Theme Session D
New trends in diseases of marine organisms: causes and effects

ICES CM 2008/D:01

The Fish Disease Index: a method to assess wild fish disease data in the context of marine environmental monitoring

Thomas Lang and Werner Wosniok

Based on empirical data derived from a long-term German fish disease-monitoring programme, a Fish Disease Index (FDI) has been developed that provides data on the overall disease status of individual fish and on temporal changes in the disease status of fish populations. The FDI approach also offers a method for regional assessments of FDI levels and trends and for regional comparisons. Examples illustrating the construction and application of the FDI approach are given, using data on diseases of the common dab (*Limanda limanda*), the major target species in the North Sea and adjacent areas. The potential of the FDI approach in the context of international marine monitoring and assessment programmes such as the OSPAR Coordinated Environmental Monitoring Programme (CEMP) is highlighted.

Keywords: fish disease index, disease status, monitoring, assessment.

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ICES CM 2008/D:02

Antibody against infectious salmon anaemia virus among feral Atlantic salmon (*Salmo salar*)

Rocco C. Cipriano

Archived sera from Atlantic salmon that returned to the Penobscot River, Merrimack River, and Connecticut River from 1995 to 2002 were analysed for antibodies against infectious salmon anaemia virus (ISAV) using an enzyme-linked immunosorbent assay (ELISA). A maximum of 60 samples were archived per river system per year. In any given year, the number of fish sampled by ELISA for ISAV antibodies in the Penobscot River ranged from 2.9 to 11.2%, whereas the range of salmon sampled was between 31.3–100% and 20.0–67.5% in the Merrimack River and the Connecticut River, respectively. Archived sera were not available for the 1995 and 2002 year classes from the Connecticut River. A total of 1141 samples were processed and 14 samples tested positive for antibodies to ISAV. In the Penobscot River, one fish tested positive in each of the 1995 and 1999 year-class returns and two fish tested positive in the 1998 returns. In the Merrimack River, four fish tested positive in each of the 1996 and 1997 returns and two fish were positive in the 2002 return. None of the archived sera from Atlantic salmon that returned to the Connecticut River tested positive.

Keywords: indirect ELISA, Atlantic salmon, *Salmo salar*, antibody, feral fish.

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ICES CM 2008/D:03

Hyperpigmentation in North Sea dab (*Limanda limanda*): spatial and temporal patterns, host effects and possible causes

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Hyperpigmentation is a term describing a pigment anomaly affecting dab (*Limanda limanda*) in the North Sea and, less frequently, dab in adjacent areas and other North Sea flatfish species. The condition is characterized by the occurrence of green to black patchy pigment spots in the skin of the upper body side and pearly white pigment spots in the skin of the lower body side, caused by a hyperplasia of pigment cells (melanophores and iridiphores, respectively). In heavily affected fish, the condition is sometimes associated with inflammatory reactions in the integument. There has been a significant increase in prevalence recorded in almost all North Sea areas over the past 20 years. Prevalences recorded in 'hotspot' areas for this condition increased from approximately 5% to more than 50% during this period. There is a pronounced spatial pattern of hyperpigmentation in the North Sea, with higher prevalences in areas closer to the coast than in more central areas of the North Sea. In the dab stock from the western Baltic Sea, hyperpigmentation is virtually absent. It has been suggested that hyperpigmentation is related to size and age and that it affects the growth and condition of affected fish. Some of the possible causes of hyperpigmentation have been studied (involvement of pathogens) and others still need to be studied. Some of these are highlighted in the present paper.

Keywords: pigment anomaly, hyperpigmentation, North Sea dab, spatial and temporal patterns.

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ICES CM 2008/D:04

The emergence of bitter crab disease as an international crustacean health issue

J. Frank Morado, Earl G. Dawe, and Richard J. Cawthorn

Bitter crab disease is a fatal disease of crustaceans caused by a parasitic dinoflagellate of the genus *Hematodinium*. In 1931 the type species, *H. perezi*, was described and encountered at low prevalences in adult *Carcinus maenus* and *Liocarcinus depurator* from Normandy, France. From 1931 to 1985 the parasite was infrequently encountered in North Atlantic crabs. In 1938, *Hematodinium* was recorded in 22.5% of *Portumnus latipes* collected from the northeast Brittany coast. In 1975, *Hematodinium*-like infections were reported for the first time in North America and it was suggested that *Hematodinium* sp. could cause significant mortalities in blue crab (*Callinectes sapidus*) populations along the east coast of the USA. Over the next 10 years, *Hematodinium* sp. was encountered at low prevalences in several species of crabs along the eastern USA, expanding both the susceptible species list and range of occurrence. In 1985, the parasitic dinoflagellate was encountered for the first time in a North Pacific crab when large numbers of tanner crabs (*Chionoecetes bairdi*) were rejected by processors because of their bitter flavour. Further research showed that 70% of local crabs as small as 70 mm carapace width were infected with *Hematodinium*. Since 1985, the number of *Hematodinium* reports has increased dramatically across the North Atlantic and Pacific Oceans. In total, approximately 30 decapod species are currently known to be infected at significant prevalences worldwide. Several decapods are important commercial species and others play key roles in their respective ecosystems.

Keywords: Bitter Crab Disease, *Hematodinium*, parasitic dinoflagellate, crabs.

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ICES CM 2008/D:05

The potential role of sea ice reduction on the transfer of diseases from terrestrial to marine mammals in the Arctic

E. H. Follmann

The reduction of sea ice in the Arctic appears to be accelerating faster than many models have predicted and is projected to continue well into the present century. This will have significant effects on both marine and terrestrial mammals, increasing contact between species and facilitating the transfer of diseases such as rabies, morbillivirus (e.g. canine distemper), and canine adenovirus between and among species. Similar transfer of parasitic infestations could result from these associations. Pagophilic seals, namely ringed and bearded seals, and polar bears are most dependent on sea ice and constitute a significant predator–prey association in northern waters. The Arctic fox at times also uses the ice in winter to forage. The transfer of diseases from foxes to seals and bears could initiate an epizootic, particularly in seals, similar to that which occurred in the past in northern Europe with morbillivirus infections in harbour seals. Other terrestrial factors, such as the greater northward incursion of red foxes into coastal areas, will probably change the dynamics of disease transmission within and between species of fox. These environmental changes will undoubtedly affect the subsistence harvest of marine mammals by Native communities in the north and could increase their exposure to zoonotic diseases such as rabies.

Keywords: seals, polar bear, arctic fox, red fox, Native subsistence harvest.

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ICES CM 2008/D:06

Lungworm transmission in porpoises and seals: molecular tools determine fish intermediate hosts

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Metastrongyloids infect a wide range of mammals and are usually found in the bronchi, parenchyma, or blood vessels associated with the lungs. Most terrestrial metastrongyloids are heteroxenous. using molluscs as intermediate hosts. Little is known about the biology of lungworms infecting marine mammals and their

transmission in the marine environment. Lungworm disease and associated pneumonia are important in the health of wild populations and a common cause of mortality in porpoises and seals. In this study we dissected various species of benthic prey fish species from different locations within the North Sea (*n*=250). Larval nematodes from the gastrointestinal tract were removed. We isolated larval DNA and amplified the ITS-2 region from the ribosomal DNA (rDNA). The primers used were designed to sequence the ITS-2 from adult specimens of all six metastrongyloid species infecting porpoises and seals in the North Sea. Histology and *in situ* hybridization using digoxigenin-labelled species-specific RNA probes were performed on intestinal tissue. ITS-2 (18S rDNA control) sequences of larvae found in dab (*Limanda limanda*) were identified as *Pseudalius inflexus* (Pseudaliidae; *n*=15), a porpoise lungworm, and sequences from plaice (*Pleuronectes platessa*) were determined as *Parafilaroides gymnurus* (Filaroididae; *n*=14), a seal lungworm. Turbot (*Psetta maxima*) from aquaculture were infected experimentally with lungworm larvae. This is the first study to determine three fish intermediate hosts for lungworms of these marine mammals. It elucidates the so far unknown life cycle of two metastrongyloid species parasitizing seals and porpoises. Molecular tools proved to be highly suitable for the determination and differentiation of larval lungworm stages.

Keywords: marine mammals, parasites, lungworms, fish.

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ICES CM 2008/D:07

Francisella spp. infections in farmed and wild fish

Duncan J. Colquhoun and Jarle Mikalsen

Bacteria within the genus *Francisella* are non-motile, Gram-negative, strictly aerobic, facultatively intracellular cocco-bacilli. While the genus includes pathogens of warm-blooded animals (including humans) and potential bioterror agents, there is also increasing evidence of a number of as yet unrecognized environmental species. Due to their nutritionally fastidious nature, bacteria of the genus *Francisella* are generally difficult to culture, and growth is also commonly inhibited by the presence of other bacteria within sample material. For these reasons, *Francisella*-related fish diseases may be underdiagnosed. Following the discovery in 2004/2005 that a granulomatous disease in farmed and wild Atlantic cod (*Gadus morhua*) is caused by a previously undescribed member of this genus (*Francisella philomiragia* subsp. *noatunensis*), similar diseases have been identified in fish in at least seven countries around the world. These infections affect both fresh-water and marine fish species and involve bacteria more or less closely related to *Francisella philomiragia*, an opportunistic human pathogen. Recent work relating to characterization of the diseases, classification of fish pathogenic *Francisella* spp., and vaccine development is presented. The potential impact of francisellosis in wild and farmed fish on a global perspective is also discussed.

Keywords: *Francisella*, farmed, wild, fish, aquaculture, disease.

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ICES CM 2008/D:08

Infectious diseases in marine mammals from the North and Baltic Sea

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Among cetaceans, the harbour porpoise is the most common cetacean on the German coast. The only native phocid species in German waters are harbour seals and grey seals. Marine mammals stranded and bycaught by fishers have been recorded and examined pathologically and zoologically since 1990. Several hundred animals are collected each year through a stranding network and intensive necropsies are performed. The majority of lesions in porpoises and seals were found in the respiratory tract. Nematodes were found in the bronchial tree and blood vessels. Secondary bacterial infections had caused bronchopneumonia of various degrees, extent, and character. Parasites were found in the digestive tract, liver, pancreas, ear, and skin. Several potentially pathogenic bacteria were isolated from different organs, causing bronchopneumonia, gastritis, enteritis, hepatitis, dermatitis, abscesses, and septicaemia. Serological investigations concerning antibody titres against the zoonotic bacteria *Brucella* indicated that a large number of seals were infected or in contact with these bacteria. A phocine distemper virus epidemic caused two devastating mass mortalities with several thousand dead harbour seals in 1988/1989 and 2002. Serological investigations showed that protective antibody titres were found for just 4–6 years following the die-off. In 2007, the first case of dolphin morbillivirus infection found in German waters was detected in a white beaked dolphin. It still remains unclear whether increasing anthropogenic activities in the North Sea and Baltic Sea are having a negative impact on the health status of marine mammals, making them more susceptible to infectious diseases.

Keywords: marine mammals, infectious diseases, *Brucella*, Morbillivirus.

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ICES CM 2008/D:09

Causes of death of harbour porpoises (*Phocoena phocoena*) stranded on the continental coastline of the southern North Sea (Belgium, France, and Dutch coasts) between 1990 and 2007

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The Marine Animals Research & Intervention Network investigated the causes of death of marine mammals stranded on the continental coastline of the southern North Sea (Belgium and France, and selected cases of the Dutch coast). Since the end of the 1990s, there has been a significant rise in harbour porpoise (*Phocoena phocoena*) strandings in the area, with average annual strandings of fewer than 50 porpoises between 1990 and 1998, but more than 260 between 1999 and 2007. The aim of the study was to present the main lesions and causes of death of 615 porpoises found dead and necropsied, and to find a potential explanation for that dramatic rise. Most frequent observations included net marks on the skin, subcutaneous and muscular bruises, emaciation, pulmonary and gastric parasitism, acute pneumonia, and pulmonary congestion and oedema. Two causes of death were significant: bycatch in fishing nets and infectious diseases. Bycatch was mainly observed in March and April, while infectious diseases, mainly acute pneumonia secondary to parasite infestation, occurred throughout the year. Based on necropsy reports, 20% of stranded porpoises were bycaught between 1990 and 1998, and 40% between 1999 and 2007. Only 60% of bycaught animals were healthy, others having evidence of emaciation, pneumonia, and parasitosis. There are two possible reasons to explain the recent rise of stranding in the southern North Sea: one could be the increase of capture in fishing net, the other seems to be linked to the southward shift of the population within the North Sea.

Keywords: health status, disease, cause of death, harbour porpoise.

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ICES CM 2008/D:10

Making sense of a new hard clam parasite

Susan Ford, Nancy Stokes, Emily Scarpa, Eugene Burreson, Ryan Carnegie, John Kraeuter, and David Bushek

During a routine histopathological examination of 180 juvenile hard clams (*Mercenaria mercenaria*) from a site in Virginia, USA in 2007, we discovered a single individual heavily infected with what appeared to be a haplosporidian parasite. The Haplosporidia include species causing lethal oyster diseases. Scanning electron microscopy of spores indicated that the parasite belonged to the genus *Minchinia*, and sequencing of the small subunit ribosomal RNA (SSU rRNA) gene confirmed that it is a previously unknown *Minchinia* species closely related to *M. tapetis*, a parasite of the carpet shell clam (*Ruditapes decussatus*) in Europe. Further sampling of clams near the area of the first discovery found prevalences up to 100% using polymerase chain reaction (PCR). No detectable parasites were found in the same individuals using tissue-section histology with H&E staining and no unusual mortalities have occurred among the sampled groups. PCR analysis of juvenile clams from Florida in 2007, and Massachusetts, New Jersey, and North Carolina in early 2008 failed to detect the parasite. On the other hand, an unidentified haplosporidian found in a hard clam from New Jersey in 2001 has since been identified as the new *Minchinia* sp. and another, from Maine in 1999, was infected with what may be the same parasite. These findings suggest that the parasite may be geographically widespread, but only very rarely develops into disease-causing, or even detectable, infections in hard clams. The discovery underscores critical questions about molecular assays that signal the presence of a parasite, but not necessarily real infections. It reinforces the importance of histology for visual confirmation of infections.

Keywords: Minchinia, Mercenaria, PCR, histology, regulation.

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ICES CM 2008/D:12

Dichelesthium oblongum (Copepoda: Dichelesthiidae) infection in wild-caught Atlantic sturgeon (*Acipenser oxyrinchus*)

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Atlantic sturgeon were sampled in autumn 2007 and spring 2008 along the New York Bight and in the Hudson River, New York. The fish were examined for the presence of external parasites, and blood and gill biopsies were collected for subsequent serum analysis and determination of Na^+, K^+, and ATPase activity. Select tissues were also collected for histopathological evaluation. In autumn 2007, *Dichelesthium oblongum*, a parasitic copepod, was observed in 91% of the sturgeon sampled between Rockaway and Jones' Beaches. During the course of these examinations, grossly visible lesions associated with the attachment and feeding of juvenile stages of *D. oblongum* were noted on the pectoral, dorsal, and anal fins of the infected fish. These lesions consisted of focal areas of ulceration with a raised border. Histologically, the lesions were characterized by necrosis or complete loss of both epidermis and dermis, as well as focal necrosis of the underlying musculature. In areas in proximity to the lesions, where the epidermis was intact, focal areas of spongiosis were sometimes observed. Serum chemistry of the most heavily infected animals indicated ion loading (i.e. sodium, calcium, magnesium), possibly as a result of water loss through the epithelial breach. The interaction between the parasite and the host life history characteristics is discussed in terms of its ecological significance to this threatened fish species.

Keywords: sturgeon, parasite, copepod, interaction, pathology.

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ICES CM 2008/D:13

Endemic mycobacteriosis in striped bass (*Morone saxatilis*) from the Chesapeake Bay

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Since the late 1990s, striped bass (*Morone saxatilis*) in the Chesapeake Bay have been experiencing endemic mycobacteriosis. Prevalence of visceral disease exceeds 75% in some age groups. Dermal disease, which is not typically associated with mycobacteriosis in wild fish, is also observed at high levels. The aetiology of striped bass mycobacteriosis in Chesapeake Bay appears to be complex, and two new species of slow-growing mycobacteria, *Mycobacterium shottsii* and *M. pseudoshottsii*, are the most common isolates obtained from diseased fish. Concomitant with the discovery of high disease prevalence, stock assessments have indicated an increase in non-fishing mortality for Chesapeake Bay striped bass. This has alarmed fishery managers, researchers, and the public and led to speculation of negative impacts on the striped bass population. As this speculation has the potential to alter management decisions and public perception of the resource, we have implemented a multidisciplinary research programme to better understand the extant and potential impacts of this disease. Lack of appropriate research tools has been one hurdle to overcome. Traditional identification methods of slow-growing mycobacteria are prohibitively time, labour, and cost intensive. For example, biochemical identification of *M. shottsii* and *M. pseudoshottsii* can take 6–12 months. Further, because of their slow-growing nature, isolation of these bacteria from environmental matrices is highly problematic. We have therefore developed rapid and specific molecular diagnostics to detect and quantify *M. shottsii*, *M. pseudoshottsii*, and other mycobacteria in striped bass tissues and environmental matrices such as water and sediment. These will allow investigation of transmission and ecology (e.g. spatio-temporal distribution and abundance in sediment, water, and vectors) of the mycobacteria, and will allow us to better understand their basic biology. In order to investigate the potential for disease-associated mortality in striped bass, we have initiated two independent field efforts to monitor the status of mycobacteriosis in Chesapeake Bay. The first uses the Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP), a fishery-independent trawl survey providing extensive spatial and temporal coverage of the Bay mainstem. The application of new epidemiological models to apparent disease prevalence data obtained by this survey has provided first evidence of disease-associated mortality in striped bass from Chesapeake Bay. A second independent field survey based in the Rappahannock River tributary of Chesapeake Bay uses tag-recapture methods to directly investigate disease progression and disease-associated impacts on the population (e.g. mortality). These studies will provide multiple, synergistic lines of evidence regarding disease impacts on the economically and ecologically important striped bass. Supported by NOAA Chesapeake Bay Office Grant NA06NMF4570295.

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ICES CM 2008/D:14

Emerging disease in Norwegian aquaculture: francisellosis

Egil Karlsbakk, Are Nylund, Karl Fredrik Ottem, Trond E. Isaksen, and Øivind Bergh

Novel diseases may represent introductions of pathogens or increased virulence of enzootic types. Increased sea temperatures have been considered a factor in the recent appearance of salmon *Neoparamoeba perurans* infections and cod francisellosis in Norwegian aquaculture. Host immunodepression caused by suboptimal

high temperatures and increased pathogen proliferation and transmission are mechanisms increasing the virulence of enzootic parasites. *Francisella piscicida* was first discovered in farmed cod from southwestern Norway and in wild cod from the Swedish west coast in 2004. Subsequently, several farms from both western and northern Norway experienced francisellosis, but the most severe outbreaks occurred in the south. Screening of wild cod from both southern and northern Norway for *F. piscicida* in 2006 and 2007 revealed "carrier" fish (quantitative polymerase chain reaction (qPCR) positive) in cod populations from southern and western Norway. These areas represent regions with no cod farming and extensive cod farming, respectively. Prevalences in these areas were generally 6–15%. In the northern parts of the country, including northwest Norway, *F. piscicida* was not detected in wild cod. The sea temperatures in southern Norway have been exceptionally high in the last decade and it is believed that the francisellosis problems in the south relates to high summer temperatures, which are suboptimal to cod. Occurrence of *F. piscicida* in farmed cod in northern parts of Norway indicates movements of infected fish from the south. Limitations on movements have now been suggested in order to prevent transmission to northern regions. Francisellosis has already caused a northward movement of cod farming activities in Norway, both to avoid high summer sea temperatures and to await the development of a vaccine. The seriousness of francisellosis to cod raises the possibility that this bacterium and disease in concert with temperature is a major factor limiting the natural southward geographic distribution of Northeast Atlantic cod. Much is unknown, however, about the host–parasite relationship between cod and *F. piscicida*, and the factors leading to the development of francisellosis at high sea temperatures.

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ICES CM 2008/D:15

Improved diagnostic methodologies for detection of betanodavirus infections of Atlantic cod (*Gadus morhua*)

Tokinori Iwamoto, David Groman, Carmencita Yason, Nellié Gagne, and Stewart Johnson

Current methodologies for detection of betanodavirus in marine finfish include virus culture in SSN-1 or E-11 cells and confirmation by reverse transcriptase polymerase chain reaction (RT-PCR) using a single-primer set designed to amplify the T4 variable region (427 bases) of Striped Jack nervous necrosis virus (SJNNV) coat protein gene. In addition, routine histopathology is used for screening of brain and retina for pathognomonic lesions, with confirmation in some labs using immunohistochemistry. Atlantic cod nervous necrosis virus (ACNNV) has routinely been isolated and identified using similar techniques (SSN-1 cells, RT-PCR primers specific to the same region in ACNNV and routine histopathology. We undertook a study to compare the efficiency of virus isolation in SSN-1 and E-11 cell lines. We also compared the use of real-time RT-PCR with RT-PCR technologies using a new primer set constructed from a conserved region of the coat protein gene of all four existing betanodavirus clads. Finally, we examined the use of *in situ* hybridization in conjunction with histopathology as a tool for routine screening. Our results indicated that the use of E-11 cells provided a minimum of 24 h time advantage over the SSN-1 cells for virus isolation. This presentation proposes an improved protocol for isolation and detection of ACNNV that utilizes E-11 cells and real-time PCR targeting a conserved coat protein primer set and an *in situ* hybridization method for confirmation of pathognomonic histopathology lesions in the brain and retinal tissues. Supporting data are presented.

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ICES CM 2008/D:18 Poster

Comparative study of phenotypes and genotypes of *Edwardsiella tarda* isolated from farm-cultured eels in Korea

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Edwardsiella tarda is the most important bacterial agent causing damage and leading to economic losses for the aquaculture industry in Korea. In this study we isolated *E. tarda* from farm-cultured eels and investigated the characteristics. *E. tarda* isolates can be divided into five genogroups through phylogenetic comparison of 16S ribosomal RNA. To compare the genotypic and phenotypic characteristics of these genogroups, we investigated characteristics such as biochemical and enzymatic activities, antimicrobial susceptibility, virulence, and pathogenicity-related factors.

Keywords: *Edwardsiella tarda*, genogroup, phenotypes, genotypes.

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ICES CM 2008/D:19 Poster

Effect of sublethal and lethal concentrations of copper on gill tissue of grass carp (*Ctenopharynogodon idellus*)

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This study evaluated the toxic impact of different sublethal and lethal concentrations of copper in water (0, 0.25, and 0.5 ppm) on behavioural responses and changes in gill tissue of *Ctenopharynogodon idellus* (*n*= 27). Hyperactivity and reduced exploratory behaviour were observed when fish were subjected to different levels of copper in the water compared with the control. Gill samples were collected after 96 h of any treatment and lesions were analysed by light microscopy. In a histopathological study of the gill tissues, hyperplasia was clearly obvious in treatment specimens. In all of the treatments a high gill mucus response was observed that correlated with concentrations of copper. In a histological study of gill tissues, epithelial cells displayed hyperplasia that increased with high copper concentrations. First lamella cells wrinkled and change formation observed in chloride cells. This lesion enhanced in higher densities as in concentrations of 2.5 and 5 mg l^{-1}, first and secondary lamella epithelial cells were degenerated.

Keywords: *Ctenopharynogodon idellus*, copper, gill tissue, fish.

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ICES CM 2008/D:20 Poster

Bottlenose dolphins (*Tursiops truncatus*) as sentinels of environmental health: health status of dolphins from two southeast US estuarine sites

P. A. Fair, J. S. Reif, J. Adams, T. Hulsey, and G. Bossart

Because of their unique physiology and high trophic level, dolphins as sentinel species can provide valuable information for evaluating exposure to biological and chemical agents and deleterious health effects. During 2003–2005, 192 comprehensive health studies were conducted on bottlenose dolphins near Charleston (CHS), South Carolina and in the Indian River Lagoon (IRL), Florida. Expert panel health classification revealed a high prevalence of disease at both sites (IRL 34%; CHS 21%). Fewer than half of the dolphins at each site were classified as healthy (IRL 49%; CHS 43%). Two diseases—lobomycosis and orogenital neoplasia—accounted for 62% of the disease diagnoses and were associated with immunologic alterations. The remaining disease diagnoses were related to haematologic/serum chemistry abnormalities and gastric inflammation. Contaminant analyses revealed high concentrations of persistent emerging contaminants, such as polybrominated diphenyl ethers (PBDEs) and perfluorocarbons (PFCs), and a suite of legacy pollutants, such as polychlorinated biphenyls (PCBs), dichloro-diphenyl-trichloroethane (DDT), and trace metals. Levels of PBDEs and perfluorooctane sulfonates (PFOSs) in Charleston dolphins represent some of the highest measured in marine mammals. CHS dolphins classified as diseased had a significantly higher total PBDE content (6512 ng g^{-1}) than those classified as normal (4288 ng g^{-1}) or possibly diseased (4494 ng g^{-1}). Findings from this study document complex diseases and high chemical body burdens of dolphins, and continued analysis will help to evaluate interactions of biological and chemical stressors on these sentinel species.

Keywords: bottlenose dolphins, sentinels, health assessment, disease, contaminants, PBDEs, PCBs.

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ICES CM 2008/D:22 Poster

Red vent syndrome caused by the nematode *Anisakis simplex sensu lato*—an emerging problem for returning salmon?

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Nematodes are common parasites of marine and fresh-water fish and are found in many internal organs. Induced pathological changes are usually restricted to the point of attachment or feeding. One of the most commonly recorded nematodes of marine fish is *Anisakis simplex*, a complex of cryptic species occurring in the viscera and musculature of numerous fish species. It has a complex life cycle involving an invertebrate host, a fish host, and a piscivorous final host. Public health concerns have been raised as the parasite can be transmitted to humans via the consumption of unfrozen raw fish products such as sashimi, although this is a relatively rare event. Over the past two summers, returning wild Atlantic salmon (*Salmo salar* L.) with swollen, bleeding vents have been observed in estuaries of Scotland, England, and Wales. Although the condition has been recorded before, there was an apparent increase in reports in 2006 and 2007, partly as a

result of better awareness. A targeted survey of affected and non-affected salmon demonstrated the presence of large number of *Anisakis simplex sensu lato* larvae, restricted to the tissues around the vent in all affected fish. Histologically, there was an inflammatory response associated with non-encapsulated worms in the connective tissue and skeletal muscle of affected fish. Although "red vent syndrome" appears to be a new emerging condition in Atlantic salmon, its significance on already depleted salmon stocks is currently unknown.

Keywords: pathology, parasitic nematode, *Anisakis simplex*, *Salmo salar*.

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Crustacean disease research in Europe—current and emerging issues

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Crustacean production in European marine waters is based around a large cold-water fishery for crabs, lobsters, and shrimp. Despite the commercial and ecological importance of these populations, there is a lack of studies on their diseases compared with those from molluscan and finfish host groups. In addition to capture production from native stocks, European states are major importers of farmed crustaceans (mainly tropical shrimp) and these products are becoming an increasingly significant component of the European seafood diet. Because of these factors, the new EC Fish Health Directive (2006/88/EC), applied from August 2008, has for the first time listed the three viral diseases white spot disease (WSD), yellowhead disease (YHD), and taura syndrome (TS) as exotic pathogens of concern. In addition to the listing of these pathogens, the EC have designated a Community Reference Laboratory (CRL) to cover crustacean diseases, with individual Member State National References Laboratories (NRL) expected to follow. The designation of a CRL for crustacean diseases in the European Community formally recognizes the ecological and commercial importance of crustaceans in the aquatic habitats of Member States and also the potential for exotic disease introductions to these populations via the international trade of live and commodity products. Improvements in the biosecurity status of native crustacean populations within the European Community and a concomitant enhancement of knowledge of native pathogens and mortality drivers are expected to develop in coming years. This paper discusses the new EU legislation in relation to experimental challenges and fieldwork surveys conducted by our laboratory.

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