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

17–20 February 2016

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ICES International Council for the Exploration of the Sea

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Executive summary

The ICES Working Group on Pathology and Diseases of Marine Organisms (WGPDMO) met on 17–20 February 2016 at the Virginia Institute of Marine Science, College of William & Mary, in Gloucester Point, Virginia USA. The meeting was chaired by Ryan Carnegie (USA) and attended by eight other participants representing eight ICES Member Countries.

The agenda included several topics related to diseases and pathology in wild and farmed fish 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 from fifteen member countries. Notable reports for wild fish included first observations of salmon gill poxvirus in Canada and piscine reovirus in Denmark; the first observation of *Vibrio anguillarum* serotype O3 in Sweden; disease associated with oomycetes in Russia and Sweden; and prevalences of *Pseudoterranova decipiens* infection in the northern Baltic Sea that were unexpectedly low given the high prevalences in the southern Baltic. Reports for farmed fish included the first observation of piscine orthoreovirus in Ireland and range expansion of salmonid rickettsial septicaemia in western Canada. Additionally, wrasse and lumpfish cultured as cleaner fish for salmonid aquaculture were noted to be affected by bacterial diseases. Salmon louse control to minimize risk to wild fish poses an ongoing challenge to salmon aquaculture in the ICES region. In shellfish, observations for Pacific oysters included the association of *Vibrio aestuarianus* with significant mortality in Ireland, the detection of *Haplosporidium costale* in England representing a first record in Europe, and the detection of a *Marteilia* not identified to species in France. *Marteilia cochillia* is an important emerging concern, causing significant disease and mortality in cockles in Spain.

Work on four additional documents was discussed, including a summary of the role of *Vibrio* pathogens contributing to mortalities in shellfish aquaculture, a synthesis on the contemporary status of oyster pathogen *Bonamia ostreae*, and a description of the distribution of amoebic gill disease in marine salmon farms, all to be prepared for publication in scientific journals; and a compilation of pathogen screening in wild salmonids, to be presented in the final WGPDMO report. The Fish Disease Index package in R was described with plans to simplify the interface between a MS Excel input spreadsheet and the R program. The package now includes features to define new FDI, which will allow the index to be applied to species other than those for which it was developed. The FDI will be circulated for testing in 2016.

One new and two revised ICES Identification Leaflets for Diseases and Parasites of Fish and Shellfish were published, including 'Francisellosis of Atlantic cod', '*Mytilicola intestinalis*' parasitism, and 'Furunculosis'. Two additional leaflets have been submitted, fourteen new leaflets have been proposed, and the entire remaining catalog has been reviewed to initiate revisions of leaflets not already updated.

The work plan for the cycle has been revised to include a new ToR i on the generation of a standard reporting template to improve data collection concerning sample sizes and pathogen prevalences and allow improved resolution of disease trends.

1 Administrative details

Working Group name

Working Group on Pathology and Diseases of Marine Organisms (WGPDMO)

Year of Appointment

2016

Reporting year within current cycle (1, 2 or 3)

1

Chair(s)

Ryan B. Carnegie, USA

Meeting venue

Gloucester Point, Virginia, USA

Meeting dates

17–20 February 2016

2 Terms of Reference a) – z)

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

ToR b) Deliver leaflets on pathology and diseases of marine organisms.

ToR c) Synthesize information on the spread and impact of *Bonamia ostreae* in flat oysters in the ICES area.

ToR d) Summarise the role of *Vibrio* sp. pathogens contributing to mortalities in shellfish aquaculture.

ToR e) Prepare a report describing the occurrence and spread of amoebic gill disease (AGD) in marine salmonid farming in the ICES area.

ToR f) Compile information on pathogen screening of wild salmonids in the ICES member states.

ToR g) Evaluate applicability of the Fish Disease Index (FDI) by using the R package following newly developed guidelines.

ToR h) Provide expert knowledge and management advice on fish and shellfish diseases, if requested, and related data to the ICES Data Centre.

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 ToRs c-f.

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

ToR c) *Bonamia ostreae* is a major pathogen of European flat oysters that has expanded its range in recent years. The present distributional status, recent trends in parasite activity, and the effectiveness of contemporary management strategies will be summarized, with perspective included on related species *Bonamia exitiosa*, recently documented in European systems.

ToR d) *Vibrio* bacteria have long been associated with larval production problems in shellfish hatcheries, but the potential impacts of vibriosis in sub-market and market-sized Pacific oysters in European production areas has become an important emerging concern. This ToR will summarize the available science to provide a synthesis on current knowledge on *Vibrio* impacts and highlight critical gaps in our understanding of these species.

ToR e) AGD has emerged as a significant issue for salmon farming in the Atlantic. This ToR will produce a report describing the spread and impact of this disease and current measures being used to mitigate its effects. It will identify knowledge gaps and future areas for research.

ToR f) Many ICES member countries screen wild broodstock used for restocking purposes for disease pathogens. This ToR will produce a report compiling information on diseases and methods used in order to prepare a common approach to screening and assess the effectiveness of current practices.

ToR g) This ToR will produce an assessment of the applicability based on its trial use by participants from among the group.

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

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
- Publication of ICES Disease Leaflet No. 24: *Mytilicola intestinalis* parasitism (Bignell, revised leaflet), No. 37: Furunculosis (Bruno, revised leaflet) and No. 64: Francisellosis of Atlantic cod (Alfjordan and Ruane, new leaflet)
- Submission of a new ICES Disease Leaflet on Brown ring disease in clams (Paillard) as well as a revision of No. 42: *Exophiala* (Bruno)

5 Progress report on ToRs and workplan

5.1 Summarize new and emerging 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 2015 submitted by Canada, Denmark, England & Wales, Finland, France, Germany, Ireland, the Netherlands, Norway, Poland, Russia, Scotland, Spain, 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

Salmon gill poxvirus (SGPV) – Reported for the first time in Canada from a healthy adult Atlantic salmon in the Magaguadavic River, New Brunswick. The finding was based on cytopathology and high-throughput DNA sequencing.

Piscine reovirus (PRV) – Reported from Denmark in 2014 for the first time, 6% of 176 Atlantic salmon brood-stock tested positive by qPCR. The virus was later detected in progeny (fry) from the affected brood fish despite disinfection of eggs. Eight wild brown trout were found to be negative for the virus.

Infectious pancreatic necrosis virus (IPNV) – In mid-Norway, the virus was detected in gill samples in 7 of 670 of returning Atlantic salmon in four rivers in 2013 and 2014.

Infectious salmon anaemia virus (ISAV) – In mid-Norway, the virus (HPR0) was detected in gill samples in 16 of 670 of returning Atlantic salmon in four rivers in 2013 and 2014, and in 2014, the virus was also detected in 5 of 204 Atlantic salmon and 2 of 18 sea trout caught in marine estuaries in the same region.

Viral haemorrhagic septicaemia virus (VHSV) – A rare observation of Genotype 1b was made in a Baltic cod from Hanö Bay, Sweden (ICES district SD 25). The fish also showed signs of fin rot, purulent exudate, splenic granulomas, endo- and pericarditis, anaemia and peritoneal haemorrhage.

Bacteria

***Vibrio anguillarum* –** In Sweden, mass mortality among Atlantic herring from the island of Orust (ICES district 21) was associated with serotype O3 ("Pacific herring serotype"), not previously reported from Sweden.

Acute/healing skin ulcerations (U) – In Baltic cod, the prevalence was 3% in waters of Poland (n=17,748), Russia (n=945) and Sweden (n=3,940). For Polish waters, this was the lowest prevalence observed since 2010. For European flounder in Swedish waters, prevalence was 1% (n=4,895).

Fungi

***Paranucleospora theridion* –** In mid-Norway, prevalence ranged from 7% to 70% during testing of nearly 900 returning Atlantic salmon between 2013 and 2014.

Oomycetes

Saprolegnia – In July–October 2015, in the Kola River (Barents Sea basin of Russia), infection in adult Atlantic salmon, European whitefish and minnow was observed for the first time with associated lethargy and mortality. Similar observations, reported in 2014 from Finland and Sweden, persisted in 2015 in Sweden. A diagnosis of ulcerative dermal necrosis (UDN) was made from a sample of 5 fish not showing oomycete growth.

Parasites

Protists

***Sphaerothecum*-like parasite (Mesomycetozoa)** – Prevalence in common dab from the North Sea stations West Dogger Bank and North Dogger Bank was 3% (n=80), and at Indefatigable Bank was 1% (n=80). Infections were observed in the liver and kidney at low intensity, usually associated with a granulomatous host response.

Ichthyobodo salmonis – In mid-Norway, prevalence was approximately 50% during testing of nearly 900 returning Atlantic salmon between 2013 and 2014.

Myxozoa

Parvicapsula pseudobranchicola – In mid-Norway, prevalence was approximately 38% during testing of nearly 900 returning Atlantic salmon between 2013 and 2014.

Nematoda

Contracaecum osculatum – The increasing trend reported earlier from Baltic cod continued in 2015 with data from Denmark, Poland, Russia and Sweden. Small cod (35–40 cm) harboured intense infections of up to 300 parasites per fish (n=66 liver samples).

Pseudoterranova decipiens – In the Barents Sea (ICES areas 1 and 2b), infections in long-rough dab increased between 2014 and 2015 from 21% to 30% and 12% to 35%, respectively. In Atlantic cod from area 2b, prevalence increased from 17% to 24%. In Baltic cod caught east of Bornholm, prevalence up to 55% and intensity up to 56 worms per fish were reported. In Swedish waters, over 60% of Baltic cod and 100% of shorthorn sculpin were infected, indicating that the upward trend reported earlier continues. Further north into the Baltic, around Gotland, prevalence in cod was 7%, and in shorthorn sculpin was 9%. Finally in the archipelago of Stockholm and the sea of Åland, prevalence decreased to nearly zero, with only a single nematode found in over 200 examined fish. It is not known why the prevalence was so low in northern areas despite the presence of significant concentrations of grey seal. Another factor such as salinity or the absence of suitable intermediate hosts may be responsible.

Anisakis simplex – Prevalence in common dab from waters of England and Wales remains high (13–55%) at the majority of fishing stations in the North Sea. The Tyne Tees region exhibited the highest prevalences, of 37%, 55% and 20% at Amble, Flamborough and Tees Bay, respectively. In ICES area 1, prevalence in polar cod decreased from 64% to 33% and in capelin from area 2b, from 52% to 28%. Prevalence in cod from area 2b increased from 93% to 100% and in herring from area 1, there was an increase from 47% to 64%. In Polish waters, prevalence in cod decreased from 31% (n=278) to 15% (n=303). The prevalence of infection was higher in the Gulf of Gdansk (30%) than in the Western Baltic

(9%) and middle coast (5%). Previously, higher values were recorded in the western and middle Baltic. For Baltic herring in Polish waters, analysis of prevalence data using a generalized linear model (GLM) revealed that estimated year effects for 2013, 2014 and 2015 strongly decreased in comparison to effects of 2011 and 2012. A similar decrease was revealed for intensity.

Monogenea

***Gyrodactylus salaris* –** The parasite was discovered for the first time in the River Rolfsån on the Swedish west coast. Together with the nearby River Kungsbackaån, this was one of two water systems previously recognised as *G. salaris*–free.

Other diseases

Eye Pathology – Persisting in capelin (3%), polar cod (2%) and Atlantic cod (0.4%) from the Barents Sea as acute exophthalmos, cataract, red eyes, or ocular degeneration.

Hyperpigmentation – Continued to be observed in common dab at relatively high prevalence in the North Sea in 2015 compared to the Irish Sea, Severn and English Channel regions (between 0% and 25% in 2014): Amble (30%), Tees Bay (15%), Flamborough (43%), North Dogger (35%), Central Dogger (49%), West Dogger (49%), Indefatigable Bank (39%), and Off Humber (39%). Moreover, North Sea regions continued to show an increasing trend concerning prevalence of this condition.

Effects of munition dumpsites – Based on German data, no major differences in the health status of Baltic cod have been observed between munition dumpsites and reference areas in the western and eastern Baltic Sea. However, condition factors of cod in the main dumpsite east of Bornholm were significantly lower compared to all other study areas.

Conclusions

- A salmon gill poxvirus (SGPV) sequence was obtained from a healthy Atlantic salmon in New Brunswick, eastern Canada.
- Piscine reovirus in Atlantic salmon was reported for the first time from Denmark.
- In Sweden, mass mortality among Atlantic herring from the island of Orust was associated with *Vibrio anguillarum* serotype O3.
- High morbidity and mortality among migrating Atlantic salmon in Russia (Kola River) and Sweden (Baltic Sea, west coast) were associated with oomycete infection. UDN was diagnosed from samples not showing oomycete growth.
- Prevalence of *Pseudoterranova decipiens* in Baltic cod and shorthorn sculpin declined along a salinity gradient in the Baltic Sea despite the presence of large seal populations.
- No measurable differences in health status of Baltic cod were attributed to proximity to munition dumpsites. A reduction in condition factor among cod collected near dumpsites was measured.

5.1.2 Farmed Fish

Viruses

Infectious pancreatic necrosis virus (IPNV) – In Sweden, two cases of IPN serotype ab were diagnosed in rainbow trout in a national screening program. One of the farms was in the Baltic Sea, the other in an inland lake. In Norway, the number of cases declined from 48 in 2014 to 30 in 2015, continuing a trend reported previously. IPNV was found in Atlantic halibut fry in Norway on two occasions.

Infectious salmon anaemia virus (ISAV) – The disease was diagnosed in 15 Atlantic salmon farms in Norway, an increase from 10 farms in each of the two previous years. Only three cases were considered primary outbreaks, one in brood fish, one at a sea site, and the third in a smolt farm. Four secondary cases received fish from the smolt farm. The remaining secondary cases were likely caused by horizontal spread from neighboring farms. Two epidemics in northern Norway from 2013 and 2014 are still not declared eradicated. At two sites, rainbow trout were infected following infection of Atlantic salmon at the same site. These cases are the first registered in rainbow trout under ordinary farming conditions. In eastern Canada, sporadic outbreaks with the North American genotype persist, however surveillance revealed a high prevalence of European type HPR0 strains. In western Canada, 0 of 2207 Atlantic salmon tested positive by qRT-PCR.

Salmonid alphavirus (SAV) – In Norway, there are two endemic regions with two subtypes of the virus, SAV2 and SAV3, and the northernmost part of the country is surveilled to maintain SAV-free status. One case of SAV2 was seen in Atlantic salmon in this region, and the affected population was immediately culled. During 2014 and 2015, there have been cases of pancreas disease (PD) caused by SAV2 in the SAV3-zone. The number of PD cases in 2015 was 135, close to the historically high number of 142 in 2014. Ireland experienced seven outbreaks of PD, after only three in 2014.

Piscine orthoreovirus (PRV) – Heart and skeletal muscle inflammation (HSMI) was diagnosed for the first time in Ireland at one marine Atlantic salmon site, and detection of PRV was confirmed by qPCR. Mortality was reported to be low. In Norway, the number of HSMI outbreaks in Atlantic salmon was 135, a reduction from the historical peak of 181 in 2014 that coincided with national delisting of this disease. Using qRT-PCR, the virus was detected for the first time in eastern Canada in all Atlantic salmon from one lot held in quarantine. In addition, 6 of 11 salmon originating from another hatchery and held at a government research facility tested positive. None of the Canadian salmon were examined histologically for evidence of HSMI.

***Onchorhynchus mykiss* reovirus –** A new viral disease in rainbow trout first reported in 2013 from four different hatcheries in Norway was documented in the WGPDMO report from 2015. This disease had also caused mortality in fish transferred to seawater. Sequencing of the new viral agent showed that it is related to PRV in Atlantic salmon. No disease outbreaks have been registered in 2015, however, the virus was detected at 9 marine sites from among 50 farms tested.

Salmon gill poxvirus (SGPV) – Salmon gill poxvirus disease has been known in Norway since 1995. The first genome sequence of this DNA-virus was described in 2015. SGPV was diagnosed in a total of 18 Atlantic salmon farms last year, 15 marine sites and three smolt farms.

Bacteria

***Aeromonas salmonicida* –** One case was diagnosed in a marine Atlantic salmon site in Ireland. In Norway, *A. salmonicida* subsp. *salmonicida* was isolated in one case of increased mortalities in lumpfish transferred to a sea-site containing vaccinated Atlantic salmon, which were not affected. In Scotland, atypical *A. salmonicida* has been detected in moribund ballan wrasse being used as cleaner fish for farmed Atlantic salmon. In Norway, atypical *A. salmonicida* has been diagnosed in lumpfish used as cleaner fish in 51 cases, and in wrasses in 32 cases.

Atypical *A. salmonicida* was found in three cases in Norway, all involving Atlantic halibut fry.

Yersinia ruckeri – Norway had 34 cases of yersiniosis in Atlantic salmon in 2015, eight in smolt farms, 25 in sea farms, and one in brood fish. Detected cases have increased over the last four to five years. As a consequence, smolt farms are increasingly using vaccines.

***Moritella viscosa*/winter ulcers –** Winter ulcer syndrome was diagnosed in Atlantic salmon from three sites in Scotland and three sites in Ireland. In Norway, 57 cases of winter ulcers in Atlantic salmon and four cases in rainbow trout were diagnosed, compared to 44 cases in salmonids in 2014.

***Vibrio-infections* –** In Norway, *Vibrio anguillarum* has been isolated from diseased cleaner fish used to control salmon lice. The bacterium was detected in lumpfish from twelve farms and wrasses from two. Three cases of *V. ordalii* have been reported in lumpfish.

Flavobacterium*/*Flexibacter – Three cases of infection with *Flavobacterium psychrophilum* in rainbow trout were reported in Norway, two from marine sites and the third from an inland farm. Two cases were registered in 2014, and septicemic flavobacteriosis in rainbow trout has been a list 3 disease in Norway since that time.

***Pasteurella*/*Pseudomonas* –** In lumpfish from Norway, *Pasteurella* sp. was isolated in 14 cases and *Pseudomonas anguilliseptica* in four.

***Piscirickettsia salmonis* –** The range of salmonid rickettsial septicaemia in Atlantic salmon in western Canada expanded to a new management zone and the disease now occurs throughout the year in some locations. Between 2013 and 2015, the annual number of diagnoses in Atlantic salmon has increased from 8.5% to 29% and in Pacific salmon, from 4% to 38%.

Parasites

Crustacea

***Lepeophtheirus salmonis* –** Salmon lice control remains the most important challenge with regard to Atlantic salmon culture in ICES member countries.

Paramoebida

***Paramoeba perurans* –** In Canada, infection has been reported in two new management zones along with increased mortality in zones that had earlier been identified as affected. AGD prevalence in Norway and Scotland has stabilized after increasing in previous years.

Conclusions

- Salmon louse control for the purposes of minimizing risk to wild fish continues to pose a great challenge to salmon aquaculture.
- Amoebic gill disease (AGD) prevalence has increased in Canada and stabilized elsewhere.
- Wrasse and lumpfish cultured as cleaner fish for use in salmon aquaculture have been recognized as affected by bacterial diseases.
- Spatial and temporal ranges of salmonid rickettsial septicaemia caused by *Piscirickettsia salmonis* in Atlantic salmon have expanded in western Canada, coincident with an increase in the number of diagnoses.

5.1.3 Wild and farmed molluscs and crustaceans

Viruses

Oyster Herpes Virus – OsHV-1 µVar continues to be detected in association with mortality in Pacific oysters in France. *Vibrio aestuarianus* detection by PCR is often observed in these cases.

Low levels of OsHV-1 DNA have been observed in mortality cases involving a number of bivalve species in France, including Mediterranean mussels (1 of 1 case) and cockles (1 of 4 cases), with accompanying *Vibrio splendidus* DNA detection in both cases. OsHV-1 DNA was also detected in Manila clams along with *Perkinsus* sp. in 1 of 2 cases with 40–50 % mortality.

Western Canada remains OsHV-1-free based on qPCR analysis of 40 seed oyster samples. OSHV-1 µVar-related mortalities in Pacific oysters have ceased in Norway and Sweden following outbreaks in 2014, although the infection status of populations there was not determined.

In southern England the virus has spread within areas already affected, from the Blackwater to the Mersea Creeks and the Colne, and from the River Crouch to the River Roach in Essex It has also spread, to new parts of the coast, along the north Kent coast in feral populations at Minnis Bay and Pegwell Bay as well as to farmed juvenile Pacific oysters in the River Teign in South Devon. The virus was detected in a new area in Ireland at low prevalence (2 of 30 Pacific oysters) and with no mortality. The virus is now considered to be present in 34 out of 43 Pacific oyster growing areas in that country.

OsHV-1 was detected in Pacific oysters from Bodega Bay, California, USA, following very high summer mortalities (~75% in the affected groups) associated with elevated water temperatures. This represents a new geographic record, the pathogen previously having been detected only in Tomales Bay, California. The viral genotype has not been determined.

Bacteria

***Vibrio aestuarianus* –** Continues to be detected in Pacific oysters and cockles from France. In Pacific oysters it was detected by qPCR in association with mortality in all age classes. In cockles, mortalities of 32–50% were observed and *V. aestuarianus* DNA was

detected in three of four of these cases. Vibrios belonging to the *V. splendidus* group were also detected in two of the batches of cockles that were positive for *V. aestuarianus*.

Significant mortality events affecting principally adult Pacific oysters occurred in 16 bays around the coast of Ireland. Juveniles were affected in seven of 16 bays and spat mortality was recorded in four of 16 bays. *V. aestuarianus* was identified at high levels in fourteen of the bays by qPCR. The bacterium was also cultured from these same bays and pathology consistent with infection (as described by the EURL) was evident in the majority of sites. Mortality levels varied widely (10–90%), and environmental influences such as prolonged heavy rains and a bloom of alga *Karenia mikimotoi* may have contributed to mortality in places.

***Vibrio* spp. –** Vibrios belonging to the *V. splendidus* group were also detected in Mediterranean mussels in France (14 of 15 positive batches) in association with abnormal mortality ranging from 10 to 50%. Similar events occurred in 2014. A number of other Vibrios including *Vibrio ostreicida* , *Vibrio tubiashii* subsp. *europeus* and *Vibrio bivalvicida* have been reported as contributing to problems affecting production of larval and spat stages of bivalve molluscs in Spain, including carpet shell, Manila, pullet and wedge clams, and arched, grooved and pod razor clams.

Candidatus *Xenohaliotis californiensis* – The northward distributional extent of *X. californiensis* in red abalone is now identified as Bodega Bay, California, where the pathogen was first observed in 2010. A phage infecting *X. californiensis* appears to have been present in this red abalone population in 2015 after having not been detected in 2010. Phage infection of *X. californiensis* in black abalone has suggested reduced bacterial pathogenicity.

Parasites

***Marteilia refringens* –** Found in Mediterranean mussels in France in 3 of 15 batches where mortalities were seen. The same three batches were positive for Vibrios from the *V. splendidus* group. In Sweden *M. refringens* continues to be present albeit at lower prevalence (3%) in blue mussels but without observation in flat oysters.

***Marteilia cochillia* –** Reported as causing significant disease and mortality in cockle populations in Spain.

***Marteilia* sp. –** Was detected histologically in adult Pacific oysters in France at low prevalence and with no observed mortalities. Three of four sampled batches were positive, with detection in 1 of 39, 1 of 40 and 5 of 40 oysters, respectively.

***Haplosporidium costale* –** Detected following a mortality event in farmed Pacific oysters from the River Dart estuary at the end of 2015. Histological analysis revealed low-intensity infections in two of 30 juvenile oysters that were confirmed to be *H. costale* through DNA sequence analysis. The role of the parasite in the observed oyster mortality is uncertain. This is the first reported case in Europe.

***Haplosporidium nelsoni* –** A sporulating haplosporidian infection observed in one of 30 Pacific oysters undergoing mortality in a site in the southwest of Ireland in 2013 has been confirmed using DNA sequence analysis to be *H. nelsoni*. In the Virginia portion of Chesapeake Bay, USA, unexpectedly high prevalences and intensities were observed in aquaculture industry samples of Eastern oysters evaluated in spring and summer, with

maximum prevalence reaching 40% and serious infections common. Typical prevalence does not exceed 10%. Distribution of the parasite was found to have expanded in the Maryland portion of Chesapeake Bay as well.

Hematodinium perezi – Prevalence in juvenile blue crabs from the Eastern Shore of Virginia, USA, has been found to be 100% in multiple annual samples over 2012–2015, far higher than prevalence in adults, which is typically about 30% in non-epizootic years. While noted earlier in a more limited study, this observation brings a renewed focus to the role of juvenile crabs in the epidemiology of this pathogen.

Conclusions

- The distribution of OsHV-1 in California, USA, has expanded to Bodega Bay.
- *Vibrio aestuarianus* was associated with significant mortality in Pacific oysters in Ireland.
- *Marteilia cochillia* has a significant impact on cockle populations in Spain.
- *Marteilia* sp. was detected by histology at low levels in adult Pacific oysters in France.
- *Haplosporidium costale* was detected for the first time in Europe, in a case from southwest England.
- *Haplosporidium nelsoni* has been detected at increasing prevalences and intensities on the East Coast of the USA.

5.2 Deliver leaflets on pathology and diseases of marine organisms (ToR b)

At the 2015 WGPDMO meeting it was agreed to update all disease leaflets during the next 3 years and also to increase the visibility and relevance of the leaflets.

Since the 2015 meeting the following new leaflet has been published.

- No. 64: Francisellosis of Atlantic cod (Alfjordan and Ruane)

In addition two revised leaflets have also been published.

- No. 24: *Mytilicola intestinalis* parasitism (Bignell)
- No. 37: Furunculosis (Bruno)

Further leaflets have been submitted and will be published in the near future.

- Brown ring disease in clams (Paillard) (new leaflet)
- No. 42: *Exophiala* (Bruno) (revised leaflet)

It remains important for the WGPDMO to continue to propose titles of new leaflets and to suggest potential authors for these so that the series remains current with up to date and relevant information. In addition, the editor has contacted authors for production of further revised leaflets which are to be submitted during 2016. As part of the ongoing task to update all remaining leaflets more than ten years old the WGPDMO reviewed the list of published leaflets and identified members to either take responsibility to produce a revised leaflet or to propose an alternative author to the editor.

As part of the ToR on updates on 'new disease trends' the group proposed the following emerging disease conditions that should generate new disease leaflets:

1) *Mikrocytos* spp. (Carnegie)
2) *Bonamia exitiosa* (Carnegie)
3) Ostreid herpesvirus (Renault)
4) Infectious salmon anaemia (ISA) (Falk)
5) Pancreas disease (PD) (Taksdal)
6) *Haematodinium* (Stentiford)
7) X-cell in dab (Feist and Bass)
8) Vibriosis in oysters (Renault)
9) Gonadal neoplasia in bivalves (Renault)
10) Tenacibaculosis in farmed fish (Jones)
11) Vibriosis in farmed salmonids (Lillehaug)
12) *Sphaerothecum* in dab (Feist and Paley)
13) Mycobacteriosis in wild fish (Madsen)
14) QPX in hard clams (Smolowitz)

5.3 Synthesize information on the spread and impact of *Bonamia ostreae* in flat oysters in the ICES area (ToR c)

Bonamiosis is a disease notifiable both to the OIE and the EU (under Directive 2006/88/EC) which has recently spread to new areas. In 2014 *B. ostreae* was detected in the Limfjorden in Denmark, representing the first detection of the parasite in native flat oysters in the area. In 2008 *B. ostreae* was found in Norway, until now the only time that it was found in this specific area. In the UK there has also been a range expansion recently, while the range in Ireland has been stable for a decade. In the USA the parasite remains endemic in flat oyster populations on Atlantic and Pacific Coasts, although with minimal impacts on those host populations in recent years. Over the next two years the WGPDMO will prepare a report synthesizing current knowledge on the distribution of *B. ostreae* and its impacts on flat oyster aquaculture and fisheries in ICES member countries. Perspective will be included on the related species *Bonamia exitiosa*, considered an emerging pathogen in European systems, and on the effectiveness of management strategies for control of both these pathogens.

5.4 Summarise the role of *Vibrio* sp. pathogens contributing to mortalities in shellfish aquaculture (ToR d)

Vibrio bacteria pathogenic to Pacific oysters and other bivalve molluscs have been increasingly documented in WGPDMO national reports from the last several years, with 2015 no exception. Whilst it is becoming increasingly apparent that particular species such as *V. aestuarianus* and *V. splendidus* are involved in mortalities observed in aquacultured bivalves in natural waters, additional species have been reported as pathogens in hatchery and nursery environments, for example in 2015 in Spain. Still, there exists a lack of clarity in relation to the pathogenic role of different vibrios, particularly where multiple species or other pathogens such as the OsHV-1 µVar are detected in a single event. Over the next two years the WGPDMO will provide a synthesis on the current state of knowledge relating to these pathogens through a review of the existing literature and

data from events which have occurred in recent years, with a view toward identifying key knowledge gaps to be addressed through future research. The group's objective will be to elucidate the established roles of different *Vibrio* species in mortalities in both wild and aquaculture populations. Concurrently, a new EU project "Vivaldi" (*Preventing and mitigating farmed bivalve diseases*) includes among its aims an examination of the roles of the pathogens OsHV-1 and *Vibrio* species and their interactions. Relevant Vivaldi participants will be included as collaborators in the review being undertaken by the WGPDMO to ensure that the review is informed by results from the Vivaldi project.

5.5 Prepare a report describing the occurrence and spread of amoebic gill disease (AGD) in marine salmonid farming in the ICES area (ToR e)

AGD has emerged as a significant issue for salmon farming in ICES member countries. Over the next two years, the WGPDMO will prepare a report describing the spread, impact and current measures taken to mitigate effects of the disease and identify knowledge gaps and future areas for research. A recent paper (Oldham *et al.* 2016) provides an epidemiological review of the incidence and distribution of AGD. Our report will utilize recent information, including data from WGPDMO national reports.

5.6 Compile information on pathogen screening of wild salmonids in the ICES member states (ToR f)

Many ICES member countries screen wild broodstock used for restocking purposes for disease pathogens. Over the next two years, the WGPDMO will compile information on diseases and methods used in these screening efforts. The goal of the report is to describe the screening methods used and their effectiveness and to determine the practicalities of adopting a common approach to screening.

5.7 Evaluate applicability of the Fish Disease Index by using the R package following newly developed guidelines (ToR g)

The present version of the R package is able to perform following actions: read rawfish disease data (ICES format or user-supplied), calculate descriptive statistics, calculate disease prevalence including confidence limits (per area, over time), calculate FDI values (raw and standardized, per individual and per population), do assessment of FDIs based on BAC and EAC in a traffic light fashion, display the assessment on a map, do a long-term trend assessment. Standard versions of the FDI for common dab (*Limanda limanda*), cod (*Gadus morhua*) and flounder (*Platichthys flesus*), are included in the package. The package also contains features to define new FDI and to derive new BAC and EAC. User input to the programme is done via an Excel spreadsheet into which all necessary inputs are entered. At present, this spreadsheet has to be stored and subsequently the user has to start the R programme manually. This procedure will be simplified by allowing to start the programme directly from the Excel interface. This change will be done in the next weeks. The programme will subsequently be circulated to volunteering WGPDMO members for testing.

5.8 Provide expert knowledge and management advice on fish and shellfish diseases, if requested, and related data to the ICES Data Centre (ToR h)

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.

6 Revisions to the work plan and justification

Proposed new ToR i: Development of a standard template for National Reports (D. Cheslett, S. Jones, W. Wosniok).

Justification: Variability exists within the National Reports for wild and farmed finfish and shellfish regarding disease occurrence and how it is reported. More comprehensive and uniform presentation of pathogen prevalences and sample sizes in particular over time will allow improved resolution of increasing or decreasing trends in disease activity reported annually in ToR a.

7 Next meetings

The 2017 meeting of the WGPDMO will take place at the National Marine Fisheries Research Institute, Gdynia, Poland, 14–18 February 2017.

The location and dates of the 2018 meeting of the WGPDMO and final meeting of this reporting cycle remain to be determined.

Annex 1: List of participants

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Annex 2: Common and scientific names of host species in the report

abalone, black	*Haliotis cracherodii*
abalone, red	*Haliotis rufescens*
clam, arched razor	*Ensis magnus*
clam, carpet shell	*Ruditapes decussatus*
clam, grooved razor	*Solen marginatus*
clam, Manila	*Ruditapes philippinarum*
clam, pod razor	*Ensis siliqua*
clam, pullet	*Venerupis corrugata*
clam, wedge	*Donax trunculus*
cockle	*Cerastoderma edule*
cod, Atlantic	*Gadus morhua*
cod, Baltic	*Gadus morhua*
cod, Polar	*Boreogadus saida*
crab, blue	*Callinectes sapidus*
dab, common	*Limanda limanda*
dab, long-rough	*Hippoglossoides platessoides*
flounder, European	*Platichthys flesus*
halibut, Atlantic	*Hippoglossus hippoglossus*
herring, Atlantic	*Clupea harengus*
lumpfish	*Cyclopterus lumpus*
minnow	*Phoxinus phoxinus*
mussel, blue	*Mytilus edulis*
mussel, Mediterranean	*Mytilus galloprovincialis*
oyster, Eastern	*Crassostrea virginica*
oyster, European flat	*Ostrea edulis*
oyster, Pacific	*Crassostrea gigas*
salmon, Atlantic	*Salmo salar*
sculpin, shorthorn	*Myoxocephalus scorpius*
trout, brown	*Salmo trutta*
trout, rainbow	*Oncorhynchus mykiss*
whitefish, European	*Coregonus lavaretus*

wrasse, ballan *Labrus bergylta*