more complete characterisation of the condition.
- The WGPDMO noted with concern that some ICES member countries have not provided sufficient resources to support wild fish monitoring programmes, resulting in an insufficient spatial and temporal coverage of fish populations. It was emphasised that this lack of data will affect marine ecosystem health assessments in national and international programmes (e.g. under the EU Marine Strategy Framework Directive, OSPAR Coordinated Environmental Monitoring Programme (CEMP), and revised HELCOM monitoring programme). Additionally, there is a risk that emerging disease conditions affecting marine fish will not be detected.
- WGPDMO request that the disease maps are removed from the ICES website.

1 Administrative details

Working Group on Pathology and Diseases of Marine Organisms

Year of Appointment: 2013

Reporting year within current cycle: 2

Chair:

Neil Ruane, Ireland

Meeting venue

ICES, Copenhagen, Denmark

Meeting dates

25–28 February 2014

2 Terms of Reference a) – k)

ToR a) New disease trends in wild and cultured fish, molluscs, and crustaceans based on national reports.

ToR b) Parasites and other infectious agents in marine finfish and shellfish species posing a hazard to human health.

ToR c) Disease interactions between farmed and wild finfish.

ToR d) ICES publication 'Trends in important diseases affecting the culture of fish and molluscs in the ICES area 2003 – present'.

ToR e) Maps of fish and shellfish diseases.

ToR f) The Fish Disease Index (FDI) in relation to results of FDI assessments of diseases of flounder and Baltic cod and liver histopathology and macroscopic liver lesions in the common dab.

ToR g) Disease associated population effects of commercial fish and shellfish species.

ToR h) ICES publications on pathology and diseases of marine organisms.

ToR i) Provide expert knowledge and advice on fish disease and related data to the ICES Data Centre on a continuous basis.

ToR j) Development of templates for the national reports from ICES Member Countries.

ToR k) OSPAR Special Request (OSPAR 4/2014) Interactions between wild and captive fish stocks.

3 Summary of Work plan

ToR a) New disease conditions and trends in diseases of wild and cultured marine organisms will be reviewed. This is an annual, ongoing ToR for WGPDMO and will provide information for ToR d).

ToR b) A range of parasites and other infectious agents reported by WGPDMO have the potential to be harmful to human health if ingested in under processed food.

There is an upward trend in the consumption of raw fish and other seafood products which may increase this risk. Literature reviews of risk, prevention and mitigation strategies will be prepared.

ToR c) WGPDMO has produced reports on disease interactions between farmed and wild finfish since 2010. The reports will be reviewed and a decision made regarding their suitability for publication in an ICES journal. Contact with WGEIM and WGAQUA will be established should collaboration be deemed necessary (see ToR k).

ToR d) The previously published report requires updating with new information on diseases of importance for aquaculture, including new and emerging diseases. The current draft of the document will be reviewed and final updates added during the meeting with a view to preparing the report for publication as an ICES Cooperative Research Report.

ToR e) Much of the information presented on the ICES website regarding the distribution of aquatic diseases is outdated. WGPDMO will discuss the suitability of the maps in the light of the current reduction in wild fish monitoring programmes in ICES Member Countries and potential duplication of information presented by other organisations.

ToR f) The FDI has been validated for use in dab, flounder and cod. The preparation of data sets and an approach to calculate the FDI using the free software R will be discussed.

ToR g) The potential risk to fish and shellfish populations due to disease is of considerable ecological and economical concern. A report providing information on diseases causing population effects will be discussed.

ToR h) A number of ICES publications currently in preparation will be reviewed by WGPDMO. This is an ongoing, annual ToR.

ToR i) This is an annual ToR in compliance with a request from the ICES Data Centre.

ToR j) Variability exists within the National Reports for wild and farmed finfish and shellfish regarding disease occurrence and how it is reported. A generic reporting structure will be presented and discussed as to its suitability for use in future meetings.

ToR k) In response to a special request from OSPAR (4/2014) on interactions between wild and captive fish stocks, WGPDMO will discuss how the current ToR (c) can be utilised to provide a response to this request.

4 List of Outcomes and Achievements of the WG in this delivery period

- A report on new disease trends in wild and farmed fish and shellfish in ICES Member Countries, which is the only annual expert report available on this topic.
- ICES Disease Leaflet Series (new): No. 59 'Piscine myocarditis (cardiomyopathy syndrome' (D. Bruno).
- ICES Disease Leaflet Series (new): No. 60 'Amoebic gill disease (AGD) of farmed Atlantic salmon (*Salmo salar* L.' (N. M. Ruane & S. R. M. Jones).

5 Progress report on ToRs and workplan

5.1 Produce an update of new disease trends in wild and cultured fish, molluscs and crustaceans based on national reports (ToR a)

The update in the following sections is based on national reports for 2013 submitted by Canada, Denmark, England & Wales, Finland, France, Germany, Ireland, Norway, Poland, Russia, Scotland, Sweden and the USA. It documents significant observations and highlights the major trends in newly emerging diseases and in those identified as being important in previous years.

5.1.1 Wild Fish

Viruses

Piscine reovirus (PRV) associated with heart and skeletal muscle inflammation (HSMI) in Norway had a prevalence of 14% in Atlantic salmon brood fish. Phylogenetically related strains do not appear geographically connected and may originate from cultured fish. In Western Canada PRV was detected by quantitative real time PCR in adult Pacific salmon: 36% Chinook, 21% Coho and 19% sockeye salmon. No histological evidence of HSMI was detected.

Viral haemorrhagic septicaemia (VHS) was detected in wild caught ballan wrasse, cuckoo wrasse, corkwing wrasse, rockcook wrasse and goldsinny wrasse contained in holding facilities in Scotland for use as 'cleaner fish' for salmon lice. VHS genotype3 was detected in moribund fish belonging to all 5 species of wrasse. Morbidity was not linked to virus isolation since several other pathogens were detected. There was no evidence of VHSV in farmed salmon, where stocks of these wrasse had previously been used. [www.scotland.gov.uk/Resource/0043/00435632.pdf]

Bacteria

Renibacterium salmoninarum was isolated from a single Atlantic salmon brood fish, this being the first report in wild salmon in Bothnian Bay, Finland.

Oomycetes

In Finland and Sweden, numerous reports of severe *Oomycete* infections in mature Atlantic salmon and European whitefish in the rivers and river outlets of Bothnian Bay.

Parasites

Crustacea

Salmon lice surveillance results of wild salmonids in Norway concluded that sea lice infection pressure in Atlantic salmon was reduced in 2013 in most areas compared to 2012, while infection pressure seemed to increase for sea trout during the summer.

Myxozoa

Myxidium/Zschokkella-like infection was detected in emaciated Atlantic cod, captured by trapping in the coastal region of the Baltic between the county of Skåne and Blekinge, Sweden and were associated with multiple liver cysts and necrotic bile ducts. Samples from skin ulcers and superficial skin erosions, taken from the same

fish, revealed the presence of different fungal pathogens (*Acremonium* spp., *Mucor* spp. and *Cladosporium* spp.). However, these were not associated with clear histopathological findings. Further investigations are planned.

Nematoda

Anisakis simplex was found in Baltic herring (2/229) and Atlantic salmon brood fish (2/331) in the Gulf of Bothnia in Finland In Poland the prevalence of cod infected with anisakid nematodes (*A. simplex* and *Contracaecum osculatum*) increased in comparison to the results of studies conducted in earlier decades (4% in the 1980s and 1990s) and a further increasing trend was observed in 2011 (11.2%) and subsequent years (> 50% in 2012/2013).

Pseudoterranova decipiens shows an increasing prevalence in cod from the Baltic (2% in 2012 to 30–40% in 2013, n=147) at locations east of Bornholm Island. In Finland the parasite was found in perch which is the first time it has been reported in this species.

Digenea

Diplostomum petromyzi-fluviatilis was detected in 21% of spawning river lampreys sampled from rivers entering the Gulf of Bothnia, Finland.

***Diplostomum* spp.** metacercariae were found in association with cataracts in European flounder (n = 88) caught at different depths around the island of Gotland, Sweden. The highest prevalence (95%) of cataracts was seen at a depth of 10 m and the lowest (47%) was found at 70 m.

Other diseases

Externally Visible Diseases – A clear gradient of increasing prevalence was recorded in common dab from the German Bight to the SE Dogger Bank.

'Red eye' syndrome – accounted for 76.5% of recorded pathologies in Barents Sea cod, but appears to be decreasing in polar cod, blue whiting and capelin. The aetiology of this condition remains unknown.

Conclusions

- The prevalence of anisakids in Baltic Sea fish species is increasing. The potential correlation between this increased prevalence and an increase in the grey seal population in the Baltic should be investigated.
- WGPDMO should instigate further investigations into the aetiology of Red-eye Syndrome in the Barents Sea.

5.1.2 Farmed Fish

Viruses

Infectious Salmon Anaemia Virus (ISAV) – The number of cases in Norway increased to 10, from 2 in 2012. Seven of these cases were primary outbreaks and three were the result of horizontal transmission through water from affected sites.

Infectious Pancreatic Necrosis Virus (IPNV) – In Norway, the number of sites with clinical disease decreased to 56, from 119 in 2012. The decline may be related to increased use of IPN-resistant salmon and eradication of the virus in hatcheries. On the east coast of Sweden, two cases in rainbow trout triggered depopulation at both sites. In Finland, the number of cases increased to 12, from 4 in 2012. All but one case be-

longed to genogroup 2, the other belonged to the more pathogenic genogroup 5. There was no clinical disease in Swedish or Finnish cases.

Viral Haemorrhagic Septicaemia Virus (VHSV) – In Finland, the virus was not detected in rainbow trout following several years of decline.

Piscine Reovirus (PRV) – In western Canada, piscine reovirus was detected by real-time RT-PCR in 67 of 78 (86%) of Atlantic salmon (from 8 marine sites and several unknown locations) and in all 30 (100%) Chinook salmon sampled from one site. There was no histological evidence of HSMI in any of these salmon. Virus sequences from two Atlantic salmon and one Chinook salmon were identical to a Norwegian virus sequence.

Piscine Myocarditis Virus (PMCV) – The number of CMS outbreaks in Norway continued the upward trend with 100 cases, up from 89 in 2012.

Salmonid Alphavirus (SAV) – In Norway, the number of cases of pancreas disease decreased to 99 from 137 in 2012. The decline was associated with genotype SAV3 (to 48 from 97 cases) whereas, genotype SAV2 increased to 51 cases from 44. Similarly in Scotland, there was a continued decrease in SAV to 11% of cases investigated by Marine Scotland from 13% in 2012 and 19% in 2011. In contrast, in Ireland the number of cases increased to 8 from 5 in 2012.

Bacteria

Vibrio salmonicida – Cold-water vibriosis was the major disease problem in Atlantic salmon production during the 1980s in Norway, however, after vaccines were introduced the disease has almost been eliminated. Despite ongoing vaccination, the number of cases in Northern Norway remains high (five cases were reported in 2011, 21 in 2012, and 13 in 2013, mainly in salmon, a few involving rainbow trout).

Parasites

Crustacea

Lepeophtheirus salmonis – Sea lice remain a serious challenge in Scotland, Ireland and Norway. The situation regarding lice being multi-resistant against pharmaceuticals is aggravated in Norway. Salmon have been slaughtered where farms could not comply with the regulations stating maximum lice counts per fish. A surveillance programme for resistance has been established.

A new model for infection pressure for sea lice has been developed by the Norwegian Veterinary Institute. The model is based on reports of lice counts in fish farms, number of fish in the region and water temperature. The method involves a simple stepwise processing of lice data and results in estimates of the relative densities of infectious copepodites along the coast. This estimates the actual infection pressure from each aquaculture site. The results can be combined to show infection pressure at any given time in different areas. This model demonstrates a reduction in infection pressure in 7/9 counties in Norway, in 2013 compared to 2012, while 2/9 experienced an increase.

The situation in Scotland with sea lice was mixed and largely area specific depending on the stage of the production cycle. Lice burdens in the North West of Scotland were elevated and intervention treatments were required. Companies use a range of treatments to reduce the risk of resistance build up, i.e. initial treatment with SLICE followed by a second bath treatment with Excis or hydrogen peroxide, the latter

becoming common in 2013. Reports of reduced efficacy to SLICE have resulted in a number of sites struggling to keep counts below threshold levels. Currently authorisation for a range of treatments and a sound management strategy to reduce the risk of efficacy issues has been successful. The general trend is a build-up of lice in the second year of production when site biomass is high, however complicated by other infections such as pancreas disease or amoebic gill disease which reduces the range of options for treatment.

Paramoebida

***Paramoeba perurans* –** In Norway, the number of cases of amoebic gill disease (AGD) in Atlantic salmon increased to 52 from 5 in 2012. Losses varied from negligible up to 50%. In Norway, AGD has also been diagnosed in ballan wrasse and corkwing wrasse. Amoebic gill disease continues to be a significant issue for marine farming in Ireland with mortality levels averaging 15%. In contrast, Scotland has reported a downward trend (10% of diagnostic cases, down from 39% in 2012).

Conclusions

- A 50% decline in the number of cases of infectious pancreatic necrosis occurred in Norway, possibly associated with use of IPN virus-resistant salmon and virus eradication practises.
- Piscine reovirus is prevalent (>80%) in Atlantic and Chinook salmon in British Columbia, Canada, with no histological evidence of heart and skeletal muscle inflammation.
- A model estimated reduced *Lepeophtheirus salmonis* infection pressure at salmon farms along most of the Norwegian coast. Hydrogen peroxide received temporary approval for bath application on salmon in British Columbia, Canada.
- There has been a 10-fold increase in the number of cases of amoebic gill disease on Atlantic salmon in Norway. Losses ranged up to 50%. The disease is also reported in ballan and corkwing wrasse used as sea lice cleaner fish.

5.1.3 Wild and farmed molluscs and crustaceans

Viruses

Ostreid herpesvirus 1 (OsHV-1) – Mortalities were reported in Pacific oysters from a site in Poole Harbour, United Kingdom and found to harbour the variant μVar. Twenty-three of 30 oysters (77%) were found to be positive for the virus, the identity of which was confirmed through DNA sequencing. 100% nucleotide identity with the OsHV-1 μVar sequenced from France in 2010 was found. The Poole Harbour OsHV-1 μVar differered in sequence by a single nucleotide from viruses found earlier in oysters from Whitstable and Blackwater.

In Ireland, the variant μVar was detected in a further three bays which were part of the surveillance programme, bringing the total positive bays in Ireland to 32. Temperatures were significantly higher in 2013 than in the previous two years, hence prevalence and mortality rates were also significantly higher with up to 100% mortality being reported in some stocks. A single tested site in Scotland was negative for OsHV-1 variants.

Bacteria

***Vibrio aestuarianus* in Pacific Oysters** – the bacterium was identified for the first time in seed and juvenile oysters in four bays in Ireland. *V. aestuarianus* was identified in Scotland from one of two oyster farms that experienced increased mortalities (15% and 40%, respectively) in October 2013. Several cases of abnormal mortality (20 – 60%) were reported in adult oysters (18/18 cases) in association with *V. aestuarianus* detection in France.

***Aerococcus viridans* in European lobster** – *A. viridans* was detected in January 2013 in Scotland in European lobster.

Parasites

***Mikrocytos* sp. in Pacific oyster –** Abnormal mortality (20%) in intertidally farmed, triploid oysters on the north Norfolk coast of southeastern England was associated with a microcell parasite resembling *Mikrocytos mackini*. Genetic analyses indicated that the parasite is novel, and the name *Mikrocytos mimicus* has been proposed. Disease was observed in the spring (May), primarily in adult oysters, and included presentation by the host of discrete pustular lesions in the digestive gland and adductor muscle. The disease emerged following a protracted period of cold weather during late winter and early spring of 2013 but was undetectable in August.

***Bonamia exitiosa* in eastern oyster** – Following its first observation in eastern oysters in North Carolina in 2012, *B. exitiosa* was observed in farmed oysters in Stage Harbour, Cape Cod, Massachusetts, in late June 2013. This was the first definitive observation of this parasite north of Cape Hatteras, North Carolina. Histological prevalence was 23%, and intensities were light, with no associated mortality. The infections were observed in hatchery-produced seed of ~1 month of age exposed to open waters in a nursery system.

***Bonamia ostreae* in dredge oyster** - During October 2013 a routine screening of a wild population from the Menai Strait of northwest Wales, United Kingdom, found 8/150 oysters infected with a parasite of the genus *Bonamia* by histology. Identification of the species was performed by sequence analyses of PCR products from four positive oysters, identifying it as *B. ostreae*.

***Marteilia* sp. in blue mussels -** In Sweden, 2/30 (7%) blue mussels were PCR-positive for *Marteilia refringens* at a farm in the county of Bohuslän, region of Västra Götaland. Two other samples of 30 farmed mussels from the same region were *M. refringens*-negative. One of two samples of 30 wild mussels from Bohuslän was *M. refringens*-positive, with a prevalence of 11/30 (36%). Surveillance for *Marteilia* sp. in blue mussels in areas outside Limfjorden, Denmark, including Kattegat, Belt Sea, Isefjorden, Storebælt and Smålandsfarvandet was conducted between September 2012 and January 2014 and the parasite was not observed.

***Haplosporidium nelsoni* in Pacific oyster** – Two new cases of sporulating *H. nelsoni* were observed in Pacific oyster in Canada and Ireland. In British Columbia, Canada the overall prevalence of infection by *H. nelsoni* remains extremely low (<0.5%), but 1/60 oysters in one sample presented a heavy infection with prominent sporulation. In Ireland, a heavy infection with sporulation was observed in 1/30 oysters sampled during a mortality event. These were the first observations of *H. nelsoni* sporulating in both Canada and Ireland. In both cases, the identity of the parasite was confirmed using molecular assays.

***Perkinsus marinus* in eastern oyster** – Levels of *P. marinus* in wild adult eastern oysters decreased sharply in the Virginia part of Chesapeake Bay, USA, with mean autumn prevalence among 29 monitoring stations falling from 75% in 2012 to 60% in 2013. Considering the reduction in infection intensities as well, this was the lowest degree of *P. marinus* parasitism observed since 2004. Mean prevalences among approximately 1260 Maryland Chesapeake Bay oysters from 43 fixed sampling stations decreased from 59% during 2012 to 57% during 2013. Both values were moderate by comparison to the record-high prevalence of 94% during 2002.

Other Diseases

Microsporidiosis in pink shrimp - A parasite (Cryptomycota: Microsporidia) infecting the musculature of pink shrimp was discovered in July 2013 in 4/2000 shrimp from the Wash fishery of the east coast of the United Kingdom. Histopatopathology and transmission electron microscopy revealed advanced infection of musculature in which unikaryotic life stages (meront, sporont, sporoblast and spores) completely replaced host cell myoplasm. Molecular characterization of the parasite is ongoing.

Shell pests of Japanese scallops - Scallops from the coastal zone of the Sakhalin and Kuril Islands in Russia were infested by a boring sponge of the family Clionaidae and a presumptive *Polydora* sp. (polychaete). Prevalence of sponge infestation varied between 34–42% from coastal waters of Sakhalin Island, and 3–91% from the coastal zone of Kuril Island. Prevalence of *Polydora* sp. infestation varied between 40–70% at sites off Sakhalin Island and 72–100% at sites off Kuril Island. Micro-predatory gastropods, *Odostomia fujitanii*, were also present off Sakhalin Island, at 50% prevalence.

Conclusions

- The range of the OsHV-1 µVar in the Pacific oyster expanded to new locations in Ireland and the United Kingdom.
- *Vibrio aestuarianus* continues to be detected in the context of high oyster mortality. The high numbers of bacteria observed suggest that they may have played a role in mortality which is supported by experimental challenge trails conducted under laboratory conditions. However, the role of other pathogens or environmental stressors acting as trigger factors remains to be elucidated.
- A novel *Mikrocytos* sp. was observed infecting Pacific oysters in England.
- The known geographic distribution of *Bonamia exitiosa* in Eastern oysters in the eastern USA expanded to New England in the northeast. The distribution of the parasite in eastern North American waters and the significance of these new observations in Eastern oyster, after decades of surveillance of this oyster with no detection, are now critical questions.
- *Bonamia ostreae* was observed for the first time in dredge oysters from Wales.

5.2 Parasites and other infectious agents in marine finfish and shellfish species posing a hazard to human health (ToR b)

A draft manuscript entitled "Parasites and other infectious agents in marine finfish and shellfish species posing a hazard to human health" was revised intersessionally by A. Alfjorden, M. Podolska, L. Madsen and T. Karaseva. The following points were discussed: the necessity to focus on zoonotic agents frequently observed in the national reports (with emphasis on new findings and new trends) and reported in the

annual WGPDMO reports, and the need to decide which agents (parasitic, bacterial and viral) of human disease transmitted by the consumption of seafood to be included in the final manuscript. A table containing a list of zoonotic agents recorded in WGPDMO reports 1999–2013 has been prepared (Annex 4). In this period, the most frequently reported pathogens were anisakids and *Diphyllobothrium* sp. The 2014 WGPDMO report shows that there is an increasing problem in fish from the Baltic Sea infected with anisakid nematodes, particularly in cod. This will be included in an updated and revised version of the manuscript, which will focus solely on nematode infections. The paragraph referring to prevention and control of human infection will be updated according to currently available literature data, by including a brief description of other processes, which may potentially affect survival of parasites (i.e. ultrasound and larvicidal effects of monoterpene compounds). A manuscript focusing on the zoonotic agents (and their trends) reported in the annual WGPDMO reports will be presented to the WGPDMO at its 2015 meeting.

5.3 Disease interactions between farmed and wild finfish (ToR c)

A draft manuscript "The extent and significance of pathogen interactions between maricultured and wild finfish: a review" was revised intersessionally by S. Jones, D. Bruno and L. Madsen. Following a request from OSPAR (4/2014) to report on "Interactions between wild and captive fish stocks" for 2014, this ToR has been incorporated with ToR k. A WGPDMO summary response can be found in Annex 5. A full response to this request will involve WGPDMO, WGAGFM, WGMME and WGAQUA. An advice drafting group will combine the different contributions into one complete ICES advice document.

5.4 Trends in important diseases affecting the culture of fish and molluscs in the ICES area (ToR d)

Information on the diseases affecting cultured fish and molluscs of commercial interest have been updated using data from previous WGPDMO reports and published literature. One of the major objectives of the report is to provide a valuable source of information on diseases that are not notifiable in addition to notifiable diseases under EU Directives or to the World Organisation for Animal Health (OIE). For finfish the major diseases have been completed with the addition in the last year of sections on amoebic gill disease, enteric redmouth and pseudomoniasis in eel. For molluscan pathogens, the sections on viral and bacterial pathogens have been completed. Work will continue intersessionally to complete the final sections on parasitic molluscan diseases, and the final report will be reviewed at the 2015 meeting with a view to publication as an ICES Cooperative Research Report.

5.5 Maps of fish and shellfish diseases (ToR e)

T. Lang informed WGPDMO of the status of the ICES disease maps produced by WGPDMO members in the late 1990s, displaying (a) trends and spatial patterns in diseases of North Sea dab for the period 1993–1997 and (b) the geographical distribution of marine VHS virus in commercial fish and *Bonamia ostrea, Marteilia referingens, Perkinsus marinus* in shellfish species in the ICES area. These maps have remained (almost) unchanged on the ICES website since the late 1990s. The future need for the disease maps was discussed at the 2013 WGPDMO meeting.

After internal discussion prior to the 2014 meeting, T. Lang suggested that, for the time-being, these maps should no longer be produced and displayed on the ICES website. This is due to the following reasons:

- At present, it is not clear which countries around the North Sea will continue their wild fish disease monitoring with dab as one of the key target species.
- Information on the geographical distribution of diseases and parasites of commercial fish and shellfish is already available, e.g., on the website of the OIE, in the International Database on Aquatic Animal Diseases (IDAAD) of the OIE Collaborating Centre for information on aquatic animal diseases at Cefas, UK, on the website of the EU Reference Laboratory for Fish Diseases and also in the ICES Disease Leaflets.

The WGPDMO supported the recommendation to remove the disease maps from the ICES website. If new information becomes available in the future, WGPDMO will consider producing new maps that could be published on the ICES website as required.

5.6 The Fish Disease Index in relation to results of assessments of diseases of flounder and Baltic cod, and liver histopathology and macroscopic lesions in common dab (ToR f)

W. Wosniok presented the present state of developing an R package for the FDI analysis of fish disease data.

As agreed at the WGPDMO 2013 meeting, the present SAS programme for FDI calculation is being transferred to an R version, which is a freely available software and more accessible to potential users. In the course of developing the R version, a guiding document was prepared that will later serve as a user manual for the software. The document describes the purpose of the package, the intended output (descriptive statistics, FDI values, FDI assessments on individual and sampling location level, long-term trend analysis if the data allows) and the input required from the user (fish disease data and a control parameter file plus optional standardization parameters, BACs, EACs). It also addresses the default files for standardization and assessment that will be provided as part of the package, and the technical requirements for installing the package. The software package will be distributed as a zip file with a directory structure that can easily be copied by the user to obtain a suitable data processing environment. To facilitate interaction with the package, an Excel based interface will also be supplied. The first version of the R package is expected to be available at the end of June 2014. A TIMES draft, which will make strong reference to the package, is planned for the end of September 2014.

5.7 Disease associated population effects of commercial fish and shellfish species (ToR g)

T. Lang provided information on the status of the draft report that aims at reviewing published information on known or suspected population effects of diseases in marine gastropods, bivalves, crustaceans and fish. The report in its present form provides information for each disease on diagnosis, causative agents, host and geographical range, effects at the individual and population level and discusses the information presented. The major essence of the information is summarized in a table. In a discussion among the responsible WGPDMO members prior to the WGPD-

MO meeting, there was consensus that the contents of the report and its structure need to be revised in order to generate an improved and more concise "product" with a clear "story" that reaches the wider readership envisaged, not only epidemiologists and pathologists, but also ecologists and stock assessment experts. The goal is to publish the information as a scientific paper in a peer-reviewed journal.

5.8 ICES publications (ToR h)

WGPDMO members discussed the status of the Disease Identification Leaflets and agreed that all leaflets should be reviewed so that up to date information is presented. It was agreed that subsequent review on each leaflet should be conducted within a five year period or less, depending on the importance of new information. The editor agreed to contact WGPDMO members and other experts to assist with this process with the aim of updating at least ten existing leaflets prior to the 2015 meeting of the WGPDMO.

The previously proposed list (see WGPDMO 2013 Report) of new Disease Identification Leaflets was reviewed and it was suggested that consideration be given to combining those related to *Vibrio* species infections in shellfish. The editor undertook to discuss this option with the proposed author (T. Renault).

WGPDMO members were requested to propose titles of new Disease Identification leaflets to the editor. A number of new disease leaflets are currently in preparation:

- Ostreid herpesvirus-1 infections in bivalves (T. Renault)
- Francisellosis in farmed cod (A. Alfjorden)
- Pseudomoniasis (*P. anguilliseptica*) in farmed fish (P. Vennerstrom)
- Hyperpigmentation of common dab (*Limanda limanda* L.) (T. Lang, S. W. Feist, P. Noguera)
- Liver nodules in flatfish (S. W. Feist, T. Lang)
- *Bonamia exitiosa* (R. Carnegie)
- *Bonamia ostreae* (R. Carnegie)
- *Mycobacterium* spp. in wild fish (L. Madsen)

As part of the ToR on update on 'new disease trends' the group agreed to highlight those emerging disease conditions that should generate a new disease leaflet so as to ensure that the series remains current with up to date and relevant information.

In order to facilitate the production of new and revised leaflets the ICES Publications Unit have set up a SharePoint facility and provided a user manual and set of guidelines on how to navigate around the new SharePoint site. The facility will incorporate a working document to monitor progress on the various leaflets that can be used to report to WGPDMO and ICES.

5.9 Provide expert knowledge and advice on fish disease and related data to the ICES Data Centre (ToR i)

Members of the WGPDMO continue to provide support to the ICES data centre in relation to the clarification of details concerning the submission of data.

5.10 Development of templates for National Reports (ToR j)

The development of a template for the national reports was discussed by the WGPDMO members. It was decided that a table will be developed and circulated to the group (P. Vennerstrom and S. Jones) for discussion at the 2015 meeting.

5.11 Special request: interactions between wild and captive fish stocks (OSPAR 4/2014; ToR k)

Following a special request from OSPAR (04/2014) on interactions between wild and captive fish stocks, WGPDMO have worked intersessionally to combine this request with the current work ongoing in ToR c. The current advice from WGPDMO can be found in Annex 5.

6 Revisions to the work plan and justification

ToR b) Following discussions, WGPDMO have decided to focus the review on zoonotic parasite infections e.g. Anisakis and Pseudoterranova. This will result in a more concise document on these zoonotic parasites for which there is a growing body of scientific work as evidence by recent WGPDMO reports.

ToR e) It was decided to discontinue this ToR due to the reasons outlined above in section 5.5.

ToR h) The following changes are to be noted for planned WGPDMO publications:

2013/1/SSGHIE06: 'Trends in important diseases' will be finalised in time for the 2015 WGPDMO meeting (Feb 2015) and thereafter submitted to the ICES CRR series.

2013/1/SSGHIE07: 'Disease-associated population effects' report is ongoing and planned to be finished by the 2015 meeting. However the main authors now feel that they want to submit it to a peer-reviewed journal and not CRR as previously stated in the draft resolution.

2010/1/SSGHIE03: 'Fish Disease Index' is planned to be submitted to the TIMES series by the end of this year.

ToR g) The following suggestions for changes to the disease associated population effects document were made:

- The introduction should include a convincing justification why such an article is needed, highlighting increasing anthropogenic impacts on populations and their diseases, caused by over-exploitation, physical habitat change, climate change, maritime industries, pollution etc.
- A new key section is included, describing the major mechanism (known or suspected) and "trigger" factors involved in the onset of population effects of diseases. This information will be presented in text form and, in a condensed manner, as an easy-to-digest diagram.
- The text and the diagram will address for different life stages e. g., lethal and sublethal effects (energy allocation, growth, reproductive output, behaviour), and the effects of chronic and episodic diseases, endemic and epidemic diseases, adaptation and immunity as well as the mechanistic links between all of these effects. The potential role of environmental variability (e.g., from permissive to non-permissive states) will be indicated.
- Based on the mechanisms involved, categories of diseases can possibly be defined acting in similar ways on the host population.

- Examples of diseases (or disease categories) affecting marine molluscs, crustaceans and fish including examples of freshwater species, will be described for which there is either published evidence or at least a strong suspicion that they exert population effects in the described ways.
- The few publications available that address population models for effects of diseases in marine species will be highlighted.
- A gap analysis will be performed identifying steps to be taken in order to generate quantitative information on population effects of diseases.
- Based on the results of the gap analysis, suggestions will be made for modifications of existing disease surveillance and stock assessment activities.

ToR k) Following a special request from OSPAR (04/2014) on interactions between wild and captive fish stocks, WGPDMO have worked intersessionally to combine this request with the current work ongoing in ToR c. The current advice from WGPDMO can be found in Annex 5.

7 Next meeting

The 2015 meeting of the WGPDMO and final meeting of this reporting cycle is scheduled to be hosted by the Finnish Food Safety Authority, Helsinki, 24–28 February 2015 (Annex 6).

Annex 1: List of participants

Name	Institute	Email
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Annex 2: Recommendations

Recommendation	Adressed to
1. It is recommended to obtain material of 'red eye syndrome' in Barents Sea cod for histological and other laboratory analysis for more complete characterisation of the condition.	SCICOM representative for Russia
2. The WGPDMO noted with concern that some ICES member countries have not provided sufficient resources to support wild fish monitoring programmes, resulting in an insufficient spatial and temporal coverage of fish populations. It was emphasised that this lack of data will affect marine ecosystem health assessments in national and international programmes (e.g. under the EU Marine Strategy Framework Directive, OSPAR Coordinated Environmental Monitoring Programme (CEMP), and revised HELCOM monitoring programme). Additionaly, there is a risk that emerging disease conditions affecting marine fish will not be detected.	Initially to ICES for advice on how to progress the recommendation.

Annex 3: Common and scientific names of host species in the report

capelin	*Mallotus villosus*
cod, Atlantic	*Gadus morhua*
cod, Polar	*Boreogadus saida*
dab, common	*Limanda limanda*
flounder, European	*Platichthys flesus*
herring, Baltic	*Clupea harengus membras*
lamprey, river	*Lampetra fluviatilis*
lobster, European	*Homarus gammarus*
mussel, blue	*Mytilus edulis*
oyster, Argentinian flat	*Ostrea puelchana*
oyster, Australian flat	*Ostrea angasi*
oyster, dredge	*Ostrea chilensis*
oyster, dwarf	*Ostrea stentina*
oyster, eastern	*Crassostrea virginica*
oyster, European flat	*Ostrea edulis*
oyster, Pacific	*Crassostrea gigas*
oyster, Sidney rock	*Saccostrea glomerata*
perch, Eurasian	*Perca fluviatilis*
salmon, Atlantic	*Salmo salar*
salmon, Chinook	*Oncorhynchus tshawytscha*
salmon, coho	*Oncorhynchus kisutch*
salmon, sockeye	*Oncorhynchus nerka*
scallop, Japanese	*Mizuhopecten yessoensis*
shrimp, pink	*Pandalus montagui*
trout, rainbow	*Oncorhynchus mykiss*
whitefish, European	*Coregonus lavaretus*

Annex 4: A list of zoonotic agents recorded in WGPDMO reports 1999 – 2013

WGPDMO report	Country	Parasite	Virus	Bacteria
2013	none			
2012	Poland	*Anisakis simplex, Contraceaecum osculatum*, *Pseudoterranova decipiens* in the liver of Baltic cod		
	Russia	*Anisakis simplex* increasing trend in Baltic herring *Anisakis simplex* in cod, capelin, haddock in Barents sea		
	Russia	*Pseudoterranova decipiens* in Barents sea cod		
	Russia	*Diphyllobothrium dendriticum* (tapeworm) plerocercoid in smelt (abdominal cavity) in Baltic		
2011	Poland	*Anisakis simplex* in herring		
	Russia	*Anisakis simplex* in herring in Baltic sea and cod in the Barents sea		
	Ireland	Red vent syndrome in Atlantic salmon		
	Scotland	Red vent syndrome in Atlantic salmon		
	Sweden	*Pseudoterranova decipiens* in cod, longspined bullhead, fourhourn sculpin		
2010	Poland	*Anisakis simplex* in Baltic herring		
	Russia	*Anisakis simplex* in capelin		
	Norway	Red vent syndrome		
	Scotland	Red vent syndrome		
2009	USA			*Mycobacterium pseudoshotsii* and *Mycobacterium shotsii* in striped bass and bluefish
	Poland	*Anisakis simplex* in Baltic herring		
	Russia	*Anisakis simplex* in haddock and capelin Barents sea		
	Scotland	Red vent syndrome in salmon		
	Ireland	Red vent syndrome in salmon		
	Russia	*Pseudoterranova decipiens* in cod from Barents sea		
	Denmark			*Mycobacterium marinum* in farmed turbot
2008	Russia	*Anisakis simplex* in Baltic herring		
	Poland	*Anisakis simplex* in Baltic herring		
	UK	Red vent syndrome in Atlantic salmon		
	Netherlands			*Vibrio vulnificus* in farmed barramundi
2007	USA			*Mycobacterium* spp. in striped bass
	Denmark			*Vibrio vulnificus* in eels (wild)
	Russia	*Anisakis simplex* in Baltic herring		
	Poland	*Anisakis simplex* in Baltic herring		
	Spain			*Vibrio vulnificus* in farmed eel
2006	Poland	*Anisakis simplex* in Baltic herring		
	Russia	*Anisakis simplex* in Baltic herring		

	Russia	*Pseudoterranova decipiens* in Barents sea cod		
2005	USA			*Mycobacterium* in striped bass
	Scotland	*Anisakis simplex* in cod, haddock and whiting		
	Russia	*Anisakis simplex* in Barents sea cod		
	Poland	*Anisakis simplex* in Baltic herring		
	Russia	*Anisakis simplex* in Baltic herring and in Barents sea redfish, pink salmon and chum salmon (Far Eastern region of Russia)		
	Russia	*Pseudoterranova decipiens* in Barent sea cod		
2004	none			
2003	USA			*Mycobacterium* spp. in striped bass
2002	USA			*Mycobacterium* spp. in striped bass
	Canada	*Pseudoterranova decipiens* in American plaice		
	Russia	*Anisakis simplex* in beaked redfish		
	Spain	*Anisakis simplex* a.o. in anchovies		
	UK	*Anisakis simplex* in flounder		
2001	Poland	*Anisakis simplex* in herring		
	Russia	*Anisakis simplex* in Barents sea cod		
	Russia	*Pseudoterranova decipiens* in Barents sea cod		
2000	Poland	*Anisakis simplex* in Baltic herring and cod		
	Russia	*Anisakis simplex* in Barents sea cod and pink salmon and keta salmon		
	Spain			*Vibrio vulnificus* in eels
1999	USA			*Mycobacterium* in stripes bass
	Europe!			Mycobacterial granulomata in North sea cod
	USA			*Vibrio cholera* non-01 in striped bass and perch
	Russia	*Anisakis simplex* in Barents sea cod, red fish and long rough dab		
	Russia	*Pseudoterranova decipiens* in Barents sea cod		

Annex 5: WGPDMO response to OSPAR Request (04/2014): Interactions between wild and captive fish stocks

In 2010, ICES convened a mariculture advice drafting group (ADGMAR) to formulate a document (ICES, 2010) in response to a request from OSPAR (OSPAR 2010/3) on the effects of mariculture on populations of wild fish. A report, prepared by the WGPDMO for peer-reviewed publication and entitled: "Farm-based epidemiological evidence informs the risk of pathogen interactions between maricultured and wild salmonids", responds to parts b_{ii} and c_{ii} of a more recent request (OSPAR 4/2014), articulated as follows:

a. Recalling the conclusion of the QSR 2010 that mariculture is a growing activity in the OSPAR maritime area, EIHA 2012 considered the potential for increasing environmental pressure relating to the growth of this industry. As yet this is not an established work stream within EIHA, and Contracting Parties have requested that more information be brought forwards on this issue. This was reiterated by EIHA 2013.

b. Mariculture has a number of associated environmental pressures such as the introduction of non-indigenous species, which can have ecological and genetic impacts on marine environment and especially on wild fish stocks; in addition, pressures from mariculture might include:

i. introduction of antibiotics and other pharmaceuticals;

ii. transfer of disease and parasite interactions;

iii. release of nutrients and organic matters;

iv. introgression of foreign genes, from both hatchery-reared fish and genetically modified fish and invertebrates, in wild populations;

v. effects on small cetaceans, such as the bottlenose dolphin, due to their interaction with aquaculture cages

c. EIHA proposes that OSPAR requests ICES to provide:

i. an update on the available knowledge on these issues;

ii. concrete examples of management solutions to mitigate these pressures on the marine environment;

iii. advice on which pressures have sufficient documentation regarding their impacts to implement relevant monitoring and suggest a way forward to manage these pressures.

d. It may be appropriate to explore cooperation with other competent authorities working in this field, such as the European Food Safety Authority with respect to disease transfer or parasites, or the North Atlantic Salmon Conservation Organisation (NASCO), in particular with respect to existing cooperation between NASCO and ICES on issues pertaining to pressures from mariculture.

The following text is the taken from this document.

Conclusions

A broader understanding of the extent and significance of pathogen interactions between maricultured and wild salmonids is limited by relatively few epidemiological assessments of disease in wild salmon populations. In contrast, the occurrence and characteristics of certain pathogens in salmon mariculture, as well as factors contributing to the development of disease caused by these pathogens have been described.

We suggest therefore, that risk of pathogen transmission to wild stocks/populations may be estimated using epidemiological data generated to understand pathogen dynamics and disease progression in mariculture, whether salmonid or otherwise. Infectious salmon anaemia virus, salmon pancreas disease virus and *Lepeophtheirus salmonis* are well-documented pathogens associated with important diseases in salmon mariculture. Considerable scientific effort has been expended to understand these pathogens and the diseases they cause and they are found to share certain epidemiological traits:

- All are dispersed among mariculture sites in prevailing water currents;
- The magnitude of an infected site as a source of infection is proportional to site biomass and salmon density;
- Clusters of sites within a hydrographically-defined area may act as a single source. In this case biomass and density of the cluster is relevant;
- For SAV and ISAV, the risk of infection is inversely related to distance from an infected site;
- For sea lice, the risk of infection is a function of time and temperature due to developmental requirements to attain infectivity. Therefore, maximum risk may occur at a distance from an infected site that is defined by local hydrographic conditions;
- In all cases, farmed based epidemiological data and associated hydrographical data support the establishment of zones of risk associated with known sources of infection in mariculture.

The epidemiological evidence indicates transmission of ISAV, SAV and salmon lice to wild fish can occur within a zone of risk associated with the infected mariculture site. However, very little documented evidence of infections in wild fish exists to support this claim for ISAV and SAV, and this may be a consequence of limited surveillance opportunities. In contrast, there is considerable evidence to support this claim for salmon lice. The extent to which salmon lice contribute to measurable population-level effects is beginning to be explored, but there is uncertainty. In the treated-smolt studies, researchers must estimate the extent to which the apparent louse effect is related to mariculture. Therefore, while effective at estimating risk of pathogen transmission, epidemiological data are limited with respect to predicting the development and severity of disease in wild populations. The following management actions in mariculture are expected to mitigate pathogen transmission between farmed and wild salmonid populations:

1) Systematic collection of disease-relevant data including pathogen identification, prevalence, severity, mortality;

2) Systematic collection of data related to farm species and biomass, seawater temperature and salinity and plankton density;

3) Archive data in an accessible format. Establish data sharing protocols;

4) Develop and apply circulation models to characterise hydrographic processes in mariculture coastal zones to estimate pathogen dispersion from farms or farm clusters;

5) For each farm or farm cluster, establish management zones, defined on local hydrography and biological properties of infectious agents. Management zones should incorporate limits to local biomass, and protocols for coordinated activities such as stocking, disease pathogen monitoring, harvesting, single age-class, sea lice treatments.

6) Whenever feasible, conduct pathogen surveillance of adjacent wild populations to document marine reservoirs of infection and validate mariculture management practises.

References

ICES, 2010. Report of the ICES Advisory Committee, 2010. ICES Advice, 2010. Book 1, pp. 229-243.

Annex 6: WGPDMO resolution and final meeting in 2015

2012/MA2/SSGHIE02 The **Working Group on Pathology and Diseases of Marine Organisms** (WGPDMO), chaired by Neil Ruane, Ireland, will meet in Helsinki, Finland, 24-28 February 2015 to work on ToRs and generate deliverables as listed in the Table below.

WGPDMO will report on the activities of 2014 (Year 3) by 9 April 2015 to SCICOM.

ToR	Description	Background	Science Plan topics addressed	Duration	Expected Deliverables
a	New disease trends in wild and cultured fish, molluscs, and crustaceans based on national reports	New disease conditions and trends in diseases of wild and cultured marine organisms continue to appear and an annual assessment of these should be maintained.	1.3, 1.4, 2.2, 2.5	annual	Annual summary of trends to ICES member countries, OSPAR
b	Parasites and other infectious agents in marine finfish and shellfish species posing a hazard to human health	A range of parasites and other infectious agents reported by the WGPDMO in the annual update of disease trends have the potential to be harmful to human health if ingested in under processed food. There is an upward trend in the consumption of raw fish and other seafood products which may increase this risk. Literature reviews of risk, prevention and mitigation strategies will be prepared.	1.4, 1.7	Years 1, 2 & 3	Submit manuscripts for publication in peer-reviewed journal
c	Disease interactions between farmed and wild finfish	WGPDMO has produced reports on disease interactions between farmed and wild finfish on disease in 2010, 2011 and 2012. In conjunction with OSPAR request 4/2014 a manuscript will be submitted for publication prior to an ICES Advice Drafting group meeting in the summer of 2014.	2.2, 3.1	Years 1, 2 & 3	Manuscript submitted for publication, OSPAR request 04/2014, WGPDMO
d	ICES publication 'Trends in important diseases affecting the culture of fish and molluscs in the ICES area 2003 - present'	The earlier "Trends" document provided valuable information to researchers and fisheries managers on trends of diseases in aquaculture and . That document requires updating with new information on those diseases of most importance for aquaculture, including new and emerging diseases, during 2003 to the present.	1.4, 3.1	Years 1, 2 & 3	Manuscript submitted for publication as an ICES Coop Res Rep, WGPDMO
e	Maps of fish and shellfish diseases	ToR discontinued.			
f	The Fish Disease Index (FDI) in relation to results of FDI assessments of diseases of flounder and Baltic cod and liver histopathology and macscopic liver lesions in the common dab	The FDI approach has been developed for the analysis and assessment of data obtained by ICES Member Countries running regular fish disease surveys as part of their national environmental monitoring programmes. Progress in the finalisation of the R version for calculating the FDI as well as the guidance manual will be reviewed. The application of the FDI as an assessment tool for environmental monitoring under OSPAR/HELCOM/EU MSFD is considered as a longer-term activity of WGPDMO.	1.2, 1.4, 3.3	Years 1, 2 & 3	Publish FDI methodology in the ICES TIMES series. ICES member countries, WGPDMO

g	Disease-associated population effects of commercial fish and shellfish species	There is increasing information from studies in wild freshwater and marine fish species that diseases affect growth, reproduction and survival of different life stages of fish and shellfish and thus, may have an impact on recruitment and stock structure. However, only in a few cases have diseases been explicitly considered in population dynamics models. The potential risk to fish and shellfish populations due to diseases is of considerable ecological and economical concern. A draft paper prepared by WGPDMO will be reviewed. It is anticipated that the review document will be relevant to a range of ICES Expert Groups, including the stock assessment groups.	1.2, 1.4, 2.5, 3.1	Years 1, 2 & 3	Manuscript to be published as an ICES publication, member countries, WGPDMO
h	ICES publications on pathology and diseases of marine organisms	A number of ICES publications, either web-based or in ICES publication series, are being prepared or updated at present, the progress of which will be reviewed by WGPDMO.	1.4, 3.1	annual	WGPDMO internal report
i	Provide expert knowledge and advice on fish disease and related data to the ICES Data Centre on a continuous basis.	In compliance with a request from the ICES Data Centre.	1.4, 3.3	annual	Data and data management advice, ICES, ICES member countries
j	Development of templates for the national reports from ICES Member Countries	Variability exists within the National Reports for wild and farmed finfish and shellfish regarding disease occurrence e.g. prevalence, number of animals, species infected etc. This ToR will aim to standardise the reporting structure. Tables will be prepared intersessionally capturing disease trend information from national reports. This will aid in the assessment of new disease conditions and trends assessed annually by the group in ToR a	1.3, 1.4	2 & 3	Reporting structure for aquatic diseases

Summary of the Work Plan

Year 1	Three terms of reference (a, h and i) are annual tasks and form a core part of WGPDMO activities. The WGPDMO will tackle these and all other ToRs.
Year 2	Terms of reference c and d were extended and will be finalised with the final review by the WGPDMO and submission of manuscripts for publication at the final meeting in year 3.
Year 3	Terms of reference b, f and g will be finalised. A template for the reporting of national reports will also be presented to the group.

Supporting information

Priority	The current activities of this Group will lead ICES into issues related to the ecosystem effects of fisheries, especially with regard to the application of the Precautionary Approach. Consequently, these activities are considered to have a very high priority.
Resource requirements	The research programmes which provide the main input to this group are already underway, and resources are already committed. The additional resource required to undertake additional activities in the framework of this group is negligible.
Participants	The Group is normally attended by some 12–15 members and guests.

Secretariat facilities	
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	There are no obvious direct linkages.
Linkages to other committees or groups	There is a very close working relationship with all the groups of SSGHIE. It is also very relevant to the Working Group on Aquaculture (WGAQUA).
Linkages to other organizations	OSPAR, HELCOM

Annex 7: Technical minutes by RGFISH

1. Special request: Interactions between wild and captive fish stocks (OSPAR 4/2014)

a) Recalling the conclusion of the QSR 2010 that mariculture is a growing activity in the OSPAR maritime area, EIHA 2012 considered the potential for increasing environmental pressure relating to the growth of this industry. As yet this is not an established work stream within EIHA, and Contracting Parties have requested that more information be brought forwards on this issue. This was reiterated by EIHA 2013.

b) Mariculture has a number of associated environmental pressures such as the introduction of non-indigenous species, which can have ecological and genetic impacts on marine environment and especially on wild fish stocks; in addition, pressures from mariculture might include:

i) introduction of antibiotics and other pharmaceuticals;

ii) transfer of disease and parasite interactions;

iii) release of nutrients and organic matters;

iv) introgression of foreign genes, from both hatchery-reared fish and genetically modified fish and invertebrates, in wild populations;

v) effects on small cetaceans, such as the bottlenose dolphin, due to their interaction with aquaculture cages.

c) EIHA proposes that OSPAR requests ICES to provide:

i) an update on the available knowledge of these issues;

ii) concrete examples of management solutions to mitigate these pressures on the marine environment;

iii) advise on which pressures have sufficient documentation regarding their impacts to implement relevant monitoring and suggest a way forward to manage these pressures.

d) It may be appropriate to explore cooperation with other competent authorities working in this field, such as the European Food Safety Authority with respect to disease transfer or parasites, or the North Atlantic Salmon Conservation Organisation (NASCO), in particular with respect to existing cooperation between NASCO and ICES on issues pertaining to pressures from mariculture.

2. Technical Minutes from the Review Group Interaction between Wild and Captured Fish Stocks (RGFISH)

- RGFISH
- Review deadline 17 June 2014
- Peer Reviewers: Luc Comeau (Canada); Ellen Kenchington (Canada; RG Chair)
- Working Group: WGPDMO

2.1. WGPDMO Summary

A broader understanding of the extent and significance of pathogen interactions between maricultured and wild salmonids is limited by relatively few epidemiological

assessments of disease in wild salmon populations. In contrast, the occurrence and characteristics of certain pathogens in salmon mariculture, as well as factors contributing to the development of disease caused by these pathogens have been described. We suggest therefore, that risk of pathogen transmission to wild stocks/populations may be estimated using epidemiological data generated to understand pathogen dynamics and disease progression in mariculture, whether salmonid or otherwise. Infectious salmon anaemia virus, salmon pancreas disease virus and *Lepeophtheirus salmonis* are well-documented pathogens associated with important diseases in salmon mariculture.

2.2. Review of Annex 5: WGPDMO response to OSPAR Request (04/2014): Interactions between wild and captive fish stocks

The accurateness of Annex 5 is entirely validated by a science manuscript titled "Disease management mitigates risk of pathogen transmission from maricultured salmonids" and co-authored by Simon Jones, David Bruno, Lone Madsen and Edmund Peeler. This well-referenced paper was made available to RGFISH and explains that there is scarce information on diseases in wild marine finfish populations, and that these diseases are not obviously linked to mariculture. Nevertheless, the paper makes a convincing argument that the potential for pathogen spillback from farmed to wild populations does exist. Consequently, RGFISH concludes that Annex 5 draws on existing knowledge of sufficient scope and depth for this request.

WGPDMO list specific actions to assist in both the development and validation of mitigation measures. There is some overlap between WGPDMO and WGAQUA, since both groups considered the sea lice issue. Interestingly both groups identified the development of larvae circulation models and the establishment of management zones as important for mitigation. However, while these management actions are clearly recommended in the WGPDMO report, they are only mentioned in the WGAQUA report. WGPDMO did not explicitly address monitoring although the recommendation for the development of systematic data collection infers that data are not currently sufficient for this purpose. RGFISH suggests that WGPDMO comment on whether the Fish Disease Index (FDI), which has been developed for the analysis and assessment of data obtained by ICES Member Countries running regular fish disease surveys as part of their national environmental monitoring programmes, could be incorporated into modeling of disease interactions between aquaculture sites and wild fish stocks. ICES has previously stated in advice to OSPAR that "This trial application of a Fish Disease Index to the available fish health data clearly demonstrates the utility of this approach to assess fish health and to evaluate the impact of anthropogenic induced stresses on fish. There is considerable value in national laboratories making their fish health data available to the ICES Data Centre so that the disease assessment can be expanded in the future" (see ICES. 2009. Report of the Working Group on Pathology and Diseases of Marine Organisms (WGPDMO 2009)). Enhancement of this existing framework to include diseases and species of relevance to mariculture might be a useful approach to monitoring.